

**The roles and use of prospective knowledge practices in sustainability-
related transitions: A realist evaluation and pragmatist synthesis**

Stephen McGrail

Institute for Sustainable Futures

University of Technology Sydney

Thesis submitted for the award of Doctor of Philosophy

November 2017

CERTIFICATE OF ORIGINAL AUTHORSHIP

I certify that the work in this thesis has not previously been submitted for a degree nor has it been submitted as part of requirements for a degree except as part of the collaborative doctoral degree and/or fully acknowledged within the text.

I also certify that the thesis has been written by me. Any help that I have received in my research work and the preparation of the thesis itself has been acknowledged. In addition, I certify that all information sources and literature used are indicated in the thesis.

Signature of Student:

This research is supported by an Australian Government Research Training Program Scholarship (Australian Postgraduate Award (APA) scholarship).

Acknowledgements

This research was aided by the support of CSIRO staff who assisted with the data collection (e.g. by assisting with arranging interviews and the survey research) and also provided feedback on the case analysis. I would particularly like to acknowledge Paul Graham's involvement. Even though he is a super-busy expert (Paul is currently CSIRO Energy's Chief Economist) Paul frequently made himself available to discuss data interpretation issues which his close involvement with the focal case was relevant to. Additional CSIRO staff such as Dr Deborah O'Connell went beyond the "call of duty" when responding to my many inquiries. Other experts such as Professor Susan Pond also provided valuable guidance. Ultimately, the case interpretations and related judgements are my own and aren't necessarily consistent with the views of CSIRO staff or others whom I discussed the case with.

I also would like to acknowledge the helpful discussions that occurred more informally at (or via) key conferences I attended, particularly the 2014 Australasian Evaluation Society International Conference and the 2015 Bioenergy Australia conference. For example, I vividly recall one public servant whom I met at Bioenergy Australia lamenting what he saw as the tendency to repeatedly use the same approaches (e.g. doing or commissioning 'roadmaps') whilst having little insight into why the outputs tended not to be acted upon or implemented as hoped. These discussions often occurred at crucial times during my candidature and provided further motivation to persevere and complete the study.

As a remote PhD student juggling study with an academic research job (for most of my candidature) regular contact with my principal supervisor, Professor Chris Riedy, has been essential and I thank him for his commitment, availability and support. My partner Melissa and others were a regular sounding board when I needed to talk through ideas-in-development (despite their comparatively limited interest) and I thank them.

Finally, the Institute for Sustainable Futures (ISF) at the University of Technology Sydney is one of the few places in Australia where I could have pursued my research interests at the doctoral level. So, I also wish to thank ISF for giving me the opportunity.

Table of contents

Acknowledgements	iii
List of Figures	vii
List of Tables.....	viii
List of publications and conference papers related to this thesis	ix
PART 1: Framing and introductory materials	xii
CHAPTER 1: Introduction	1
1.1 Introductory remarks.....	1
1.2 The core object of investigation and guiding logic	3
1.3 Introduction to the focal case.....	9
1.4 Current perspectives on prospective knowledge practices and knowledge gaps.....	12
1.5 Research aims, related goals and focal questions	18
1.6 Introductory overview of realist evaluation	21
1.7 Thesis overview and summary.....	23
CHAPTER 2: Methodology	27
2.1 Introduction	27
2.2 Overview of the research methodology and research design	27
2.3 Conceptual framework	28
2.4 Research design and data analysis procedures	33
2.5 Validity, generalisability and limitations.....	54
PART 2: Case research.....	60
Part 2a: Examination of the expected impact and utility of the futures forums	61
CHAPTER 3: Identified intervention theories to be tested	62
3.1 Introduction	62
3.2 Intervention characteristic and process design.....	62
3.3 Futures forum intervention theories	66
3.4 Relationship between intervention theories and the process design, convening approach, and stated futures forum objectives	78
3.5 Comparative analysis results: How unique are these intervention theories?	82
3.6 Chapter conclusions.....	86
CHAPTER 4: Assessment of the intervention theories	88
4.1 Introduction	88
4.2 Examination of the case evidence for the CMOc statements	88

4.3	Additional intervention theory-related findings and the implications for this evaluative case study	121
4.4	Chapter conclusions.....	128
Part 2b: Additional theoretical perspectives on the case		130
CHAPTER 5: Prospective knowledge practices as social activities		131
5.1	Introduction	131
5.2	Theoretical perspective and key concepts.....	132
5.3	Case evidence and interpretation.....	136
5.4	Implications for the intervention theories to-be-tested	154
5.5	Chapter conclusions.....	156
CHAPTER 6: Prospective knowledge practices as political practices.....		158
6.1	Introduction	158
6.2	Theoretical perspective and key concepts.....	159
6.3	Case evidence and interpretation.....	164
6.4	Implications for the intervention theories to-be-tested	187
6.5	Chapter conclusions.....	188
CHAPTER 7: An alternative perspective on reasoning relevant to prospective knowledge practices		190
7.1	Introduction	190
7.2	Theoretical perspective: the argumentative theory of reasoning and an interactionist view of reason.....	191
7.3	Case evidence and interpretation.....	196
7.4	Implications for the intervention theories to-be-tested	216
7.5	Chapter conclusions.....	218
PART 3: Discussion and conclusions		220
CHAPTER 8: Discussion of the implications of the research findings for the intervention theories		221
8.1	Introduction	221
8.2	Putting the theories into practice: Do implementation or process issues explain the findings, or are there fundamental problems with the intervention theories?	222
8.3	Contextual factors revealed by the case analysis	225
8.4	Implications of the case study findings for the existing CMOc statements and for improved intervention theories.....	233
8.5	Considerations regarding the transferability of the intervention theory findings ...	251
8.6	Chapter summary and concluding observations	251

CHAPTER 9: Discussion of the functions of prospective knowledge practices and their use and roles in sustainability-related socio-technical transitions	253
9.1 Introduction	253
9.2 Revisiting the case evidence of the roles and use of prospective knowledge practices	255
9.3 Prospective knowledge practices and socio-technical transitions: reconsidering the case evidence of their functions in this context	259
9.4 Functions of prospective knowledge practices in energy transitions, or functions in socio-technical transitions more generally?	270
9.5 Broader implications of the case study for theory and practice	272
9.6 A deeper pragmatist synthesis?.....	276
CHAPTER 10: CONCLUSION	281
10.1 Introduction	281
10.2 Answers to the case analysis questions and associated insights into the use of prospective exercises in socio-technical transition contexts.....	285
10.3 Contributions, implications and limitations of the study	302
10.4 Concluding discussion and statements.....	307
APPENDICES	311
Appendix 1: Overview of the Futures Fuels Forum and research undertaken on this forum....	312
Appendix 2: Overview of the Sustainable Aviation Fuel Road Map (SAFRM) Forum and research undertaken on this forum	341
Appendix 3: Overview of the Future Grid Forum and research undertaken on this forum .	373
Appendix 4: Example online survey instrument (used for research on the Sustainable Aviation Fuel Road Map Forum)	409
References list	413

List of Figures

Figure 1: Over-time perspective outlining the three main study phases	26
Figure 2: Phase 2 research process.....	46
Figure 3: Trends in oil prices (West Texas Intermediate), 2003–09 (from Khan 2009)	90
Figure 4: Decision support provided by futures forums (self-report assessment).....	93
Figure 5: Self-reported impact of the futures forums on decision-making and policy-making	102
Figure 6: Stated reasons for participating in a CSIRO futures forum.....	124
Figure 7: Future Grid Forum scenario development framework (CSIRO 2013a, p. 25).....	150
Figure 8: Trends in oil prices (West Texas Intermediate), 2003–09 (from Khan, 2009)	318
Figure 9: Agreements between airlines and fuel producers (IATA 2014, p. 11).....	345
Figure 10: Multi-stakeholder initiatives on alternative aviation fuels (IATA 2014, p. 13)	346
Figure 11: Sustainable Aviation Fuel Road Map report launch event	354
Figure 12: Impact of the SAFRM Forum on beliefs and assumptions (self-report)	357
Figure 13: SAFRM Forum report content ranking (public policy implications).....	359
Figure 14: Impact of the SAFRM Forum on decision-making confidence (self-report)	361
Figure 15: Impact of the SAFRM Forum on policy-making/decision-making (self-report).....	361
Figure 16: Aviation representatives Delia Dimitriu (Airbus), David White (Virgin Australia), Future Farm Industries’ Peter Zurzolo and GE’s Ben Waters inspect a Great Southern mallee plantation (Nyman 2012).....	364
Figure 17: Impact of the Future Grid Forum on beliefs and assumptions (self-report)	388
Figure 18: Impact of the Future Grid Forum on decision-making confidence (self-report)	389
Figure 19: Impact of the Future Grid Forum on policy-making/decision-making (self-report)	389
Figure 20: Comparison of process outcomes reported by Future Grid Forum participants	390

List of Tables

Table 1: Key realist evaluation concepts.....	30
Table 2: Focal futures forums	35
Table 3: Explanation of categories which guided interviewee selection.....	37
Table 4: Overview of data types and associated methods data sources.....	38
Table 5: Summary of data collected on each futures forum	39
Table 6: Intervention theory interviews	41
Table 7: Online survey question type and foci.....	42
Table 8: Grouping of themes into meta-themes	51
Table 9: Central elements of the futures forum process.....	63
Table 10: Identified mechanisms, their hypothesised operation, and explanatory notes	68
Table 11: Enabling intervention contexts emphasised by CSIRO staff	74
Table 12: Identified links between the intervention theories and process design	80
Table 13: Stated objectives for each futures forum	81
Table 14: Summary of case evidence for CMOC-1 mechanisms.....	97
Table 15: Summary of case evidence for CMOC-2 mechanisms.....	107
Table 16: Summary of case evidence for CMOC-3 mechanisms.....	113
Table 17: Summary of case evidence for CMOC-4 mechanism	118
Table 18: Summary of evidence for the CMOC statements.....	120
Table 19: Forum attendance motivations.....	122
Table 20: Key factors influencing the credibility of the forum outputs (survey responses).....	125
Table 21: Alternative bases for decision-making (Beckert 2013b, p. 223)	154
Table 22: Key themes and issues ranking data (SAFRM meeting record – meeting 1)	173
Table 23: Future Grid Forum findings emphasised in the CSIRO media release	183
Table 24: Potential consequences of motivated reasoning (from Mercier & Sperber 2011)...	195
Table 25: Contextual factors identified in the focal case.....	226
Table 26: Potential refinements to, or reformulations of, hypothesised mechanisms.....	234
Table 27: Contributions of the theory-driven evaluative research	294
Table 28: Overview of sectoral participation in the Future Fuels Forum	314
Table 29: Future Fuels Forum mix participants and non-participants.....	316
Table 30: Overview of Future Fuels Forum scenario modelling	322
Table 31: Industries and organisations represented at the SAFRM Forum.....	344
Table 32: Issue ranking data (from SAFRM Forum meeting notes).....	350
Table 33: Sectoral breakdown of delegates (Future Grid Forum)	377
Table 34: Use of the outputs of the Future Grid Forum by networks businesses/industry	390
Table 35: Limited use and non-use of the outputs of the Future Grid Forum	391
Table 36: Electricity sector outcomes reported by forum delegates	395

List of publications and conference papers related to this thesis

Some of the research presented in this thesis has been published or presented elsewhere. These publications and conference papers are listed in chronological order. I also list a major conference presentation (made at the 2015 Bioenergy Australia Conference) in which ideas presented here were also discussed:

1. McGrail, S. (2014), 'Rethinking the roles of evaluation in learning how to solve 'wicked' problems', paper presented at the *2014 Australasian Evaluation Society International Conference*, 8-12 September 2014, Darwin, Australia. (Awarded the Rosalind Hurworth Prize for best conference paper and subsequently published [see below]);
2. McGrail, S. (2014), 'Rethinking the roles of evaluation in learning how to solve 'wicked' problems: The case of anticipatory techniques used to support climate change mitigation and adaptation', *Evaluation Journal of Australasia*, Vol. 14 No 2, pp.4-16;
3. McGrail, S. & Riedy, C. (2015), 'Creating scenarios or creating and sustaining social worlds? Towards new sociological understandings of the use and impacts of scenario planning', *International Journal of Foresight and Innovation Policy*, Vol. 10 No 2-4, pp.103-125;
4. McGrail, S. (2015), 'Aviation biofuels and the challenge of transformative change: examining the use and roles of industry roadmapping exercises', presentation to the *2015 Bioenergy Australia Conference*, 30 November – 1 December 2015, Launceston (Tasmania), Australia; and
5. McGrail, S. (2016), 'A theory-driven impact evaluation of prospective practices used in transition contexts: results from an evaluation of the CSIRO "futures forum" process', paper presented at the *2016 International Sustainability Transitions Conference* (conference theme: "exploring transition research as transformative science"), 6-8 September 2016, University of Wuppertal, Germany.

Abstract

This thesis proposes the concept of prospective knowledge practices (PKPs) and investigates their use in sustainability-related transition contexts. An evaluative case study is presented, examining the use of PKPs in, and related to, the “futures forums” convened by staff from CSIRO, Australia’s peak research agency. A futures forum is a participatory scenario intervention used to explore energy transition-related topics and options.

PKPs, and related attempts to explore or “use” the future, are common in transition contexts but too little research has evaluated their utility and impact. Similarly, the limited investigation of day-to-day practices and associated intensive work during futures forum-like processes (e.g. work carried out to manage conflict or protect scientific credibility) calls for research using a knowledge practices lens.

This thesis notes that PKPs are typically used as interventions. Guided by this, the study initially used an evaluation approach termed realist evaluation to investigate intervention theories articulated by CSIRO staff. Formal theories guided further explanatory analysis of the intervention outcomes. Finally, the case was related to relevant transition concepts and theories to consider whether the case supports them.

Based on the realist evaluation, I argue that the limited, variable, and often unintended intervention outcomes can be partly explained by intervention theory deficiencies. I also identify potential improvements to these theories.

Further case analysis identified additional causal mechanisms, contextual factors and associated practices that help to account for the identified intervention outcomes and participants’ experiences. Related chapters – examining PKPs as social activities, PKPs as political practices, and an alternative perspective on reasoning – can also inform intervention theories and enhance practice.

This case analysis informs a central claim: by investigating the social, political, and reasoning dimensions of PKPs we can better understand both their potential functions and limitations. I argue that the net effect of the identified mechanisms and contextual factors constrained the roles and impacts of the futures forums.

Finally, I build on the case to offer prescriptions for enhancing the use of PKPs in transitions. Key elements of pragmatist philosophy and associated action theories are utilised to synthesise and build-on case themes. This pragmatist perspective calls for reflection on routines and habits, which this thesis shows can be informed by evaluative inquiry. It also calls for greater attention to how PKPs “cash out” in action, experience, and with respect to present exigencies. The prescriptions should be widely transferable given the characteristics of knowledge practices commonly used in transition contexts.

Part 1: Framing and introductory materials

CHAPTER 1: Introduction

1.1 Introductory remarks

This thesis presents an evaluative case study of future-oriented inquiry and the associated interventions that are increasingly common in climate change-related and energy policy-related analysis both in Australia (which is the focus of the study) and elsewhere. For example, electricity system scenarios are frequently modelled (e.g. AEMO 2013; Elliston, MacGill & Diesendorf 2014; Teske et al. 2016). Forward-looking studies also consider broader decarbonisation options and associated potential socio-technical pathways (e.g. ClimateWorks Australia et al. 2015; Jotzo et al. 2014). A further prominent example is the production of scenarios emphasising energy supply risks and related claims with the hope of creating self-denying prophecies (e.g. Blackburn 2013; Blackburn 2014; Dodson & Sipe 2005). Such studies and reports both respond and contribute to the contemporary emphasis on expectations and imagined futures, as seen in innovation processes, strategy-making activities and public policy processes (e.g. Beckert 2016; Borup et al. 2006; Kaplan & Orlikowski 2013; van der Steen 2008). Associated ways of exploring what socio-technical ‘transitions’¹ could develop in the future or what transitions may be required, and of acting to try to influence their emergence or evolution, have become much more common over recent decades.

Scholars in related fields, including sustainability transition studies and sustainability science, have called for greater research on and greater use of forward-looking methods (e.g. Berkhout, Hertin & Jordan 2002; Miller et al. 2014; Robinson et al. 2011; STRN 2010; Swart, Raskin & Robinson 2004). When used effectively these methods may play important functions in transition processes (e.g. Wiek, Binder & Scholz 2006), in wicked problem domains (e.g. Wilkinson & Mangalagiu 2012), as well as with respect to environmental decision-making (Cook et al. 2014). However, to-date too little evaluative inquiry has assessed the utility of

¹ Socio-technical transitions have been conceptualised in multiple ways, for example as “system innovations, i.e., a change from one sociotechnical system to another” (Geels 2005, p. 681) and as “a fundamental change in the (socio-technical) regime” (Haxeltine et al. 2008, p. 101). In general, “a transition consists of a dynamic that leads to a fundamental change in ... structures, actors and practices” (Haxeltine et al. 2008, p. 96). Similarly, the editors’ essay that launched the journal *Environmental Innovation and Societal Transitions* notes that solutions to environmental problems are increasingly viewed as requiring “a combination of technical, organizational, economic, institutional, social-cultural and political changes” and such change is “increasingly referred to as a socio-technical transition” (van den Bergha, Truffer & Kallis 2011, p. 2). The use of the term socio-technical transition in this thesis is consistent with this broad conceptualisation as articulated by van den Bergha et al (2011).

these methods in sustainability-related transition contexts.

Additionally, as is described in more detail later in this introductory chapter, many scholars and some practitioners have questioned and criticised the use of such methods, their theoretical basis, and the extent to which their use and impact has been adequately scrutinised. Addressing such issues and gaps is crucially important for understanding and enhancing their use by sustainability transition-oriented scholars.

Issues to do with salience and influence on decision-making have also been raised, pointing to important questions: “How does envisioning potential futures translate into action? How can this be done more effectively?” (Miller et al. 2014, p. 243). Similarly, sustainability transition-focused scholars have called for more research assessing the impact and effectiveness of possible transition ‘instruments’ (as they are called) such as “envisioning and scenario exercises” (STRN 2010, pp. 10-1). At the same time, scholars have highlighted many aspects of socio-technical transitions that are relevant to their potential functions. They argue that actors must “navigate their way through multiple uncertainties” (Geels, Elzen & Green 2004, p. 10); that images of the future and actors’ expectations can be influential in transition processes (Farla et al. 2012; Gaede & Meadowcroft 2016; Sondejiker et al. 2006; Wiek, Binder & Scholz 2006); and they highlight related “expectations work” (Farla et al. 2012).

To contribute to clarifying and potentially enhancing the use and utility of future-oriented methods this thesis presents an evaluative case study of a high-profile case of forward-looking inquiry in the Australian context and examines the use of anticipatory knowledge. This study was conducted in collaboration with a case study partner – a research group at Australia’s peak national research agency, CSIRO (see *Section 1.3*) – and involved conducting theory-driven evaluative inquiry which examined three interventions run by this group. I draw on this case to analyse the use, roles and utility of such practices in transition contexts, with a focus on potential transitions to low-carbon energy and transportation.

To further set the scene this opening chapter has four main aims. First, it further defines the core object of study and the guiding logic which framed the inquiry. As part of the scope definition I also note what the study wasn’t about. Second, I introduce the focal case. Third, the chapter presents a review of related literature that establishes the need for the research, raises relevant questions (e.g. about the use of forward-looking methods) and points to

knowledge gaps. Fourth, the chapter outlines the aims of the thesis and core research question, along with what follows in terms of thesis structure and main arguments. Finally, I introduce the main evaluative approach that was used (realist evaluation).

1.2 The core object of investigation and guiding logic

The central object of study is the prospective knowledge practices (PKPs) used in contemporary sustainability-related transition contexts. The prospective aspect refers to future-orientation, as commonly seen in the use of formal modelling methodologies amongst many other future-oriented methods (the concept of prospective knowledge practices is formally defined below in *Section 1.2.1*). The knowledge practices aspect refers to the day-to-day activities, or on-the-ground *work*, of actors involved in producing, assessing, disseminating and using knowledge claims (Camic, Gross & Lamont 2011a).

The study further focussed on participatory uses of forward-looking methods. This aspect responds to trends towards approaches involving greater collaboration between researchers and relevant stakeholders when developing knowledge and where researchers (or scientists) act as process facilitators. Indicative trends consistent with this include collaborative “futures work” being conducted in inter-organisational settings to address wicked problems (Wilkinson & Mangalagiu 2012, p. 383); “foresight” exercises (Borch, Dingli & Jorgensen 2013); and other participatory methods (Robinson et al. 2011; Talwar, Wiek & Robinson 2011).

1.2.1 Prospective knowledge practices

In this thesis, the term prospective knowledge practice (PKP) is used as an umbrella term for activities involved in the production, assessment and use of anticipatory knowledge forms.² Broadly, PKPs can be conceptualised as practices used to produce, assess or use anticipatory knowledge. A formal working definition can be adapted from a definition of social knowledge practices (in Camic, Gross & Lamont 2011b).³ A prospective knowledge practice is:

² In this respect the term is an alternative to other terms which are used in related literatures such as “futures methods”, “foresight practices” and “futures analysis”.

³ In this edited volume Mallard and Lakoff (2011) researched the use of future-oriented practices which they term “techniques of prospection”. In the terminology adopted here, the use of techniques of prospection by strategic actors is a prospective knowledge practice.

An ensemble of patterned activities – related to the situated tasks with which human beings are engaged – used to advance, assess, or put to use knowledge claims about the future which are (at least in part) empirically based and warrantable.

Some PKPs are primarily used for producing such knowledge claims; others are primarily used to assess these knowledge claims and/or put them to use. Whilst Camic et al (2011b, p. 3) state that the concept of knowledge practices is focussed on efforts “to advance empirically based and empirically warrantable claims” (which is reflected in the above working definition), they also note that such activities are “inherently multifaceted, woven of cognitive, emotional, semiotic, appreciative, normative and material components” (p.7).

Four elements of the working definition require further explanation. First, ‘ensemble’ refers to the way that a PKP typically has multiple elements or activities that are combined for a purpose (e.g. a combination of workshop design elements, facilitation activities, and analytical processes). These ensembles can be more or less complex. Inayatullah’s (2008, 2015) “six pillars” approach and the “la prospective” approach developed by Godet (2000, 2006) are examples of complex ensembles. A less complex example is a simple one-day facilitated scenario-building workshop using a brainstorming style approach. The mix of typical activities in the futures forum process (see *BOX 1.2*) is consistent with this element.

Second, the core notion of ‘patterned activities’ refers to the influence of the social setting and environment on these activities (see Camic, Gross & Lamont 2011b). Related to this Camic et al (2011b, p. 10) note research by Science and Technology Studies (STS) scholars which has gathered evidence of the ways that “the knowledge-making practices of natural scientists are thoroughly configured by the social worlds that they inhabit”. The taken-for-granted routines (or habits, broadly defined) that knowledge practices include (Camic, Gross & Lamont 2011b, p. 7) – a key element of PKPs which is deeply explored in *Part 3* of this thesis – can also be shaped and reinforced by this social patterning (see Gross 2009).

Third, the concept of a knowledge practice also refers to activities “by which human beings confront and structure the situated tasks with which they are engaged” (Camic, Gross & Lamont 2011b, p. 7). For example, regarding social knowledge practices, such tasks include considering and determining regulatory decisions and efforts to theorise human societies, amongst myriad other tasks (Camic, Gross & Lamont 2011a). In organisational settings, such tasks can include justifying decisions and strategy-making. Broader tasks relevant to the focal

case include efforts to influence policy processes and other forms of advocacy.

Finally, the working definition emphasises efforts to advance and consider claims (about the future) which are empirically based and warrantable. This aspect clearly places a limit on what is a PKP according to the working definition (also see *BOX 1.1* below). These terms are used in a broad sense – that is, seeking to “omit... fictional and fabricated material” (Camic, Gross & Lamont 2011b, p. 3) – to emphasise those practices which collect, or are informed by, relevant evidential support. This is a fraught consideration, in part due to the arguably fictional character of claims about the future and actors’ expectations (e.g. see Beckert 2016; Ramirez & Wilkinson 2016). However, in practice, efforts are typically made to avoid fanciful notions that have no evidential basis (e.g. future scenarios featuring perpetual motion machines or that are inconsistent with relevant knowledge), and claims can be more or less grounded in an evidential basis such as knowledge of the past, present, relevant theories, or other knowledge (e.g. knowledge of actors’ intentions). During forward-looking inquiry emphasis is often also placed on what can plausibly be inferred from known facts. A focus on *knowledge practices* places the focus on epistemic claims rather than unrestrained speculation.

BOX 1.1: What forward-looking practices are included or excluded?

Being a definition, the working definition must be limiting and exclude some things from its scope (otherwise it would be too vague). Most forecasting and scenario methods are consistent with the working definition. Some more unconventional methods such as those only using intuitive speculation are likely to be inconsistent with the definition particularly if those doing this speculation are poorly informed. Similarly, visioning methods can be more or less empirically-based. For example, some visioning methods are systematic and aim to be grounded in a strong evidence base which can provide an appropriate warrant for the normative claims and statements that are advanced. These visioning methods can be considered knowledge practices. Other visioning approaches remain in the realm of fantasy (e.g. vague wishful thinking or forms of ‘dreaming’) and are less grounded in appropriate evidence and consequently shouldn’t be viewed as knowledge practices.

This new terminology has been proposed for four core reasons. Firstly, it is important to consider activities through which anticipatory knowledge is produced, assessed and put to use (or not) by actors. All three types of activity can be conceptualised as PKPs (Camic, Gross & Lamont 2011b). Secondly, as outlined above, the underlying concept of a knowledge practice usefully points to the need to consider the ways such practices are socially patterned and to

probe the consequences of this. Thirdly, some transition scholars have pointed to the “significant prospective disposition” (Turnheim et al. 2015, p. 247) that they argue needs to be central to much sustainability transition-related research by which they mean a future-orientation. The use of the term prospective in this study is consistent with this. Finally, it points to the potential to abstract from a case transferable insights. Put this way, use of the concept helps to convey the intent to do more than evaluate interventions.

The concept of a PKP may be further clarified by briefly noting some examples. PKPs are frequently used to *produce* forward-looking perspectives and insights such as via scenario development methods and forecasting techniques (e.g. see Berkhout, Hertin & Jordan 2002; Miller et al. 2014; Swart, Raskin & Robinson 2004). The notion of PKPs also draws attention to activities undertaken to *assess* such knowledge (or claims of anticipatory knowledge) and the diverse settings in which these activities occur (e.g. in workshop settings, within management teams, etc.). A scenario may be assessed by actors with respect to whether the possibilities it conveys represent an opportunity or risks, or it may be interrogated for perceived plausibility or credibility. Finally, we can also consider how (and whether) anticipatory knowledge is *used* and/or *disseminated*.⁴ A prominent example is the use of scenarios or modelling results in policy processes, such as when modelling results are mobilised to justify policy preferences or criticise opponents’ views (e.g. see Denniss 2015). Scenarios may also be used to stimulate creativity (de Brabandere & Iny 2013) or to challenge assumptions (Wright & Cairns 2011). Similarly, we can probe decisions not to use anticipatory knowledge.

1.2.2 Guiding logic and associated research lenses

A key aspect of the focal object which guided the inquiry is the common framing of PKPs as *interventions*. For instance, some scholar-practitioners refer to such forward-looking inquiry as a “foresight intervention” (Inayatullah 2015), a “scenario intervention” (Wright & Cairns 2011) or a “scenario planning intervention” (Ramirez & Wilkinson 2016), and as “participatory intervention methods” (Pesch & Quist 2010). Consistent with this, some scholar-practitioners also refer to underpinning “intervention logics” (Ramirez & Wilkinson 2016, p. 112), make strong claims about how to influentially “use the future” (Miller 2011, 2015a), and make

⁴ Similarly, scholars working on sustainability-related research have recognised the need to consider both the production and the mobilisation of knowledge along with the links between these activities such as whether ‘usable knowledge’ is produced (e.g. Clark et al. 2016).

related claims about whether and why such practices “work” as interventions (Inayatullah 2015). Similarly, Ramirez and Wilkinson (2016) argue scenario planning interventions should be viewed (and practiced) as a *means* towards specific ends.⁵

These ideas, and related knowledge gaps such as the limited evidence of whether and how “futures work bears fruit in the present” (Wilkinson & Mangalagiu 2012, p. 372), suggest that there is a need for *evaluative* research on the use of PKPs as interventions and their effectiveness. As Wilkinson and Mangalagiu (2012) and others suggest, empirical case studies are one way of getting a greater purchase on such evaluative questions.

The above aspects and starting points also point to the potential value of evaluating specific interventions in ways which aim to go beyond traditional impact evaluations and examine underlying theories of change. Such theory-driven evaluation research – guided by underlying “intervention theories” (Pawson 2013, p. 194) – has multiple aims including assessing existing ideas about what makes the intervention work and refining these ‘intervention theories’ as well as gathering evidence for impact assessments (Pawson 2013).

Two associated research lenses guided the inquiry and framed the main ways of looking at and examining the focal case. Firstly, a realist approach to evaluative inquiry was used. Realist evaluation has an explanatory focus (also see Chapter 2 and *Section 1.6*), with a core focus on explaining the main outcome patterns that are identified (Pawson 2013; Pawson & Tilley 1997b). Consistent with this explanatory focus, this thesis presents an explanatory case study investigating ‘how’ and ‘why’ questions (Yin 2009). Additionally, realist evaluation emphasises context-dependent causal processes – which are termed generative causal mechanisms (a process theory of explanation) – and views the resulting knowledge as partial and corrigible (Maxwell 2012; Pawson 2013). Rather than seeking to definitively define ‘what works’ (e.g. interventions and logics claimed to ‘work’ for *any* forward-looking exercise in *any* context), such inquiry recognises the importance of context. This realist philosophical stance can also be contrasted with some theorisation of socio-technical transitions which focusses on identifying recurring transition “patterns” (which is similar to the theorisation of social laws).

⁵ Their language for this point is as follows: “the design of a scenario planning intervention is not seen as an end in itself but a means to something else” (Ramirez & Wilkinson 2016, p. 138). They contend that a core aspect of such interventions is ensuring that they are “designed to serve a specific purpose and set of actors” (p.163). How such interventions ought to be evaluated is not addressed in detail in this textbook, though the authors suggest case study research may be one solution (p.168).

Second, research on, and theories of, social knowledge practices also informed this study and the conceptualisation of the focal object (see Camic, Gross & Lamont 2011a). As discussed later in this thesis, all aspects of social knowledge practices – i.e. the patterned activities and ‘on-the-ground’ work involved in producing, assessing, and using knowledge (or not using it) – are relevant to intervention theories and understanding the potential contributions of PKPs to transitions. This lens also emphasised probing the routinised aspects of PKPs, including how or if this occurred, as well as considering other nonregularised forms of action that typically also form part of knowledge practices (Camic, Gross & Lamont 2011a).

1.2.3 What this study isn’t about

The study didn’t examine technical issues. For example, the study didn’t examine the construction of techno-economic models and associated modelling decisions.

Second, although the epistemic reliability (or accuracy) of anticipatory knowledge was considered it wasn’t a major focus. The reason is that the study focussed on the perceived utility of forward-looking process and associated impact questions.⁶ A participant in a forward-looking exercise could find a resulting forecast or a set of scenarios useful even if they turn out later to be inaccurate or flawed in other ways. Similarly, if a study seeks to influence *present* behaviour, those communicating scenarios may want to be proved “wrong” when desired behavioural changes prevent the predicted future from occurring (May 2007). What these examples illustrate is that when the focus is on utility and impact being correct can be less important than other process outcomes or goals.

⁶ On this point, there are long-standing debates amongst forecasters, and many others doing futures studies, regarding whether accuracy (i.e. correctly predicting the future) is a useful criterion for assessments of the validity or value of forward-looking inquiry. For example, Hines (1995) argues that evaluations of whether a specific forecast is a good forecast should not be determined by whether it turns out to be accurate. In his view the more important factors – particularly regarding the usefulness or overall *utility* of the forecast – are whether a forecast “stimulates your thinking and leads to subsequent action” and whether it has “shaken your conception of the future” (p.24). Additionally, many scenario planning scholar-practitioners – to take another example PKP – view uncertainty as being fundamental and conflicting with predictive ambitions. For example, Ramirez and Wilkinson (2016, p. 138) contend that a core focus of scenario planning is “maintaining a more open sense of the future”, rather than – or in contrast to – a predictive focus. They suggest that a scenario planning intervention can have significant value even if none of the considered scenarios come to pass.

Third, the study didn't seek to make a major contribution to methodology development for forward-looking inquiry such as by developing a new generic process or a methodological framework (for examples see Hines & Bishop 2013; Inayatullah 2008; Quist 2007), or by seeking to identify the best method. Whilst the findings of the study may assist practitioners the intention wasn't to produce recipes for the use of such methods.

Related to this, Ramirez and Wilkinson (2016, p. 113) make the following important claim about assessments of the effectiveness of scenario planning methods (one commonly used approach):

In clinical medicine, the effectiveness of a method is assessed using randomized, controlled trials that inform a meta-assessment of different treatments. There is no such thing in scenario planning to determine objectively that one method is best.

Finally, given the emphasis of the study was on prospective knowledge practices, the study did not seek to develop or test theories of socio-technical transitions. Nonetheless, the case study can be drawn on to consider its relevance for current theories. For example, the findings may provide evidence that supports or challenges a theory of socio-technical transitions. These aspects and possibilities are taken up further in *Part 3* of the thesis.

The main research aims and questions are further clarified in *Section 1.5* of this chapter.

1.3 Introduction to the focal case

As has already been noted, the study examined the use of PKPs in potential transitions related to energy and climate change in Australia. Additionally, a case was chosen that is consistent with trends towards the participatory approaches that are commonly viewed as vital to such inquiry in sustainability-related contexts (e.g. see Miller et al. 2014; Quist & Vergragt 2006; Robinson 2003; Robinson et al. 2011; Talwar, Wiek & Robinson 2011).

The study examined such practices used by a prominent research group at Australia's peak research agency, CSIRO. This group, originally named the Energy Transformed Flagship (from the early 2000s through to 2013), was created when CSIRO management created new thematic research units called "national research flagships" as part of a major organisational change (Sandland & Thompson 2012). (More recently its name has changed, first in 2013 to

the Energy Flagship, and more recently to CSIRO Energy; in the thesis, I primarily refer to the group as “the Flagship”, consistent with its names during the relevant time period [roughly 2007-2016]). The case thus considers not only the utility or impact of forward-looking inquiry but also the way such activities are approached by staff at a formal scientific organisation (CSIRO) during a period of significant reflection on its roles in the national innovation system and its place in society more broadly (Sandland & Thompson 2012).

From the beginning of the Flagship’s existence an underpinning future-oriented research theme was a core aspect of its activities. This theme was originally called “energy futures” (Sandland & Thompson 2012, p. 291) and later focussed on “carbon futures”. Aside from developing an energy sector modelling capability, a core activity was convening multi-stakeholder forums. In addition to providing information to other actors these forums aimed to inform and assist the Flagship, such as by helping to define, justify and/or advance their research priorities (J. Wright, 2014, personal communication, 9 June).⁷

This approach of convening “futures forums” (as Flagship staff term them) is the core focus of the case (see *BOX 1.2* for an overview of the process and its outputs). The futures forum process can be further defined as a *prospective exercise*; that is, a participatory process which is facilitated in which the main activities involve “prospection” (Gilbert & Wilson 2007), i.e. thinking about, describing and discussing possible futures. The term prospective exercise can thus be used to connote a specific type of PKP: a participatory group exercise, and associated research, which seeks to look *forward* and involves relevant actors.⁸

BOX 1.2: Overview of the CSIRO futures forum process

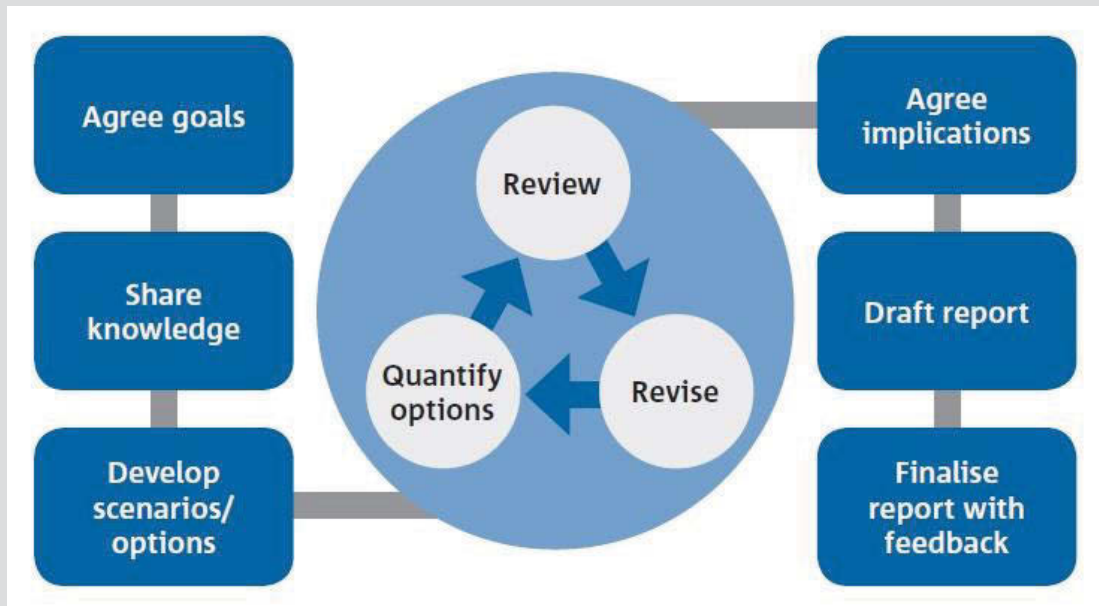
Flagship staff describe the “futures forum” process as a series of structured workshops resulting in public reports in which participants: (i) share knowledge; (ii) work collaboratively on the definition of a set of scenarios and options which are subsequently examined quantitatively via modelling; (iii) develop a collective view of the related challenges, opportunities and options; and (iv) contribute to reports which are authored by CSIRO staff to capture and communicate the findings of the forum (CSIRO 2012). Flagship staff lead the

⁷ Throughout this thesis interviews are cited as personal communications (as per the Harvard referencing style); a list of interviewees for each futures forum including their details (e.g. employer at the time of the relevant futures forum) is provided in the Appendices.

⁸ The intended meaning of the adjective prospective is “relating to or effective in the future” (Merriam-Webster dictionary, <https://www.merriam-webster.com/dictionary/prospective>), in particular ‘relating to ... the future’. That is, discussions at such exercises principally refer to what may, will or should happen in the future and connect the inquirer (mentally) to such future possibilities.

supporting techno-economic modelling work, with support from specialists if required, and are the lead authors of the public forum reports.

The following visualisation of the process was presented in a futures forum project prospectus:



As will be further outlined in Chapter 3, the process is also characterised by (i) broad participation of relevant stakeholders and actors (the futures forums examined in this study had 43, 62 and 102 core participants), and (ii) the aim of being relevant for policy-making and decision-making but not prescriptive. Regarding the later aspect, the project proposal for one forum states that “the Forum will not seek to arrive at a consensus on specific recommendations for government policy or investment” and would, instead, produce “an agreed view of the various options to be considered” (CSIRO 2012, p. 5).

Three CSIRO futures forums run by the Flagship were included in the study: the Future Fuels Forum (run in 2007/08), the Sustainable Aviation Fuel Road Map Forum (run in 2010/11), and the Future Grid Forum (run in 2012/13). For more detail see Chapter 2 and the description of each forum provided in *Appendices 1-3* (each Appendix outlines a futures forum, the main identified forum outcomes, and the forum participants).

The focus on CSIRO futures forums meant that high-profile and, therefore, potentially high impact interventions were evaluated. Important and potentially influential actors from the public, private and wider community sectors participated in each futures forum. To give one example, participants in the Sustainable Aviation Fuel Road Map Forum included staff from

Qantas, Virgin Australia, Boeing, Airbus, Caltex, the Worldwide Wildlife Fund (WWF), The Climate Group and relevant Federal and State government departments.

The case selection also meant some approaches that are widely used in the context of sustainability and socio-technical transitions such as backcasting and visioning exercises were not the focus. However, these approaches are some of the more widely studied, particularly backcasting (e.g. Davies, Doyle & Pape 2012; John et al. 2015; McGrail, Gaziulusoy & Twomey 2015; Quist 2007; Quist, Thissen & Vergragt 2011; Robinson 1988; Robinson et al. 2011; Vergragt & Quist 2011; Weaver et al. 2000; Wiek & Iwaniec 2014).

Finally, it is also important to note the geographic and sectoral focus of the case. Some of these foci may influence the transferability of the case study findings.

The chapter now progresses to briefly review existing perspectives on PKPs, with a focus on their use in transition contexts, and key issues raised in relevant literature.

1.4 Current perspectives on prospective knowledge practices and related knowledge gaps

1.4.1 *The potential functions of PKPs in transition contexts and associated challenges*

The frequent production and use of future-oriented analysis in transition contexts suggests that PKPs are useful and may be *necessary* during transitions. Many claimed functions and benefits have been highlighted by scholars in transition studies and other fields.

In their study of the functions of scenarios in transitions, Wiek et al (2006) argued that scenario construction processes can have many functions such as providing an enhanced basis for decision-making. Scenario building is claimed to have other benefits such as enhancing the ability of actors to cope with uncertainty and improving teamwork.

Broader potential benefits of PKPs have been emphasised by sustainability-related scholars. For example, Miller et al (2014, p. 241) argue that they can enable more “explicit treatment of the normative, ethical and political issues” which “are often obscured by descriptive analysis”. More ambitious claims about “fuelling a mindset change” (Sondeijker 2009, p. 21) have also been made, linked to the goal of “fuel[ling] the emergence of the will and force for gradually

bending the curve of development” towards sustainability goals (Sondeijker 2009, p. 19).

Scholars in other fields have similarly argued that PKPs have a range of benefits. Four are frequently emphasised: (i) enabling a broader or open sense of the future; (ii) challenging existing thinking (or ‘mental models’); (iii) improving decision-making; and (iv) promoting joint learning (e.g. see Ramirez & Wilkinson 2016; van der Heijden 1996; Varum & Melo 2010; Wright & Cairns 2011; Wright, Cairns & Bradfield 2013). For example, scenario exercises are claimed to reduce cognitive inertia and biases (Healey & Hodgkinson 2008; Meissner & Wulf 2013) and to have a core “enlightenment function” (Parandian & Rip 2013, p. 3) whereby they “sensitize and enlighten their users to think more broadly about futures”. Others further contend that related social practices termed “temporal work” are what makes action possible in “the face of uncertainty” (Kaplan & Orlikowski 2013, p. 965).

However, sustainability and transition researchers have also identified challenges that are commonly faced when using PKPs. An important example is participants having “severe difficulties getting disengaged from the present” (Vergragt & Quist 2011, p. 750), a dynamic termed “presentism” (Gilbert 2007). Scholars also emphasise the barriers to achieving the consensus outcomes and/or shared understandings which are frequently sought (Berkhout, Smith & Stirling 2004; Krzywoszynska et al. 2016). Questions have also been raised about the links between such knowledge and action (Miller et al. 2014). Miller et al (2014, p. 242) argue that the outputs from these studies “rarely “speak” to stakeholders or get considered in real decision processes that influence development pathways”.

1.4.2 Knowledge and practice gaps regarding the use of PKPs in transition contexts

Though the amount of research conducted on specific PKPs varies, general pertinent gaps regarding the use and utility of PKPs in transition contexts can be readily summarised:

Involvement of stakeholders in transition-related modelling: Holtz et al (2015, p. 47) argue that the use of “models to facilitate stakeholder processes have so far received limited attention of transition modellers” and they further note that there has been limited experimentation with ways of collaborating with stakeholders in such participatory modelling activities. Recent case studies have raised questions about some claimed benefits of participatory modelling (e.g. Krzywoszynska et al. 2016).

Supporting evidence for claimed benefits: example unsubstantiated claims include the claim that the development of scenarios of socio-technical pathways “can enhance the analytical depth and reflexivity in policy making, especially by explicating the dynamics of transitions and by opening up the (often hidden) choices at the third policy (paradigm) level of general goals and strategies” (Verbong & Geels 2010, p. 1220). Similarly others claim that scenario analysis is a “powerful tool” for sustainability research but they too provide little supporting evidence (e.g. Swart, Raskin & Robinson 2004), though case study research has recently been published that provides mixed evidence and reveals many challenges (e.g. Cairns et al. 2013; Hulme & Dessai 2008; Mulligan et al. 2009; Vervoort 2014).

Understanding participation and power in PKPs: many of these unanswered questions echo earlier scholarship in the social studies of science (Krzywoszynska et al. 2016; Stirling 2007, 2014). For example, some poorly understood tensions concern who participates (e.g. a bottom-up focus on involving innovators who are often termed ‘frontrunners’?) and existing power structures (e.g. do other powerful stakeholders also need to be involved in order to better enable change?). Broader power relations issues tend to be poorly addressed (Holtz et al. 2015), though the politics of sustainability transitions has recently been given greater attention by some transition scholars (e.g. Avelino et al. 2016).

Tensions between epistemic and instrumental functions: whilst scholars recognise that “instrumental pressures” are often “at work” (McDowall & Geels 2017, p. 43), and that models can be used as “political tools” (Krzywoszynska et al. 2016, p. 811), the influence of related issues and tensions on forward-looking research has only been partly explored.

Philosophical foundations and related gaps: transition scholars have also pointed to continuing epistemological and ontological questions and gaps (McDowall & Geels 2017; Turnheim et al. 2015). Such issues address specific challenges and knowledge gaps regarding efforts to use computer-based models to model transition processes (which is highly relevant to PKPs) and general knowledge gaps about transitions e.g. theory gaps (McDowall & Geels 2017). Similarly, issues to do with the philosophical positions of transition researchers have only been partly explored and addressed (e.g. see Geels 2010; McDowall & Geels 2017).

1.4.3 Broader knowledge gaps

The wider literature on forward-looking methods (e.g. the literatures on futures studies, foresight exercises, etc.) discusses a broader set of gaps including the following:

Theoretical underpinning: Piirainen and Gonzalez (2015, p. 191) note calls for greater focus on the theoretical underpinning of ‘foresight’ exercises (one type of forward-looking exercises and one umbrella term for these activities), arguing it “lacks a coherent theoretical basis”. One aspect relevant to the present study concerns what Piirainen and Gonzalez (2015, p. 197) term a utility theory: that is, theorising “what affects foresight impact or ... how and why foresight works” (p.197). They suggest that such utility theories can inform improved understandings of “the utility and attribution of foresight as an intervention” (p.199).

Poor understanding of linkages with decision-making: a further gap concerns understandings of the links with decision-making and other uses of the outputs from forward-looking research. Reported cases often convey disappointment regarding limited use (e.g. Kleiner 2003; Miller et al. 2014; Rickards et al. 2014; von Stackelberg & Jones 2014).⁹ Related research questions have been proposed (Miller et al. 2014). Whilst various ideas have been proposed – such as that scenarios can enable actors “to be creative, pragmatic and productive in coping with change” (de Brabandere & Iny 2013, p. 283) and enable robust planning (Lempert et al. 2006) – the literature suggests there is poor knowledge of enablers and barriers.

Limited analysis of the influence of social factors on prospective knowledge practices and related ethical and social issues: social scientists and some practitioners have only begun to explore social influences on PKPs and have called for more attention on these (e.g. on the factors that influence what information or issues get emphasised or suppressed during scenario construction). For example, little research has explored social constraints on, and enablers of, forward-looking inquiry (Cerulo 2006; Garb, Pulver & Vandever 2008); processes of negotiation amongst stakeholders, e.g. during scenario construction (Hulme & Dessai 2008);

⁹ Influential management thinker and writer Art Kleiner puts this as follows: “most companies that create scenarios of potential risks and opportunities find it difficult to actually make effective real-world decisions based on the stories they imagine” (Kleiner 2003). von Stackelberg & Jones (2014, p. 58) put the issue this way: “it is not uncommon for excellent foresights and insights to be discounted or completely ignored while “business-as-usual” continues even in the face of threats that should be obvious.”

and issues of power (Ramirez & Wilkinson 2016). The existing literature focusses on narrower aspects such as social interaction and exchange during workshops (e.g. Kerr, Phaal & Probert 2012), related group processes and cognitive effects (e.g. van der Heijden 1996), and organisational learning aspects (van der Heijden 2004; van der Heijden et al. 2002). Questions about scenario planning raised by Ramirez and Wilkinson (2016, p. 47) point to a larger set of issues (see *BOX 1.3*) that are typically inadequately addressed.

BOX 1.3: Ethical and power-oriented questions regarding scenario planning processes highlighted by Ramirez & Wilkinson (2016, p. 47):

- In whose interests are the scenarios being built – and against whose interests?
- Who finances scenario planning initiatives and with what strings attached?
- Is the scenario planning process itself, not only the result, going to be considered ethical, particularly by stakeholders who will inevitably feel excluded or feel marginalised?
- How well has the scenario process and design been documented, for it to be tested and contested critically?
- Who gets involved and how? Who gets excluded and why? Who might be impacted and how? Who convenes meetings and with what mandate?
- Who is attempting to shape a future with the scenarios, and what alternative futures are being excluded by the way this set of scenarios are built and designed?

Poor understanding of the influence of scientific contexts on forward-looking inquiry and its utility: A final gap particularly relevant to this thesis – given its focus on studies led by staff from CSIRO – is the limited examination of the issues that scientists can face when doing such research and the influence of scientific institutions. Notable exceptions point to dynamics where research is influenced by efforts to ensure research is seen as rigorous or ‘scholarly’ (e.g. see van Asselt et al. 2010), and where the place of normative scenarios or analysis is diminished (Ogilvy 1996, 2002). A recent study found that such dynamics resulted in potential discontinuities tending to be omitted from such studies (van Asselt et al. 2010).

1.4.4 Other social scientific perspectives on prospective knowledge practices

Research and perspectives in other fields also suggest that greater assessment of the use of PKPs is needed. Williams (2006, p. 328) critiqued recent attempts “to look further into the future and map the technical and social outcomes in greater detail than previously”. He drew

on historical studies which demonstrated that early ideas about the implications of new and emerging technologies (which are often a key focus in future-oriented inquiry, including in the case studied here) tend to be “so far removed from ultimate outcomes as to be uninformative” (p.330). Linked with this Williams warned about the significant barriers to those insights which may produce (or enable) better foresight.

Other STS scholars such as Van Lente (2012) have critically analysed the potential for PKPs such as so-called “foresight methods” to be an antidote to lock-in. Drawing on findings from a field of research called the sociology of expectations he writes that:

The efficacy of this antidote [provided by “foresight” methods to lock-in situations], however, can only be limited, according to the sociology of expectations. Since foresight necessarily draws from existing repertoires of expectations [i.e. participating actors draw on existing expectations about the future and related currently credible discourses], it will not generate many ‘new’ expectations, although ‘new combinations’ between elements of the repertoires are possible. The same risks loom for the objectives of networking and vision building: they may reproduce images and arguments that are already circulating (van Lente 2012, p. 778).

Given the centrality of lock-ins to much transition theory, and the conceptualisation of related transition research, this is potentially a major shortcoming. Specifically, transition-related interventions are often conceptualised as seeking to overcome the lock-in processes which reinforce existing systems (Farla et al. 2012; STRN 2010), a dynamic which is also described as path dependencies entrenching dominant structures (Avelino et al. 2016).

Critical perspectives can also be found in other fields such as management science. Given the inherent uncertainty and dynamism of transition processes (Geels, Elzen & Green 2004), some management scientists such as Rumelt (2011) would argue that it is a mistake for actors to try to look far ahead (i.e. into the future). Rumelt (2011, p. 111) writes that:

Many writers on strategy seem to suggest that the more dynamic the situation, the farther ahead a leader must look. This is illogical. The more dynamic the situation, the poorer your foresight will be. Therefore, the more uncertain and dynamic the situation, the more *proximate* a strategic objective must be. [Emphasis in original]

Other management scientists have also suggested that a balanced perspective on PKPs is required which recognises the potential for PKPs to exacerbate biases and hamper decision-

making (e.g. Bradfield 2008; Healey & Hodgkinson 2008). Based on a study of the behaviour of people in scenario development exercises Bradfield (2008) made a number of observations relevant to transition contexts. He found that when people are analysing “inherently uncertain and complex situations and issues” (which is common in the context of socio-technical transitions) cognitive barriers constrain the development and interpretation of scenarios as well as the search for relevant information and use of data during scenario development activities (Bradfield 2008, p. 210). As he puts it, in the scenario exercises he studied “the search for information was largely guided by what individuals already had an understanding of and was constrained by their cognitive anchors, experiences, and belief systems; information that did not accord with this was generally discarded” (p.210).

Some issues identified by management scientists raise questions about the use of PKPs in transition contexts. For example, transition processes are typically dynamic and highly complex. Looking far ahead may be inherently problematic (Rumelt 2011).

1.5 Research aims, related goals and focal questions

1.5.1 *Research aims and related goals*

Informed by the current state of knowledge and associated trends (see earlier sections of this chapter), four main aims motivated and guided the present study:

1. To critically examine the use, roles and utility of prospective knowledge practices in sustainability-related transitions and transition contexts;
2. To deepen and broaden the theoretical perspectives which are used to understand how and why a ‘prospective exercise’ (one common type of prospective knowledge practice) has influence or, in other instances, doesn’t have the intended influence;
3. To trial the use of a type of theory-driven evaluative inquiry – realist evaluation – which appears to offer a suitable alternative to seeking to define ‘what works’; and
4. To contribute to a better understanding of the use of prospective knowledge practices by scientists and the working theories that guide them (e.g. their utility theories).

Related to these specific research aims were some more general goals. By conducting research guided by these aims the study sought to contribute to a better understanding of the functions of PKPs in transition contexts (both intended and actual), what affects their impact, and what

enhancing their impact might require. The increasing use of PKPs in sustainability transition-related contexts is perhaps surprising given the significant challenges that are commonly faced and related theoretical and practical issues that must be grappled with (see *Section 1.4*). What therefore motivates their use and are these benefits realised?

Additionally, consistent with the use of PKPs in the context of problems related to energy and climate change, and the importance of society's responses to these challenges (IPCC 2014), the study sought to probe the potential roles of PKPs. By examining real-world cases we may gain a better understanding of whether the use of such practices can contribute to the resolution of related social problems.

As has been noted these aims were, in part, operationalised by conducting evaluative research. Consistent with this approach, and the "tools-in-use" perspective proposed by Jarzabkowski & Kaplan (2015), I sought to consider how and why tools were 'mobilised' and to avoid simplistic good/bad and correct/incorrect style judgements.

1.5.2 Overarching research question and related guiding questions

The following three-part question was the overarching research question for this study: **How and why are prospective knowledge practices used in sustainability-related socio-technical transition contexts, with what effects, and how could their use and theorisation be enhanced?**

Related guiding questions were also defined for the case study research, each of which address parts of the overarching research question and are aligned with the main aims:

1. How and why were prospective knowledge practices mobilised in the focal case (e.g. by CSIRO staff working at the Flagship), and what outcomes resulted from these activities?
2. In this case, what social processes, and associated contextual and cognitive factors, influence the production, assessment and use of anticipatory knowledge? How do these compare to the intervention theories guiding CSIRO staff?
3. What additional conclusions can be drawn from the case regarding the use and utility of prospective knowledge practices in the context of sustainability-related socio-technical transitions, including regarding what enables and constrains scientists as

agents of change?

4. How can theory-driven evaluative research contribute to the empirical and theoretical underpinning of prospective knowledge practices that are used as interventions?

These guiding questions are related to the main aims as follows. Question 3 addresses the need to better understand the utility and use of PKPs in sustainability-related transition contexts (see research aim #1). Question 2 is focussed on contributing to improved theoretical underpinnings and guiding theories (see research aim #2 and #4). Question 4 refers to how use of a realist evaluation approach in this research will provide knowledge about the potential value of this approach (see research aim #3). Question 1 is aligned to most of the aims and acknowledges the limited scope of investigation.

1.5.3 *Expected/desired relevance of the research*

It is expected that the results of this research will contribute to sustainability transition research and be useful for practitioners (i.e. those using PKPs).

As was outlined earlier in this chapter, some transition scholars have emphasised the “prospective disposition” of much sustainability transition-focussed research (e.g. Turnheim et al. 2015, p. 247). The evaluation research approach adopted in this case study is a novel way of examining the ways in which such practices are expected to contribute to particular outcomes in a real-world case and associated research outcomes.

Second, insights into the potential functions, significance and limitations of PKPs are expected to be useful for practitioners (e.g. those convening or facilitating scenario exercises). For example, given the published literature features poorly substantiated and theorised claims (e.g. claims made about the ‘power of scenarios’, the creation of ‘safe spaces’, and about producing enhanced ‘foresight’), more case study research is needed to clarify and probe such claims and inform reflective practice.

The research is also relevant to researchers focussed on socio-technical transitions related to energy and climate change. For example, impact related lessons may be relevant to researchers seeking to contribute to such transitions. Like the CSIRO researchers who led the focal prospective exercises examined in the present study, researchers may also be

practitioners who use PKPs (or may be considering doing so).

Consideration of aspects of PKPs that to-date have been insufficiently or only partly explored also promises to deliver new insights. For instance, to the extent that “looking forward is a socially conditioned process” (Ramirez & Wilkinson 2016, p. 23) then non-technical aspects of forward-looking inquiry need further attention.

Finally, although this is not the focus, examination of the use and role of PKPs in transition contexts may shed light on the dynamics of transition processes.

1.6 Introductory overview of realist evaluation

In this study, an evaluative inquiry approach called realist evaluation was used as part of the case study research. A final key task for this opening chapter is to provide a fuller introductory overview whilst leaving the finer details for the methodology chapter.

The realist evaluation lens centrally assumes that the focal practices being evaluated aim to create change. As leading realist evaluation theorist and practitioner Ray Pawson (2013, p. 9) puts it, “programmes and interventions spring into life as ideas about how to change the world for the better”. Related roles for evaluative inquiry include surfacing, assessing and refining these ideas (McGrail 2014; Pawson 2013). As was noted these ideas are conceptualised as intervention theories which guide social interventions and can be used to explain their effects (Pawson 2013). This approach to evaluation research seeks to extract guiding theories, uses applied social science inquiry to test their validity, and – by developing causal explanations – seeks to contribute to refined guiding theories (Pawson 2013).

A few further words on ‘realism’ and the ‘realist’ underpinnings of such inquiry are also in order. The realist part of ‘realist evaluation’ has several important meanings.

One meaning of realist is a general sense of realism. Realist evaluation doesn’t seek to definitively define ‘what works’. Rather, realist evaluators engage in nuanced contextual

thinking and recognise that there generally aren't silver bullets.¹⁰ Interventions are further expected to 'work' differently for different people and/or subgroups. The generic guiding question posed in realist evaluation, of "What works for whom in what circumstances and in what respects, and how?" (Pawson & Tilley 2005), thus points to key considerations when examining the utility and use of PKPs. Related issues are addressed such as to what extent every intervention situation is truly unique – as argued by some practitioners (e.g. Ramirez & Wilkinson 2016, p. 140) – and the *transferability* of insights.

Second, Pawson (2013) draws on philosophers of science to argue that realist refers to "corrigible realism". That is, realists "admit to a permanent state of partial knowledge" (Pawson 2013, p. 84), and call for "a keen awareness of the limitations, but also the value, of partial knowledge" and "acute modesty about what is obtained" (p.85). Pawson further outlines the meaning of this perspective in the context of evaluation:

The coverage of research is always partial and the understanding of any intervention is always imperfect, impermanent and thus corrigible. One issue after another may be grasped but with each discovery other imponderables are unearthed and the chase continues – permanently (Pawson 2013, p. 85).

In addition, the social research conducted for such inquiry is recognised as being inherently difficult: "social research is supremely difficult and prone to all kinds of error, mishap and bias" (Pawson 2013, pp. 8-9). For Pawson, the complexity of human societies and the contexts in which interventions are conducted further demand this perspective.

The third main meaning of realist refers to the underlying research strategy and view of causation which Pawson and Tilley originally termed 'scientific realist' analysis (Pawson & Tilley 1997a; also see Pawson, 2013). That is, the development of realist evaluation reflected the emergence of a new "generative view of causation which had come to the fore in the philosophy of science" (Pawson 2013, p. xix), whereby causation is examined and understood in terms of underlying 'mechanisms' whose operation is contingent on an appropriate context (see Chapter 2) rather than seeking to define generalised 'laws'.

¹⁰ Pawson and Tilley (2005) argue that "it is impossible to provide the exact recipe for success", a view which is echoed by experienced practitioners who specialise in the use of forward-looking methods such as Inayatullah (2015). They further argue that the end product of a realist evaluation "is never a pass-fail verdict" on a focal social intervention or social policy. Related to this perspective realist evaluation was originally termed *realistic* evaluation (see Pawson & Tilley 1997b, 2005).

1.7 Thesis overview and summary

The empirical component of this thesis presents an explanatory analysis of the focal case. A comparative structure is used which presents and considers alternative possible explanations of the focal case (Yin 2009). I then draw on each of these explanations when reaching explanatory and evaluative conclusions. A detailed description of each prospective exercise – including an overview of each futures forum process, the participants in each futures forum, and identified process outcomes – is included in the *Appendices*.

The remaining chapter in *Part 1* outlines the methodology. Attention is placed on how the realist evaluation approach was operationalised (also see *Part 2a*) and, secondly, on how the other theoretical perspectives were selected and utilised to further analyse key case themes and explain the outcome patterns that were identified (see *Part 2b*).

The core empirical case research is presented in *Part 2*. *Part 2a* presents analysis that was guided by the practitioners' intervention theories. Chapter 3 outlines the characteristics of the interventions and intervention theories which were elicited via interviews with current and former CSIRO staff and compares them with existing theories in the literature and related ideas about the role of science in society. Chapter 4 then tests these theories against the case evidence and secondly, as per the explanatory focus of realist evaluation, considers whether these theories adequately explain the intervention outcomes.

The intervention theory-focussed evaluative inquiry in *Part 2a* suggests a two-part explanation for the main outcomes patterns in the case: (i) the validity of the intervention theories influences the intervention outcomes that are realised; and (ii) intervention theory deficiencies led to reduced forum impacts and this explains, in part, the outcome patterns.

However, the intervention theory-focussed analysis in *Part 2a* can only do so much explanatory work in accounting for the identified intervention outcomes. *Part 2b* expands the case analysis and considers more formal theoretical perspectives and causal mechanisms. Consideration of these perspectives informs additional case explanations. Specifically, these chapters consider, and review the evidence for, the ways in which PKPs are social activities (Chapter 5), are political practices (Chapter 6), and are shaped by reasoning processes and

associated competencies (Chapter 7). Additionally, the consequences of these aspects of PKPs (where they have been reasonably established by the study) are briefly explored, such as in terms of the intervention theories presented earlier. Overall, these chapters aim to help explain the main outcome patterns and to address knowledge gaps and issues that were identified by a literature review (as was summarised in *Section 1.4*).

This analysis points to three additional case explanations (for the outcome patterns) which are partly overlapping and complement the intervention-theory focussed analysis:

- The outcomes reflect the social aspects of PKPs, including (but not limited to) the ways that knowledge claims about the future – along with their use and downstream effects – are the *result* of social processes, and the consequential ways in which PKPs are *marked* by the contextual circumstances (see Chapter 5);
- The outcome patterns emerged because the futures forums, their outputs, and their effects were enabled and constrained by politics (see Chapter 6). From this perspective, forward-looking processes and anticipatory knowledge are also *resources* which actors have differing capacities to put to strategic use; and
- The outcome patterns can be explained by the functions and tendencies of human reasoning and the conditions under which this occurs (see Chapter 7).

These case explanations and associated case analysis also inform a central argument that is developed in the thesis: by investigating the social, political, and reasoning dimensions of PKPs we can better understand both their potential functions and their limitations.

Part 3 includes two discussion chapters which present further interpretations of the focal case and the concluding chapter. The first chapter (Chapter 8) further considers the implications of the case for the elicited intervention theories, including lessons potentially relevant to other practitioners. This chapter draws on both the findings in *Part 2a* and the additional intervention theory related findings presented in *Part 2b*. This discussion points to possible refinements to the intervention theories. The second discussion chapter (Chapter 9) shifts focus somewhat to consider what the case may tell us about the utility and use of PKPs in socio-technical transition contexts.

Chapter 9 and the concluding chapter also introduce a philosophical position – pragmatism – and a related action theory informed by pragmatism. These are introduced as tools for further

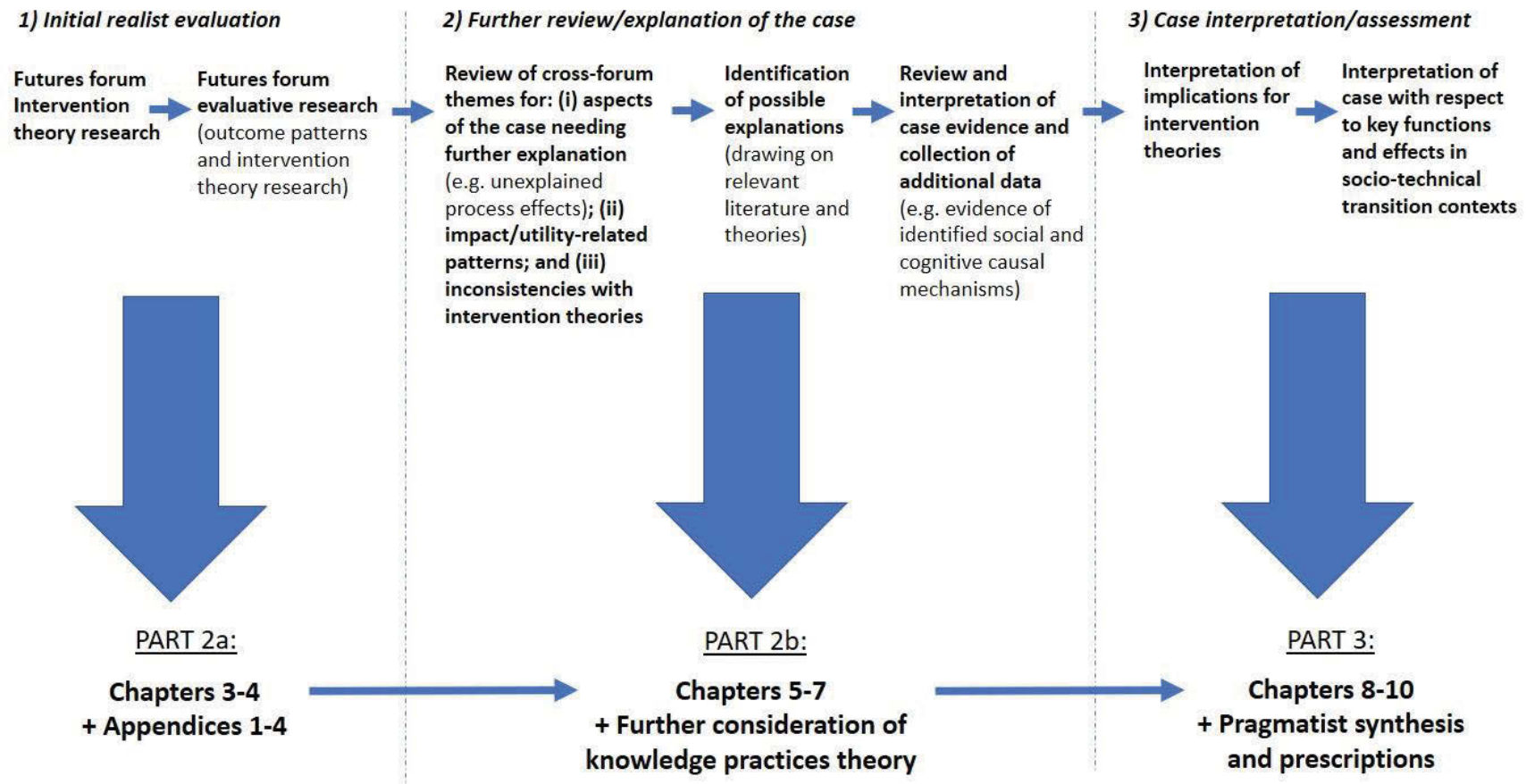
synthesising the analysis and for proposing ways that the use and theorisation of PKPs could be enhanced (see the third-part of the overarching research question). I will leave the philosophical details for later chapters; however, it is important to note that the term pragmatism is not principally used in a narrow sense – such as only with respect to the so-called “pragmatist maxim” (Hookway 2015) – nor in the everyday sense such as where it is disparagingly used to describe unprincipled forms of incrementalism (Joas 2001).

The above structure is also represented in *Figure 1* below in terms of the progression of the study over-time and the chapters which each step informed.

This study and its core findings pertain both to the validity of the identified intervention theories (and similar theories used by other practitioners) and, secondly, to the use of PKPs in transition contexts. The case provides some mixed support for the intervention theories (e.g. credible evidence that the futures forums supported some strategic decision-making under uncertain conditions by reducing actors’ uncertainty), and it provides strong evidence of the consequences of intervention theory validity for intervention outcomes. The case provides limited evidence of the dominant claims about PKPs and their utility and provides greater evidence for alternative roles and functions such as belief reinforcement and providing actors with ‘political ammunition’ (Weiss 1979). The case also demonstrates that the use and effects of PKPs are institutionally structured in consequential ways.

The concluding chapter also outlines the central arguments and associated claims and draws on these to propose a set of pragmatist prescriptions for the use of PKPs in transition contexts. These high-level prescriptions call attention to the relevance of pragmatist action theories, pragmatist epistemology and the need to consider how and whether PKPs – and related processes and outputs – “cash out” in present action and empirical experience (as pragmatist philosophers would put it).

Figure 1: Over-time perspective outlining the three main study phases



CHAPTER 2: Methodology

2.1 Introduction

As noted in the first chapter the study trialled a type of theory-driven evaluative research – realist evaluation (Pawson 2013; Pawson & Tilley 1997b) – which offers an alternative to seeking to define ‘what works’. This chapter provides a more detailed overview of realist evaluation and describes its place in the broader evaluative case study research that was conducted. I also describe other parts of the guiding conceptual framework, how this was used, and the research design.

The emphasis on *evaluating* social interventions may raise questions about the scope of inquiry. For example, influential evaluation theorist Michael Scriven has argued that evaluation research and social science are fundamentally different undertakings. Scriven contends that evaluation focusses on determining “the merit, worth, or value of things” (i.e. reaching evidence-informed evaluative judgements guided by normative and/or subjective evaluative criteria), whereas social science – in Scriven’s view – has the aim of objectively answering empirical questions (Scriven 2004), though others clearly adopt broader notions of social science. Whilst this study did aim to reach evaluative conclusions – with a focus on developing related insights into whether and how prospective exercises can ‘work’ as interventions and the utility of prospective knowledge practices (PKPs) – it also sought to gather evidence relevant to objectively answering questions about the roles and use prospective knowledge practices in transition contexts. Regarding the latter aim, the study described and analysed a relevant case. Generalisability of the case is an important consideration and related attention was given to relevant factors (also see the discussion of limitations).

This chapter proceeds by initially providing an outline of the methodology and research design. The core elements of the conceptual framework, study components and methods are then presented. Issues related to validity, generalisability, and limitations are then outlined.

2.2 Overview of the research methodology and research design

The study used an explanatory case study methodology (Harder 2010; Yin 2009) to examine the focal case (see *Chapter 1* and overview of case characteristics below). This research design

also enabled comparative analysis as multiple futures forums were run by CSIRO over the past decade and three of these interventions were evaluated and compared as part of this study. Consequently, the research design can be summarised as a single-case explanatory case study design with a comparative component. The explanatory aspect of the case research refers to the focus on ‘how’ and ‘why’ style questions. As Harder (2010) summarises, “explanatory case studies not only explore and describe phenomena but can also be used to explain causal relationships and to develop theory”.¹¹

Whilst case studies, particularly historical narrative case studies, are common in sustainability transition research, the present study is unique in that it was designed as a realist evaluation-informed study of PKPs using a qualitative case study methodology. The research was conducted in collaboration with CSIRO staff to gain better access to relevant staff (e.g. for in-depth interviews), gain access to case data and address validity threats.

Maxwell’s (2013) model of qualitative research design was used which has the following five components: goals (see the introductory chapter); guiding conceptual framework; research questions (see introduction); methods; and validity. The components not yet discussed are outlined in this chapter along with some of the finer details of the study, i.e.:

- *Conceptual framework* – that is, the theories, concepts and prior research findings (from other studies) that guided or informed the study;
- *Methods*; and
- *Validity* – where this is understood as the correctness or credibility of a description, conclusion, explanation or other account – and strategies used to address key validity threats. Related limitations of the study are also discussed.

2.3 Conceptual framework

The conceptual framework used in a study is “the system of concepts, assumptions, expectations, beliefs and theories that support and informs your research” (Maxwell 2013, p. 39). Additionally, Maxwell (2013, p. 39) argues that the conceptual framework must be

¹¹ Some case study researchers argue that a necessary preliminary step when developing explanatory case studies is developing “some type of flowchart or logic model that portrays the patterns to be investigated” which, they argue, “is necessary in order to ensure that the investigation stays on track” (Harder 2010). In this study, the intervention theories – using realist evaluation concepts – functioned as this “logic model”.

constructed by the researcher for the specific study so that it's relevant to what you plan to study and how.

The core conceptual framework for this study integrated ideas, theories and assumptions from a range of fields. The core framing assumption that PKPs are *purposeful* practices is central to the overall coherence of the framework. One way of expressing this assumption is that PKPs are “a means rather than an end” (Ramirez & Wilkinson 2016, p. 15). A related assumption is that effective use of PKPs is likely to entail addressing the specific needs of actors in their specific circumstances (Ramirez & Wilkinson 2016; also see Chapter 9-10). This implies that the effectiveness of PKPs as a “means” should be examined, e.g. via evaluative research, along with the processes that produce related effects. Consistent with these underlying assumptions, as was noted in the introduction, forward-looking practices are frequently described and used as *interventions* (e.g. a “scenario planning intervention”, etc.).

Other central guiding concepts have already been introduced such as knowledge practices (Camic, Gross & Lamont 2011a). The related turn to practice, as defined by Camic et al (2011b, pp. 6-7), calls attention to “the day-to-day action and processes through which the producers of social knowledge actually go about the on-the-ground work of making, evaluating, and disseminating the kinds of social knowledge that they are involved with producing”.

Evaluation theory and concepts also informed the study, specifically a realist evaluation approach (also see McGrail 2014). This approach doesn't stipulate a methodology or research technique (Pawson & Tilley 2005). Rather, it should be understood as an *approach* which stipulates a logic of inquiry and related concepts, beliefs (e.g. about how an intervention produces change) and assumptions. Realist evaluation theorist Ray Pawson argues that this approach “centres around exploring the ‘mechanisms’, ‘contexts’ and ‘outcomes’ associated with an intervention” (Pawson 2013, p. 1). These are core concepts in realist evaluation – see *Table 1* below. Social interventions are seen as “theories incarnate” and as having socially contingent outcomes (Pawson 2013; Pawson & Tilley 2005), and evaluators should therefore seek to understand these underpinning theories and contextual dependencies. In their simplest form, such theories are ‘if we do ‘X’ then, in the following circumstances, we expect outcome ‘Y’ style ideas and articulate key context dependencies. Related to this, realist evaluators assume that no intervention, policy or program is a panacea or works

unconditionally. Interventions are understood to “never work indefinitely, in the same way, or in all circumstances, nor do they work for all people” (Pawson & Tilley 2005).

When interventions are viewed as “theories incarnate” these theories can be more or less formal such as informal practitioner theories or, alternatively, formal theories which are the product of social science. For example, Pawson and Tilley (1997b) outlined how social scientific theory could guide a realist evaluation of a smoking prevention program, and Pawson (2013, p. 18) argued that practitioners’ experiences with an intervention can be drawn on to develop preliminary theories to-be-tested and that “these ‘folk conjectures’ ... can provide a legitimate focus for the investigation”. The latter approach centred initially on practitioners’ conjectures was used in this research. This guided the use of a theory-driven approach based on the expectation that assessment of these conjectures would both contribute to useful practitioner reflection and provide a useful starting point. Additionally, to the extent that such practitioner theories actively guide their practices – and therefore influence intervention outcomes – it is important that practitioners consider the validity of their theories.

Realist evaluators also strongly emphasise context. Pawson summarises his related observations as follows: “the success of an intervention depends crucially upon its location in an appropriate context” (Pawson 2013, p. 36). He further argues that “the circumstances in which it [the intervention] is played out” should not be viewed as “unwelcome noise, nor a confounding variable to be controlled for” (p.36), but, rather, should be understood as being inherent to an intervention and its complexity.

The core realist evaluation concepts are further defined below in *Table 1*.

Table 1: Key realist evaluation concepts

Concept	Definition(s)
Intervention / program mechanism	“Mechanisms are agents of change. They describe how the resources embedded in a programme [or intervention] influence the reasoning and ultimately the behaviour of programme subjects” (Pawson 2013, p. 115). Thus, in realist evaluation the processes of changes that are theorised as mechanisms are centrally about reasoning processes and how such mental processes influence subsequent action. In Pawson’s terms, mechanisms “are embodied in the subjects’ reasoning” (Pawson 2013, p. 20).

Context	<p>“Features of the conditions in which programs [or interventions] are introduced that are relevant to the operation of the program’s [or intervention’s] mechanisms” (Pawson & Tilley 2005). Pawson (2013, pp. 36-7) emphasises four interconnected context “layers”:</p> <ul style="list-style-type: none"> • Individuals: the characteristics and capabilities of stakeholders; • Interpersonal relations: the relationships of involved stakeholders; • Institutional settings: relevant rules, norms and local customs; and • Infrastructure: “the wider social, economic, and cultural setting” (p.37).
Outcome patterns	<p>“The intended and unintended consequences of programs [or interventions], resulting from the activation of different mechanisms in saliently different contexts” (Pawson & Tilley 2005).</p>
Context-mechanism - outcome pattern configurations (CMOc) statements	<p>CMOc statements are propositions or models “indicating how programs [or interventions] activate mechanisms, among whom, and in what conditions to bring about alterations in behavioral or event or state regularities (Pawson & Tilley 2005). CMOc statements cast each intervention theory as an “if-then proposition” (Pawson 2013, emphasis in original).</p>
Social interventions are ‘active’	<p>“The triggers of change ... are ultimately located in the reasoning and resources of those touched by the program [or intervention]. Effects are thus generally produced by and require the active engagement of individuals” (Pawson & Tilley 2005). To illustrate this idea Pawson and Tilley (2005) compare typical public health interventions (which typically require active engagement) with the fluoridation of water (which is a passive intervention).</p>

Three additional *causal explanation* related ideas guided the study: a realist view of causation, the concept of ‘mechanisms’ of causation (commonly termed “causal mechanisms”), and intervention theories. These are outlined below.

Realist accounts of causation inform realist evaluation research, in particular the emphasis on context-sensitive mechanisms (Astbury & Leeuw 2010; Pawson & Tilley 1997b). Outcomes are explained via the operation of mechanisms in salient contexts, which is frequently termed the “firing” of mechanisms. In addition to the realist evaluation definition of a mechanism (see *Table 1*), a more general definition is: “[the] underlying entities, processes, or structures which operate in particular contexts to generate outcomes of interest” (Astbury & Leeuw 2010, p.

368).¹² Two elements of this definition are particularly notable. First, mechanisms are usually unobservable or hidden (see the term ‘underlying’). This aspect informs the idea that mechanisms are not an observable part of an intervention such as the activities that are conducted (Astbury & Leeuw 2010; Pawson 2008, 2013). Second, the realist understanding of mechanisms emphasises that their operation – or “firing” – is contingent on an appropriate context (Astbury & Leeuw 2010). A closely related concept used by social scientists is causal mechanisms. Causal mechanisms are similarly theorised and used to develop contingent mechanism-based explanations of causation (Little 1991, 2011).

The so-called “black box” problem in evaluation (Astbury & Leeuw 2010) also informed the study.¹³ The black box problem is one in which attention is focussed on measuring impact but too little (so the argument goes) is placed on how and why these effects were produced or contributed to (Astbury & Leeuw 2010). This problem was also alluded to in Chapter 1, such as with respect to calls for more examination of how practices used to envision potential futures “translate into action” (Miller et al. 2014, p. 243). This call for research points to a “black box” with respect to how particular activities lead (potentially) to subsequent action.

A final key concept is an intervention theory (Pawson 2013). In realist evaluation these theories are conceptualised as context-mechanism-outcome pattern configurations (CMOC) statements (see *Table 1*). Realist evaluators argue that the underlying theories guiding an intervention should be the core unit of analysis (Pawson 2013).

¹² Also see Maxwell (2012) on a realist approach to causation in qualitative research which is consistent with the Pawson & Tilley’s conceptual framework for realist evaluation. Maxwell (2012, p.32) argues for a philosophical stance he terms critical realism and contends that this realist ontology and approach to causality “provides a valuable conceptual framework both for doing and for justifying qualitative research that is intended to draw causal conclusions” (contra competing claims that qualitative research can only be descriptive or interpretive). Briefly put, Maxwell (2012, p. 35) contrasts “the “regularity” theory of causation” – which *infers* causation where there is an established regularity in the association of events (termed constant conjunction) – with an alternative, realist approach to causality which sees causality as “fundamentally referring to the actual mechanisms and processes that are involved in particular events and situation”. These mechanisms are further viewed to be situationally contingent (i.e. not general ‘laws’): “their actual context is inextricably part of the causal process” (Maxwell 2012, p. 36), consistent with the model of explanation used in realist evaluation.

¹³ Related to this use of “black box” metaphors, the idea of opening the black box is used in sociology of science (Camic, Gross & Lamont 2011b; Pinch 1992). As Pinch notes (1992, p. 488), it points to the “internal workings of science – and, crucially, the processes whereby scientific knowledge is produced”. This perspective informed knowledge practice studies (Camic, Gross & Lamont 2011a).

Many other concepts and theories informed aspects of the analysis. Theories and concepts relevant to the identified outcome patterns and the intervention theories were also reviewed. These are introduced in later chapters. For example, theories relevant to understanding the identified effects of interventions were drawn on throughout, and are specifically applied in the case analysis that is presented in *Part 2b* and *Part 3* of the thesis.

2.4 Research design and data analysis procedures

2.4.1 Selection and initial scoping of case study approach

The research design needed to be consistent with the core explanatory focus of realist evaluation. Following the decision to focus on a single main case (see introductory chapter), an appropriate qualitative approach – also suitable for the mostly historical nature of the study – was identified. An explanatory single case design was adopted, consistent with realist evaluation.

Good practice guidance for explanatory case studies was also noted (Harder 2010; Yin 2009). In addition to general good practices for case study research – such as developing and validating an accurate description of the main facts of the case (to the extent possible) – Harder (2010) argues investigators must clearly distinguish between the case evidence and their interpretation of this evidence and, second, that explanatory case studies should consider multiple plausible explanations. The latter aspect was operationalised by initially treating the intervention theories as one potential explanation of the outcome patterns (see *Part 2a*) and then considering additional possible explanations (see *Part 2b*).

2.4.1.1 Case characteristics

An initial decision was taken to focus on the use of PKPs in the context of decarbonisation processes and possible focal cases were initially identified with a focus on energy transitions. The selected case is relevant to this focus, was feasible (e.g. in terms of access to data), and was potentially significant with respect to understanding the use and impact of PKPs in sustainability-related socio-technical transitions. These characteristics of the case are briefly elaborated on below.

A significant amount of CSIRO Energy's research is focussed on low and zero emission technologies and related decision-making regarding Australia's future energy mix. Greenhouse gas emissions abatement has been a major theme in this research group's use of PKPs. Consequently, the relevance of the CSIRO futures forums was judged to be high.

Regarding convenience and access, CSIRO staff were interested in being part of this study and were willing to provide assistance (e.g. by inviting forum participants to complete surveys and sharing relevant data). Selecting an Australian case also had significant advantages, including easier access to informants and the ability to conduct in-person interviews when convenient for interviewees.

Finally, the potential significance was judged as high. The Flagship (now CSIRO Energy) is part of Australia's peak research agency. Being part of CSIRO contributed to the ability of Flagship staff to secure strong participation in the futures forums and to conduct high-profile studies. Evaluation of the futures forums can therefore reasonably be expected to provide insights into the impact potential of PKPs. Additionally, the context of a peak research agency can enable consideration of issues that scientists may face when doing forward-looking research and convening related participatory processes. Related considerations about the type of case (e.g. a critical case, or an extreme or atypical case, etc.) and its potential limitations/value are further discussed below (see 'Validity, generalisability and limitations').

2.4.1.2 Selection and overview of the focal forums

Three of five futures forums were examined. The first forum was excluded due to the length of time since it was held (in 2004-06) and associated data collection and data quality concerns. CSIRO staff were asked to nominate more recent forums which would be a fair test of the intervention theories. One forum, the Australian Low-Carbon Transport Forum, was excluded on the basis that it was judged to be atypical. The three remaining forums were selected (see *Table 2* below). An alternative approach could have been to select the Low-Carbon Transport Forum as a comparison case (of sorts) as part of the intervention theory testing process. However, it was judged to be less relevant (in particular by CSIRO staff involved with the futures forums) because it lacked many elements of a normal futures forum process (see Chapter 3). This futures forum was much less participatory and viewed as a researcher-driven exercise, particularly as compared with other forums which were viewed as more participant-

driven and, overall, more deliberative exercises. In these respects, it was less of a “forum” and more of a techno-economic modelling study led by CSIRO staff.

Table 2: Focal futures forums

Forum	Date	Initiating organisation(s)	Participating organisations	Key issues and topics examined
Future Fuels Forum	2007-08	CSIRO	31 organisations; 62 core forum delegates from: <ul style="list-style-type: none"> • CSIRO • Fuel producers, retailers and refiners • End-user groups • Vehicle manufacturers • Peak oil activists and environmental groups • Government organisations 	<ul style="list-style-type: none"> • Rising fuel costs and potential future fuel supply constrains (e.g. peak oil) • Alternative transport fuels including other low emission transport technologies (e.g. use of electricity as a transport ‘fuel’) • Potential changes to Australia’s fuel mix • Potential changes in travel behaviour • Role of government
Sustainable Aviation Fuel Road Map Forum	2010-11	CSIRO; Australasian branch of the Sustainable Aviation Fuel Users Group (SAFUG); and Defence Science and Technology Organisation (DSTO)	28 organisations; 43 core delegates from: <ul style="list-style-type: none"> • Airline industry (Australia and New Zealand) • Aviation and aerospace sector organisations • Fuel supplier, retailer, or technology developer • Finance sector • Climate change action and environmental groups • Government organisations 	<ul style="list-style-type: none"> • Viability of commercial production and use of alternative (sustainable) aviation fuels • Alternative jet fuels (termed ‘drop-in’ substitutes) • Sustainability of alternative fuels • Related challenges and actor roles
Future Grid Forum	2012-13	CSIRO, General Electric Australia (via the GE “ecomagination” initiative)	49 organisations; 102 core delegates form: <ul style="list-style-type: none"> • Electricity sector businesses and peak bodies • Energy technology suppliers • Government organisations • CSIRO and other research organisations • Other businesses e.g. consultancies 	<ul style="list-style-type: none"> • Rising electricity prices and related concerns • Decline in aggregate electricity consumption and aggregate peak demand • Increase in distributed and on-site generation • Climate change • Related challenges for policy and actors

2.4.2 *Methods, research phases, and data analysis procedures*

Qualitative research methods were used in this study. The four main components of the use of qualitative methods proposed by Maxwell (2013, pp. 90-116), and associated research related design decisions, are discussed below for the following:

- Establishment of research relationships;
- The selection of setting(s), and/or individuals and/or sources of information;
- Data sources and collection procedures; and
- Research phases and associated data analysis procedures and strategies.

2.4.2.1 *Research relationships*

A core research design choice was to conduct the study in collaboration with CSIRO staff. CSIRO staff involved with the futures forums were consulted on the study design and involved in the data collection and some case analysis. The Flagship staff member most involved with the futures forums invited forum participants to complete the online survey. The same CSIRO staff member also reviewed and commented on draft case description and case analysis materials. This design choice also helped to facilitate access to other relevant CSIRO staff, such as for in-depth interviews.

Whilst an evaluative study of the CSIRO futures forum process could have been conducted independently, practitioner involvement was useful for gathering and accessing case data. These relationships also did not constrain the independence of the analysis process. For example, whilst a CSIRO staff member was given an opportunity to comment on draft case descriptions and draft analyses – which also provided an opportunity to collaboratively examine important aspects of the case – the conclusions were reached independently, i.e. without interference.

Relationships with informants and interviewees often also requires careful management (Maxwell 2013, p. 92). This was especially the case for government employees. In many instances, it would have been better (for the study) if these informants had spoken 'on the record' however this was unacceptable to some interviewees and would have resulted in reduced openness and involvement.

2.4.2.2 Overview of site and participant selection

The focal case was selected using a purposeful selection approach. Importantly, the case entailed a focus on practitioners within a scientific research organisation and therefore not others (e.g. private consultancy-based practitioners, NGO-led studies). Such design decisions are an essential part of research methods in qualitative studies (Maxwell 2013).

Decisions about who to interview were also guided by a kind of purposeful selection informed by realist evaluation principles. Realist evaluators ask: “what is it about the programme [or the intervention] that works for whom, in what circumstances, in what respects, over which duration?” and why (Pawson 2013, p. 15)? It is assumed that for different participants (or different subgroups) an intervention will work differently and be more or less effective, and that associated contextual factors need to be explored. This informed the purposeful selection approach which sought to explore divergent outcomes (as reported by the forum participants) to understand whether such patterns were evident. This was achieved by placing forum participants and other interviewees into three categories: ‘worked’, ‘mixed outcomes’, and ‘didn’t work’ (as is explained in *Table 3* below). An overall 50/50 split was sought, with 50% of interviewees reporting that the futures forum process ‘worked’ and 50% reporting either mixed or poor/disappointing outcomes. A matrix approach was used to combine this purposeful selection with consideration of the sectoral mix at the forum in order to have a broadly representative mix (see later discussion of internal generalisability).

Table 3: Explanation of categories which guided interviewee selection

Category	Definition	Illustrative example from the Future Fuels Forum
Worked	Reported significant benefits from participating and/or use of futures forum outputs.	<u>John Wright, CSIRO Energy Transformed Flagship</u> : John reported that the forum assisted him with getting research programs approved (one of his objectives). The process had other strategic benefits (e.g. reputational benefits).
Mixed outcomes	In some respects, the process is perceived to have worked (e.g. met their specific needs); in other respects, it was perceived to not work (e.g. the participant criticised an aspect of the futures forum and/or its outcomes which was important to them).	<u>Public servant at Victorian Government department (non-identifiable)</u> : The diverse participation (e.g. participants with diverse views on oil supply risks and related policy issues and options) and the forum outputs were described by this forum participant as “thought provoking” and valuable. However, the outputs were described as “difficult to employ as evidence in support of decision making and policy development” and the credibility of analysis was questioned in government. These criticisms were seen as related to the consensus approach.

Category	Definition	Illustrative example from the Future Fuels Forum
Didn't work	Reported no or little benefit from participating and/or was highly critical of process.	Bruce Robinson, Association for the Study of Peak Oil and Gas (ASPO)–Australia: Although Bruce was highly complimentary when asked about the Future Fuels Forum process and analysis, he stated that ASPO-Australia did not benefit. The exercise and their subsequent advocacy (in which ASPO representatives drew on the forum findings and outputs) were judged to be ineffectual from the perspective of ASPO-Australia's main objectives.

The capacity to conduct purposeful sampling was somewhat constrained by the survey response rate (see discussion later in the chapter). Nonetheless, survey responses provided an initial indication of perceived outcomes (e.g. in terms of the three categories above).

2.4.2.3 Data collection, methods and sources

Four main data types were collected: (i) process data on each futures forum; (ii) interview data (i.e. written transcripts of in-depth interviews with forum participants, CSIRO staff involved with the forums, and other key informants); (iii) self-report data; and (iv) additional documentary data (see *Table 4*). Some data collection was done in response to an emerging research issue, such as conducting a key informant interview or doing further desktop research to refine evaluative judgements. Relevant data was provided by CSIRO (e.g. meeting records), collected for the study, and identified via desktop research. Web-based research was also conducted to identify whether, and by whom, forum reports had been cited.

Table 4: Overview of data types and associated methods data sources

Data type	Technique(s) and/or source(s)	Comments
Process data	<ul style="list-style-type: none"> Meeting records Transcripts of report launch event Project prospectus sent to potential forum participants Presentation materials used during the futures forums Final forum reports Internal project review/assessments 	This data is about the process itself – e.g. meeting records were taken by CSIRO staff or the facilitator(s) and circulated with participants following each forum meeting.
Interview data	<ul style="list-style-type: none"> Conducting and transcribing in-depth interviews with CSIRO staff, other forum partners (e.g. the initiating organisations), and forum participants Identifying and interviewing additional key informants 	Interviews covered both forum objectives (of the specific actor) and perceived outcomes/utility of the forum. Key informant interviews were used to better understand or clarify forum impacts.

Self-report data	<ul style="list-style-type: none"> Participants' evaluative judgements collected via survey research: forum participants were invited to complete an online survey (see <i>Appendix 4</i>) 	The survey focussed on the specific futures forum they participated in and collected participants views on the process outcomes/value, i.e. self-reports of utility or impact.
Additional documentary data	<ul style="list-style-type: none"> Media releases, company announcements Government reports and policies Other documents (e.g. submissions to government inquiries) and reports related to participating organisations (e.g. annual company reports) News articles 	This data provided evidence of the use of forum reports (e.g. where a forum report was cited) and/or supporting evidence of impacts.

A summary of the data that was collected and was available on each of the examined futures forums is presented in *Table 5* below.

Table 5: Summary of data collected on each futures forum

Data type and source(s)	Future Fuels Forum	Sustainable Aviation Fuel Roadmap Forum	Future Grid Forum	TOTAL
PROCESS DATA				
Meeting records (written record of each forum meeting)	✓	✓	✓	N/A
Other forum process data (e.g. final reports, presentation materials)	✓	✓	✓	N/A
Report launch event transcript	✓	X	✓	N/A
Internal (CSIRO) project review documentation	✓	✓	X	N/A
INTERVIEW DATA				
Interviews with project leader(s) and partner(s)	3	5	5	13
Interviews with forum participant, informants	15	14	12	41
SELF-REPORT DATA				
Completion of an online survey (1 per forum)	Response rate: 19% (12 / 62 delegates)	Response rate: 35% (15 / 43 delegates)	Response rate: 23% (23 / 102 delegates)	50 (24% response rate)
ADDITIONAL DOCUMENTARY DATA				
Desktop research on other documentary data (e.g. news articles)	✓	✓	✓	N/A

The data collection and analysis procedures are further specified below.

2.4.2.4 Research phases and associated data analysis procedures and strategies

The study proceeded through three main phases: 1) initial realist evaluation; 2) further review and explanation of the case; and 3) case interpretation and synthesis. Although the term “phases” is used it is important to note that in practice qualitative analysis is typically recursive (Bazeley 2013). For example, the additional explanatory analysis (see phase 2) also informed refined assessments of the intervention theories (phase 1), such as with respect to developing an enhanced understanding of the main outcome patterns which were suggested by the case evidence.

Phase 1: Initial realist evaluation research

Identification of the intervention theories to be tested

In-depth interviews were conducted with former and current CSIRO staff and reviewed to identify the working intervention theories of CSIRO staff (i.e. the practitioners).

An elicitation approach (Leeuw 2003) was used to identify these intervention theories. Probing questions were asked in hour-long semi-structured interviews – with the former and current CSIRO staff who have been most closely involved with the futures forum exercises – which aimed to provoke reflection on the design of the futures forums and related theories of change and theories of impact. Guided by the assumption that PKPs are purposeful activities, interviewees were asked about the main objectives of the forums (e.g. in the context of their research activities), related choices (e.g. methodological choices) and whether and *how* and *why* the forums fulfilled the desired functions and purposes. Seven interviews were conducted (see *Table 6* below).

Realist evaluation concepts weren't explicitly discussed during these in-depth interviews. Instead, the following four analytical steps were used:

- ***Step one:*** Each interview was transcribed and reviewed for relevant ideas and working theories. Key passages were identified and labelled which were interpreted as emphasising contextual factors, hypothesised mechanisms and outcome patterns

and then these were grouped into the main themes;

- **Step two:** The interview findings from step one were used to construct Context-Mechanism-Outcome pattern configuration (CMOc) statements. This step involved further consideration of both the mechanisms and intervention contexts emphasised by CSIRO staff, relating these ideas to one another (e.g. the precise circumstances under which a given mechanism would be expected to ‘fire’) and considering the outcome patterns which are consequently expected. (The realist evaluation slogan for this perspective is “*if the right processes operate in the right conditions then the programme will prevail*” (Pawson 2013, p. 22)). Given that interventions should only be expected to work in appropriate circumstances (Pawson 2013, p. 12), effort was made to identify logical context-mechanism relationships;
- **Step three:** respondent validation was used as a strategy to check this data analysis: the draft intervention theories were presented for feedback to check the data interpretation (e.g. to received feedback on the CMOc statement construction); and
- **Step four:** The analysis was more formally written up as a set of hypothesised mechanisms and associated CMOc statements – see Chapter 3.

Table 6: Intervention theory interviews

Interviewee	Position at the time of the futures forums	Date(s) conducted
Dr John Wright	Inaugural Director, Energy Transformed Flagship, CSIRO. Strongly involved in Future Fuels Forum.	09/06/2014
Paul Graham	Project leader/manager (of the futures forums); Chief Economist, CSIRO Energy/Energy Flagship	02/06/2014 06/06/2014
Flagship staff member (non-attributable)	Senior position within the Energy Flagship, CSIRO; also had some involvement in futures forums run by the Flagship.	13/06/2014
Dr Jim Smitham	Theme Leader, Low Emissions Electricity, CSIRO Energy Flagship; part of the Flagship’s leadership team	19/06/2014
Mark Paterson	Forum Chair, Future Grid Forum; Manager – Smart Grid Partnerships, CSIRO Energy Flagship	17/06/2014
Dr Deborah O’Connell	Member of project team (Future Fuels Forum, Sustainable Aviation Fuels Road Map Forum)	04/09/2014

Futures forum evaluative research

The futures forum evaluative research (on each forum, or ‘sub-case’) involved data collection, assessment of forum outcomes and the intervention theories, and detailed forum descriptions

(see *Appendices 1-3*) which were reviewed by the project leader at CSIRO. A related effort was made to gain an intimate knowledge of each futures forum and its outputs.

Data collection on each of the futures forums progressed through the following six steps:

- **Step one:** collection and review of process data (e.g. meeting records, reports, etc.);
- **Step two:** interviews with involved CSIRO staff and key project partners. In-depth interviews were conducted to understand the main intended outcomes (e.g. forum objectives), perceived outcomes, and perceived effectiveness of the forum;
- **Step three:** the futures forum participants were then invited to complete an online survey (see an example in *Appendix 4*) in which they could outline the perceived value of the futures forum they participated in (e.g. perceived benefits, negative aspects, etc.) and provide further feedback to CSIRO (see further details below in *Table 7*). The survey was also constructed to enable participants to provide judgements relevant to the intervention theories to-be-tested;
- **Step four:** in-depth interviews with selected forum participants who were purposefully selected, informed by the survey responses and guiding criteria (see *Section 2.4.2.2*);
- **Step five:** as/if required key informants were also interviewed, e.g. interviewing a government employee to clarify the public policy impact of a forum; and
- **Step six:** further desktop research was conducted to inform the case analysis, such as identifying relevant government reports or related to relevant events.

The online survey was administered by the Survey Monkey website. *Table 7* below outlines the question types and the foci (also see example survey provided in *Appendix 4*).

Table 7: Online survey question type and foci

Question type	Foci of these questions
Multiple choice (tick at least one box)	<ul style="list-style-type: none"> • Motivations for participating in the forum (“which of the following best expresses your interest...”)
Dichotomous (yes/no)	<ul style="list-style-type: none"> • Whether the outputs from the forum were used
Likert scale question (level of agreement or disagreement)	<ul style="list-style-type: none"> • Perceived credibility of the forum outputs • Perceived impact of the forum on their beliefs and/or assumptions • Perceived communications effectiveness of the forum report • Perceived relevance for decision-making and/or policy-making • Whether they made more confident decisions because of the forum • Whether they made different decisions because of the forum

Open question	<ul style="list-style-type: none"> • General feedback for CSIRO and/or the process facilitators • Suggestions for future projects run by CSIRO • Suggested interviewees
Ordinal scale (ranking) question	<ul style="list-style-type: none"> • Aspects of the futures forum reports which were most-to-least important (for them and/or their organisation)

The sectoral mix of respondents and interviewees was broadly representative of forum participants, though NGO representatives were over-represented in the survey responses:

- 50% of survey respondents were from industry/private sector, compared with 54% of participants in the three focal futures forums;
- 26% of respondents were from the public sector, compared with 29% of participants;
- 16% of respondents were from NGOs, compared with 8% of participants; and
- 8% of respondents were from research sector, compared with 9% of participants.

Nonetheless, some parts of *Table 5* above convey limitations, such as the relatively low survey response rate. (Related issues, and the strategies that were used to address the main validity threats, are discussed later in this chapter, under the subheading ‘Validity, generalisability and limitations’).

This data was subsequently used in the following forum analysis-related tasks:

- ***Preparation of a detailed description of each futures forum process:*** description of the main objectives, the forum context, and a written summary of the main meetings and process-as-a-whole. For example, the meeting records from each futures forum and interview transcripts were used for this purpose. (See the description of each futures forum provided in *Appendices 1-3*);
- ***Identification of the forum outcomes substantiated, or at least indicated, by the available evidence (e.g. survey responses, interview transcripts, other documentary data and desktop research):*** outcomes within an intervention (the outcome patterns) were examined, rather than comparing an intervention and counterfactuals; and
- ***Preparation of a more analytical review of each futures forum process and the outcome patterns:*** this step involved reviewing and summarising the available evidence regarding the firing of the mechanisms and related CMOc statements. Consistent with the conceptualisation of mechanisms in realist evaluation, the interviews provided an opportunity to probe actors’ contexts, their mental processes

and whether the forum influenced these, and subsequent decision-making. This informed the assessment that is presented in Chapter 4.

The rationale for preparing a description of each futures forum process was two-fold: 1) understanding the implementation of each process may assist with explaining some outcomes and developing related conclusions; and 2) knowledge of the finer details of each process may assist with identifying transferable lessons (e.g. practitioner-relevant insights).

Consistent with a realist evaluation approach the review and analysis of each forum covered (i) the process *context*, (ii) identified *outcome patterns*, and (iii) the available evidence regarding the firing of *mechanisms* and associated Context-Mechanism-Outcome pattern configurations. Respondent validation was used to refine the description and this analysis.

Intervention theory testing (initial cross-forum analysis)

This cross-forum analysis considered whether the intervention theories were supported by the case evidence. Key questions were: does each future forum provide supporting evidence for the operation of the mechanisms and context-mechanism-outcome pattern configuration (CMOc) statements? Are the outcome patterns consistent with the theories?

This comparison of the three futures forums focussed on the following:

- Comparison of the evidence for the firing of mechanisms, associated contextual factors, and the forum outcomes: I asked, is the evidence similar or different across the three forums? Basic categorisation strategies (Maxwell 2013) noted similarities and differences;
- Summarising and comparing the evidence for each CMOc statement (e.g. is the evidence strong or weak? Similar or different across the three forums?). This analysis was the core part of the intervention theory-testing and is presented in a summary form in Chapter 4; and
- Consideration of the extent to which the existing intervention theories are consistent with the outcome patterns and other case evidence. For example, are the intervention theories consistent with why actors wanted to participate in the futures forums? Any inconsistencies suggested a need for further analysis (see *Phase 2*).

Additionally, the core realist evaluation question – ‘*What works, for whom, in what*

circumstances and in what respects, and how? – was considered. The three forums were reviewed for possible patterns regarding what ‘worked’ and didn’t ‘work’, for whom, and why. For example, patterns were noted regarding the perceived level of decision support provided by the futures forums.

Phase 2: Further review and explanation of the case

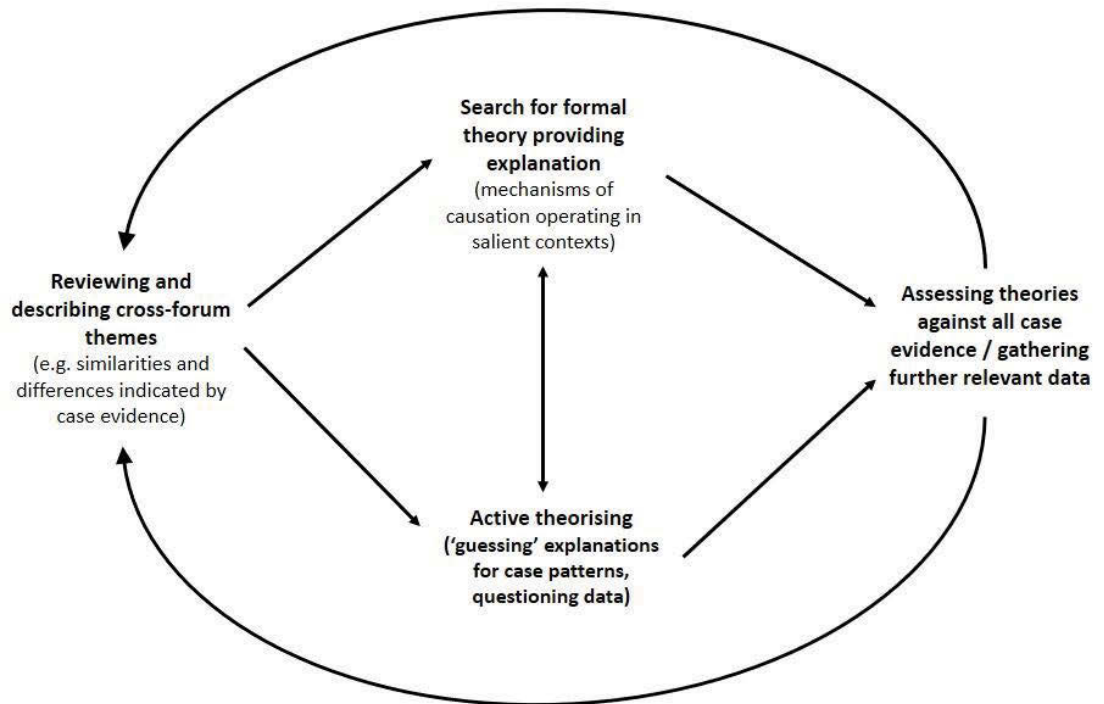
The explanatory aims of the study (e.g. identifying and understanding causal relationships) were only partly achieved by the intervention theory-focussed analysis (see *Chapter 4*). The study aimed to explain how and why prospective knowledge practices (PKPs) were used, what effects resulted from this and why, which required further causal analysis.

Three analytical activities were conducted in a highly recursive, iterative manner:

- Further review of cross-forum themes related to (i) aspects of the case that needed further explanation (e.g. unexplained process effects); (ii) important impact and utility-related patterns; and (iii) inconsistencies with the intervention theories;
- Identification of possible explanations informed by social scientific theory; and
- Interpretation of case evidence and collection of additional evidence (e.g. more documentary data) relevant to emerging possible explanations

The steps that were followed for each activity are outlined below along with some illustrative examples. Both inductive and deductive reasoning were used: inductive in the sense of developing emergent explanations informed by case evidence and identified patterns; and a deductive approach in the sense of looking for evidential support for possible causal explanations (i.e. asking: if this explanation is right then what supporting evidence would I expect to see?). The stopping rule for the inquiry was to stop when the analysis was judged to plausibly account for the main outcome patterns in the case, consistent with the core foci of realist evaluation. This process is presented visually in *Figure 2* below:

Figure 2: Phase 2 research process



Further review of cross-forum themes

The findings of *Phase 1* analysis provided the starting point. Case data was further reviewed with respect to impact and utility-related themes and the identified similarities and differences between the forums (for an example see *BOX 2.1* below). Interviewees were also categorised (i.e. in ‘worked’, ‘mixed outcomes’, and ‘didn’t work’ categories) to aid this analysis.

The following additional tangible analytical activities were conducted:

- Descriptive level coding of data aiming to further *classify* and *connect* data into themes (or patterns) related to forum outcomes (see *BOX 2.1* for an example) and identify inconsistencies between the intervention theories and identified themes. This was initially done through notations on paper copies (e.g. of transcripts) and electronic files (e.g. survey responses), and analytic memo writing on case themes;
- Speculation on “patterns of association” (Bazeley 2013, p. 285) evident in the data which informed consideration of relevant theory. For example, I considered possible associations between process choices and process outcomes, and between antecedent conditions (e.g. participants’ beliefs or positions) and consequences; and
- Comparing data from defined subgroups (e.g. the participants in the ‘worked’ and

'didn't work' subgroups)

A further initial task was to review aspects of the case which were identified in *Phase 1* but had been poorly explained (e.g. the limited impact of the forums on inertia) – also see Chapter 4.

These analytical activities produced an initial list of case themes for further analysis which were identified as relevant to developing the case explanation.

BOX 2.1: Example of an identified theme – ‘divergent/confirmatory interpretation’ of futures forum findings and outputs – and how it was identified

When the survey and interview data collected for the Futures Fuels Forum was reviewed I noted stark differences in participants stated interpretations of the forum findings and related participant learning. For example, differences were identified with respect to peak oil and its perceived policy/response implications, the energy security threats this implied, the merits of mandatory vehicle standards (e.g. as a policy for reducing transport emissions), and the potential of specific alternative fuels (e.g. as substitutes for current transportation fuels). That is, participants reported contrasting views on the main forum findings and what they learned. These interpretations influenced how the outputs were used and process effects and were also relevant to understanding the difference between the intervention theories and some of the identified outcomes (e.g. related to whether a stronger consensus was produced by the forum process).

This theme sensitised me to consider whether other case evidence for other futures forums was consistent with this. This analysis identified similar patterns in the other forums.

Interpretations of the Sustainable Aviation Fuel Road Map (SAFRM) Forum and its findings were found to also frequently diverge, such as with respect to:

- Whether the findings were judged to support (or question) beliefs about the viability of biofuels as a drop-in substitute for conventional jet-fuel;
- Whether these forum findings suggested additional resources should be committed to supporting a transition to aviation biofuels (e.g. by their organisation); and
- Interpretations of the public policy implications of the forum findings (e.g. whether these were interpreted as being consistent or inconsistent with policy agendas).

Interpretations of the Future Grid Forum and its main findings also diverged in some instances, such as with respect to:

- The perceived implications of the findings for energy policy and energy innovation related to distributed electricity generation and local energy storage;
- Whether the findings were judged to support expectations of a large percent of consumers leaving the electricity grid over coming decades (that is, the future

emergence of a major “off-grid” movement); and

- The level of actual or implied support for *strong* carbon/climate policy and associated public policy needs and options (the report emphasised related investment risks due to policy uncertainties and called for bipartisan agreement on a long-term emissions reduction target).

Additionally, these divergent interpretations were, in many cases, found to be related to the pre-existing positions held by forum participants on these issues or topics. In these respects, many forum participants reported confirmation of pre-existing beliefs and assumptions (e.g. where their interpretation of the outputs contributed to “bolstering” their existing beliefs). This observation led to the theme being labelled as ‘divergent/confirmatory interpretation’. Consideration of such patterns pointed to possible explanations.

The recursive aspects – particularly the close linkage of theme identification with consideration of possible theoretical explanations – can be clearly recognised by considering Bazeley’s (2013, p. 297) argument that “pattern analyses should be theoretically driven”. In other words, later consideration of theory (see below) prompted reviews of cross-forum themes.

Identification of possible explanations informed by social scientific theory

As per a critical realist view of causality (see footnote 12 on p.32), this step considered casual mechanisms (Bazeley 2013; Maxwell 2012) which may account of the identified themes and patterns. Attention was given to social and cognitive mechanisms that had been found by other scholars to operate in salient contexts such as under deep uncertainty, in group situations (as per a “forum” process), and in the context of the social settings of involved actors (e.g. mechanisms that influence policy processes, decision processes, etc.).

This also involved the following additional analytical and explanation identification activities:

- Deductive inference making, such as when reading transcripts and survey responses (Bazeley 2013), thereby developing informed ‘guesses’;
- Identifying mechanisms (social and cognitive mechanisms) which formally theorise casual processes relevant to such explanatory hunches (see *BOX 2.2*); and
- Expanding my theoretical “tool box”: as Little (1991, p. 8) explains, causal analysis requires social scientists to “confront the range of phenomena that constitute their domain with a sensitivity to the diversity of social processes and a well-stocked tool box filled with the findings of various parts of social theory”. This activity consequently required familiarising myself with additional social theory so as to have “well-stocked tool box”.

As part of the tool box expansion I also considered social scientific perspectives on human actors (i.e. theories of human actors and action processes). For example, social scientists argue human actors, and their thoughts and actions, are socially constituted and embedded (Beckert 2016; Little 2014; also see *Part 3* of this thesis).

BOX 2.2: Example identification of possible explanations for the ‘divergent/confirmatory interpretation’ case theme

Given that the futures forums aimed to inform and support decision-making, this theme was chosen as a relevant one to consider for understanding forum process effects. The identification of possible causes involved some ‘guessing’ (i.e. asking ‘why might this have occurred?’) and identification of social scientific theory that may offer a plausible explanation for the identified pattern(s).

Several possible causes came to mind including the influence of cognitive biases (e.g. confirmation bias), the influence of actors’ interests and values (e.g. participants placing greater emphasis on forum findings that were interpreted as being aligned with their interests and/or values, etc.), the influence of thinking styles, and others related to cognitive capabilities (e.g. the bounded rationality of human beings).

These initial explanatory ‘guesses’ prompted: (i) further engagement with psychological theories and associated literature such as on reasoning and cognitive flexibility; (ii) consideration of potential group and process factors and relevant social psychological theories of group dynamics and information processing, including mechanisms such as group polarisation and biased assimilation of evidence (Sunstein 2009); and (iii) consideration of further perspectives on actor learning such as a political perspective on learning processes (Cairney 2015b; also see Chapter 6).

These guesses and theory reviews prompted me to further assess the case evidence to critically consider and further develop these explanatory ideas – see *BOX 2.3*.

Assessment of case evidence and collection of additional data

This stage involved going back to the data to test (in a broad sense) and refine emerging explanatory ideas (see *BOX 2.3* for an example). The following analytical activities were conducted:

- Trawling through the data to identify case evidence that supports or challenges possible explanations, such as evidence from which it is reasonable to infer the operation of mechanisms;
- Comparing evidence across the forums (this informed the findings in Chapters 5-7) and

- checking some data interpretation with CSIRO staff (respondent validation);
- Collection of additional data to aid evaluating explanatory ideas (e.g. documentary data such as government reports that provides evidence of mechanisms); and
- In some cases, identification of new/refined explanatory ideas (see *BOX 2.3*).

Ultimately, this process involved reviewing the plausibility of explanatory ideas and, as part of this, comparing what I found to social scientific theory. A detective analogy has been proposed by evaluation theorist Michael Scriven to describe this process in which identified “clues” are compared with known patterns identified in prior research (Bazeley 2013, pp. 340-1).

BOX 2.3: Example review and assessment of case evidence for explanation-building

Several cross-forum themes – such as ‘divergent/confirmatory interpretation’ of forum findings and outputs (outlined earlier in this chapter) – pointed to the relevance of psychological theory and reasoning theories. For example, case data could be interpreted as evidence of the effect of cognitive biases.

Many aspects of the case seemed inconsistent with a ‘classical’ (or intellectualist) view of reasoning. These theories assume that the main function of reasoning is to *enhance* the reasoner’s beliefs and decisions, such as via conscious use of reasoning skills to correct misguided intuitions and arrive at better beliefs (Mercier 2012; Mercier & Sperber 2017). In contrast, some case data could be interpreted as evidence of the following:

- Evidence of actors focussing on identifying reasons that support or help to rationalise their point of views and/or initial intuition;
- Forum participants discounting credible evidence that challenges their views and not adjusting their views when presented with credible counter-arguments;
- Related evidence of biased assimilation of forum findings, thereby enabling divergent interpretation of the main forum findings; and
- The use of reasoning driving some forum participants and other actors toward decisions that are easiest to find reasons for (see Mercier & Sperber 2017) – i.e. those they can best justify – rather than better decisions.

Related case evidence was reviewed including interview transcripts (e.g. actor statements about whether and why participation in a futures forum challenged their beliefs and/or assumptions) and relevant process data (e.g. presentations, meeting notes, etc.).

As per the recursive analytical process emerging case analysis findings also led me to investigate theories of reasoning that could better account for the case patterns. I identified a theory which proposes that the human capacity for reason is first and foremost a social competence with two core functions: (i) convincing others through argumentation; and (ii) justifying beliefs and actions (Mercier & Sperber 2011, 2017). It offered a relevant

alternative theoretical perspective on reason (which was usefully different to commonly used theories such as dual process perspective popularised by Daniel Kahneman) which appeared to better account for the main case themes. The chosen theory also pointed to contextual factors which were also consistent with case evidence such as with respect to group composition factors and other situational factors such as actors' anticipation of dialogic contexts in which they needed to defend their views.

This led me to further review each forum – initially one-by-one, then comparatively – from this theoretical perspective, considering how well (or poorly) it accounted for important case evidence. This case evidence analysis (applying the identified theory of reasoning) is presented in Chapter 7.

This assessment of the case evidence and analysis produced multiple, partly-overlapping, partly-rival explanations. In effect, three main *meta-explanatory themes* were identified which grouped together related case and explanatory themes (see *Table 8*) and could form the basis of distinct chapters offering credible case explanations (see chapters 5-7). In one instance (Chapter 7) an overarching theory was also identified that could help to integrate the findings on the cognitive and social mechanisms. The 'stopping rule' for this analysis was to stop when these explanatory perspectives and associated arguments could plausibly account for the main outcome patterns (especially the outcome patterns identified in phase 1).

Table 8: Grouping of themes into meta-themes

Meta-theme	Example case and explanatory themes related to the meta-theme
Prospective knowledge practice as social activities (Chapter 5)	<p><i>Example case theme:</i></p> <ul style="list-style-type: none"> • Influence of organisational norms and related conventions; • Influence of prevailing expectations which are currently viewed as credible (e.g. those circulating in actor networks); • Social vulnerabilities of prospective exercises; and • Limited creativity of some actor behaviour – a constraint on futures forum impacts. <p><i>Example explanatory themes:</i></p> <ul style="list-style-type: none"> • Institutional structuring of actor behaviour; • The 'social-ness' of human being as actors; and • Expectation dynamics and expectations work in transition processes and contexts.

Meta-theme	Example case and explanatory themes related to the meta-theme
Prospective knowledge practices as political practices (Chapter 6)	<p><i>Example case themes:</i></p> <ul style="list-style-type: none"> • Political objectives of many forum participants; • Unequal actor power and its consequences; • Need to manage contention during each forum (e.g. via forms of ‘dissensus management’ work); and • Instrumental ‘cherry picking’ of futures forum findings that support pre-existing actor convictions. <p><i>Example explanatory themes:</i></p> <ul style="list-style-type: none"> • Bargaining processes and games; • Actor learning as a political process; and • Agenda movers/moving.
An alternative (non-classical) view of reasoning/reason (Chapter 7)	<p><i>Example case themes:</i></p> <ul style="list-style-type: none"> • Divergent/confirmatory interpretation of futures forum findings and outputs; • Evidence of greater polarisation of views (rather than producing a stronger consensus); • Less evidence of critical reflection on actors’ assumption and beliefs than predicted by the intervention theories; and • Futures forums viewed as an argumentative setting in which to convince others and/or refine arguments. <p><i>Example explanatory themes:</i></p> <ul style="list-style-type: none"> • Cognitive biases (e.g. myside bias focussed on identifying support for the reasoner’s point of view); • Biased assimilation of evidence; and • Group polarisation.

Finally, the meta-themes were considered in relation the focal object of investigation. For example, the fact that “we cannot perceive the future but only infer it” (Mercier & Sperber 2017, p. 53) implies that reasoning will strongly influence intervention outcomes.

Phase 3: Case interpretation

This phase had two main components: (i) interpretation of the implications for the intervention theories; and (ii) interpretation of the case with respect to the key functions and effects of PKPs in sustainability-related socio-technical transitions. These are outlined below.

Interpretation of the implications for the intervention theories

In addition to the Phase 1 research (which resulted in findings on the validity of the intervention theories), the case explanations developed in Phase 2 were reviewed for implications for:

- The *hypothesised mechanisms*: I asked the following questions – are these theoretical perspectives and the case analysis findings consistent with the mechanisms in the intervention theories? Do they present related considerations (e.g. countervailing

processes that also need to be considered, causal processes involved in such change/impact processes)? Or does the case research suggest alternative mechanisms?

- Insights into relevant *contextual factors* that influenced the forums and their impact

Three further analytical tasks were conducted. The findings were reviewed with respect to:

- Specific contextual factors relevant to the identified intervention theories (e.g. the operation of particular mechanisms);
- New intervention theories suggested by the identified case patterns (i.e. new or refined Context-Mechanism-Outcome pattern configuration [CMOC] statements); and
- The broader implications these suggest for forum convening and process facilitation.

Learnings from this implications assessment aimed to be relevant to the ongoing development of intervention theories. Revised theories can be used and tested in future practice by CSIRO staff or others who are using similar methods and/or similar guiding theories.

Interpretation of the case with respect to the functions and effects of PKPs in transition contexts

Finally, the case was critically reviewed and reconsidered with respect to what it may tell us about the functions of PKPs, their specific roles (or functions) in sustainability-related transition contexts, and about transition theories and concepts. These interpretations were compared to other claims made about the functions of PKPs.

The following additional analytical activities and strategies were used to deepen and progressively synthesise the main interpretations of the case:

- *Summarising* and *reviewing* both the core patterns identified in the case and exceptions to these patterns (i.e. atypical roles that were also evidenced by the case);
- *Relating* these case findings to other arguments and ideas about deliberative processes and forward-looking methods – e.g. other arguments about their use, roles, and utility in similar contexts (e.g. wicked problem contexts) – which either challenged or supported the case analysis and the identification of implications (e.g. process convening implications for practitioners);
- *Exploring* established and emerging theories of socio-technical transitions to: (i) explore the implications of the case for these theories (e.g. the case may provide

evidence that supports existing socio-technical transition theories or concepts), and (ii) draw on these theories when interpreting the case patterns and the transferability of these findings; and

- *Reviewing* knowledge practices theory, and related philosophical traditions (for arguments on the importance of these for forward-looking inquiry see Voros 2007), in order to further interpret how and why PKPs were mobilised in the case (e.g. by CSIRO staff, etc.) and to aid the synthesising of related case findings. For example, the case findings were considered with respect to the knowledge-making practices of Flagship staff and related organisational routines/norms and how related social mechanisms may also help to explain case patterns.

The final strategy aimed to help synthesise an interpretation of the case guided by the knowledge practices ‘lens’ which addresses identified important aspects of the case. A related philosophical tradition (pragmatism) was drawn on to guide this case interpretation.

2.5 Validity, generalisability and limitations

Validity in qualitative research involves the use of strategies to minimise validity threats and interrogate provisional accounts or conclusions (Maxwell 2013). This understanding of validity is centrally about the *account* that is developed which Maxwell (1992, pp. 282-3) summarises as follows: “all qualitative researchers agree that not all possible accounts of some individual, phenomenon, activity, text, institution, or program are equally useful, credible or legitimate”.

The following five strategies were used to address identified validity threats (see below):

- ***Respondent validation***: “soliciting feedback about your data and conclusions from the people you are studying” (Maxwell 2013, pp. 126-7);
- ***Use of interview strategies to promote openness/honest disclosure***: e.g. where appropriate or requested interviewees were assured of anonymity;
- ***Informal comparison*** (Maxwell 2013): interpretation of data can be aided through informal comparison with other cases (e.g. those reported in the literature) and, to

less extent, my own experience with PKPs.¹⁴ Whilst the latter strategy also raises questions about researcher bias (if personal experience problematically biases interpretation) it can be useful for informed interpretation;

- **Searching for discrepant evidence;** and
- **Triangulation:** using evidence gathered from multiple sources and methods

The main identified validity threats, and the use of related strategies, are outlined below:

Researcher bias: this is a generic issue for qualitative research (Maxwell 2013). Additionally, when conducting evaluative research it is possible that the perspective of the evaluator(s) will be too critical in contrast with those involved with a program/intervention who could exhibit the opposite bias (e.g. exaggerated claims of positive results, or claiming positive results where there is insufficient supporting evidence). Respondent validation is “an important way of identifying your biases and misunderstandings of what you observed” (Maxwell 2013, p. 127) and this was frequently used. For example, the project leader from CSIRO reviewed draft case materials and interpretations of data were frequently checked by interviewees. Similarly, well-placed industry experts were identified to provide feedback on draft findings.

Data reliability issues: the time that had passed since some of the futures forums contributed to related threats such as inaccurate data due to faulty memories.¹⁵ To some extent these issues are unavoidable when examining impact years after a project (the focal intervention) and related limitations must be acknowledged. Triangulation enabled use of corroborating or disconfirming evidence (e.g. reviewing documentary evidence that either supports or challenges interview statements). Additionally, in-depth interviews provided an opportunity to probe statements, such as by asking interviewees for supporting evidence.

¹⁴ I have approximately a decade of experience with forward-looking inquiry in a range of contexts (such as management consulting, academic research, and applied research in the private sector) and I am familiar with the literature on such methods. When reviewing aspects of the case and case evidence (such as when reading interview transcripts) I was frequently reminded of similar situations encountered in my own research/work and other cases I am aware of.

¹⁵ This was also a cause of data collection challenges as most forum participants had changed professional roles since the forum (at least once). This created challenges for contacting participants and, in some cases, may also have influenced their motivation to participate in the study. The latter may have influenced data quality. For example, where survey respondents had limited motivation to participate, but still completed the survey, this may have influenced data quality, such as where only a ‘minimal’ responses are provided (e.g. very brief/rushed statements).

Reliability of self-reports: there is a need to recognise the potential unreliability of self-report data. The most readily available strategies were: (i) actively considering the subjectivity of interviewees and respondents (e.g. considering what might bias their account); (ii) seeking multiple sources of evidence (also termed triangulation), and (iii) addressing interviewee concerns which could constrain openness.

Additional descriptive validity threats: the limited ability to verify descriptive data (e.g. the descriptions of each forum provided by the meeting records or by interviewees) also generated validity issues. For example, meeting records are often partial, e.g. due to errors of omission. Similarly, the outcomes that were reported by interviewees and survey respondents could not be assumed to be accurate. The most readily available strategies to deal with this were: (i) respondent validation; (ii) reviewing multiple sources such as additional documentary evidence (e.g. meeting agendas, presentation materials, etc.) and transcriptions or recordings (which were only available for two forum report launch events); and (iii) transcribing interviews and providing interviewees with an opportunity to check statements. Descriptive validity issues can be resolved by accessing appropriate data (Maxwell 2013); however data was limited. For example, if the forums had been recorded (e.g. audio recording all meetings) this would have aided resolution of many factual matters.

Reactivity (Maxwell 2013): the influence of researchers on data collection (e.g. on interviewee statements) also raises validity threats. Generally, a neutral stance was adopted during interviews and, related to this, mostly open questions were asked during interviews to avoid any perception that a particular response was sought. On fewer occasions interviews were conducted in a more directive manner, such as when judgements were specifically sought on the veracity of provisional evaluative conclusions. In the latter case, there can be a risk of interviewees telling the interviewer what they think they want to hear, however the reasons for the judgments of informants could be explored.

Broader validity threats related to theoretical or evaluative validity: theoretical understandings address “an account’s function as an *explanation*” (Maxwell 1992, p. 291, emphasis in original). Related validity threats exist regarding the construction and application of theoretical constructs to descriptive or interpretive understandings (e.g. within a case study) and, secondly, regarding the postulated theoretical relationships (Maxwell 1992). Respondent feedback was the core strategy that was used to check the construction and application of the

informal intervention theories (e.g. this analysis was reviewed by a CSIRO staff member). Some aspects of these assessments involved subjective interpretation of data. For example, if a forum participant strongly agreed in their survey response with the statement '*I made more confident strategic decisions because of the forum*' this was often interpreted as supporting evidence of the 'reduction of uncertainty' mechanism given that more confident decision-making was an expected consequence of the mechanism. Triangulation strategies were also used to check the application of the intervention theories.

Further questions concern the legitimacy of the application of formal theories and concepts to the facts of the case. This was, in part, a recursive process: the significance of comments made by forum participants and other actors often became clearer when using formal theories; and theories informed pattern analysis and the gathering of additional case data. However, related *interpretations* of data remain interpretations. Informal comparison (Maxwell 2013) with other cases reported on or discussed in literature also provided guidance.

An additional validity threat concerned the application of the evaluation framework; that is, incorrect application of the realist evaluation framework. The main strategy was to follow guidance provided by leading realist evaluators (e.g. Pawson 2013; Pawson & Tilley 2004).

2.5.1 Generalisability: internal and external generalisation

Internal generalisation is an important consideration for case studies (Maxwell 2013, p. 137); that is, "generalizability of a conclusion within the case, setting, or group studied, to persons, events, times, and settings that were not directly observed, interviewed, or otherwise represented in the data collected". Given I was unable to interview or survey all forum participants, nor all other relevant actors, there was a threat that the conclusions would have limited internal generalisability.

Four main strategies were used to try to maximise internal generalisability:

1. Identifying and interviewing key informants who were well placed to check the internal generalisability of provisional conclusions and fill-in gaps;
2. Reviewing online survey responses to get a sense of the likely range of participant experiences and forum impacts that needed to be investigated;

3. Targeting interviewees who were representative of the sectoral and actor mix that attended the futures forum. For each forum, the mix of interviewees was checked before finalising the analysis using a matrix approach; and
4. Conducting desktop research on all main forum participants, i.e. on all organisations that were represented. This research provided an indication of whether other research (e.g. interviews, survey data) was likely to have missed important impacts.

Nonetheless, none of these strategies can ensure internal generalisability. Greater confidence was gained by combining these strategies with others such as respondent validation.

Regarding external generalisation, the emphasis of realist evaluation on contextual analysis can inform consideration of generalisability: what we learn about a case is more likely to be transferable to similar contexts. However, some important contextual aspects of the focal case – such as process convening by staff from a formal scientific organisation – may limit external generalisability. A further strategy is the “development of a theory of processes operating in the case studied, ones that may well operate in other cases” (Maxwell 2013, p. 138). The realist evaluation approach can inform consideration of ‘middle-range’ style theories that may be transferable (Pawson 2013); that is, theories address delimited, tangible empirical phenomena (the original example of this was Robert Merton’s theory of reference groups which has been applied to a range of settings), rather than proposing ‘grand’ theories. These strategies and aspects are taken up in later chapters.

2.5.2 Limitations

Whilst the potential benefits of a case study approach are large – such as enabling consideration of PKPs as they are used in real-life situations – the study design also had limitations related to both the qualitative approach, where the researcher is the central research instrument (Maxwell 2013), and the research design. Related validity threats were discussed above.

Data limitations, and related issues to do with the timing of the study, constrained the study and what conclusions could be substantiated. First and foremost, only a limited subset of forum participants and other relevant actors participated in the study. In this respect the study was limited by the extent to which forum participants and other actors were willing to

participate and by the ability to contact those who had changed employers or careers. Additionally, the data may be biased in terms of the participant experiences that are represented if those who are willing to complete a survey, etc., are more likely to have had a particularly good or poor experience. Further, two of the forums were conducted many years ago which raises questions to do with data reliability. Whilst efforts were made to check the accuracy of the accounts that were provided this wasn't always possible.

These empirical limitations were reinforced by the limited data collection by CSIRO staff at the time of the forums. Impact wasn't measured, nor was participant satisfaction assessed post-forum (e.g. via a survey 3 or 6 months afterwards). Baseline data was not collected either.

The above data reliability issues and associated methodological challenges place limitations on what conclusions can reasonably be drawn from the study and, furthermore, mean that conclusions were reached with varying confidence. In some instances, the overall picture is clear and presented with high confidence (e.g. in terms of the overall impact of a forum) but some finer details are less clear. The methodology had a limited ability to establish the operation of causal processes and check causal validity. The nature of the focal objects of the study also raise these issues given the influence of multiple causal factors and the wide range of associated social and cognitive processes.

Finally, potential limitations (and value) of the study are linked to case selection and different understandings of the roles of case study research (Flyvbjerg 2006). For example, Flyvbjerg (2006, p. 228) argues that "the force of example" is often underestimated and it's often possible to "generalize on the basis of a single case". The focal case being examined in the present study could be termed an extreme or deviant case (see Flyvbjerg 2006) in the sense that it has an unusual range of characteristics, including: (i) the process convenors are from a scientific organisation and sought to adopt a scientifically-credible approach; (ii) a strong future-orientation as well as a change orientation; and (iii) a participatory approach characterised by the broad participation of actors (e.g. not only "frontrunners" as per many transition management exercises). Additionally, some transition scholars argue some features of the energy domain can limit the generalisability of findings (e.g. Raven et al. 2016). These broader generalisability and transferability issues are taken up in later chapters.

Part 2: Case research

Part 2a: Examination of the expected impact and utility of the futures forums

CHAPTER 3: Identified intervention theories to be tested

3.1 Introduction

This chapter presents the intervention theories to-be-tested and outlines how they are related to the futures forum process (e.g. the main process design choices made by CSIRO staff) and to stated futures forum objectives. The working practitioner theories describe the *expected* utility and impact of the CSIRO futures forum process (as well as similar interventions) which can then be examined in a real-world case.

The chapter is structured as follows. Important aspects of the characteristics and design of the interventions are initially outlined. Along with the intervention theories to-be-tested these details provide a more comprehensive overview of the *evaluand*. Given that these social interventions are expected to contribute to specific outcomes when conducted in particular contexts – as per ‘realist’ intervention theories (Pawson 2013) – this overview of the forums helps to enable informed consideration of the intervention theories. Next, key findings are presented on the identified intervention theories. The relationship between the identified intervention theories and the process design, convening approach and the stated forum objectives (which were detailed in the project proposals sent to potential participants) is subsequently reviewed. Finally, the chapter presents a brief analysis of the uniqueness of the intervention theories. Many theories and assumptions are presented in the existing literatures on prospective knowledge practices (e.g. the literatures on scenario methods in strategic management and corporate foresight) and sustainability transition research. This enables consideration of whether the theories and assumptions reported in this literature are similar or different to the identified intervention theories.

The subsequent chapter, having outlined these intervention theories, will assess their validity through an impact evaluation of the three focal futures forums.

3.2 Intervention characteristic and process design

The futures forum process is a multi-actor participatory process which has a very strong future-orientation. A futures forum process aims to focus on the longer-term future (e.g. 2050 is a main time horizon in two of the three forums which were studied in this research, the

Future Fuels Forum and Future Grid Forum; multiple time horizons – 2050 and 2020 – were considered in the Sustainable Aviation Fuels Road Map Forum). The process involves and integrates a participatory techno-economic modelling process which draws on the modelling capabilities of CSIRO (as well as other specialist modellers as/if required) and a dialogue process. Multiple meetings are held – typically full day or two-day long meetings – over many months. The tangible end products are a publicly released forum report and a technical modelling report. This type of participatory forward-looking inquiry has been termed “collaborative futures interventions” and “collaborative futures work occurring in the inter-organisational settings” (Wilkinson & Mangalagiu 2012, p. 383).

Table 9 below further outlines process design choices emphasised by CSIRO staff (e.g. in interviews) and their approach to convening futures forums. These elements of the process are further considered below in relation to the intervention theories to-be-tested.

Table 9: Central elements of the futures forum process

Element	Description
Broad participation: a “balanced group of interests” (represented at the forum)	Participation of a diverse group of relevant actors, such as a cross-sectoral mix (e.g. industry, government, civil society and research sector) and a combination of incumbents and other players developing new innovations. This was typically termed having a “balanced group of interests” represented at the forum. To enable this broad participation only some participants paid to attend: typically, industry participants contributed most funding, and CSIRO and government agencies also provided funding and in-kind support; civil society actors didn’t pay to attend. CSIRO issues all participants with a contract with identical terms.
Scenario approach	Through group discussion and debate at forum meetings participants explore and agree potential future scenarios (termed the scenario set) which are judged to be plausible. Typically, a futures forum explores alternative ‘plausible scenarios’ rather than, for example, developing a shared vision. Different workshops or scenario-building exercises are conducted at different forums; the common aspect is group debate.
Long-term orientation	A long-term orientation is the central focus, with some exceptions (e.g. defining shorter-term goals and a related action plan in a ‘roadmap’).
Detailed modelling (e.g. techno-economic modelling)	CSIRO staff conduct and/or lead modelling studies related to the scenarios or issues that are being explored. Claims/conclusions in the report are often supported by these modelling results.
CSIRO/CSIRO staff as the process “convenor” but not the process facilitator	An independent process facilitator is hired by CSIRO. CSIRO staff and researchers do supporting analysis (e.g. conduct the modelling processes) and lead the report development, but, generally, try to stay at “arm’s length” from the scenario construction and analysis. This approach is defined as a “hands-off” convening philosophy.

Consensus process	The futures forum process has a consensus orientation (e.g. seeking to produce a consensus report, an agreed set of options for dealing with identified challenges or other issues, etc.).
Iterative process of exploration, analysis and open debate	Forum processes involve a series of meetings in which issues and ideas are progressively reviewed and debated, ideally moving towards shared positions and shared understandings.
Seek participant 'ownership' of the forum outputs	<p>This element has several core components:</p> <ul style="list-style-type: none"> ▪ The main forum report is a 'committee-written report': report writing is led by CSIRO staff but drafts are shared with forum participants and changes are made in response to feedback/comments. The end-result sought by CSIRO staff is report sign-off by all forum participants; ▪ CSIRO seeks inclusion of participant logos in the final report; and ▪ Public presentation of forum findings by forum 'spokespeople' (e.g. provide commentary in media related to the project). <p>Additionally, a further rationale of the non-interventionist stance mostly adopted by CSIRO staff is that it is expected to contribute to outputs and outcomes being 'owned' by the forum participants (e.g. scenarios and other findings get determined by participants).</p>
Public report launch event	The main forum report is publicly launched at an event attended by a group of futures forum "spokespeople" and the media/journalists. Different formats are used such as Q&A style events.
Policy-relevant but not policy-prescriptive	Futures forum processes do "not seek to arrive at a consensus on specific recommendations for government policy or investment" (CSIRO 2012). Instead, the process seeks to identify a set of "options to be considered" (CSIRO 2012).
Objective and neutral analysis	Forums seek to produce a "fact-based outcome" (CSIRO 2010) and/or "fact-based evaluation of options" (CSIRO 2012). The forum process is also described as a fact-building, fact-gathering process.

Some of the above elements are stated in forum documentation, such as the project prospectus sent to potential participants (e.g. CSIRO 2012), and others were identified through interviews with CSIRO staff. For example, regarding the scenario approach used in the futures forums CSIRO staff said the following:

"We felt that a scenario approach was the only one that would allow us to have all the stakeholders in the room. Of course, it was a consensus process but we needed to give them room to see their own ideas in there where they didn't necessarily agree. That's why we had to adopt a scenario approach. People could then say I acknowledge that scenario is possible or plausible even but maybe I don't think it's likely. So, there'd be some scenarios that maybe the NGOs in the room think are more likely or desirable and business would see other scenarios as more likely or desirable" (P. Graham, 2014, personal communication, 2 June).

"The scenario process lent itself very nicely to those agreements and disagreements [i.e. between the futures forum participants] because people could put their things in various scenarios, and you get a different result according to the scenario... but it would accommodate all the inputs" (J. Wright, 2014, personal communication, 9 June).

Similarly, the emphasis on objective and neutral analysis and being policy-relevant but not policy-prescriptive was evident in both documentation and interview statements:

“We didn’t want to go further and get into a position where CSIRO was seen as trying to drive policy, but we wanted to provide factual information that could support people who are in that position” (P. Graham, 2014, personal communication, 2 June).

“The Forum will not seek to arrive at a consensus on specific recommendations for government policy or investment. However the process will deliver an agreed view of the various options to be considered – their regulatory barriers, risks, benefits and trade-offs, the action agenda required to move those options forward towards achieving an optimised electricity system and the roles of each stakeholder” (CSIRO 2012)

“The purpose of these forums is to gain a new, shared and fact-based understanding of the possible futures that a sector or an issue can take and then to develop a mutually-agreed pathway of how to get there... it’s not having just a free-wheeling dialogue (Flagship staff member [non-attributable], 2014, personal communication, 13 June).

As a final illustrative example, a strong emphasis on broad participation is evident in project prospectus documentation of all the futures forums that were researched:

“The goal of the Future Fuels Forum is to bring together transport fuels stakeholders from community, industry and government to determine plausible scenarios for the future of transport fuels in Australia and examine their implications... CSIRO is seeking to gather a set of Australian transport fuel stakeholders that represents a balanced group of interests to participate in the forum” (CSIRO 2007b, pp. 1-2).

“[The project] is seeking to gather a set of Australian and New Zealand aviation fuel stakeholders that represent a balanced group of interests from the aviation industry, fuel supply chain, government and the community to participate in the roadmap study” (Sustainable Aviation Fuel Users Group, CSIRO & Defence Science and Technology Organisation 2010)

“The Future Grid Forum ideally includes representation from generators, transmission and distribution networks, energy retailers and customers as well as government and regulators. The goal is to achieve a balance of interests across the entire electricity supply chain (including a range of views about Australia’s energy future)” (CSIRO 2012, p. 6)

CSIRO staff members described and emphasised this participatory approach as follows:

“I wanted something that would more or less take into account everybody’s point of view without pushing any one point of view” (J. Wright, 2014, personal communication, 9 June).

“The purpose of the forum is to draw on the wisdom of [a] whole lot of different stakeholders who have relevant specialist knowledge and so that improves the quality of the economic modelling because they bring their specialist expertise. So that when you look at the final report front page yes it is produced by CSIRO but you also see the logos of 20 other organisations” (J. Smitham, 2014, personal communication, 19 June).

“You could still do a process that claims to be independent and fair, we were thinking, but you could still lose that perception if you don’t have everyone at the table” (P. Graham, 2014, personal communication, 2 June).

Some of the perceived interconnections between the process elements were also described by Flagship staff. For example, a longer and more iterative process was viewed causally linked to the production of consensus outcomes and participant learning:

“[W]hen you put people in group settings and then spend a lot of time together they have trouble maintaining their agenda” (P. Graham, 2014, personal communication, 6 June).

“[Y]ou need a process and enough familiarity with each other so that the participants start to challenge one another in a non-confrontational manner” (J. Smitham, 2014, personal communication, 19 June).

This chapter now progresses to present and briefly consider the identified intervention theories.

3.3 Futures forum intervention theories

The findings reported below use the intervention theory structure proposed by realist evaluators. I first outline the identified hypothesised mechanisms, which are themselves theories of change (of a more ‘micro’ variety). I then summarise the contextual factors which were emphasised by interviewed CSIRO staff and formally specify the related intervention theories as context-mechanism(s)-outcome pattern configuration (CMOc) statements. (See Chapter 2 for an overview of realist evaluation). The resulting CMOc statements can be understood as a type of middle range theory (Pawson & Tilley 2004).

3.3.1 Identified intervention theories

3.3.1.1 Mechanisms

In realist evaluation mechanisms theorise ways in which the resources that are provided (by an social intervention or program) are interpreted and used by actors and, secondly, how these interpretive and reasoning processes influence actors' decisions.¹⁶ A mechanism centrally considers actors' reasoning; in Pawson's (2013, p. 20) terms "mechanisms change minds". Such cognitive change is expected to subsequently shape decision-making.

Eleven potential mechanisms were identified. Each hypothesised mechanism describes ways in which the resources provided by a futures forum – such as modelling results, access to other stakeholders, etc. – may be interpreted and may influence decision-making:

- Reduction of uncertainty (M1);
- Provision of resources that can credibly support strategic decision-making (M2);
- Critical reflection on actors' assumptions and beliefs (M3);
- Creation of common understandings (M4);
- Diffusion of ideas (M5);
- Informal dispute resolution (M6);
- Enhanced coordination (M7);
- Forum participation as an affecting experience (M8);
- Advocacy/action informed by more holistic understanding (M9);
- Appropriation (M10); and
- Social validation stimulating increased confidence (M11).

Table 10 below outlines each of these hypothesised mechanisms.

¹⁶ Pawson (2013, p. 20) puts this as follows: mechanisms are "embodied in... reasoning".

Table 10: Identified mechanisms, their hypothesised operation, and explanatory notes

Mechanism	Hypothesised operation	Example interview statements (interviewee statements related to the theory of change)	Explanatory notes (interpretation of statements)
<p>M1: Reduction of uncertainty</p>	<p>A futures forum is perceived to generate, and provide access to, an enhanced fact-base and a perceived/actual consensus amongst relevant actors. These forum process outcomes reduce the level of perceived uncertainty and enhances actors' confidence levels (<i>actor's reasoning process</i>). This reduction of uncertainty enables and/or encourages actors to make decisions related to new technology pathways (<i>influencing subsequent decision-making</i>).</p>	<p>"[The end result of the futures forum is that] there are a lot of things we don't know about the future but at least we know generally that 'this' is what the future is most likely going to look like, and here's a bunch of strategic implications. So, OK, that argument is essentially finished and now we need to move on to the question 'what do we do about that?'" (M. Paterson, 2014, personal communication, 17 June).</p> <p>"We've got this theory that if we can make technology pathways clearer, so strip away some of the uncertainty away from them, not all of it, but as much as we can by bringing our fact base and our consensus process to it, then people will be able to adopt those pathways sooner because uncertainty is the enemy of investment. In fact, there is actually quite a lot of economic theory that backs that up. So, we want to make these pathways clearer" (P. Graham, 2014, personal communication, 2 June).</p> <p>"I think confidence is built [in forums]... it's just peer pressure. It is kind of like a peer pressure process. You just understand that... if everyone is thinking the same way [e.g. about where a particular industry is going], then, you just feel more confident about doing something. (P. Graham, 2014, personal communication, 2 June).</p>	<p>These statements specify process results (e.g. surfacing areas of consensus/agreement) which can plausibly reduce uncertainty and consequently influence action (e.g. a decision to 'adopt' a new technology pathway). Related goals were stated, e.g. seeking to "strip away some of the uncertainty".</p>

Mechanism	Hypothesised operation	Example interview statements (interviewee statements related to the theory of change)	Explanatory notes (interpretation of statements)
<p>M2: Provision of resources that can credibly support strategic decision-making</p>	<p>A combination of factors – broad participation of actors, a credible analytical toolkit (e.g. rigorous techno-economic modelling), and the perceived/actual endorsement of the results of a futures forum (e.g. through inclusion of logos in the final forum report) and/or the perceived consensus that is achieved – enable production of anticipatory knowledge which is viewed as being in the “right zone”, i.e. within the ‘plausible range’. This knowledge is perceived to be credible (<i>actor’s reasoning</i>), thereby providing credible resources that can be used for making or justifying decisions (<i>influencing decision-making</i>).</p>	<p>“It gives it that stamp of authority; that we’re not just putting out another CSIRO futures study we’ve got all these solid industry people backing it [by including their logo in the report] it is symbolically powerful” (J. Wright, 2014, personal communication, 9 June).</p> <p>“By doing transparent modelling with pairs of eyes watching you do it, reviewing it at every step, etc., their ability to get confidence in the model and then basically to be a spokesperson for the process and forum process” (J. Smitham, 2014, personal communication, 19 June).</p> <p>“A forum will almost never fall short in this area [presenting a ‘reasonable’ whole-of-industry view]... That’s important for adoption and by adoption I mean, this [the report/analysis] is something that I should seriously refer to, it doesn’t have an agenda, it is a source of objective facts, so it is worth my time to read. It is worth my time and to say ‘OK that’s something that I’ll have to take on board” (P. Graham, 2014, personal communication, 6 June).</p> <p>“What’s the point of getting the information that a forum provides? What’s different about forum information? Forum information is consensus information and it takes a lot longer as a result to produce it” (P. Graham, 2014, personal communication, 6 June).</p>	<p>These statements all address elements which are expected to enhance credibility and thereby promote greater use in decision processes (e.g. involving actors in the modelling process). The notion of “symbolic power” speaks to the expectation that ‘endorsement’ via logos in the report – representing other actors’ belief in the credibility of the analysis/conclusions – will influence perceptions.</p>

Mechanism	Hypothesised operation	Example interview statements (interviewee statements related to the theory of change)	Explanatory notes (interpretation of statements)
M3: Critical reflection on actors' assumptions and beliefs	A futures forum process may prompt greater critical reflection (<i>actor's reasoning process</i>), such as in the following ways: 1) over-time the participants get more comfortable with one another and speak more openly, sometimes challenging one another's views; 2) the modelling and scenario analysis conducted by/for the forum challenges actors pre-existing views; and/or 3) gaining new knowledge about the changing external environment that they operate in. Critical reflection on assumptions and beliefs is assumed to influence actors' choices following a forum (<i>influencing decisions</i>).	<p>"You also don't want to have a situation where one personality dominates over everybody – the 'I know the answer' sort – and everybody else then shuts up. You want a situation where silence is not necessarily interpreted as agreement. So, you need a process and enough familiarity with each other so that the participants start to challenge one another in a non-confrontational manner" (J. Smitham, 2014, personal communication, 19 June).</p> <p>"Everyone is testing each other's ideas [during a forum process]" (P. Graham, 2014, personal communication, 6 June).</p> <p>"The forum... [must] take a certain amount of time. [For example] sometimes when you did the modelling you got a different result to peoples' opinions and people then need time to change their minds" (J. Smitham, 2014, personal communication, 19 June).</p>	These statements express the expectation that aspects of the forum process will prompt participants to reflect more deeply on their assumptions/beliefs (e.g. that participants "challenge one another" during a forum, that modelling results can cause reflection where they differ from actors' expectations).
M4: Creation of common understandings	The process leads to the development of a common understanding of 'what is going on', its implications and, possibly, 'what should be done' (<i>actor's reasoning process</i>). This may partly operate through a decision to be more open and share one's views, development of a common language, and by producing new inter-subjective understandings. This could lead to better coordinated action and/or increased respect for the views of others (<i>i.e. influencing decision-making</i>).	<p>"It's the power of a shared coming to terms with this in a common language... whilst it's kind of subtle and somewhat abstract, it is very profound" (M. Paterson, 2014, personal communication, 17 June).</p> <p>"It was used in a number of different ways... probably the majority of the cases were people who were referring to the forum as a key source of truth" (M. Paterson, 2014, personal communication, 17 June).</p> <p>"I think what makes the process quite powerful is that we've tried to get just about everybody in the tent to make this work. So you've increased the ownership of the outcomes – it's not just "I said" or "he said, she said" it's a case of "we said" (J. Smitham, 2014, personal communication, 19 June).</p> <p>"There's this social thing that goes on around where people are embarrassed to bring their partisan company view. They do generally prefer to engage... in my experience, they actually prefer to act in the mode where they can just be honest" (P. Graham, 2014, personal communication, 2 June).</p>	These statements convey the idea (or expectation) that the forums produce a shared understanding and common knowledge amongst the participants and participating organisations (e.g. by having access to a shared "source of truth", developing a "common language"). A related theory is that group dynamics, over-time, promote more common views (rather than biased partisan viewpoints).

Mechanism	Hypothesised operation	Example interview statements (interviewee statements related to the theory of change)	Explanatory notes (interpretation of statements)
M5: Diffusion of ideas	Attending a forum provides opportunities for actors to advocate and discuss strategic ideas. ‘Leading’ thinkers may perceive an opportunity to spread their ideas and try to persuade other attendees of their validity; and ‘lagging’ thinkers may see an opportunity to catch-up (<i>actor’s reasoning process</i>). This may lead to different choices being made by the participants (<i>decision-making</i>).	<p>“Once the forum gets to the point where it has got some ideas that are starting to be accepted by everyone, that starts to go back... it is the kind of thing that people will report when they go back to their “homes” [e.g. their organisation]. They know when the report is coming out, there is a project plan. People actually start to adopt the ideas before they are publicly launched in the reports” (P. Graham, 2014, personal communication, 2 June).</p> <p>“[You] have leading thinkers in the group... who are, maybe, just happy that the forum has been able to help socialise an idea that they already had. Almost the benefit to them is socialising an idea within the industry... Or it’s that, for the lagging thinkers, it’s more about bringing them up to speed” (P. Graham, 2014, personal communication, 2 June).</p>	These statements specify different forms of idea diffusion within and beyond the futures forum.
M6: Informal dispute resolution	The futures forum space and process is interpreted as providing a credible, independent and fair process in which to raise, debate and, partially, resolve challenging issues. Access to an enhanced fact-base and/or scientific knowledge which is perceived to be highly credible causes participating actors to re-evaluate their positions and weakens related disputes (<i>i.e. access to new information influencing actors’ reasoning</i>). This could lead to new decisions that reduce the level of contention and enable action/innovation (<i>decision-making</i>).	<p>“CSIRO can cast itself as an independent arbiter on some issues [e.g. via a futures forum process] ... [and] we can investigate [i.e. review/collect data on the key issues] and people can check them, we can be transparent about it” (P. Graham, 2014, personal communication, 2 June).</p> <p>“It’s all about exploring more effective ways to transition an energy system and providing a platform for societal dialogue that is really lacking. For me it’s a much broader role playing in the space of transdisciplinary research and providing a platform and safe place for dialogues about how we as a society are going to transition into an uncertain future” (D. O’Connell, 2014, personal communication, 4 September).</p> <p>“When a controversial idea comes up and we have these arguments and debates, sometimes a really robust debate, in a plenary session at the end of the session what people will often say is ‘hey, we had a really good conversation there’ and get quite excited, animated and quite happy, even though it may have been uncomfortable... But what they’ll sort of say is ‘now we’re really talking’ and they start understanding each other’s views” (P. Graham, 2014, personal communication, 6 June).</p>	These statements address three aspects of the process which are expected to promote dispute resolution: 1) clarifying the main facts of the matter on controversial issues; 2) creation of a “safe place” in which genuine dialogue and more productive arguments can occur; and 3) the broader social role of a national science agency. This is expected to help resolve conflicts that are hampering action.

Mechanism	Hypothesised operation	Example interview statements (interviewee statements related to the theory of change)	Explanatory notes (interpretation of statements)
M7: Enhanced coordination	By surfacing or clarifying the expectations, positions and/or need of actors the process enables actors to coordinate their decisions/understandings and better identify potential allies (<i>actor's reasoning process</i>). This may lead to or enable building networks, joint action, and/or help actors to better work in concert (<i>influencing decision-making</i>).	"[A forum can provide] a better idea of what the key research questions are and which stakeholders are interested in different parts of it. [For example] here's who wants to know about the feedstocks you can grow, and related questions... questions around conversion technologies; and so on" (D. O'Connell, 2014, personal communication, 4 September).	This statement conveys the idea that better knowledge of the needs, interests and beliefs of other actors can enhance coordination.
M8: Participation is an 'affecting experience'	Participation in a futures forum results in new knowledge of vulnerabilities (e.g. new understanding of threats perceived as credible) and an associated strong emotional response (<i>actor's reasoning process</i>). A new/strengthened sense of threat motivates related action (<i>decision-making</i>).	<p>"They can see the big potential for change and they're concerned about how it's going to impact them... In some of the futures we examine [during a futures forum process] their company doesn't exist anymore. That it is very confronting" (P. Graham, 2014, personal communication, 6 June).</p> <p>"I was just amazed and alarmed at what top executives from the likes of Chevron thought was plausible and the information that was revealed about how much oil there really isn't in the system, refined oil in particular with our dwindling refining capability [in Australia]. I guess that's what had a really profound impact on me and made me feel more committed to biofuels research" (D. O'Connell, 2014, personal communication, 4 September).</p>	These statements express the way that a forum process could lead to an enhanced awareness of vulnerabilities and/or threats (e.g. due to consideration of scenarios which are "confronting" for some participating organisations).
M9: Advocacy / action informed by more holistic understanding	A futures forum attracts a senior group of cross-sectoral and sector-wide stakeholders – which exposes participants to a more diverse range of perspectives – and provides access to more in-depth big picture economic modelling (<i>influencing actors' reasoning</i>). For example, the process may enable diverse players who otherwise wouldn't talk to each other to discuss a complex issue improving their understanding of an issue or challenge. This, in turn, may influence advocacy/action.	<p>"[A forum is] not just as an outreach process but [an exercise] in developing joint knowledge, the co-development of knowledge. It is a transdisciplinary exercise. It's putting the best of our knowledge together with the best of the knowledge of the people who ultimately are able to shape the future of the energy sector" (D. O'Connell, 2014, personal communication, 4 September).</p> <p>"The purpose of the forum is to draw on the wisdom of whole lot of different stakeholders who have relevant specialist knowledge and so that improves the quality of the economic modelling because they bring their specialist expertise" (J. Smitham, 2014, personal communication, 19 June).</p>	These statements express the idea that the broad participation of actors (broad range of stakeholders with different relevant knowledge) leads to more holistic understanding of the issues and analysis, which can enhance action/advocacy.

Mechanism	Hypothesised operation	Example interview statements (interviewee statements related to the theory of change)	Explanatory notes (interpretation of statements)
M10: Appropriation	Futures forum participants perceive an opportunity to further their organisation's interests by participating in and strategically influencing the forum process itself (<i>actor's reasoning process</i>). For example, participants may seek to influence the analysis or the final forum reports, or seek to leverage the process and its outputs in other ways. These choices (<i>actor's decision-making</i>) may lead to the appropriation of the process and related process or organisational outcomes.	<p>"We expect them [the futures forum participants] to behave self-interestedly... Everyone is bringing an agenda" (P. Graham, 2014, personal communication, 6 June).</p> <p>"Maybe they [the participants who are putting more time and efforts into contributing to the futures forum report] have strong alignment with the outcomes in terms of their company's views and strategies. So, having something come out [i.e. the public forum report] which reinforces their views is beneficial to them and the more they get involved in the writing the more that they can ensure that alignment. I think that is probably the single biggest motivator" (P. Graham, 2014, personal communication, 6 June).</p>	These statements address actors' assessment of opportunities (and/or risks) during a forum process and how this can influence the process, outputs or outcomes, e.g. seeking to influence the forum report.
M11: Social validation stimulating increased confidence	Participation in a forum could increase the confidence of participants if others agree with their ideas and/or are perceived to validate their ideas (<i>actor's reasoning process</i>) – especially if the opinion of the other forum participants is respected by the participant. This validation could prompt additional/new action (<i>subsequent decision-making</i>).	<p>"You get more confidence about whether your strategic ideas are good ideas if you get the chance to get into a process where they can sort-of be tested and debated... If you reach a point, particularly through a forum process, where there is actually a strong consensus around a few central ideas then that just gives you a huge amount of confidence that the idea is probably right" (P. Graham, 2014, personal communication, 2 June).</p> <p>"So, the trick for them [forum participants] becomes: everyone is testing each other's ideas and are they willing to take the risk to put ideas forward that they might be shot down, or modified, or whatever. You only know if you put the ideas up. What they generally find is more agreement than they expected" (P. Graham, 2014, personal communication, 6 June).</p>	These statements address the (perceived) validation of strategic ideas through group debate and the resulting expected effects (greater confidence in these strategic ideas, etc.). Similar to the reduction of uncertainty mechanism (see above) increased confidence is expected to promote action.

3.3.1.2 Intervention contexts

Five main broad social contexts were judged to widely promote participation in a futures forum and to be constitutive of the need for such a process:

Table 11: Enabling intervention contexts emphasised by CSIRO staff

Contextual factor	Example interview statements
<p>C1: High level of uncertainty (actual or perceived)</p>	<p>“I had a fairly strong sense of the need for such an animal [the future forum, given that there was]: an environment where there’s a 1000 different opinions about how the future might unfold. Having 1000 views, and many of them at least semi-credible, doesn’t really help you to make decisions about ‘what do we do about all this?’” (M. Paterson, 2014, personal communication, 17 June).</p> <p>“[A] hugely uncertain phase about what direction they’re heading in [is the context motivating participation by industry players]” (P. Graham, 2014, personal communication, 6 June).</p> <p>“I wanted some direction and I wanted some support. So that was really the reason we put this together...” (J. Wright, 2014, personal communication, 9 June) – <i>Dr Wright also mentioned related challenges in defining and establishing a coherent research agenda for the Flagship given the uncertainties around possible research and development options, the need to clarify external and internal support for possible research directions, etc.</i></p>
<p>C2: Major current strategic challenge(s)</p>	<p>“It has to be something quite big to get people to come to one of these tables and put in so much of their personal time and do what is a very sort-of high-level... [Pause]... for them to come and do a “navel gazing” exercise is quite often outside of their comfort zone. There needs to be a big issue driving them [to participate]” (P. Graham, 2014, personal communication, 2 June).</p> <p>“They [industry] have to be having some sort of existential crisis because this is too radical and too big a process for them to break out of their normal ways of doing things. These companies have their own internal strategic planning processes. Why would they jump out of those processes and do this odd project... I don’t think it is just the CSIRO brand. I think it is the fact that an industry has to be really facing something that if they get it wrong it will almost mean the end of their business or the ways they currently know it” (P. Graham, 2014, personal communication, 2 June).</p> <p>“When picking a topic for the forum, it has got to be of sufficient “currency” that people see it as important enough to invest an adequate amount of time in over one or two years” (J. Smitham, 2014, personal communication, 19 June).</p>
<p>C3: Conflict(s) / dispute(s) related to possible transitions</p>	<p>“I think if a structural break or discontinuity or an issue comes up but everyone is in agreement about what should be done about it then it doesn’t mean that you do or come to a forum process. I think you probably need some conflict around it, and maybe there always is [around major energy issues]” (P. Graham, 2014, personal communication, 6 June).</p>

Contextual factor	Example interview statements
	<p>“Everything in the energy sector is extremely polarised... So rather than just have something like an ABC panel show where people bring their prejudices, they have an hour, the moderator just lets them air their prejudices and then at the end of the show nobody has changed their view... [what’s needed is a different kind of process] where we can, in an objective fashion, translate some of the underlying assumptions [of the forum participants] into an economic model and then show you the effect of those assumptions, and all the assumptions are transparent” (J. Smitham, 2014, personal communication, 19 June).</p>
<p>C4: Discontinuous change</p>	<p>“A major break [has just emerged or is developing] – so a structural break in something that underpins an industry” (P. Graham, 2014, personal communication, 6 June).</p> <p>“[T]he electricity industry has probably been more or less in stasis for several decades. It’s been a very slow-moving evolution, if anything. Really in the last five years, last 10 years certainly but particularly the last three-to-five years, the pace and scale of change has significantly shifted” (M. Paterson, 2014, personal communication, 17 June).</p>
<p>C5: Unsolved and challenging collective action problem</p>	<p>“Another theory [of mine] is that there is something about the way that the future needs to evolve that a whole bunch of stakeholders will need to work together more closely. Basically, one actor can’t resolve the problem that is now in front of them. They can see the problem but unless the whole industry sees the problem too it cannot be solved... an industry has to change and one actor can’t achieve it alone” (P. Graham, 2014, personal communication, 6 June).</p>

In addition, some more specific contextual factors were noted by interviewees related to specific mechanisms (e.g. the mix of participants – see *Section 3.4* below) and subsequent adoption of the outputs (e.g. the level of appetite for risk-taking at the time).

3.3.1.3 Context-mechanism-outcome pattern configuration statements

Four context-mechanism-outcomes pattern configuration (CMOc) statements were identified. As noted in Chapter 2, a CMOc statement logically links a context with the ‘firing’ of mechanisms and the outcomes patterns which are subsequently expected if these mechanism fire under these conditions. Each CMOc statement is summarised below as a causal process followed by the key contextual factors and mechanisms.

CMOc-1: Credible strategic and decision-making guidance under uncertain conditions

Description of hypothesised causal processes:

Under uncertain conditions actors in which new strategic challenges have emerged, actors are looking for decision guidance they can trust and a better understanding of what futures are possible or plausible (C1, C2). These needs promote participation in a futures forum. A futures forum meets these needs by producing an enhanced fact-base, a stronger consensus amongst relevant actors or stakeholders, and an assessment of future possibilities and/or options which are judged to be plausible (see M2). A number of elements of the process promote the production of outputs that are judged to be plausible, including: (i) the broad participation of actors (e.g. a 'balanced group of interests'); (ii) underpinning techno-economic modelling and other inputs provided by CSIRO staff; and (iii) the perceived endorsement of the results by participants (as per the including of logos and delegate details in the final report) and/or the perceived group consensus. The production of anticipatory knowledge interpreted as being credible (see M2) promotes wider adoption of the outputs and reduces the level of perceived uncertainty (M1), supporting actors in justifying proposed courses of action and enabling confident strategic decisions.

Contextual factor(s): high level of uncertainty – actual or perceived (C1); major current strategic challenge(s) (C2).

Hypothesised generative mechanisms: 1) Reduction of uncertainty (M1); and 2) Provision of resources that can credibly support strategic decision-making (M2).

CMOc-2: Reduction of inertia in the context of a destabilising 'structural break'

Description of hypothesised causal processes:

Major discontinuities – or the emergence of a disruptive 'structural break' in economic terms (C4) – contribute to a sense of existential threat in the industries that are impacted by these changes. For example, major threats to existing business models may be perceived (C2). These threats promote the participation of industry decision-makers and other relevant stakeholders in a futures forum. The extended process of open debate, information sharing, informal group conversations, and analysis that occurs during a futures forum promotes the open sharing of views and concerns (M3) and the development of inter-subjective understandings amongst forum participants. Consequently, a futures forum is expected to result in shared understandings (M4) and improved knowledge of emerging threats (M8). These forum process outcomes contribute to faster adoption of new technology pathways by forum participants to address identified threat(s) and, consequently, also to reduced inertia.

Contextual factor(s): Discontinuous change (C4); and major current strategic challenge(s) (C2).

Hypothesised generative mechanisms: 1) Critical reflection on actors' assumptions and beliefs (M3); 2) Creation of common understandings (M4); and 3) Participation an affecting experience (M8).

CMOc-3: Enhanced coordination and coalition formation in the context of a collective action problem

Description of hypothesised causal processes:

If actors are facing a tough problem that they cannot solve alone – i.e. a collective action problem (C5) – this motivates engagement with other relevant actors in multi-stakeholder exercises like a futures forum. These needs promote strong participation in a futures forum. The extended process of open debate, information sharing, informal group conversations, and analysis that occurs during a futures forum helps to surface and clarify actors' positions, expectations, and beliefs/ideas (M4, M5). By becoming more aware of the expectations and positions/views of other actors, futures forum participants – along with other actors who follow the process and review its outputs – are also better able to coordinate their activities and identify potential allies and enemies (M7). Consequently, the process contributes to the development of new joint actions for advancing desired pathway(s) for addressing a shared problem (e.g. new collaborative initiatives, associating with other actors in formal and informal networks, pursuit of collaborative innovation opportunities amongst multiple firms, etc). The net effect of these outcomes is new forms of collective action.

Sub-proposition: the fashioning of *common understandings* (M4) during a futures forum process may also be influenced by the capacity of leading thinkers to convince others of the merits of a strategic opportunity/idea, which would therefore help to enable the *diffusion of ideas* (M5).

Contextual factor(s): Unsolved and challenging collective action problem (C5).

Hypothesised generative mechanisms: 1) Creation of common understandings (M4); 2) Diffusion of ideas (M5); and 3) Enhanced coordination (M7).

CMOc-4: Providing a safe space which enables informal dispute resolution in the context of conflict/contention

Description of hypothesised causal processes:

The futures forums contribute to the resolution of debates and controversies surrounding problems related to energy use and Australia's future energy mix (C3) by contributing to the development of scientific knowledge and wider acceptance of relevant knowledge/facts. By convening an independent, fair, transparent, and inclusive process the Flagship/CSIRO Energy is able to help to resolve disputes that are preventing decision-making or beneficial actions. The Flagship/CSIRO Energy also enhances its own reputation by playing this role. These outcomes are achieved by generating greater agreement on the relevant facts and credible solution options (M6). This process outcome causes futures forum participants, and potentially also other relevant actors, to re-evaluate their views or positions on related issues (M6) and thereby weakens disputes. Because CSIRO is a reputable body the participants and/or other actors (e.g. those reading forum reports) will look to CSIRO to adjudicate the credibility of claims and will place greater weight on this analysis.

Contextual factor(s): Major conflict/dispute related to possible (energy) transitions (C3).

Hypothesised generative mechanisms: 1) Enabling informal dispute resolution (M6).

3.4 Relationship between intervention theories and the process design, convening approach, and stated futures forum objectives

The interview statements were also reviewed to note and consider the ways in which the process design and convening approach are related to these theories. Illustrative example statements are shown below, followed by a table which summarises important aspects of the process design and convening approach which are related to the intervention theories.

Several comments were made by CSIRO staff about the importance of broad participation in futures forums and how this is expected to contribute to greater utility/impact, e.g.:

“The forum has to come up with plausible futures, genuine options, without leaving out major things it should be [including] but still staying within the plausible range because if it is not plausible then it won't be adopted. So, we [therefore] need that mix of 'incumbents' and 'challengers' to kind of force us into the right zone that we need to be working in, if we miss this zone then the work will be seen as not credible. Either not credible because it is too conservative, or not credible because it is seen as out in wacky land. So absolutely the whole process doesn't work unless the forum helps us to shape that sweet spot in the middle where all the thinking needs to be” (P. Graham, 2014, personal communication, 6 June).

“You could still do a process that claims to be independent and fair ... but you could lose that perception if you don’t have everyone at the table. The more we thought about it we thought there are some core ingredients. You need to have true broad stakeholder representation which means that – even though industry funds it – you need to invite a lot of people in who play for free” (P. Graham, 2014, personal communication, 2 June).

Interview statements also appear to emphasise process design aspects closely related to the critical reflection on actors’ assumptions and beliefs (M3):

“So, the idea of the forum was they had to take a certain amount of time because you needed time for people to get comfortable so that they could speak openly, to understand that everybody’s opinion was equally valid. Sometimes when you did the modelling you got a different result to peoples’ opinions and people then need time to change their minds” (J. Smitham, 2014, personal communication, 19 June).

Many statements were made about the iterative and participatory approach that is used and the expected effects of this. The following illustrative statements convey this:

“When people have to step back a lot, and then come back to something, and then step back, and come back, over a long time period there’s always the opportunity to correct whatever was said on a particular day at a meeting, if some error crept in. Ideas get tested many times by many different people and they get written down in different ways. I think there is something about a long group process... And then the modelling will come back, and it could come back six or seven times. There’s something about that that means you get many chances to improve on the output” (P. Graham, 2014, personal communication, 6 June).

“[Y]ou need a process and enough familiarity with each other [which develops over-time] so that the participants start to challenge one another in a non-confrontational manner” (J. Smitham, 2014, personal communication, 19 June).

The strong emphasis that is also placed on establishing or clarifying the facts of the matter (at hand) and related evidence is emphasised by the following remarks by a CSIRO staff member:

“It’s the combination of the modelling with dialogue, because in the dialogue you flesh out what the key issues are that people are grappling with and then you use the modelling and, generally, a fact-based and analytical approach to actually discuss the issue in a fact-based logical way and not in an uninformed, spin way where people put opinions forward that are not backed by facts” (Flagship staff member [non-

attributable], 2014, personal communication, 13 June).

“I think that is important because I think what often happens is you have one meeting where you have a debate but then there’s no follow-up. For instance, if you said ‘I think a renewable energy is cheaper and therefore I don’t think it wouldn’t cost more to go to a completely renewable energy system’, and if I said something different, then unless we have further meetings we cannot resolve this debate. We could have a second meeting where we review the data on projects, what they actually cost, plus two or three reasonable approaches for how people have projected those costs forwards and, therefore, here’s the likely outcome. And then we have another debate about it. Then if we are still disagreeing on some the assumptions then we can refine them further and then have another discussion. So that is the only way forward to get us to a mutually-agreed position” (Flagship staff member [non-attributable], 2014, personal communication, 13 June).

Table 12 below summarises the identified relationships between the intervention theories and process design and convening approach.

Table 12: Identified links between the intervention theories and process design

Intervention theory	Relevant aspects of process design and/or convening approach
CMOc-1: Credible strategic and decision-making guidance under uncertain conditions	<ul style="list-style-type: none"> • Seeking broad and balanced participation in the forum to help ensure key outputs such as the scenarios are in the “plausible range” (e.g. both ‘incumbents’ and ‘challengers’, etc.); • Participatory modelling process; • Public ‘ownership’ of the outputs/results through inclusion of logos on the final forum report; and • Consensus-oriented and fact-based/fact-clarifying process (which is theorised to reduce actors’ uncertainty and produce credible outputs), aiming to produce “consensus information”.
CMOc-2: Reduction of inertia in the context of a destabilising ‘structural break’	<ul style="list-style-type: none"> • Holding multiple meetings held over many months so that participants get more familiar, and, consequently, are potentially more willing challenge each other’s views/beliefs; • Iterative approach; and • Examination of the implications of scenarios deemed plausible by the group (e.g. threat identification/assessment).
CMOc-3: Enhanced coordination and coalition formation in the context of collective action problems	<ul style="list-style-type: none"> • Facilitating a consensus-oriented group process which seeking to reach broad agreement throughout; • Iterative approach; and • NOTE: no specific processes included for coalition formation / collaboration: “[we] assume that if people spend enough time with each other and reach a certain level of consensus it will happen organically” (P. Graham, 2015, pers. comm.).
CMOc-4: Providing a safe space which enables ‘informal dispute resolution’ in the context of conflict/contention	<ul style="list-style-type: none"> • Try to establish a process judged as independent, fair, and credible and therefore judged to be a ‘safe space’ in which to discuss contentious issues; • Holding multiple meetings held over several months; and • Seeking broad agreement on the facts: futures forum process aims to be a “fact-building process” and “fact-based process”.

3.4.1 Relationship between the intervention theories and stated forum objectives

The project prospectus for each forum (i.e. which was sent to potential forum participants) was also reviewed to assess the relationship between the identified intervention theories and the *explicitly* stated objectives (both the intended forum outputs and intended outcomes).¹⁷

Table 13 summarises the stated objectives of each focal futures forum:

Table 13: Stated objectives for each futures forum

Stated objective (intended output or outcome)	Future Fuels Forum	SAFRM Forum	Future Grid Forum
Intended outputs			
Set of plausible scenarios	✓	✓	✓
Quantitative assessment of the characteristics of the identified scenarios/options/future pathways (techno-economic modelling; assessment of key indicators; examination of potential trade-offs, etc.)	✓	✓	✓
Qualitatively discuss and report on the identified key challenges, options and implications	✓	✓	✓
A public “road map” that outlines a shared view of opportunities and challenges	X	✓	✓
Co-developed “strategic information” incorporating participant views into a public report	✓	X	X
Development of new analytical frameworks	X	X	✓
Intended outcomes			
Bring together a diverse set of relevant stakeholders and enable constructive and open debate	✓	✓	✓
Provide inputs to decision-makers (e.g. evidence relevant to policy-making and investment decisions)	✓	✓	✓
Advance and/or influence current debates on energy options (e.g. low-carbon alternatives)	X	✓	✓
Networking or stakeholder interaction opportunities	✓	X	X
Influence debates about regulatory models	X	X	✓
Enhance participants’ reputation	✓	X	X
Creation of a respected coalition of experts	X	X	✓
Forged consensus solutions by systematically working through complex issues	X	X	✓

This table shows that there are a diverse range of intended outputs and outcomes (based on the project prospectuses) and some commonalities. Related to CMOC-1 there is a strong

¹⁷ NOTE: the issue of unstated (or implicit) forum objectives is taken up in later chapters – for example see Chapter 6.

emphasis on decision-support and related outputs. Related to CMOC-3 and CMOC-4 (and to lesser extent CMOC-2) there is a common focus on bringing together diverse stakeholders and enabling constructive debate and, in recent forums, more focus on producing a shared view of opportunities and challenges. Some intended outputs can be interpreted as consistent with all CMOC statements (e.g. a credible set of scenarios). This is further explored below.

3.5 Comparative analysis results: How unique are these intervention theories?

This final major section of the chapter reports on a review of related literatures on prospective practices (e.g. published in relevant academic journals such as *Futures*, *Technological Forecasting and Social Change*, *Foresight*), sustainability transition research, and science studies (also termed Science and Technology Studies [STS]). A recent jointly authored ‘position paper’ on the benefits and potential contribution of modelling approaches in transition research (see Holtz et al. 2015) is principally drawn on to consider the alignment of the intervention theories with the views and practices of transition researchers.

The main objective of this review was to ascertain the extent to which the identified intervention theories are novel. Aside from providing a basis for judging whether the initial phase of the research produced *original* theories this can also inform assessments of the broader relevance of the research findings reported in Chapters 4-7. For example, where an intervention theory is similar to other theories that are widely used (e.g. by other practitioners) the evaluative research findings potentially have broader relevance. Such judgements will be articulated in the discussion chapters.

CMOC-1: Credible strategic and decision-making guidance under uncertain conditions

Decision support is widely discussed in the literature. For example, a recent special issue on ‘scenario thinking’ and scenario techniques published in *Technological Forecasting & Social Change* argued that these are useful approaches for “supporting management decision making” (Wright, Cairns & Bradfield 2013, p. 564). Reviews have also identified an emphasis on such roles along with related strategic benefits, although the empirical evidence for related

potential impacts such as enhanced company performance is weak (Varum & Melo 2010).¹⁸ Contextual factors such as the level of uncertainty relative to the capacity of actors to anticipate or adjust (Schoemaker 1995) and the overall level of complexity, ambiguity and ‘turbulence’ (Ramírez, Selsky & van der Heijden 2008; Ramirez & Wilkinson 2016) are frequently argued to influence the utility of such practices.

Reduction of uncertainty is less widely viewed as a core function. In contrast, enhancing the capacity of actors to *cope* with uncertainty is more commonly claimed and discussed. For example, Vecchiato (2012, p. 391) argues that “strategic foresight” techniques and practices help actors to “cope with uncertainty”. Similar arguments are commonly made about the use of scenarios, such as the claims that “their role is to help managers recognize, consider and reflect on the uncertainties they are likely to face” (Varum & Melo 2010, p. 362) and that “scenarios help stakeholders to cope with uncertainty, not by eliminating it, but rather by framing it and understanding the range of associated implications” (Wollenberg, Edmunds & Buck 2000, p. 71). Authors from science studies more commonly address the aim to reduce uncertainty. For example Sarewitz (2004, p. 393) argues that there is a “standard model” for how scientific research helps to resolve an issue or controversy which he summarises as follows: “if uncertainty surrounding the relevant scientific facts can be reduced, then the correct course of action will become more apparent. Uncertainty is thus portrayed as the cause of inaction”. Other scholars who are informed by science studies research have identified related ideas about the role of science in society (e.g. Miller 2013, 2015b).

Overall, the review revealed some similarities and differences. Decision support in challenging circumstances is a common claim and/or aim. The theorised roles of PKPs in helping actors to deal with uncertainty, in part, tend to diverge from CMOC-1. The working theory of uncertainty reduction appears more aligned with how science is expected to contribute to action.

CMOC-2: Reduction of inertia in the context of a major destabilising ‘structural break’

The usefulness of prospective practices for revealing and challenging existing assumptions and/or beliefs is commonly discussed and claimed. Transition modellers (Holtz et al. 2015)

¹⁸ Practitioners and scholars have also articulated additional specific ways in which practices such as scenario exercises could enhance or support decision-making, such as by helping to assess the ‘robustness’ of proposed plans of action (Harries 2003) or provide a ‘safe space’ in which to rehearse possible decisions (Hayward & Morrow 2009).

argue that process of modelling assists with revealing and discussing assumptions and, consequently, enhances discourse. Modelling requires making assumptions more explicit and this “leads to discourse and can reveal differences in understanding between involved researchers and stakeholders that [otherwise] may remain unnoticed” (Holtz et al. 2015, p. 43). Scenario planning scholar-practitioners claim that scenarios function as ‘cognitive devices’ (e.g. Healey & Hodgkinson 2008; van der Heijden 1996) and that scenario exercises are “a mode of facilitating challenge” (Wright & Cairns 2011, p. 5). Similarly, Pierre Wack argued that “the single most important aim of scenario planning is to challenge the assumptions of decision makers about how the world works and compel them to change their image of reality” (as cited in Chermack & van der Merwe 2003). Related to such functions Parandian and Rip (2013, pp. 2-3) claim that scenarios have an “enlightenment function”; that is, they can “sensitize and enlighten their users to think more broadly about futures”.¹⁹

Fewer claims are made about the creation of common understandings or achieving impact through ‘affecting experiences’, though transition modellers have pointed to the former benefit. Holtz et al.’s (2015, p. 53) discussion of participatory modelling practices asserts that “discussing assumptions can help stakeholder groups to reach consensus or at least identification of underlying causes of disagreement and thus supports communication and learning between modellers, decision makers and other stakeholders”. This function is also described by Holtz et al (2015) as “serving the creation of shared understanding” (p.53). Some backcasting and scenario planning practitioners do claim that such practices can enable the creation of common understandings (see CMOc-3 below) but this is not a strong theme in these literatures. Regarding the notion of participation in a prospective process can be an ‘affecting experience’, Mallard & Lakoff (2011) argue that such exercises can stimulate a *stronger* sense of vulnerability and uncertainty. However, this appears to be the only claim of such a function (see discussion of contrasting claimed functions above).

This review indicates that one of key mechanisms for this CMOc statement – critical reflection on actors’ assumptions and beliefs – is a common theory of change. Many scholar-practitioners have proposed related ideas about the functions of scenarios and scenario

¹⁹ Similarly, some justifications of the use and role prospective practices such as scenario methods emphasise problems such as managerial overconfidence and tunnel vision (Schoemaker 1995). Schoemaker (1993) has also sought to clarify and test the psychological basis of scenario planning, such as the cognitive biases it may help to minimise as well as its potential to contribute to cognitive biases.

exercises. The other hypothesised mechanisms are noted by some scholar-practitioners but are much less widespread.

CMOc-3: Enhanced coordination and coalition formation in the context of collective action problems

Some influential scholar-practitioners such as van der Heijden (1996) and Robinson et al. (2011) have emphasised social functions which are similar to this CMOc statement such as mental model alignment and mutual learning. van der Heijden (1996, p. 51) further argues that by performing such functions scenario planning “permits coherent strategic action”. Related claims are made in a range of literatures. Some planning theorists and change consultants argue that representations of the future are an important means for gaining agreement (e.g. Kahane 2012; Myers & Kitsuse 2000). Some scenario planning theorists-practitioners have argued collaborative scenario-building helps to avoid a silo mentality and enable ‘joined-up’ analysis (Cairns et al. 2006), and that efforts to build ‘common ground’ can be aided by focusing collective attention on alternative futures (Chakraborty 2011; Ramirez, Selsky & van der Heijden 2009). As noted earlier Holtz et al (2015) argued that participatory modelling approaches can help stakeholders to reach consensus or, at least, move towards shared understanding. However, related contextual factors emphasised by this CMOc statement – such as the need to address a complex collection action problem – are infrequently addressed in the literature. Some exceptions (e.g. Kahane 2012; Ramirez & van Der Heijden 2007) and literature on the use of ‘roadmapping’ to advance multi-actor innovation processes (Masum, Ranck & Singer 2010; McDowall 2012) have recently emerged.

Thus, CMOc-3 addresses a somewhat novel focal context (collective action problems) but the hypothesised mechanisms have been widely proposed in the literature.

CMOc-4: Providing a safe space which enables ‘informal dispute resolution’ in the context of conflict/contention

Finally, the use and utility of prospective practices for dispute/conflict resolution has not been widely discussed. Few practitioners, such as Kahane (2004, 2012), have experimented with such practices in conflict resolution contexts, however the specific utility of particular practices (e.g. scenario methods) and the causal mechanism are unclear. Holtz et al (2015) occasionally refer to conflict situations and make related claims such as that through participation in modelling activities stakeholders can “learn about each other’s perspectives” (p. 47), and that

“discussing assumptions can help stakeholder groups to reach consensus or at least identification of underlying causes of disagreement” (p.53). Science studies scholars have noted related claimed roles of science in society, including the approach of creating knowledge with the aim of solving social problems (e.g. Erickson 2016; Miller 2013, 2015b; Miller et al. 2014; Sarewitz 2004). Such research addresses the common aim of using scientific knowledge to resolve political disputes or conflicts and facilitate decision-making and action (for a critical discussion of such aims see Sarewitz 2004).²⁰ Overall, CMOc-4 is less common in the literature on PKPs but it is present in the literature on science and society (sometimes as part of critiques of such theories) and is discussed by some transition modellers.

In sum, the comparative analysis demonstrated many similarities between the intervention theories and the theories that are reported in the literature on prospective practices and that are discussed by transition modellers. Many of the hypothesised mechanisms which aren't strongly aligned with existing theories (e.g. reduction of uncertainty, and informal dispute resolution) are consistent with common beliefs about the roles of science in society. The expression of such theories by scientists at CSIRO may result from their internalisation of collective narratives (e.g. about the roles of science in society), although such speculation goes beyond the focus and scope of this chapter.

3.6 Chapter conclusions

A clear set of intervention theories were identified along with strong alignment between these theories and the process design (i.e. key process and analytical choices and the intention behind these choices), convening approach and stated forum objectives. Consistent with realist evaluation theory, it is also clear that the futures forums require the active engagement of relevant actors which emphasises the importance of participants' needs and related contextual factors. Each of the CMOc statements points to potential motivations along with ways that futures forums and their effects are currently understood to be contingent on social conditions.

²⁰ Such claims have also been examined by energy policy experts and energy research scholars. For instance Sovacool et al (2016, p. 4) argue that “conflicts in the domain of energy are not primarily due to one party lacking scientific facts or objective truths – or, at least, not always”. They emphasise the impact of “ideological frames” and framing processes on “deliberations about energy” (Sovacool, Brown & Valentine 2016).

Second, there are envisaged links between these working theories and process design choices. This was seen, for example, in the expected influence of ensuring a diverse participant mix and the decision to convene longer collaborative processes which occur over many months (9-18 months). Further interrogation of these links can inform evaluative judgements.

The identified intervention theories guiding CSIRO practitioners are, to a significant extent, consistent with the theories guiding other practitioners. Many of the key differences appear related to the scientific context (i.e. the convening practitioners are from a formal scientific organisation) and common accounts of the roles of scientific knowledge and scientists in society. These findings can support identification of transferable lessons (see *Part 3: Discussion and Conclusions*).

CHAPTER 4: Assessment of the intervention theories

4.1 Introduction

This chapter examines the Context-Mechanism-Outcome pattern configuration (CMOc) statements. As was discussed in the previous chapter each CMOc statement outlines the expected impacts and utility of the future forum process in specified circumstances. This chapter considers the empirical support for each CMOc statement and whether these intervention theories serve their core explanatory function (see the outline of realist evaluation in Chapter 2).

Initially each CMOc statement is considered sequentially by outlining the relevant evidence for each component (i.e. the forum contexts, the firing of mechanisms, and associated outcome patterns) and assessing the overall support for each CMOc statement (see *Section 4.2*) This analysis informs consideration of the case support for the intervention theories.

The analysis presented in *Section 4.2* provides a basis for considering how well (or poorly) the intervention theories *explain* the case and what aspects of the case require further explanation (along with more detailed description of each forum [*Appendices 1-3*]). *Section 4.3* further analyses the extent to which the core intervention theories (CMOc statements) provide a robust, i.e. empirically valid, explanation of the identified outcomes and other important aspects of the case (e.g. who participated, whether and how the outputs were used, etc). This analysis, along with the forum process and intervention theory findings that were presented in chapter 3, also informed identification of key aspects of the case require further examination (see *Section 4.4*), a task which is further undertaken in the remainder of the thesis.

4.2 Examination of the case evidence for the CMOc statements

4.2.1 *CMOc-1: Credible strategic and decision-making guidance under uncertain conditions*

CMOc statement summary

This CMOc statement emphasises the provision of decision support in the context of

uncertainty and strategic challenges (**C1**, **C2**; also see Chapter 3). Two key mechanisms were proposed to explain why: 1) reduction of uncertainty (**M1**); and 2) provision of resources that credibly support strategic decision-making (**M2**). The relevant case evidence is summarised below.

Forum contexts

In all the futures forums many participants (but far from all) faced strategic decision-making challenges (**C2**) and highly uncertain conditions (**C1**). Most of these participants were from industry. Some government actors also were dealing with related public policy issues. Additionally, some forums focussed on domains in which CSIRO staff themselves needed to make complex decisions such as regarding what areas of research to focus on.

In the Future Fuels Forum (which was run in 2007-08), some participants faced major uncertainties and decision-making challenges regarding rising fuel prices, climate change policy, emerging issues in the fuel sector (e.g. declining oil refining capacity) and declining competitiveness of related industries, in particular car manufacturing and oil refining.²¹ New debates regarding Australia's liquid fuel security had developed during the early 2000s period (**C1**), i.e. about the level of energy security and the capacity of existing policies and market arrangements to ensure fuel security into the future (Australian Fleet Managers Association 2006; Commonwealth of Australia 2013; Ferguson 2011). These issues were strategically important (**C2**) for participants from the automotive sector (e.g. GM Holden) and the retail sector (E.g. Woolworths Limited). State governments in Victoria and South Australia were also grappling with emerging issues in the automotive industry and this motivated forum participation (K. Handberg, 2014, personal communication, 28 November). Probably the most important issue causing uncertainty was rising and more volatile oil prices (see *Figure 3* below) and debates about possible causes. Oil prices rose throughout the forum and reached a record high of US\$147/barrel on the day the forum report was released, however they dropped rapidly over subsequent months – reaching \$30/barrel in December 2008 – which plausibly

²¹ For example, following Mitsubishi's announcement in February 2008 that it will close its last Australian manufacturing plant – which occurred during the Future Fuels Forum – the Federal Australian Government announced the Bracks Review of the Automotive Industry which was conducted by Steve Bracks, the former Premier of the State of Victoria in Australia (Bracks 2008). A wide range of factors reduced the competitiveness of local manufacturing and raised questions about the viability of the industry (Bracks 2008). Other manufacturers (GM Holden, Ford and Toyota) later also decided to cease manufacturing automobiles in Australia.

reduced the level of uncertainty during the period when the report was considered.

Figure 3: Trends in oil prices (West Texas Intermediate), 2003–09 (from Khan 2009)



WTI = West Texas Intermediate
Source: US Department of Energy.

Finally, the developing global financial crisis (GFC) was also a source of uncertainty. The GFC “reached its zenith in September 2008 when US securities company Lehman Brothers went into bankruptcy, and the large insurance company AIG was rescued by the US Government along with the two large mortgage agencies, Fannie Mae and Freddie Mac” (Reserve Bank of Australia 2010). However, issues related to the GFC did not motivate participation in the forum.

In the Sustainable Aviation Fuels Road Map (SAFRM) Forum (which was run in 2010-11) the participation of some participants was motivated by decision-making challenges under uncertainty. The aviation sector in Australia was concerned about the potential impacts of climate policies, such as carbon pricing (which the then Federal Labor Government had tried to legislate and subsequently did in July 2012), and it had been impacted by volatile and rising oil prices (C1, C2). Both contextual factors promoted greater interest in alternative fuels (N. Williamson, 2014, 6 November). However, the future commercial viability of alternative fuels was a major uncertainty. Expectations of the near-term prospects of aviation fuels had risen – particularly in the context of higher and more volatile oil prices – which was evident in the International Air Transport Association’s goal of “10% alternative fuels of non-crude oil sources

by 2017” (International Air Transport Association 2008). However, limited ‘concrete’ data was available to inform assessments and data available at the time of the forum indicated that aviation biofuels were “approximately double the current conventional jet fuel price” (International Air Transport Association 2010, p. 3). When and if alternative jetfuels would become cost competitive was unknown at the time of the forum (C1).²²

In the Future Grid Forum (which was run in 2012-13) the main actors who were grappling with major decision-making challenges under uncertain conditions (C1, C2) were from the electricity networks sector (who were 32% of forum participants from the electricity sector and 17% of all participants). For example, demand uncertainty had developed in the context of declining electricity consumption and emerging technologies (e.g. for localised generation and energy storage). Other participants from the electricity sector, such as generators and retailers, also faced a changing and uncertain context due to emerging technologies and contention regarding climate policy (C1). The Federal Liberal Opposition party policy was to repeal existing climate change policies (which was later implemented in 2014).

Evidence of outcome patterns and the firing of mechanisms

Relevant outcome pattern details for each forum are outlined below. Subsequently, additional case evidence related to the firing of each hypothesised mechanism is summarised.

Future Fuels Forum outcomes

Future Fuels Forum (FFF) participants from different sectors reported different levels of decision support. Many participants from the research sector and from industry stated that the forum supported and/or influenced decisions, including the following examples:

- The Director of the CSIRO Energy Transformed Flagship (which it was called at the time of this forum) used the forum’s modelling and findings internally – i.e. within CSIRO – to defend and justify research priorities and secure resources (J. Wright, 2014, personal communication, 15 August). The forum was a resource that assisted the Director when convincing management to fund research;
- Other researchers within the Flagship drew on the forum’s analysis when committing to lines of research on transport biofuels or when justifying this research (Dr T. Beer,

²² A number of related issues and uncertainties were being faced such as the potential of different feedstocks, supply/volume questions, and future supply chain arrangement uncertainties.

2014, personal communication, 14 September);

- GM Holden staff drew on the forum when justifying moves towards “energy diversification” in their product portfolio i.e. making cars powered by a range of fuel sources (R. Marshall, 2014, personal communication, 23 October); and
- The forum’s findings informed a decision to trial new fuels in Woolworth’s fleet.

Participants from governmental contexts tended to state that the forum provided less support. For example, one public servant in Victoria asserted that “the forum provided thought provoking material and a tool for analysis, but was difficult to employ as evidence in support of decision making and policy development” (, 2014, personal communication, 22 August). This public servant further stated that:

“The outputs were difficult to directly use as they were consensus based rather than demonstrably supported by rigorous evidence. While the consensus approach was effective at building buy-in from a wide range of parties, it meant that no single member of the forum was able to stand behind all of the results and made it a little more difficult to use the results as a hard-edged piece of evidence to underpin government decision making” (forum participant [non-attributable], 2014, personal communication, 22 August)

Another Victorian public servant, who asserted that the forum “didn’t have an impact”, also pointed to perceived limitations which limited decision-making utility:

“A Minister will then say ‘well, what do you want us to do?’ and that part was a little bit unclear. What did the stakeholders want? What did the forum actually suggest should be done? It was not absolutely clear what they were saying should be done. Of course, there wasn’t necessarily a consensus view in the forum on that, and that was where vested interests came to bear on the process again... It quickly became ‘so what?’, ‘what are we supposed to do with this?’ and the lack of a clear direction was challenging. What are any of the key decision-makers meant to do other than just go ‘well, there’s another problem’... getting some advice from the forum on what they should do would be better” (K. Handberg, 2014, personal communication, 28 November).

A further important outcome pattern was differing judgments regarding which scenarios developed by the forum were plausible; regarding whether, overall, a consensus on plausible scenarios was reached; and thirdly, regarding whether the right issues were focussed on. (These forum outcomes are further discussed below regarding CMOc-2, with a focus on

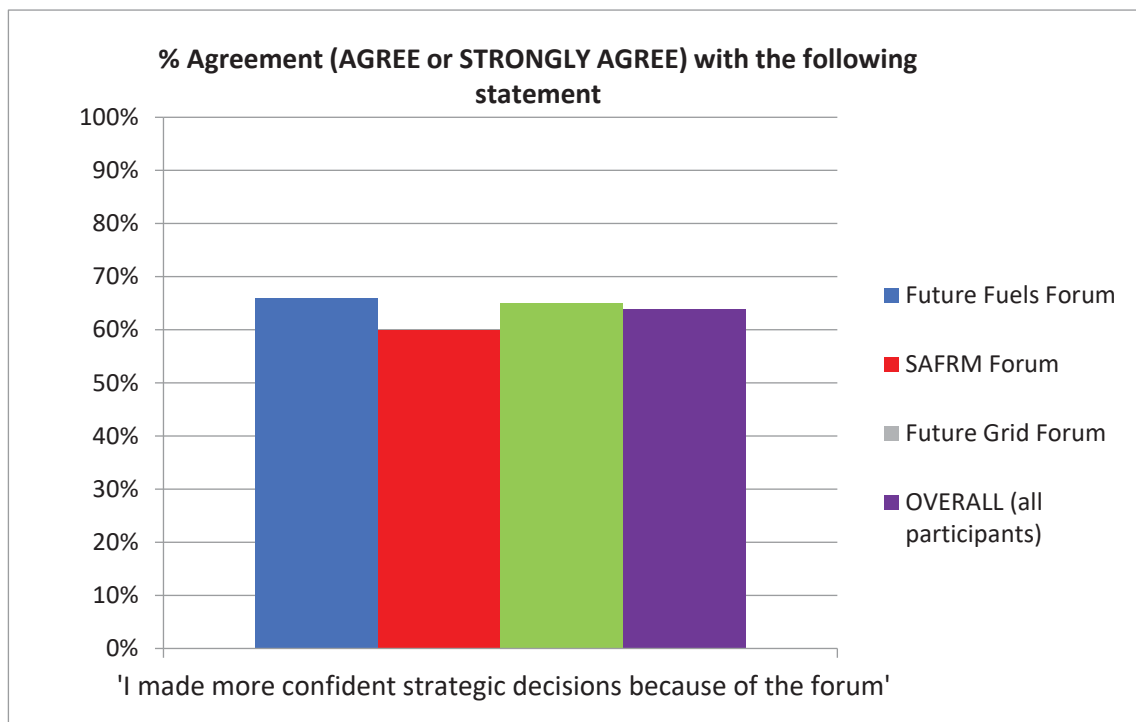
whether common understandings were enabled by the forum). The following remarks convey this pattern:

“More than half of the scenarios in the study we wouldn’t have thought were credible and didn’t fit with our view of where the world is heading” (P. Hart, 2014, personal communication, 10 October).

“I was absolutely convinced of this future diesel [fuel] problem and that got very little of the attention and publicity” (T. Beer, 2014, personal communication, 14 September).

Survey data shown in *Figure 4* below is relevant to these outcome patterns (responses from participants in other forums will be referred to below in the discussions of the other forums). Two-thirds of surveyed participants in the FFF reported more confident decision-making.

Figure 4: Decision support provided by futures forums (self-report assessment)



The Sustainable Aviation Fuel Road Map Forum outcomes

Sixty percent of surveyed participants in the Sustainable Aviation Fuel Road Map (SAFRM) Forum stated that the forum enabled more confident strategic decisions (see *Figure 4* above). The forum most strongly provided decision support to participating airlines and other aviation sector actors. Consistent with this, two-thirds of the surveyed participants who agreed that the

process enabled them to make more confident strategic decisions were from an airline or the broader aviation sector, and all participants who strongly agreed were from these sectors (specifically, from Virgin Australia, Boeing, and General Electric which is an aircraft engine manufacturer). For example, the (then) climate change manager at Virgin Australia (VA) stated that the findings made it easier to secure managerial support for a renewable fuels strategy:

“It [the final forum report] also says “it is a feasible option”, which is one key message... it basically says that it is possible and that was a big boost, obviously, and something our senior managers took note of. It was easier to sell up the chain with it” (D. White, 2015, personal communication, 1 June).

Post-forum VA developed a renewable fuels strategy and both VA and Air New Zealand signed a related Memorandum of Understanding with a local biofuel firm, Licella. Both VA and Qantas publicly committed to sourcing 5% of their fuel from ‘sustainable sources’ by 2020 (i.e. using bio-derived jetfuel). Two participating airlines, VA and Air New Zealand, focussed on the use of lignocellulosic biomass as a feedstock, consistent with the forum findings.

Other actors involved in the fuels market reported decision support. Caltex, one of two aviation fuel suppliers in Australia, decided not to focus more on sustainable aviation fuels and judged “material changes” towards them to be “some way off” (M. Ridley-Smith, 2015, personal communication, 7 May). Proponents of a biofuel production technology got greater clarity on resource limitations relevant to product commercialisation.

There is no evidence that the SAFRM forum prompted or informed capital intensive or high stakes decisions, such as major investment decisions to enable commercial production or use of alternative aviation fuel or for industry development. Some forum participants such as local airlines conducted further feasibility assessment-oriented activities, test flights, and policy advocacy. The forum also didn’t influence the policy positions of the Australian government. Consequently, commercialisation processes weren’t significantly advanced (in the Australian and New Zealand contexts) and, overall, advanced biofuel technologies remain at a mostly immature stage of development (industry informant, 2015, personal communication, 22 May; P. Graham, 2015, personal communication, 26 March).

Future Grid Forum outcomes

Many Future Grid Forum (FGF) participants from industry and the research sector stated that the forum provided credible decision support. Many participants from network businesses reported that the forum outputs were used in network planning and that it informed consideration of the evolving role of networks within the electricity supply chain. Some network businesses that didn't directly participate have also referred to the forum's findings (e.g. TransGrid 2016). Other industry participants, such as staff from energy providers such as AGL Energy and major property developer Stockland, also stated that it provided support, such as by adding "an external view to our internal company views of future scenarios" and by providing "context for various internal conversations" (J. Jarvinen, 2016, personal communication, 10 February), and by informing identification of "customer opportunities and options" through its "guidance on the future energy positions that may eventuate in Australia" (M. Napper, 2016, personal communication, 12 February). Some participants – from Telstra and a network business – stated that the forum's findings weren't given much attention and the issues weren't viewed as a strategic priority (M. Faith, 2016, personal communication, 14 February; industry informant, 2016, personal communication, 24 March).

CSIRO staff and other researchers stated that the forum provided useful resources which were used to both justify and inform research directions:

"It has provided something of a broad narrative, almost a metanarrative of possibilities, that has framed so many of the discussions and so many of the projects not necessarily in detail but it has provided the broad outline... [for example] for when we [CSIRO staff] pitched the concept [of the Network Transformation Roadmap project] off the back of the Future Grid Forum to them [Energy Networks Australia] and others essentially the whole narrative of the pitch was rooted in what had gone before in the forum" (M. Paterson, 2015, personal communication, 21 December).

"As a research leader it was valuable to provide a framework for new projects in Australia and overseas... [for example] motivation for several associated PhD projects which have produced research results in the FG [future grid] frame, I am currently working towards a related project in Hong Kong" (D. Hill, 2016, personal communication, 31 March).

Like the Future Fuels Forum, some government participants and informants questioned the relevance, and overall utility, of the analysis for policymakers:

“I have not used much of that work. It has been useful background context, among other reports and work, but I have not seen a need to quote that work in any way in anything I have been doing” (Australian Energy Regulator informant, 2016, personal communication, 20 April).

“It probably encouraged broader thinking or provided a general sense of direction but I think it had a longer-term focus than what was relevant to the policy decisions or, let’s say, the implementation decisions that we were working on... I think it was worthwhile but I don’t think it was directly applicable to the everyday work of the policy groups” (State government informant, 2016, personal communication, 18 March).

“I’m not trying to be critical at all, [but] how does this report contribute? It doesn’t... It’s primarily a modelling exercise of four scenarios but the four scenarios are meaningless from a policy perspective. It’s just four scenarios it doesn’t tell me anything about whether my policy settings are right or wrong” (Australian government agency informant, 2016, personal communication, 4 March).

Some participants did state that the FGF contributed to policy learning outcomes or that the forum provided information which was *confidently* relied upon. For example:

“I came out of it thinking that the strategic policy asks that we had were totally reasonable. I felt that I had more of a knowledge base to make the arguments that we were making” (O. Kember, 2016, personal communication, 24 March).

“The scenarios that came out of the forum were used to stimulate the guys in my investment part of the business that yep things have changed, and then to consider what are the implications of that change. In that case we’ve improved our energy and demand forecasting. This was not solely due to the Future Grid Forum, but it was a useful input. We’re now forecasting relatively flat demand for the next ten years... [Overall] it provided further confidence that we were headed in the right general direction” (industry informant, 2016, personal communication, 18 April).²³

“Leadership, framing and guidance from CSIRO was critical which is why I use the report and information to confidently rely on as a source of information for decisions” (M. Napper, 2016, personal communication, 12 February).

“I think the forum outcomes and scenarios strengthened my beliefs and assumptions” (T. Barry, 2016, personal communication, 12 February).

²³ The informant further explained – pointing to a major strategic uncertainty that was being grappled with – that “fundamentally at the time we could see that peoples’ use of electricity was changing. One of the challenges we had was considering whether that was just a temporary change or was it actually the start of something different?”

Case evidence of the mechanisms

The overall evidence – from the outcome pattern identification, survey responses and interviews with forum participants and other informants – for the firing of each mechanism is summarised in *Table 14*.

Table 14: Summary of case evidence for CMOC-1 mechanisms

Mechanism	Future Fuels Forum	SAFRM Forum	Future Grid Forum
M1: Reduction of uncertainty	<ul style="list-style-type: none"> • 66% of surveyed forum participants reported making more confident strategic decisions • The forum reproduced conflicting views on oil supply risks and related uncertainties • Some participants reported reduced perceived uncertainty • Some participants tried to leverage the results to heighten perceived uncertainty 	<ul style="list-style-type: none"> • 60% of surveyed forum participants reported making more confident strategic decisions • Generated information that reduced uncertainty e.g. about the volume potential of alternative fuels • Reinforced some commercial viability uncertainties • Some participants reported heightened uncertainty about the prospects of biofuels 	<ul style="list-style-type: none"> • 65% of surveyed forum participants reported making more confident strategic decisions • Some participants stated that the process enabled a stronger understanding of likely futures (e.g. key industry transitions, electricity demand, etc) • Many policy-relevant matters remained uncertain and contested and the longer-term outlook was uncertain
M2: Provision of resources that credibly support strategic decision-making	<ul style="list-style-type: none"> • 83% of surveyed participants agreed that the ‘forum report provided information that can support policy-making and strategic decision-making’ • 83% of surveyed participants agree that the report ‘is a credible assessment of transport fuel issues and related options’ • 66% of surveyed participants reported more confident strategic decisions • Many participants stated that the outputs provided credible support • The credibility and relevance were questioned by some governmental actors 	<ul style="list-style-type: none"> • 87% of surveyed forum participants agreed that the SAFRM study provided information that can support policy-making and strategic decision-making’ • 80% of surveyed forum participants agreed that the study ‘credibly assessed the feasibility of the Australian and New Zealand aviation sector taking up bio-derived aviation fuels’ • 60% of surveyed forum participants reported making more confident strategic decisions • Staff from local airlines stated that the outputs provided credible support for biofuels strategies (e.g. when selling “up the chain”) 	<ul style="list-style-type: none"> • 96% of surveyed forum participants agree that the ‘the forum report provided information that can support policy-making and strategic decision-making’ • 95% of surveyed forum participants agreed that the report is ‘a credible assessment of electricity grid issues, trends and future options’ • 65% of surveyed forum participants reported making more confident strategic decisions • Many industry participants used the outputs in strategic planning; less use by other actors • The relevance of the analysis was questioned by governmental actors (e.g. policy-makers)

Overall, the above evidence represents limited-moderate evidence for the mechanism of reduction of uncertainty and strong evidence for the provision of resources that can credibly support strategic decision-making with important exceptions (e.g. issues related to the utility of the outputs for policy-making and other governmental decision-making).

Assessment

Some aspects of the forum contexts, identified outcome patterns and additional case evidence (e.g. related to the firing of mechanisms) provide support for this CMOc statement. The main exceptions were governmental participants for whom the assumed context was often less salient (especially **C1**) and in which participants often reported less decision support. The strongest evidence for the firing of mechanisms was for **M2**; however, case evidence also pointed to other important contextual factors and causal processes that influence whether, and how, the futures forums support strategic decision-making (**M2**) and which influence the perceived credibility of the forum outputs (also see **M2**). These contextual factors and causal processes are further discussed later in this thesis.

4.2.2 CMOc-2: Reduction of inertia in the context of a major destabilising 'structural break'

CMOc statement summary

This CMOc statement theorises reduced inertia related to new technological pathways in the context of a major threat – an 'existential threat' (**C2**) – which emerged in relation to a destabilising discontinuity (**C4**).²⁴ Three core mechanisms are expected to contribute to reduced inertia: 1) critical reflection on actors' assumptions and beliefs (**M3**); 2) creation of common understandings (**M4**); and 3) forum participation as an affecting experience (**M8**).

Forum contexts

The three forums differed with respect to what extent the existence (or perception) of existential threat(s) motivated participation. The forums also differed with respect to whether such threat(s) were *current* major issues (related to discontinuities) or potential future issues.

²⁴ An existential threat was broadly defined as an emerging issue or current problem that – if not addressed – could lead to major crises and/or the demise of the organisation.

In the Future Fuels Forum (FFF) the main organisation that was plausibly motivated, in part, by a sense on existential threat was GM Holden due to the impact of rising and more volatile oil prices on vehicle preferences and travel behaviour (C2, C4).²⁵ State government participants were also, in part, motivated by emerging issues (C4) in the automotive industry (K. Handberg, 2014, personal communication, 28 November). In contrast, some participants were motivated by a sense of *opportunity*, in particular those promoting alternative fuels and electric vehicle technologies. Other industry participants wanted to manage issues associated with fuel costs but these issues were largely not major business model threats.

During the previous few years prior to the SAFRM Forum the aviation sector had begun to address issues which could potentially *become* an 'existential threat' (C2).²⁶ In 2010-11 there appeared to be less sense of immediate crisis but, over the medium-long run, there remained few feasible options to significantly reduce the greenhouse gas emissions generated by air travel. This could become an existential threat depending on level of carbon constraints and whether low carbon fuel options are affordable. Over half of the participants were from local airlines and aviation sector (e.g. airframe and aircraft engine manufacturers). Like the Future Fuels Forum some participants were motivated by potential opportunities such as those who were promoting possible alternative fuels. Others from the fuels sector and from government were also interested in checking their understanding of low-carbon fuel options and exploring potential industry development opportunities.

The Future Grid Forum occurred in the context of emerging debates about threats to the business models of incumbent players in the electricity sector (C2, C4). The way one CSIRO staff member put it in 2014 was that "talk in the industry is "networks are dead"; or there's the talk of "death spirals" (P. Graham, 2014, personal communication, 2 June). The "death spiral" discourse expanded during the forum and in the immediate period following the forum (e.g. Denning 2013; Wood 2013a). Related trends included declining electricity consumption (Pears 2013; Wood & Carter 2013), uptake of household solar power, rising electricity prices (Wood 2013b), and increasing focus on customer participation (Australian Energy Market

²⁵ However, also note that GM Holden's main forum delegate stated that this wasn't their main motivation for participating (R. Marshall, 2014, personal communication, 23 October).

²⁶ In 2008, some in the aviation industry argued that the industry faced a "crisis situation" due to "the recent shocking surge in the price of fuel, the increase in environmental concerns, combined with the current economic downturn" (International Air Transport Association 2008, p. 1).

Commission 2012), amongst other changes. However, consistent with the other two forums, only a segment of forum participants could be said to be motivated by a sense of ‘existential threat’. These trends potentially presented opportunities for others. Additionally, participants from government, NGOs and research organisations attended for diverse reasons.

Evidence of outcome patterns and the operation/firing of mechanisms

Future Fuels Forum outcomes

The Future Fuels Forum (FFF) made a limited contribution to reducing inertia particularly with respect to industry participants who were most directly impacted by current events (e.g. volatile oil prices). Government participants and peak oil activists stated that the process didn’t influence government policy; however, the forum did inform small-scale experimentation and policy decisions such as the Victorian government-funded electric vehicle and electric bus trials (K. Handberg, 2014, personal communication, 28 November).

Participant assessments of such impacts indicate that inertia reduction was often related to learning outcomes which *reinforced* current views (rather than challenging assumptions), e.g.:

“The report and process reinforced our thinking on alternate fuels and helped build internal consensus on trialling new fuels for our fleet [at Woolworths]” (A. Booth, 2014, personal communication, 29 September).

“From our perspective [at GM Holden] the findings weren’t exactly new news ... [and] the company was already on a pathway and had decided that the future of this was essentially one of diversification... it added credibility to the diversification agenda” (R. Marshall, 2014, personal communication, 23 October).

“If anything, the way the Future Fuels Forum impacted my own thinking was on the need to be a little bit better prepared for such an eventuality [possible worst-case scenarios where liquid fuel supply is disrupted] ... [overall] it confirmed the direction that we [the Flagship] thought the transport fuels situation should go” (J. Wright, 2014, personal communication, 25 August).

Similarly, CSIRO staff who were working on, or were in favour of, alternative fuels research stated that the process increased their concerns about fuel security and – linked with this – increased their commitment to this research (e.g. J. Wright, 2014 personal communication, 25 August; D. O’Connell, 2014, personal communication, 4 September). For example, the then

Director of the CSIRO Energy Transformed Flagship stated that “I always did have a concern that whenever government talked about Australia and transport fuels they were not giving it the weight that I thought it should have” and that the forum “made me realise ... just how fragile we are” (J. Wright, 2014 personal communication, 25 August). This concern informed subsequent efforts to fund and develop their alternative fuels research.

The extent to which the forum reached consensus was often questioned by participants, particularly regarding what future scenarios are plausible (as was noted earlier). Further examples of participant comments regarding this outcome are presented below:

“The fast decline peak oil scenario coupled with a slow uptake of alternatives, that’s the sort of scenario that I think is quite probable but it doesn’t get the weighting it might have... I don’t particularly believe in biofuels saving the day but it is there as a scenario” (B. Robinson, 2014, personal communication, 23 October).

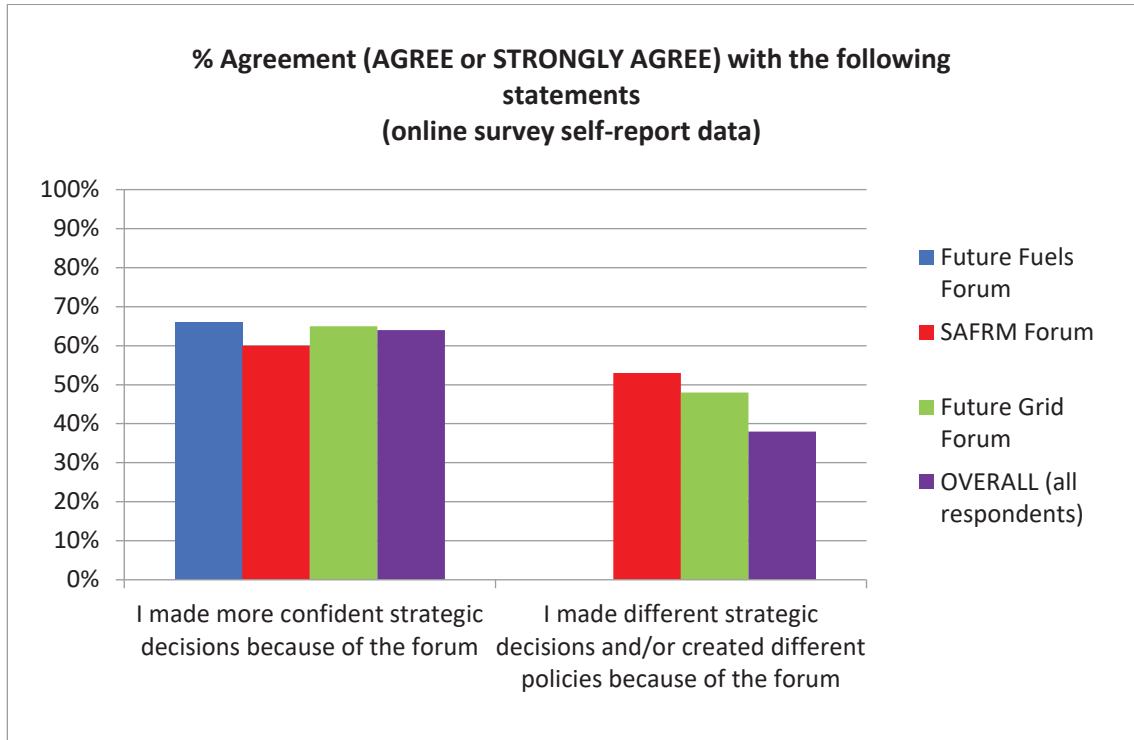
“A Minister will then say ‘well, what do you want us to do?’ and that part was a little bit unclear. What did the stakeholders want? What did the forum actually suggest should be done? It was not absolutely clear what they were saying should be done. Of course there wasn’t necessarily a consensus view in the forum on that, and that was where vested interests came to bear on the process again...” (K. Handberg, 2014, personal communication, 28 November).

There is some evidence – when considering the agreed text in the FFF report and spokesperson remarks (e.g. at the report launch event) – that the forum resulted in a shared understanding that there is a “justifiable argument for increased Australian government intervention” (CSIRO 2008a, p. 29). Many participants were already of this view (e.g. alternative fuel advocates and producers who sought greater and/or ongoing government support) but it was plausibly strengthened by the forum. The forum report and divergent policy positions held post-forum by participants (e.g. regarding the potential introduction of mandatory vehicle standards) also indicate that there was little agreement amongst participants regarding what specific interventions *should* be made.

Finally, decision-making patterns are relevant to whether inertia was reduced. As discussed in the previous section, and shown in *Figure 5* below, approximately two-thirds of surveyed participants stated that they made more confident strategic decisions because of the Future Fuels Forum (similar to the total percentage). In some instances, this contributed to reduced inertia (e.g. by enabling decision-making related to trialling alternative fuels and/or new

technologies). However, in others *different* decisions may have been necessary. No surveyed participant in the FFF stated that they made different decisions or created different policies because of the forum. This was a significantly different to the other forums (see *Figure 5*).

Figure 5: Self-reported impact of the futures forums on decision-making and policy-making



Sustainable Aviation Fuel Road Map Forum outcomes

There is also limited evidence that the Sustainable Aviation Fuel Road Map (SAFRM) Forum contributed to reduced inertia. Post-forum further initiatives did occur which sought to contribute to the production and use of aviation biofuel; however, there was limited change in core positions and actions of actors. Local airlines continued to argue that their core role is signalling demand and being “ready to buy the product when it’s available” (P. Graham, 2015, personal communication, 26 March). The Australian Government didn’t provide the support the airlines sought and, aside from its introduction of carbon pricing, adopted a minimally interventionist approach (Australian Government 2011b; Ferguson 2012).²⁷ No other actors

²⁷ David White from Virgin Australia (at the time of the forum) put this as follows: “we were going to need good robust [government] policy relating to this... This turned about to be a bit wanting, in what subsequently happened, to say the least” (D. White, 2015, personal communication, 1 June). White further noted that “there was a recommendation [in the roadmap produced by the forum] about government getting more involved with policy and support which never really happened.”

made major new commitments to aviation biofuel production and/or use, other than supporting small follow-up research projects or conducting further exploratory or feasibility assessment style projects. The forum Chair (Paul Graham from CSIRO) put this as follow: “the thing that was never agreed and resolved was essentially who has to put their neck out first” (P. Graham, 2015, personal communication, 26 March).

Many SAFRM forum participants (nearly three-quarters of surveyed participants) reported that the process challenged their assumptions and/or beliefs. A participating CSIRO scientist stated their analysis of the biofuel options, such as different feedstocks and fuel production technologies and processes, challenged the views of staff from participating airlines. In particular algal fuels were widely viewed as a highly promising *near-term* solution at the time of the forum (also see Darzins, Pienkos & Edye 2010; Edye 2015) and CSIRO scientists challenged this view, arguing instead that lignocellulosic feedstocks should be prioritised. Related to this an airline delegate from Virgin Australia Airlines stated that:

“A prime example [of the outcomes/impact] was the analysis on feedstocks and the outcome that lignocellulosic based feedstocks provided the required volumes to satisfy airline demand. It noted the difficulties with conversion but highlighted the research occurring in the area. This influenced Virgin’s strategy and we concentrated our efforts on projects producing these feedstocks and corresponding conversion technologies” (D. White, 2015, personal communication, 17 April).

Some participants’ views were challenged in other ways, such as challenging their positive expectations of the feasibility of using biofuels in aviation (A. Verdier, 2015, personal communication, 10 April), and pointing to problems with some biofuel technologies that forum participants were promoting such as those requiring biological oil feedstocks (S. Lupton, 2015, personal communication, 10 April). These impacts may have *reinforced* inertia.

Further outcome patterns are related to whether the process enabled the convergence of opinion. Some aviation sector participants reported greater alignment (N. Williamson, 2015, personal communication, 26 May). However, a contrasting outcome pattern is reinforcing conflicting views. The following statements convey this outcome:

“It [the SAFRM forum report] basically says that it is possible and that was a big boost, obviously, and something our senior managers took note of... yep this is possible.

There are challenges to overcome still but, you know, we can do it” (D. White, 2015, personal communication, 1 June).

“It gave confidence to promote biofuels as a viable alternative to fossil fuels. I already had a belief in biofuels for the aviation industry but the study reinforced those beliefs” (R. Stanier, 2015, personal communication, 11 April).

“Ultimately at the time the challenges did not warrant Caltex devoting great energy towards this type of fuel... To some extent the report confirmed Caltex's internal position that material changes towards sustainable aviation fuel were still some way off” (M. Ridley-Smith, 2015, personal communication, 7 May).

“I could not with certainty advocate a government action as the outcome was still too uncertain even with Government's involvement. I attended with a strong belief that bio-derived aviation fuels were a possibility and the results of the forum deeply challenged that perception” (A. Verdier, 2015, personal communication, 10 April).

Future Grid Forum outcomes

Like the other forums the Future Grid Forum provides limited support for CMOc-2. There is evidence that this forum made a limited contribution to reducing inertia particularly with respect to industry participants. Similar to the Future Fuels Forum, the majority of surveyed forum participants stated that the forum *reinforced* their pre-existing views. Tangible changes towards the adoption of new technology pathways include the following:

- Further work by Energy Networks Australia (ENA) in partnership with CSIRO exploring network transformation options for the 2017-2027 period;²⁸
- Subsequent networking planning and strategy work done by network businesses (multiple staff from these businesses stated that the forum’s analysis was used);²⁹
- Additional focus by Stockland on distributed electricity generation such as the inclusion of large solar arrays in major property developments; and
- Further interest in cost-reflective electricity pricing and related behavioural economics research. The forum Chair from CSIRO argued that the forum “added to the wave of

²⁸ See <http://www.energynetworks.com.au/electricity-network-transformation-roadmap> (last viewed 20/06/2016). This outcome was somewhat fortuitous in that ENA joined the forum late in the process (they attended the last few meetings), which contributed to a substantial follow-up project.

²⁹ For example, Stephen Hunt from Citipower & Powercor stated that “Our organization has over the last 18 months explored in depth the transition in the energy economy and what changes we need to make to adapt and remain competitive and in doing so considered a range of aspects and methodologies, some of these leveraging off the data and scenario aspects presented by the Future Grid Forum” (S. Hunt, 2016, personal communication, 15 February).

the focus on that topic” (M. Paterson, 2015, personal communication, 21 December).

Perceived learning outcomes are also relevant to this CMOc statement. A minority of surveyed forum participants (39%) stated that the forum challenged their assumptions/beliefs. For example, a public servant stated that “the range of views and potential developments, especially in relation to renewables and potential for consumers to leave grid, challenged traditional views of the power system” (A. Millis, 2016, personal communication, 17 February). Similarly, the CEO of ENA stated that the outputs were used “to discuss broad energy futures, [including] the diverse role of centralised and decentralised energy” (J. Bradley, 2016, personal communication, 16 February). The following comments are representative of those made by other participants such as those who stated that the process *didn’t* challenge their beliefs:

“It did more to confirm my beliefs rather than challenge them” (J. Jarvinen, 2016, personal communication, 10 February).

“In my role most of the issues identified [by the Future Grid Forum] I had seen via the continual environment scanning I undertake” (P. Wilson, 2016, personal communication, 4 February).

“I had also been thinking deeply about the issues for some time, and the FGF provided a forum and opportunity to debate these more generally, but probably did not change my perspectives greatly” (C. Popple, 2016, personal communication, 20 April).

Similarly, some participants further stated that the forum report and findings “aligned to current industry discussions and thinking regarding what the future may hold” (T. Barry, 2016, personal communication, 12 February), were “generally aligned with prevailing strategic thinking in SA Power Networks” (B. Williams, 2016, personal communication, 12 February), and “primary pulled together existing thoughts and opinions and helped order those” (A.J. van Vuuren, 2016, personal communication 12 February). Others felt that the process and report was “futuristic” (Dr I. Rose, 2016, personal communication, 15 February) and the “first real attempt to tell the whole story, across the sector” (A. Millis, 2016, personal communication, 17 February).

Some comments made by industry participants from the electricity networks sector pointed to barriers to sustained changes to expectations and deep cognitive change:

“The issue is that they [network businesses and executives] are very network-centric

and focussed because of the fact that back then and even now they don't believe that someone else is going to go build another electricity network. The basic view is that solar panels are great but you're not going to get all your electricity from them, and batteries are still in their early days, there may be some great stuff occurring but they're not there yet. They're basically seeing the future in black and white terms and customers will always want to be connected as the only reliable source of power" (industry informant, 2016, personal communication, 24 March).

"We've [subsequently] done a lot more work on that [the prospect of many customers leaving the grid] which would suggest that that's a lot harder and a lot less likely than was envisaged [by the forum], at least over the medium-term" (C. Popple, 2016, personal communication, 22 April)

Like the SAFRM forum, there were divergent views on whether the process enabled shared understanding or the convergence of opinion. Many industry participants stated that an important outcome was "the like-mindedness that came out of the process" (B. Waters, 2016, personal communication, 29 January) and argued that the forum "promoted constructive consensus-building" (J. Bradley, 2016, personal communication, 16 February). The following statements provide contrasting views on whether the process led to common views, whether this is achievable in practice, and associated challenges³⁰:

"It was amazing that over the months people came to a more common view and had respect for each other's viewpoints. No one was then arguing that the changes aren't going to happen, we were talking about how to handle it best" (B. Waters, 2016, personal communication, 29 January).

"It was recognised that there were diverse views and that no process like this Future Grid Forum one would be able to get agreement" (C. Popple, 2016, personal communication, 22 April).

"It is valuable to get the industry talking to each other... [but] the industry does not decide the future through consensus" (Government informant, 2016, personal communication, 3 February).

Finally, whilst few participant comments on the process and its impact are indicative of it being an affecting experience, for some participants (particularly from network businesses) it

³⁰ Comments were also made about the challenge of maintaining alignment: "I felt like there was a lot of alignment and excitement coming out of this and it's hard to maintain that afterwards. I know there are some follow-up activities happening with the Energy Networks Association which is great. It's just hard..." (A. Denis, 2016, personal communication, 15 March).

emphasised risks and issues facing some players in the electricity sector:

“It raised some scenarios which you force yourself to look at and to think about whether they’re realistic... just having it there to work with has probably forced me to think about things I might not have thought about otherwise... [For example] some of the Future Grid Forum scenarios have a pretty significant proportion of customers leaving the grid” (C. Popple, 2016, personal communication, 22 April).

“The document was a single view of the industry, which would serve as a great help to public policy makers. It also helped identify risks and mitigation options... underpinned by scenarios that could be easily understood and imagined – it made the issues real” (A.J. van Vuuren, 2016, personal communication 12 February).

“The Future Grid Forum also provided the opportunity to inform various stakeholders on the challenges likely to be experienced by the electricity value chain over coming years” (S. Bell, 2016, personal communication, 3 February).

Case evidence of the mechanisms

The evidence – from outcome identification, survey responses and interviews with forum participants and informants – for the firing of each mechanism is summarised in below:

Table 15: Summary of case evidence for CMOc-2 mechanisms

Mechanism	Future Fuels Forum	SAFRM Forum	Future Grid Forum
M3: Critical reflection on actors’ assumptions and beliefs	<ul style="list-style-type: none"> Minority of surveyed participants (33%) stated that the forum challenged their assumptions/beliefs No surveyed forum participants stated that they ‘made different strategic decisions and/or created different policies’ because of the forum 	<ul style="list-style-type: none"> Majority of surveyed participants (73%) stated that the forum challenged their assumptions/beliefs Half (53%) of surveyed forum participants stated that they ‘made different strategic decisions and/or created different policies’ because of the forum Core beliefs not altered (e.g. commercialisation pathways, policy beliefs) 	<ul style="list-style-type: none"> Minority of surveyed participants (39%) stated that the forum challenged their assumptions/beliefs Half (48%) of surveyed forum participants stated that they ‘made different strategic decisions and/or created different policies’ because of the forum
M8: Participation an affecting experience	<ul style="list-style-type: none"> Some participants stated that process amplified their concerns about fuel supply risks See above survey data on decision-making 	<ul style="list-style-type: none"> No interview data indicates that the process was an ‘affecting experience’ See above survey data on decision-making 	<ul style="list-style-type: none"> Some industry participants stated that ‘off-grid’ movement projections forced them to reassess their views and/or strategies See above survey data on decision-making

M4: Creation of common understandings	<ul style="list-style-type: none"> • Different ‘factions’ within forum, e.g. regarding fuel peak oil/fuel constraints; differences remained • Some agreement reached (on justification for more government intervention) 	<ul style="list-style-type: none"> • Self-report data indicates that the process reinforced some conflicting views • Airlines/aviation sector participants reported more alignment 	<ul style="list-style-type: none"> • Some industry participants argued process enabled shared understanding; others disputed the extent to which this occurred
--	--	--	---

The above evidence represents low-moderate evidence that forum participation led to critical reflection on actors’ assumptions and beliefs; limited evidence that participation was an affecting experience; and low-moderate evidence that the forums enabled shared understanding (lowest for the Future Fuels Forum, moderate for Future Grid Forum). The lower percent of surveyed forum participants who agreed that they ‘made different strategic decisions and/or created different policies’ because of the futures forum they participated in – compared to those who stated that they made more confident decisions (see *Figure 5* above) – is also indicative of moderate impact on inertia.

Assessment

Overall, there is some evidence that the futures forums contributed to reduced inertia amongst those participants who were grappling with major current and/or emerging challenges (though assessment of whether such challenges constituted an ‘existential threat’ is somewhat subjective). The strongest evidence for this CMOc statement is the identified outcomes of the Future Grid Forum – see the subsequent actions that were noted by electricity network actors – in which there perhaps was the strongest existential threat (**C2**) and discontinuities (**C1**). However, there was mixed evidence for the mechanisms hypothesised to cause this. For example, in two forums there is more evidence that inertia was reduced by *reinforcing* participants’ existing beliefs, not challenging their assumptions and/or beliefs (**M4**), a key finding which is further considered in Chapter 8. Additionally, there was limited evidence for the other two mechanisms (**M3** and **M8**).

The limited evidence for this proposition may be also related to contextual factors. Many forum participants were motivated by potential opportunities (not existential threats) or were dealing with general strategic or policy-making matters (not resolving business model threats). This, in turn, suggests that other intervention theories are needed for such contexts.

4.2.3 CMOc-3: Enhanced coordination and coalition formation in the context of collective action problems

CMOc statement summary

This CMOc statement emphasises the envisaged contribution of a participatory process (the futures forum process) to new joint actions for advancing desired pathway(s) that address a collective action problem (C5). Three mechanisms were proposed to explain why: 1) enhanced coordination (M7); 2) creation of common understandings (M4); and 3) diffusion of ideas (M5).

Forum contexts

Awareness of, and/or concern about, a collective action problem was not a major feature of the context for most forums and for most participants it was not a strong motivator. The main, but partial, exception was the SAFRM forum (as outlined below).

Whilst the development and commercialisation of alternative transport fuels can be partly viewed as a collective action problem (C5) – and it was viewed as such by a limited number of forum participants (Reuss 2008; Wright 2008) – few participants in the Future Fuels Forum emphasised this aspect of the context nor related goals. There were two partial exceptions: (i) the participant promoting gas-to-liquids (GTL) fuels – Sasol Chevron – who saw the forum as a means of “planting the seed [the idea of GTL fuels] in potential stakeholders’ minds”, given they believed that commercialisation could only occur on what they termed a “strategic basis” via the support of government and other industry actors (E. van der Wateren, 2014, personal communication, 30 October); and (ii) change advocates – such as the participating NGOs and activists - who were actively exploring the potential for alliance building.

Awareness of, and/or concern about, collective action problems is suggested by the fact that a significant percent of the funding for the SAFRM forum came from a collaborative initiative (the Australian arm of the Sustainable Aviation Fuel Users Group) and by the strong focus on value chain creation (C5). However, there was limited commitment to deep and sustained

multi-stakeholder collaboration to address such problems.³¹ Most participants had a range of motivations for participating in the forum only one of which was, in some cases, enabling coordinated action to address a shared collective action problem.

The context in which the Future Grid Forum was held did not explicitly feature major collective action problems motivating forum participation (C5), though the need for a ‘whole-of-system’ view and related options was emphasised by the forum organisers (CSIRO 2012). However, within different parts of the electricity sector (e.g. parts of the supply chain) there was some coordinated action such as amongst transmission sector or distribution players.

Evidence of outcome patterns and the operation/firing of mechanisms

Future Fuels Forum outcomes

The Future Fuels Forum (FFF) contributed to collaboration between some groups that held similar views about the importance of alternative fuels and/or about peak oil. For example, the process contributed to collaboration between the Australian Conservation Foundation (ACF) and NRMA (National Roads and Motorists' Association) and between groups of actors campaigning for more focus on ‘liquid fuel security’ (E.g. the Association for the Study of Peak Oil & Gas, Biofuels Association of Australia, and ACF). A related effect was that Monica Richter’s role as a FFF spokesperson (Richter was ACF’s delegate), and the greater exposure this provided, “assisted us with identifying people who supported our position and we could [then] go and prosecute the case with them” (M. Richter, 2014, personal communication, 13 October). Richter also argued that “the outcomes [of the forum] were pretty well aligned with what we were in general trying to advocate”. Beyond these examples there is little evidence for this CMOc statement. This may, in part, be because of the strong differences of opinion amongst participants which weren’t significantly altered (see the other CMOc statements) as well as the limited focus of attendees on collective action problems.

³¹ For example, some key participants from the aviation sector were keen to see other actors take the lead, in particular government, and defined their roles as more minor (R. Chamberlain, 2015, personal communication, 9 April; P. Graham, 2015, personal communication, 26 March). Additionally, many interviewees emphasised the very high level of competition that also existed between some of the participants (e.g. between local airlines in the Australian market). This assessment of the context is also supported by the limited resources committed to a subsequent project, the Australian Initiative for Sustainable Aviation Fuels (S. Pond, 2015, personal communication, 23 June).

Sustainable Aviation Fuel Road Map Forum outcomes

The collaborative initiatives that the *Sustainable Aviation Fuel Road Map* (SAFRM) forum contributed to – such as the Australian Initiative for Sustainable Aviation Fuels (AISAF), Brisbane “bioport” initiative and collaborations between CSIRO and Boeing – are prima facie evidence that the SAFRM forum enabled collective action. Closer inspection revealed limitations. For example, AISAF was created by a biofuel advocate who didn’t participate in the SAFRM forum and initiated AISAF for largely separate reasons (S. Pond, 2015, personal communication, 26 May).³² The level of commitment to the resulting roadmap also varied and was questioned by some participants, as indicated by the following statements:

“The SAF [sustainable aviation fuel] roadmap ... was an important step in bringing all interested parties together to develop pull together a single view on where the industry was going” (N. Williamson, 2015, personal communication, 26 May).

“Yeah... [pause] that timeline [of future actions in the roadmap]. I never really... [pause] I always thought it was something that gave potential indicators but without overarching guidance or alignment, like from government for instance... I suppose, I suppose it would be natural that ASAFUG [the Australian arm of the Sustainable Aviation Fuels Users Group] used those timelines but, again, it was always going to be tough” (D. White, 2015, personal communication, 1 June).

“There are elements of it [the roadmap] that Caltex would be comfortable with, there are elements that you question. I think that would be the same for everybody that’s involved” (M. Ridley-Smith, 2015, personal communication, 20 July).

“At the end of the day CSIRO did a lot of that work [i.e. writing of the roadmap and the underpinning research]... we were a sponsor of it and didn’t have significant scientific input” (R. Boyd, 2015, personal communication, 25 June).

“The current [biofuel] producers would say ‘OK, great, let’s get back to talking about the real world’. I think that reflects the focus of some Board members [of the Biofuels Association of Australia] who were focussed on their [current] business and their business only” (H. Bone [Brodie], 2015, personal communication, 29 May).

³² Pond stated that AISAF was primarily created to help with implementing the Memorandum of Understanding signed by the US and the Australian Government (via Department of Resources, Energy and Tourism) to work collaboratively on alternative sustainable aviation fuels. The MoU was signed in September 2011 (a few months after the SAFRM report was published). AISAF was modelled on the *Commercial Aviation Alternative Fuels* Initiative (CAAFI) in the United States, whom Pond had held discussions with through her work at the US Studies Centre. AISAF “intended to use the information out of the roadmap to implement the MoU” (S. Pond, 2015, personal communication, 23 June).

Additionally, as was outlined with respect to CMOc-2, outcomes reported by participants indicate that some conflicting views were reinforced (rather than enabling a broader consensus).

A final key outcome pattern was that the coalitions and collaborations were largely short-lived and, ultimately, not impactful in terms of accelerating the production of alternative fuels and/or industry development.³³ For example, AISAF was wound-up after two years. The Chair of AISAF argued that it never had adequate funding nor sufficient organisational commitment to achieve its goals (S. Pond, 2015, personal communication, 23 June).

Future Grid Forum outcomes

The main identified form of post-Future Grid Forum (FGF) collaboration was the new research partnership between Energy Networks Australia (ENA), the peak industry body representing gas distribution and electricity transmission and distribution businesses, and CSIRO. This partnership resulted in the Network Transformation Roadmap project.³⁴ This could be interpreted as evidence supporting this CMOc statement. However, like the SAFRM forum, there are divergent participant reports regarding related hypothesised mechanisms. As was outlined with respect to CMOc-2, outcomes reported by FGF participants indicate that some believe that the process contributed to common understanding and coordinated action within parts of the electricity industry. Others argued delegates continued to have diverse views on contentious issues such as whether network asset values should be written-down.

Case evidence of the mechanisms

The overall case evidence – from outcome identification, survey responses and interviews with forum participants and informants – for the firing of each mechanism is summarised below:

³³ Recent events may be indicative of renewed efforts and future change. Most recently, in October 2017 the Queensland Government announced a new biofuel trial in collaboration with Virgin Australia and exploration of the potential to use sugar as a biofuel feedstock and alcohol-to-jetfuel technologies for local fuel production in Queensland (in contrast to the SAFRM Forum’s emphasis on lignocellulosic feedstocks and related fuel production methods). Over the 2016-17 period two participating airlines, Virgin Australia and Air New Zealand, also attempted to jointly promote industry development by signalling demand for locally-produced biofuels via a Request for Information (RFI) process.

³⁴ The Network Transformation Roadmap project is led by ENA and CSIRO and involves “collaboration with consumer representatives, service and technology providers, policy makers, regulators, and academia” (Energy Networks Association & CSIRO 2015). Thus, this follow-up initiative seeks to facilitate further stakeholder interaction.

Table 16: Summary of case evidence for CMOc-3 mechanisms

Mechanism	Future Fuels Forum	SAFRM Forum	Future Grid Forum
M7: Enhanced coordination	<ul style="list-style-type: none"> • Process enabled some advocates of alternative fuels/transport options to identify new allies 	<ul style="list-style-type: none"> • Some further cooperation post-forum but typically not lasting or new coalitions • Process contributed to the development of social networks related to aviation biofuel development 	<ul style="list-style-type: none"> • Process surfaced and clarified actors' expectations but didn't promote joint action (aside from partnership between ENA and CSIRO)
M4: Creation of common understandings	<ul style="list-style-type: none"> • Some agreement reached e.g. justification for government intervention • Divergent views on most issues (e.g. peak oil) and policy options remained 	<ul style="list-style-type: none"> • Airlines/aviation sector participants reported enhanced alignment • Beyond the aviation sector the evidence suggests that the process reinforced conflicting views • Participants had differing views on commercialisation pathways/priorities 	<ul style="list-style-type: none"> • Some industry participants argued process enabled shared understanding; others disputed the extent to which this occurred • Forum Chair (from CSIRO) argued that the process enabled the industry to confront together key industry changes
M5: Diffusion of ideas	<ul style="list-style-type: none"> • Some participants viewed and used process as a way of "getting up-to-speed" • Attempted by some participants (e.g. by advocates of alternative fuels) but little evidence it was achieved 	<ul style="list-style-type: none"> • Aviation biofuels supporters were, mostly, already supportive pre-forum • Some diffusion of the concept in Australian aviation sector and policy communities 	<ul style="list-style-type: none"> • Process may have helped CSIRO Energy to spread its ideas (about smarter, more efficient and more distributed grids) • Some participants (e.g. from NGOs) sought to convince other attendees of their ideas/views • Many attendees stated that the forum reinforced their existing ideas

Assessment

The case provided limited evidence of coalition formation and/or enhanced coordination post-forum, mainly over the short-term. Contextual factors appear to be a factor, given that only in a limited number of cases was futures forum participation motivated by awareness of – and/or strong concern about – a collective action problem (C5). In some instances, this may be an interpretative error, such as with respect to the challenges that need to be overcome to commercialise aviation biofuels. The extent to which the futures forums produced greater

agreement or alignment amongst its participants was widely questioned and some disagreements were reinforced (see **M4**). Similarly, there is limited supporting evidence of enhanced coordination and diffusion of ideas (**M5, M7**). Thus, overall, there is limited supporting evidence for this CMOc statement.

4.2.4 CMOc-4: Providing a safe space which enables informal dispute resolution in the context of conflict/contention

CMOc statement overview

This CMOc statement posits that conflict and/or contentious issues related to possible (energy) transitions (**C3**) can be resolved through an independent and scientifically-credible process. One key mechanism is proposed to explain why: informal dispute resolution (**M6**).

Forum contexts

This CMOc statement assumes that major debates and controversies surrounding problems related to energy use and Australia's future energy mix are an important part of the context. Two out of three futures forums occurred in the context of moderate to significant contention:

The Future Fuels Forum occurred in the context of increasing contention and debate (**C3**) regarding rising oil prices, the potential peaking of oil production, and the viability of local industries in the automotive and oil refining sectors (Bracks 2008; Heinberg 2005; Senate Standing Committee on Rural and Regional Affairs and Transport 2007). 'Food versus fuel' debates had also emerged in response to the use of first-generation biofuels.

Fewer debates related to potential bio-jetfuel production and use shaped the context of the SAFRM forum. The merits of biofuels were debated ranging from commercial viability aspects through to potential environmental impacts. The potential for competition with other transport modes – i.e. competition between the road and air transport sectors for biofuel supplies – was also an emerging issue.

The Future Grid Forum was convened at a time when there was significant and growing contention (**C3**) regarding electricity prices, alleged "gold plating" of electricity networks, regulatory frameworks and industry challenges that might result in so-called "death spiral"

outcomes for industry incumbents (e.g. Sandiford 2012; Select Committee on Electricity Prices 2012; West 2012; Wood 2013a). There was also significant debate about the Clean Energy Future Legislative Package, in particular the carbon price which had come into effect two months prior to the forum.

Evidence of outcome patterns and the operation/firing of mechanisms

Future Fuels Forum outcomes

There is evidence that the Future Fuels Forum (FFF) helped to enable informed discussion about contentious fuel production/use issues and related policy challenges. For example, “food versus fuel” issues were discussed. The final report addressed concerns about the impacts of biofuels on food production and stated that second-generation biofuels are “expected to reduce the pressure biofuel production places on the food market” (CSIRO 2008a, p. 27). The report also put important dilemmas on the table such as regarding approaches to government intervention and public policy (such as the pros and cons of a “picking winners” approach or market-based instruments) but the forum didn’t aim to resolve these dilemmas nor recommend a preferred approach.

However, there is little or no evidence that the forum helped to *resolve* controversial debates or political disputes (e.g. about policy options for reducing transport-related emissions). An important example was conflicting views on peak oil. For example, a participating peak oil activist argued that the forum “challenged everyone else’s assumptions but not mine” (B. Robinson, 2014, personal communication, 23 October), whereas another participant involved in transport planning who had “always been sceptical about peak oil” stated that they left the FFF with much less concern about peak oil (C. Mottram, 2014, personal communication, 10 October). Post-process, peak oil activists emphasised the peak oil scenarios explored by the forum, whereas others mostly ignored those scenarios. Linked with this a government participant stated that officials dismissed this analysis:

“So, some of the scenarios that ended up being explored were reflecting some of those extreme views that particular groups held... As it stood, it was [perceived as] ‘well that’s just the views of that group’. It has no weight we can’t produce any evidence or analysis that proves that it’s the right thing to be using” (Government informant [non-attributable], 2014, personal communication, 17 October).

The identified forum outcomes suggest that the forums can both reinforce disputes and can themselves be controversial. Some participants expressed concerns that, on reflection, some attendees (e.g. peak oil activists) had a disproportionate influence on the process and that the policy positions of attendees constrained the scenario analysis.

Sustainable Aviation Fuel Road Map Forum outcomes

Debates related to the future production and use of alternative aviation fuels were not significantly resolved by the Sustainable Aviation Fuel Road Map (SAFRM) Forum. Many participants argued that contentious issues remained a source of misunderstanding or conflict at the end of the process, including taxation arrangements for different fuels, fuel distribution infrastructure access, and the role of government in bio-jetfuel development (H. Bone [Brodie], 2015, personal communication, 29 May; D. O’Connell, 2015, personal communication, 25 June). Commercialisation pathways also remained uncertain and conflictual, with differing views on the appropriateness of focussing on securing government support (e.g. via subsidies). The project leader put this as follows:

“There were various times when people in the room put pressure on some players, especially the airlines, to do something like that [to make commitments related to advancing industry development and biofuel production] but the airlines rebuffed them every time. They were fairly consistent in saying that they wouldn’t make commitments like that. The thing that was never agreed and resolved was essentially who has to put their neck out first” (P. Graham, 2015, personal communication, 26 March).

As noted above (regarding CMOc-3) there is evidence that the SAFRM forum reinforced conflicting views amongst relevant stakeholders. This outcome is inconsistent with the sub-proposition that the futures forum process causes participants to re-evaluate their positions.

Some participants also stated that there was significant conflict during the process, some of which were resolved such as regarding the feasibility of feedstocks and biofuel options. Some participants also believed that CSIRO’s analytical approach was problematic. In particular during the forum there was conflict between some of the industry participants and CSIRO.³⁵

³⁵ A number of interviewed participants stated this including Rupert Posner (R. Posner, 2015, personal communication, 11 June), Dr Deborah O’Connell (D. O’Connell, 2015, personal communication, 25 June), and Michael Lakeman (M Lakeman, 2015, personal communication, 9 July).

One participant from the aviation sector remarked that:

“Having a facilitator like CSIRO ... brings a methodological bias or, rather, a tendency to approach questions of the authority and authenticity of data in what is an academic approach. I’m not using the word academic disparagingly... but for this particular subject area we’ve found that too strict of a reliance on citable, published information is a weakness in that you’re not able to reflect the most accurate, up-to-date current best practices or proprietary information... The discussions around that took up quite a bit of energy that we might have spent on other things” (M. Lakeman, 2015, personal communication, 9 July).

Future Grid Forum outcomes

Like earlier forums, there is no evidence that the Future Grid Forum (FGF) enabled disputes to be resolved via re-evaluation of actors’ positions. Participants also questioned the extent to which the process explored contentious issues in the electricity sector and stated that some participants and the process convenor avoided more sensitive topics. Some forum participants described these aspects of the process and associated outcomes as follows:

“The FGF [Future Grid Forum] provided a first step in promoting the need to change and to prepare for the future... [and] a thoughtful and respectful environment... but [it] stopped short of real engagement with challenging issues where diverse opinions are more strongly held, and would have been more strongly contested” (C. Popple, 2015, personal communication, 20 April).

“The big fear of the networks obviously was asset write-downs which got discussed a couple of times but it was a very touchy subject. You couldn’t talk about that but was in the back and front of their minds the whole time but they didn’t want to talk about it” (B. Waters, 2016, personal communication, 29 January).

“The networks for example still at times have an unhealthy relationship with the regulator. Retailers are still often suspicious of the networks. The generators are still in the doldrums and have successfully fought battles with the renewables sector. We haven’t resolved the industry’s conflicts like these ones” (P. Graham, 2015, personal communication, 23 November).

“There’s no love lost between energy retailers and the distribution network. There’s a lot of animosity instead of working together to create something” (Industry informant / participant [non-attributable], 2016, personal communication, 24 March).

A further notable aspect of the FGF was that the scenario analysis reinforced the existence of competing interests. Both the meeting records and final forum report note that no scenario

was identified “that is universally advantageous to all stakeholders” (CSIRO 2013a, p. 14). A plausible consequence of such an analytical conclusion is strengthening tensions regarding future pathways given the conflicting actor interests.

Case evidence of the mechanisms

The evidence – from outcome identification, survey responses and interviews with forum participants and informants – for the firing of each mechanism is summarised below:

Table 17: Summary of case evidence for CMOc-4 mechanism

Mechanism	Future Fuels Forum	SAFRM Forum	Future Grid Forum
M6: Informal dispute resolution	<ul style="list-style-type: none"> • Helped to enable informed discussion about contentious issues and related policy challenges • High-level agreement that there is a “justifiable argument” for more government intervention (but disagreement on what interventions ought to be made) • Conflicting beliefs remained regarding the timing, likelihood, and significance of peak oil • Conflicting policy preferences e.g. regarding vehicle standards (some supported, others opposed) • Consideration of contentious energy options unresolved 	<ul style="list-style-type: none"> • Broad agreement on some feedstock options and challenges and enabled informed discussion of related contentious issues (e.g. the volume potential of algae-derived fuels) • Credible assessment of impact concerns (e.g. potential impact on food production) • Commercialisation pathways remained highly contentious and uncertain (e.g. role of different actors, taxation of different fuels, and investment financing) • Conflicting beliefs on feasibility of aviation biofuels reinforced • Some conflicting views on the desirability of aviation biofuels remained (e.g. WWF quit process midway through forum) 	<ul style="list-style-type: none"> • Stronger awareness of the views and priorities of different players in the electricity sector (participants often reported this) • Identification of possible future “fault lines” as per the competing outcome preferences revealed by the scenario analysis • Resolution of deeper industry conflicts not enabled by the process (e.g. conflicts between network businesses, energy retailers and industry regulators) • Conflicts in electricity supply chain not weakened (e.g. between different parts of the supply chain)

There is little or no evidence of the process enabling informal dispute resolution and thereby reducing the level of contention and enabling related action/innovation (**M6**). There is little or no evidence that the forums contributed to the resolution of major *non-technical* disputes or conflicts (e.g. disputes related to government policy options and/or needs). CSIRO researchers

helped to address some contentious issues which were more technical in nature, such as related to biofuel production issues and volume potential (e.g. the volume potential of different feedstocks). Some conflicts were partly resolved but remained contentious such as regarding the future competitiveness of novel fuels or other emerging technologies.

Assessment

Little or no evidence was found that conflict resolution was achieved by creating or providing access to an enhanced fact-base and related credible scientific knowledge, nor by CSIRO acting as an 'independent arbiter' (as the futures forum convenor). This doesn't appear to be a contextual issue given the moderate-to-strong contention (**C3**) at the time of two futures forums (FFF, FGF) and some contention at the time the other (the SAFRM forum). Furthermore, there is also evidence some pre-existing disputes and conflicts were reproduced or reinforced by the forums.

Some participants also questioned the extent to which an open and/or fair process was conducted which may suggest process deficiencies (also see Chapter 8). For example, one participant in the Future Grid Forum pointed to a "limited ability to explore sensitive topics such as network write-downs ... [which] appeared to be because of the objection of a small number of stakeholders" (Forum informant [non-attributable], 2016, personal communication, 30 March). Another Future Grid Forum participant questioned the extent to which participants openly shared their views "because the people in the room were not the heads of the organisations they were constrained by what they felt their senior people would allow them to say and think" (O. Kember, 2016, personal communication, 24 March).³⁶ Some participants also argued that consideration of relevant facts/information in the futures forums was constrained by methodological issues and commercial sensitivities.

4.2.5 Overall case support for the core intervention theories (CMOc statements)

In sum, the case provides partial, variable support for the intervention theories. The case

³⁶ Linked with this another forum participant who represented Grid Australia (a major peak body at the time of the Future Grid Forum) stated that "Whilst it was viewed as a diverse group of industry participants working together – and that is true – they weren't all senior people from those organisations. Many participants didn't have the ability to fully commit their organisations to a course of action and all that sort of stuff..." (C. Popple, 2016, personal communication, 22 April).

provides often strong, but variable, support for CMOc-1, including variable evidence of uncertainty reduction and decision-support; it provides some support for CMOc-2 but less for the hypothesised mechanism of critical reflection on actors’ assumptions and beliefs; it provides limited support for CMOc-3, including the variable emphasis on collective action problems; and the case provides little or no empirical support for CMOc-4, particularly for non-technical disputes/conflicts. In some instances, the contextual understanding is strong but the mechanisms appear weaker than hypothesised (or, perhaps, non-existent) or different mechanisms are suggested by the case evidence (e.g. CMOc-4, CMOc-2). In other instances, there is limited evidence for both the main contextual assumptions and the hypothesised mechanisms (e.g. CMOc-3). This is summarised in *Table 18* below:

An important example of variable support is the differences in the three forums in the self-reported decision support amongst participants in different sectors. In two forums, the Future Fuels Forum and Future Grid Forum, governmental actors (e.g. policy-makers, public servants, etc) frequently reported less decision support and utility. In contrast, a government informant (2015, personal communication, 12 June) reported that the SAFRM forum was viewed as providing strong support for their policy positions, which is reflected in the way the forum report was cited by the government (Australian Government 2011b).

Table 18: Summary of evidence for the CMOc statements

CMOc statement	Contextual alignment	Evidence of hypothesised mechanisms	Evidence of predicted outcome pattern(s)
CMOc-1: Credible strategic and decision-making guidance under uncertain conditions	Strong evidence but mostly for industry participants’ contexts	Strong evidence for M2 (provision of resources that can credibly support strategic decision-making), with some important exceptions; and limited-moderate evidence for M1 (reduction of uncertainty)	Variable, but good evidence for some participants
CMOc-2: Reduction of inertia in the context of a destabilising ‘structural break’	Strong evidence but mostly for industry participants’ contexts	Moderate-weak evidence. Some evidence of alternative mechanisms	Some evidence of further exploration of new technology pathways but limited ‘adoption’ (e.g. major investments, etc.)

CMOc-3: Enhanced coordination and coalition formation in the context of collective action problems	Limited evidence for main contextual assumptions – one partial exception (SAFRM Forum)	Weak evidence	Weak evidence aside from already aligned participants
CMOc-4: Providing a safe space which enables informal dispute resolution in the context of conflict/contention	Strong evidence for Future Fuels Forum and Future Grid Forum; moderate alignment with Sustainable Aviation Fuels Road Map Forum context	Little or no evidence	Little or no evidence (particularly for non-technical disputes)

Regarding contextual factors two additional conclusions are evident: the case indicates that some of the contextual factors emphasised by the intervention theories are relevant to the firing of the hypothesised mechanisms; and, second, additional contextual factors need to be considered to develop more robust (i.e. empirically supported) intervention theories. The former conclusion is evidenced, for example, by the evidence that under uncertain conditions some participants were looking for decision-support that is credible (or perceived as such) as per CMOc-1. It is also clear that such contexts are characterised by many other dimensions such as whether a forum occurs in a pre- or post-decisional context and whether involved actors are seeking to convince others of plans or options they are advocating. For example, if the forum occurs in a post-decisional context then the involved actors can have related needs such as justifying the decision(s) and/or building support for the decision amongst their key constituencies. Many other examples are also evident in the case. Additional factors are explored in *Section 4.3* and subsequent chapters.

4.3 Additional intervention theory-related findings and the implications for this evaluative case study

Related to the explanatory focus of realist evaluation, in which core evaluative tasks are to explain intervention outcome patterns and to assess and refine intervention theories (Pawson 2013), it is necessary to consider how well (or poorly) the intervention theories *explain* the case. This analysis can, in turn, inform consideration of what additional theories or perspectives may be relevant to explaining the case and enhancing the intervention theories. Below, relevant aspects of the case are considered to further analyse the validity of the intervention theories as a case explanation.

4.3.1 Participation in futures forums

The current intervention theories propose that attendance is primarily motivated by one of three factors: (i) facing a situation in which actors need to make major/strategic decisions under uncertain conditions (see **C1, C2**); (ii) the emergence of major business model threats in the context of a ‘structural break’ in their sector or the wider economy, which was termed an ‘existential threat’ (see **C2**); and/or (iii) the need to address a collective action problem (see **C5**). The case suggests these factors only motivated the participation of some attendees (see *Table 19*) and that they don’t convey the full range of motivators:

Table 19: Forum attendance motivations

Motivation	Case evidence
Need to make/justify difficult decisions under uncertain conditions	<ul style="list-style-type: none"> When asked why they participated in a forum approximately 60% of surveyed participants stated that the forum ‘<i>provided a source of information that was relevant to strategic decision-making processes</i>’; Few surveyed participants (9%) stated that they participated in a futures forum because ‘<i>it provided a way to understand and cope with the uncertainties facing my organisation</i>’; and A partial motivator for some industry participants (e.g. GM Holden, network businesses, airlines), less so for governmental participants
Major business model threats in context of a ‘structural break’	<ul style="list-style-type: none"> Minority of industry participants motivated by major business model threats (e.g. GM Holden, network businesses, airlines to less extent)
Need to address a complex collective action problem	<ul style="list-style-type: none"> Implicit motivator of the SAFRM forum process and roadmap from the perspective of ‘value chain’ creation and industry development; and Rarely an explicit (stated) motivator of futures forum participation

As mentioned in *Table 19* above, participant self-report data provides related data on the motivations of participants (see *Figure 6 below*). When averaged across all forums, the most commonly stated motivation was that forum ‘*provided an opportunity to influence public policy debates and/or influence corporate decision-making*’. 76% of surveyed participants stated that this was a motivation (i.e. they ticked this box on the survey). The least commonly stated motivation was that forum ‘*provided a way to understand and cope with the uncertainties facing my organisation*’ (9% of surveyed participants).

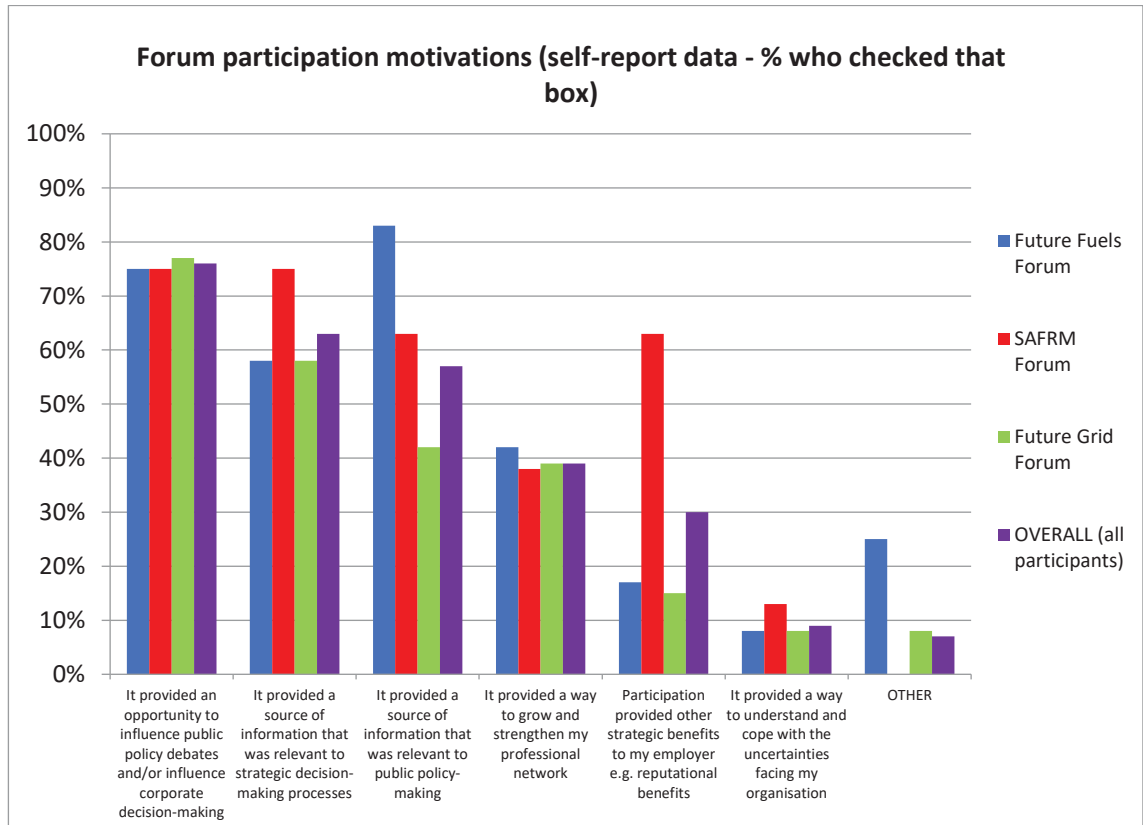
This data points to additional strategic motivations – for example, as per the *influence* objective – which are not adequately captured by the intervention theories. Explicit strategic objectives were most commonly stated for the SAFRM forum (*Figure 6*).

The following example survey responses and interview statements by industry participants point to desired benefits which are not well captured by the intervention theories:

- “A key benefit [for Sasol Chevron] was the opportunity to contribute to the visibility of GTL [gas-to-liquids] diesel in the energy industry as one of the many pathways to sustainable mobility” (E. van der Wateren, 2014, personal communication, 25 August);
- “It also provided the opportunity [for GM Holden] to provide input to a significant public document to shape and support public policy development” (R. Marshall, 2014, personal communication, 14 August);
- “There was a very strong reputational side to being involved” (R. Marshall, 2014, personal communication, 23 October);
- “The process was a positive way for the oil industry (at least from Caltex's perspective) to provide input into this important debate. I think we could provide relevant details on the practical challenges ... and be honest about the degree to which incumbency of the current system created barriers” (M. Ridley-Smith, 2015, personal communication, 7 May);
- “By being involved, Boeing was able to demonstrate its industry leadership and enhance the network of participants/stakeholders we interact with” (W. Lyons, 2015, personal communication, 19 April);
- “It established the fact that UOP had a technology for production of commercial aviation biofuel from Renewable lipid based biological oils” (S. Lupton, 2015, personal communication, 10 April);
- “Telstra was interested in energy regulatory policy during the FGF [Future Grid Forum] so it was beneficial as their representative to use our [forum] membership to gain a deeper understanding of the nuances of the 'Power of Choice' review and the implications for Telstra for future opportunities” (M. Faith, 2016, personal communication, 14 February); and
- “The primary interest [of SA Power Networks] was to gain insights into different parts of the energy sector and how they are approaching the changes facing our industry” (A.J. van Vuuren, 2016, personal communication, 12 February).

The survey data is presented below:

Figure 6: Stated reasons for participating in a CSIRO futures forum



In sum, the case evidence indicates that the intervention theories must further consider the strategic focus of actors (e.g. on influencing their stakeholders, realising opportunities, etc.), the desire for forum processes to influence or explicitly be part of policy processes, and, overall, the diversity of participant motives. The following statement on government participants also conveys the diverse range of motivations:

“There might be other motivations depending on the type of bureaucrat who attends. For instance, some people may be there to shut down ideas or don’t want to see change, they think their KPI is how many things they’ve shut down and they’ll advise against whatever it is... so they’ll have more knowledge about the triggers to say that this is a rubbish idea because of A, B, and C. Conversely, you’ll have people who want to do something” (Government informant [non-attributable], 2014, personal communication, 2 December).

4.3.2 The production of credible and useful anticipatory knowledge

A core element of the forum process and the intervention theories is producing *credible* anticipatory knowledge, termed ‘plausible futures’, which actors are therefore more likely to ‘adopt’.³⁷ CSIRO staff view broad participation – in particular ensuring the participation of a “balanced group of interests” in the forum process (see Chapter 3) – as crucial for producing credible outputs which are judged to be plausible. It is therefore important to ask whether the process resulted in such knowledge, in the ways that were expected, and whether this promoted ‘adoption’ of the results (see *Section 4.3.3*).

Some participants provided assessments consistent with the related hypothesised mechanism, e.g.:

“The independence of a reputable body [CSIRO], supported underneath that is the fact you had a broad church along with the related wide input. Those were the two biggest factors... both of those factors lead to credibility” (R. Marshall, 2014, personal communication, 23 October).

The range and type of factors emphasised by forum participants’ (in their statements about output credibility) diverged somewhat from the theories. Factors emphasised by CSIRO were mentioned less often (e.g. transparency, considering multiple agendas and views, etc). The factors emphasised by participants suggests that perceived credibility is more a function of social factors such as the status and perceived credibility of participants and sponsors (e.g. see comments below such as “the participant list helped give the report credibility”); general rigour; and oversight by a scientific organisation. This is outlined in *Table 20* below.

Table 20: Key factors influencing the credibility of the forum outputs (survey responses)

Factor	# of explicit mentions	Statements made in survey responses
Actors involved (expertise, status, stakeholders represented)	11	“Driven by experts in the sector” “The participant list helped give the report credibility” “Quality of the participants” “Quality of the sponsors and participants” “The right people attending” “Industry support added [to] the credibility of the reported outcomes”

³⁷ The project leader, Paul Graham from CSIRO, puts the general underlying claim as follows: “The forum has to come up with plausible futures, genuine options... because if it is not plausible then it won’t be adopted” (P. Graham, 2014, personal communication, 6 June).

		<p>“The report was developed by a cross sector network representing energy industry”</p> <p>“The report was developed by representatives across the whole industry”</p> <p>“A good range of stakeholders were involved”</p> <p>“The broad involvement of stakeholders”</p> <p>“The wide-ranging coverage of interested parties which gave strength to the conclusions reached”</p>
Methodology (general)	8	<p>“Sought to ensure internal consistency in scenarios, and to integrate all sectors in the analysis”</p> <p>“Looked at a wide range of options, supported with detailed modelling”</p> <p>“The forum process involved a thorough process of building scenarios and economic modelling of these scenarios”</p> <p>“Quantitative and qualitative approach were complementary and reinforcing”</p> <p>“The study was comprehensive in assessing the feedstocks and the role of the different stakeholder groups.”</p> <p>“The methodology ... was robust and tested with both econometric modelling as well as within the group dynamic”</p> <p>“Backed by strong modelling efforts”</p> <p>“Technically well-based analysis with a broad reach across fuel types”</p>
CSIRO involvement / research	5	<p>“Leadership, framing and guidance from CSIRO was critical”</p> <p>“Experienced practitioners [CSIRO] validating the inputs”</p> <p>“CSIRO brought good skills, knowledge and expertise”</p> <p>“CSIRO did an excellent job in researching, analysing and presenting the data”</p> <p>“The study (and associated projects within CSIRO) did considerable work on the availability of feedstock materials”</p>
Transparency and independence (process features)	3	<p>“The modelling was independent from many vested interests that were represented in the group”</p> <p>“The opportunity was provided to challenge the input assumptions and have alternative basic data used if appropriate”</p> <p>“The scenarios were developed and analysed in a constructive transparent manner”</p>
Range of agendas and viewpoints considered	3	<p>“Input from a wide variety of stakeholders with differing agendas”</p> <p>“Took into account all views”</p> <p>“Considered the issues from multiple stakeholders' point of view”</p>
Avoided 'extremes'	2	<p>“The Future Grid Forum considered a range of scenarios that each had a reasonable level of credibility but seemed not to encompass some more extreme aspects that may have been viewed as less credible”</p> <p>“Examined some stretch outcomes while maintaining a sense of reality and workable solution options”</p>
Fact-based process	2	<p>“Realistic and wide-ranging facts were put on the table”</p> <p>“Considerable work [was done] on the availability of feedstock materials”</p>
Unbiased approach	1	<p>“The flow of information from participants was credible and realistic, and without bias”</p>

Related statements were made about the modelling work done for the forums. For example, a participant stated that they assumed that the modelling was “robust given it was performed

independently by CSIRO” (S. Bell, 2016, personal communication, 3 February). Participants also differed in their capacity to understand the modelling that was done and engage with the details of this analysis. For some it mostly remained a ‘black box’ (e.g. government informant [non-attributable], 2014, personal communication, 17 October). This meant that, although the modelling process was participatory, an element of trust was required.

Finally, many participants – apart from most SAFRM forum participants – who judged the outputs to be credible also referred to their alignment with their beliefs and/or assumptions. This may have shaped these judgements. For example, the vast majority (80%) of surveyed Future Fuels Forum participants who agreed that the outputs were credible also *didn’t* agree with the statement ‘*The Future Fuels Forum challenged my beliefs and assumptions about transport fuel issues and the options for managing these issues*’. The majority (~60%) of Future Grid Forum participants who agreed that the outputs were credible also *didn’t* agree with the statement ‘*The Future Grid Forum challenged my beliefs and assumptions (e.g. about electricity supply and use related issues; and/or potential future electricity pathways)*’. The following comments are illustrative:

“For those familiar with the topics there were few real surprises, but a worthwhile validation of the progress being achieved” (J. Le Cornu, 2014, personal communication, 6 August).

“The forum aligned to current industry discussions and thinking regarding what the future may hold for industry, policy makers and consumers” (T. Barry, 2016, personal communication, 12 February).

“It primary pulled together existing thoughts and opinions and helped order those, which was the key benefit of the process (rather than inventing new content)” (A.J. van Vuuren, 2016, personal communication, 12 February).

These participant views suggest that, whilst some elements of the theory appear valid additional factors can also influence perceived credibility such as the social factors noted above and alignment of the findings with “circulating expectations” (van Lente 2012, p. 779).

4.3.3 Use of futures forum outputs/findings

The intervention theories emphasise particular uses of forum outputs/findings such as using the findings to support management decision-making (CMOc-1) or using the forum outputs to help solve coordination problems (CMOc-3). The case provides some evidence of these uses.

The case also indicates that other uses are also important, including the following uses:

- Using the outputs to influence other actors' expectations (e.g. peak oil activists selectively used forum outputs to try to increase concerns about oil supply risks);
- Advocating and justifying public policies (e.g. "cherry picking" the modelling results in forum reports to support policy advocacy, emphasising particular scenarios or results perceived to be aligned with policy preference and ignoring others);
- Proposing new strategies/initiatives within an organisation (e.g. viewing the forum outputs as resources which can be used to help sell a strategy);
- Using the outputs to inform company policies; and
- Promoting/justifying proposed research projects (e.g. as done by CSIRO staff).

These uses point to other functions such as those related to persuasion and communication where actors want to *convince* others. Similarly, the outputs may be viewed as resources which support an agenda or can be strategically mobilised to enable a favoured direction of change. These kinds of uses of forum outputs point to the importance of other contextual factors which influence these uses of forum outputs and their impacts.

4.4 Chapter conclusions

The case provides partial, variable support for the core intervention theories. The case provides the strongest support for CMOc-1 and least support for CMOc-4. The case also indicates that the hypothesised operation of mechanisms needs revision. For some hypothesised mechanisms, the data suggest that the mechanism is non-existent (e.g. 'informal dispute resolution') despite a salient context in which it was expected to 'fire'. Furthermore, the existing theories only partly (and sometimes poorly) capture actors' motivations for participating in a forum and the benefits they are therefore seeking.

The case evidence demonstrated that the existing core intervention theories poorly account

for the outcome patterns in some important senses, although the theory deficiencies also help to explain some of these patterns (see below). The following aspects of the case require further examination:

- The weaker influence on inertia, investment decisions, and dispute/conflicts than expected;
- The variable level of decision support as reported by actors in different sectors (e.g. weaker decision-support often reported by public sector actors/participants);
- What contributed to the limited impact on inertia and whether these factors or social and cognitive processes are consistent with the intervention theories;
- The emphasis placed by CSIRO staff on convening a consensus process and the limited nature of any 'consensus' produced by the futures forum processes;
- The 'adoption' and use of futures forum outputs (see *Section 4.3.3*); and
- Why anticipatory knowledge is/isn't perceived as credible or useful (see *Section 4.3.2*).

Further gaps and issues are related to the identified contextual factors. The case indicates partial alignment between the factors specified in the CMOc statements and the motivations for futures forum participation (on this point see *Section 4.2* and *Section 4.3.1*). Given these exercises rely on the active engagement of relevant actors this is an important issue. Additional contextual factors which are not specified in the CMOc statements also influence the use of forum outputs/findings and the impacts of these uses. Related to this, the post-forum context needs further consideration.

The case evidence and analysis presented in this chapter also suggests a two-part explanation for the main identified outcome patterns: (i) the case evidence suggests that the validity of the intervention theories influences the outcomes that are realised (e.g. where such theories informed practice, such as with respect to the expectation that participants will reach consensus and how this guided the process design and implementation); and (ii) intervention theory deficiencies led to reduced impact which explain, in part, some outcome patterns. This explanation will be further discussed in Chapter 8, following additional case analysis.

The case analysis will now progress on to considering additional theoretical perspectives. These perspectives may also be relevant to more robust intervention theories.

Part 2b: Additional theoretical perspectives on the case

CHAPTER 5: Prospective knowledge practices as social activities

5.1 Introduction

The meta-explanatory theme considered in this chapter (also see the phase 2 outline presented in Chapter 2) emphasises the broader social context and related social mechanisms, and their influence on the futures forums and their subsequent effects. This is also consistent with the strong emphasis on contextual thinking in realist evaluation which poses ‘in what circumstances...?’ style evaluative questions (Pawson 2013). That is, realist evaluators consider the social conditions into which an intervention is introduced and how this influences the firing of mechanisms. This examination of prospective knowledge practices (PKPs) as social activities (see *Section 5.2*) emphasises the potential for PKPs to be socially conditioned in consequential ways, whereas chapter 6 focusses more on the actors involved, their goals, and actor interactions and interrelationships.³⁸ Some relevant elements of the social contexts were also outlined in the previous chapter related to the CMOc statements, such as the level and types of uncertainty that actors are dealing with. Where they are salient some of these contextual aspects are further considered in this chapter.

The need to further consider the influence of such social conditions on PKPs has been recognised by some scholars and practitioners. Scenario planning scholar-practitioners Ramirez and Wilkinson (2016, p. 23) argue that “looking forward is a socially conditioned process”. Similarly, Garb, Pulver & Vandever (2008, p. 4) argue that we need to further consider “how social contexts are embedded in scenarios, often implicitly”. They further suggest that “a useful place to start would be to consider whether the scenario-formulation impulse and procedures themselves carry the imprint of their political, social, and organizational contexts of origin”. These perspectives on the potential social conditioning of PKPs inform the analysis that is presented here.

The chapter first outlines the theoretical perspective which guides the case analysis presented

³⁸ Recall the four-part context framework introduced by Pawson and Tilley that was noted in Chapter 2: (i) the individual players/stakeholders; (ii) their relationships (i.e. interpersonal relations); (iii) institutional setting(s); and (iv) the surrounding ‘infrastructure’ (Pawson 2013; Pawson & Tilley 1997b). The latter aspect is broadly defined by Pawson (2013, p. 37) as “the wider social, economic, and cultural setting” of the social intervention or program. In terms of this framework the third and fourth parts are focussed on in this chapter, and the first and second parts are mainly considered in Chapter 6.

in this chapter and then proceeds to reconsider each of the three futures forums and the case as-a-whole. The implications of this interpretation of the case for the intervention theories are then noted (and further explored in Chapter 8). The final section outlines the chapter conclusions.

5.2 Theoretical perspective and key concepts

The explanatory perspective considered in this chapter is guided by a sociology of science perspective as well as a more general sociological perspective which views human action and expectations as *social* (Beckert 2016; Dobbin 2004). In particular, Science and Technology Studies (STS) scholars view science and technology as social in that they “reflect the social conditions of their production and the social conditions of those involved in their production” (Erickson 2016, p. 1). The sociology of science emphasises that science is a human activity and, like all such activities, it is subject to institutions, related norms and beliefs, and other contextual influences. Thus, several key elements of the social context, and its potential influence on PKPs, are relevant to this explanatory perspective:

- Social institutions;
- Norms and beliefs about the role of the state in modern capitalism as these pertain to new and emerging technologies (e.g. for alternative fuel production);
- The social environment(s) structuring mental action (e.g. cognitive processes); and
- Discursive contexts and processes.

These aspects, and associated key concepts and perspectives, are outlined below:

Social institutions

Sociologists define a social institution as a “convention, some defined by law and some defined by tradition” (Dobbin 2004, p. 4). Sociological theory posits that “institutions, large and small, shape human behavior not only by providing behavioral scripts, but by representing the relationships among things” (Dobbin 2004, p. 5).³⁹ Dobbin (2004, p. 4) further contends that “sociology’s core insight is that individuals behave according to scripts that are tied to social

³⁹ Similarly a social institution, with respect to larger social macrostructures (e.g. political or economic institutions, related to family structures, etc.), is defined by Roberts (2009, p. 265) as “a settled pattern of behaviour and the associated culture that performs a specific role or function in the wider society”. A script can be viewed as a “settled pattern of behaviour” and an “associated culture”.

roles". At the collective level these scripts are termed conventions (which may exist at the macro social level or within, for example, a sector or an organisation); at the individual level they are termed cognitive "schema" (Dobbin 2004, p. 4). In sum, human action is viewed as being routinely anchored in both formal and informal conventions and associated behavioural "scripts" (Dobbin 2004).

Sociological research has also found that institutions are often influential under uncertain conditions, particularly when actors face fundamental uncertainty. When actors face fundamental uncertainty they are dealing with situations which "are essentially characterized by the possibility of creativity and structural change, and therefore by significant indeterminacy of the future" (Dequech 2003, p. 520). A consequence of this indeterminacy is that some desired information cannot be acquired (Dequech 2003). In such contexts, "script following" has been found to be a common *response* to uncertainty (Beckert 2013b). Additionally, "as perspectives on future developments are at least partially shared, they operate as conventions, which provide cognitive anchors for actors" (Beckert 2016, p. 218). A core argument made by many sociologists is that actors often rely on institutions – and related rules and norms – to reduce the uncertainties they face in decision-making (Beckert & Dequech 2005; Dequech 2003). This reliance on institutions can "limit the choice set of actors and make actions at the same time predictable" (Beckert & Dequech 2005, p. 586). Additionally, as Beckert and Dequech (2005, p. 585) note, because actors "rely often on social devices [e.g. social institutions]" this can "create rigidity in the responses to changes in an uncertain environment".

Norms and beliefs about the role of the state in modern capitalism

The emphasis of the CSIRO futures forums on new low-carbon and green technologies points to the relevance of norms and beliefs about the role of different actors during technology development and commercialisation. This is especially the case given the significant challenges that often must be overcome.⁴⁰ Economists studying innovation and major technological changes such as Mazzucato (2014, 2015) have studied the role of the State in these processes and argue that norms and beliefs about the role of the State in modern capitalism can be a

⁴⁰ This is summarised by Mazzucato (2015, p. 6) as follows: "Advanced clean technologies, like all radical technologies, have many hurdles to clear. Some hurdles may relate to technical development (such as improving or inventing production techniques), others are due to market conditions or competition. In the case of renewable energy sources, like wind or solar power, broad social acceptance or the need to provide energy at a price lower than possible by other firms and technologies are also major hurdles".

constraint on the development of novel technologies. Related issues include concerns about the ability of the State to effectively 'pick winners', the need for large-scale patient finance, and the level of willingness to take-on risk and uncertainty (Mazzucato 2015, 2016). As Mazzucato puts it "in many countries, the State is asked to take a back seat" (Mazzucato 2015, p. 8). "Business is accepted as the innovative force, while the State is cast as inertial – necessary for the 'basics', but too large and heavy to be the dynamic engine" (Mazzucato 2015, p. 2). These contemporary norms and beliefs about the role of the State in modern capitalism are consistent with a neo-liberal view of the role of the State which prescribes minimal State intervention in markets and industries (Chang 2002). CSIRO staff, and others (e.g. Western et al. 2007), argue the Australian context is largely consistent with these trends (P. Graham, 2015, personal communication, 1 December).

Aspects of the neo-liberal context can be viewed as social institutions. Institutions shape behaviour by "representing the relationships among things in the world" (Dobbin 2004, p. 5), for example between minimal State interventions and desired economic outcomes.

The social environment(s) structuring mental action

There is broad agreement amongst sociologists that mental activities such as cognition and perception are influenced by actors' social environments. Related to this Zerubavel (1997, p. 6) asserts that sociologists "reject the extreme individualistic vision of the absolutely original solitary thinker". Some sociologists go so far as to assert that "the human mind is society writ small" because "consciousness comes to reflect social institutions" (Dobbin 2004, pp. 30-1). A range of concepts have been proposed to capture these social dimensions of cognition such as 'thought communities' (Erickson 2016; Zerubavel 1997), 'epistemic communities' (Beckert 2016, pp. 139-40) and 'cognitive fields' (Beckert 2016). Thought communities entail "mental membership" in social communities (Zerubavel 1997, p. 7), which Beckert (2016, p. 139) has examined, for example, in the valuation of investment options: "an investment's profitability is calculated within an epistemic community that includes consultants, scientists, accountants, economists, analysts, investment bankers, managers, entrepreneurs, and capital owners, who assess an investment's value". He argues that expectations of future value *emerge* from social processes in these epistemic communities. Similarly, Beckert (2016, p. 218) discusses the ways that actors can "create and disseminate a shared cognitive field" which can contribute to stronger convictions regarding future possibilities. To the extent that these social dimensions and structures influence individual mental action (e.g. the thinking done by participants during

a futures forum process) they are an important part of the social environment that affects the production, assessment and use of anticipatory knowledge.

Discursive contexts and processes

Scholars that are developing the sociology of expectations have examined social processes related to the social underpinnings of cognition outlined above (Beckert 2016; Borup et al. 2006; van Lente 2012). This research has found that actors “continuously and explicitly refer to what is possible” – especially in the context of emerging sciences and technologies – and, in doing so, “they draw from and add to a repertoire of images, statements and prophecies” (van Lente 2012, p. 772). These actions “contribute to a particular dynamic”, that is expectation dynamics such as hype cycles. Van Lente (2012, p. 777) proposed the metaphor of “a ‘sea’ of expectations” to describe the context in which forward-looking studies occur and help explain these behaviours. Another way to put this is that such exercises are “embedded in discursive processes” (Beckert 2016, p. 218). Beckert (2016, p. 13) argues such discourses strongly influence imagined futures:

Discourses amongst expert communities and beliefs held by laypeople are crucially important to the formation of the imagined futures formed within the capitalist economy. Such discourses and the imaginaries prevailing at any given point in time, are framed by powerful actors such as firms, politicians, experts, and the media.

The finding that actors’ expectations are influenced by existing “repertoires” (i.e., the images and arguments that are already circulating in their social group or community) points to the importance of discursive contexts. For example, PKPs may “reproduce images and arguments that are already circulating” (van Lente 2012, p. 778) rather than create new expectations. Additionally, economic sociologists argue that related strategies are commonly used to enhance credibility and legitimacy, such as herd behaviour (e.g. aligning forward-looking analysis with others’ conclusions) and “anchoring” analysis in expectations that already exist (Beckert 2016).

I will now explore these aspects of the social context in relation to each futures forum, and whether this theoretical perspective helps to explain the identified forum outcomes.

5.3 Case evidence and interpretation

5.3.1 *Future Fuels Forum*

The role of government and policy approaches for greenhouse gas emissions reduction were frequently discussed during this forum. These aspects provide evidence of the influence of the social institutions and beliefs and norms about the role of the state in modern capitalism. The discursive context – especially regarding oil supply and prices – was also dynamic (see below).

The Future Fuels Forum occurred at a time when there was a strong policy consensus on the centrality of using an economy-wide emission trading scheme to achieve greenhouse gas emissions reduction at the least possible cost.⁴¹ Carbon pricing was the core climate policy of both the incoming Federal Labor Government (the first forum meeting was held just before the 2007 federal election which the Labor Party won) and the Liberal Party Opposition, and related social *conventions* had developed regarding climate policy and the role of government. Broadly, an economy-wide carbon price (a tax or tradable permits), and a related reliance on market mechanisms, was widely viewed as the correct policy. This is reflected in comments made during the forum which were noted in the meeting records:

“Scenario 1a is not plausible. There will be a carbon price.” (*Meeting 2 record, Future Fuels Forum*)

“It is unclear that governments would decide to impose additional punitive measures on the transport sector if the goal of emission reduction is already being achieved by the emission trading scheme.” (*Meeting 2 record, Future Fuels Forum*)

“Scenario 3 may not be needed as a low carbon price seems unlikely given current government preferences for a 60% below 1990 target by 2050.” (*Meeting 2 record, Future Fuels Forum*)

Consistent with this context emissions trading is one of the two main scenario ‘drivers’ and the modelling report notes that “a national CO₂e emission trading scheme is scheduled to be

⁴¹ Notably the Garnaut Climate Change Review — led by Professor Ross Garnaut — was conducted concurrently. Its Interim Report was published during the forum and its Draft Final Report was published in June 2008 (the same month as the forum report). The expected introduction of a carbon price was abandoned in April 2010, delayed until July 2012 (it was introduced by the subsequent Gillard Government) and then subsequently repealed in 2014 by the Abbott Government.

introduced in Australia by the end of 2010” (Graham, Reedman & Poldy 2008, p. 21). The role of sectoral policies (e.g. changes to transport fuel excise) are mostly explored in separate ‘sensitivity cases’. The forum report suggests that transport sector policies should be viewed as “complementary policies” (CSIRO 2008a, p. 23). In these ways, the analysis was consistent with the prevailing policy consensus. In contrast, climate policy in Australia has since shifted to “implicit carbon price” policies (which through other measures similarly seek to incentivise emission reduction) and to policies targeting a specific sector instead of economy-wide measures (Climate Change Authority 2016; Wood, Blowers & Moran 2015). Thus, the construction of the core scenario set was guided by the policy context and associated **conventions** in ways that increased its relevance for this context but may have reduced their utility for some participants (e.g. by not emphasising more interventionist approaches to reducing transport emissions and/or achieving long-term transport fuel security – also see further discussion below). Such choices, guided by prevailing **conventions**, may also reduce the long-term value of some of the analysis (e.g. the core scenarios).

Norms and beliefs about the role of State in the economy informed discussions and decision-making during the forum. For example, whilst some forum participants (see below extracts from the meeting records) argued for direct State interventions – not only market-driven changes such as those driven by market-based mechanisms – the forum report does not strongly argue for “picking winners” style policies or programs. Consistent with this, the meeting records state that “we should not be picking winners” (*Meeting 2 record, Future Fuels Forum*). The discussion of the potential costs and benefits of a “picking winners” policy approach in the forum report (CSIRO 2008a, pp. 29-30) also reflects general concerns about this approach. Debate about this approach and contrasting views voiced by some participants are also evident in the meeting records, e.g.:

“If Aus [is] to recognise that a particular fuel advantage to sovereign independence, nowhere in additional policy measures do we talk about the level of govt support for this sort of intervention. ‘Picking winners’ and government not keen to do this but ultimately need to recognise that this might be a sensible response and identify a fuel even as a scenario e.g. natural gas is abundant in Australia so could make large policy shift towards it in terms of vehicles and infrastructure, rather than just relying on market forces.” (*Meeting 4 record, Future Fuels Forum*)

“We currently have a set of scenarios with the market doing all the changes. We would like to see others which may have more direct intervention i.e. combine policy

measures such as subsidies for fuel efficient/low emission vehicles and fuel efficiency standards.” (*Meeting 4 record, Future Fuels Forum*)

The core scenarios produced by the Future Fuels Forum emphasise market-based policy instruments. In other words, forum participants who argued for some ‘picking winners’ and/or direct interventions by government mostly lost the argument and existing **conventions** and related **norms** shaped the report, with some exceptions (e.g. one “picking winners” option was explored as a ‘sensitivity case’ in which support is provided for algal biodiesel).

One forum participant from Sasol Chevron – who was seeking to commercialise alternative gas-to-liquids (GTL) fuel technologies – similarly argued that “decisions about the future of GTL fuels have been made on [a] commercial rather than [a] strategic basis” (E. van der Wateren, 2014, personal communication, 15 August). This participant further argued that the Australian government could have, in contrast, viewed the country’s gas reserves as offering the potential to become less dependent on imported fuels and supported this fuel option. However, this more ‘strategic’ basis for decision-making was inconsistent with the limited concerns of policy-makers about energy security and **beliefs** and **norms** about the role of government in the energy sector (and economy more broadly). The position of key policymakers was that “import dependency is not an energy security issue it itself” (Ferguson 2011, pp. 9-10). These limited concerns about energy security were also reinforced by commissioned vulnerability analyses (e.g. ACIL Tasman 2008, 2011) that were cited by the Federal Minister for Resources and Energy (e.g. Ferguson 2011).⁴²

Nonetheless, the **discursive context** was increasingly dynamic at the time of the forum (i.e. 2007-08). The forum was held at time when there was concern about rising oil prices and more prominent debates about peak oil and future oil prices. Multiple actors who were concerned about peak oil participated in the forum along with others who weren’t concerned. At the initial two-day workshop participants split into two groups which held differing views on peak oil – one group was comprised of participants who were concerned about peak oil and saw it

⁴² A Victorian public servant heavily involved with transport policy at the time of the forum (and who was a Victorian Government representative at the forum) emphasised the impact of these reports. He stated that “there was an analysis of Australia’s liquid fuel vulnerability released by the Commonwealth in 2008 [the ACIL Tasman report] which basically said we didn’t have a problem. Rightly or wrongly, the energy policy bod’s at both state and federal level were guided by this advice, and this effectively quashed any sense of urgency to respond to the issues raised in the Future Fuels Forum report” (K. Handberg, 2014, personal communication, 28 November).

as a near-term threat, and the other group wasn't concerned (*Meeting 1 record, Future Fuels Forum*). These groups constructed high-level scenarios which were the core focus of subsequent modelling. One group adopted the "'ASPO' perspective" (i.e. Association for the Study of Peak Oil & Gas) on supply constraints; the other group adopted the "'ABARE / EIA' perspective" (i.e. Australian Bureau of Agricultural and Resource Economics and Sciences / U.S. Energy Information Administration). In these ways, the process itself *reproduced* the discursive context. Collaboration between like-minded participants – i.e. within subgroups of people who had similar beliefs about resource constraints and fuel security risks – may have contributed to actors' conflicting views being reinforced by the forum.

Another significant aspect of the analysis was its alignment to the widely-held expectation (at that time) that 'the era of cheap oil is over'. This perspective on the future was widely shared and therefore may have operated as a convention (Beckert 2016) which consequently constrained thinking during the forum. As noted in the modelling report the lowest oil price scenario considered by the forum assumed that "oil prices of around US\$60 to US\$70 will be maintained for the next several decades ... [which] represents a significant break from the average in the previous decade of around US\$28/bbl" (Graham, Reedman & Poldy 2008, p. 18).⁴³ That part of the analysis drew on, and was explicitly aligned with, the analysis of energy agencies – the International Energy Agency (IEA) and the US Energy Information Administration (CSIRO 2008a).

The focus on extreme outcomes in the core Future Fuels Forum scenarios also reflects the (then) *existing discursive processes*. The 2007-08 period was characterised by heightened speculation and concern, driven by rising, volatile oil prices. The modelling report notes that "the two extremes – slow oil products decline with fast infrastructure response and fast oil products decline with slow infrastructure response" were "treated as core scenarios" (Graham, Reedman & Poldy 2008, pp. 19-20). One of these extremes (fast oil products decline with slow infrastructure response) projected fuel costs as high as A\$8 per litre by 2018 (CSIRO 2008a).⁴⁴

⁴³ Over the recent period (early 2016) oil prices returned to a low of US\$27/barrel (Hartmann & Sam 2016) and have since have tended to remain between US\$40-50/barrel.

⁴⁴ Newspaper articles on the project tended to focus on the scenario in which fuel costs are as high as A\$8 per litre by 2018 (e.g. Coorey 2008; McManus 2008; Morton 2008). Many interviewed participants commented on this, e.g.: "It was presented as if the CSIRO thinks that the fuel price is going to go to \$8 litre in the near-future which wasn't really the case, they weren't endorsing it, it was a scenario that had been put together based on the participants' ideas. I find that an unfortunate outcome – especially if CSIRO was somehow tarnished by that" (C. Mottram, 2014, personal communication, 10 October).

“[T]he remaining four combinations are discussed as sensitivity cases” (Graham, Reedman & Poldy 2008, p. 20).

The meeting records note discussion and activities that were reflective of this **discursive context** and related contention regarding what expectations should be given credence regarding oil supply, emerging technologies, and the potential impacts of new public policies. This was especially evident in early forum meetings (e.g. when the core set of scenarios were being debated and defined), e.g.:

“The IEA and EIA oil price projections are at the optimistic end of the range. We really do need an oil price projection that is more in the ‘likely’ range.” (*Meeting 2 record, Future Fuels Forum*)

“Electric vehicles may be either battery or fuel cell driven. Consider whether battery and fuel cell driven electric vehicles should be split. Will fuel cells ever be cost effective versus batteries?” (*Meeting 2 record, Future Fuels Forum*)

“The peak oil scenario is still too optimistic about the responsiveness of infrastructure.” (*Meeting 3 record, Future Fuels Forum*)

“The assumed rate of decline in oil availability will need to be assessed against the international literature” (*Meeting 2 record, Future Fuels Forum*)

Finally, as was discussed in Chapter 4, responses to the scenarios and actors’ advocacy efforts were shaped by how consistent the scenarios and related arguments were with existing assumptions and beliefs. For example, this was seen in the reactions of policymakers to peak oil-focussed scenarios and arguments about the implications of greater import dependency, both of which were largely dismissed. In these ways the production and use of the outputs point to social vulnerabilities (van Lente 2012) related to **discursive contexts**.

In sum, the above aspects of the Future Fuels Forum indicate ways in which this futures forum and its outcomes reflected social conditions during the 2007-09 period. The strong alignment between the forum findings and the social context in which it was run contributed to high salience but is also indicative of constrained thinking (e.g. about possible change to oil prices and the near-term commercial viability of alternative transport fuels). Over recent years developments have diverged from several of the expectations which informed the report. Additionally, the presence of actors from different thought communities – such as networks of

actors that were more or less concerned about fuel security or peak oil – influenced the forum process and utilisation of the outputs. Where the outputs were consistent with the dominant assumptions and arguments in these communities this increased the perceived credibility of related outputs. Where the outputs diverged this led to greater skepticism (e.g. as was evident in some actors’ reactions to the peak oil-focussed scenarios).

5.3.2 The Sustainable Aviation Fuels Road Map (SAFRM) Forum

A number of conventions were relevant to the challenges related to the commercialisation of alternative fuels. In particular, climate *policy conventions* were emphasised by the project leader from CSIRO: “the government ... basically saw the carbon price as being the sole mechanism that they needed to implement” and sought to remove and avoid other measures such as industry assistance style policies (P. Graham, 2015, personal communication, 26 March). He emphasised related challenges and questions:

“Eventually once a carbon price got high enough, the economic case would grow [for alternative aviation fuels] and I think it would go ahead eventually. A carbon price could add 50% to the price of jet fuel eventually. But eventually could be 20 years from now, or more, and this was a roadmap trying to get things started this decade. The question is: how do you get something started soon without a strong carbon price, with marginal economics and a whole bunch of uncertainties?” (P. Graham, 2015, personal communication, 26 March).

Related institutions were influential in debates regarding potential sources of investment and supply chain development options. Some participants, including one of the forum Chairs from CSIRO, expected that airlines would consider directly investing in bio-jetfuel production, such as by adopting a vertical integration model (R. Chamberlain, 2015, personal communication, 9 April). Such approaches would require *unconventional* responses to fuel supply issues. The project leader from CSIRO stated that participants from airlines responded during the forum to inquiries into such possibilities by arguing that “what they’ve learned is that they should concentrate solely on their core business” (P. Graham, 2015, personal communication, 26 March). This position can be described as a *sectoral convention* (i.e. of having a ‘core business’ focus). Consistent with this staff from Virgin Australia (VA) Airlines stated that “at the end of the day the airlines have made it clear that they just want to buy the stuff [i.e. alternative fuels]” (D. White, 2015, personal communication, 1 June) and, related to this, argued that “all we were was an end customer” (R. Boyd, 2015, personal communication, 25 June). The Federal

government didn't want to make major investments in particular fuel/technology options or companies (which would be viewed as picking winners) or use regulatory measures such as a fuel mandate to force change (Australian Government 2011b) and, as noted above, saw a carbon price as the core policy.⁴⁵ The project leader summarised this as follows:

“My sense and understanding of the government was that they had held for a long period of time the view that they don't need to get involved in the fuel market. We'd also been through the Future Fuels Forum and after that forum the government put out a couple of reports that more or less said that we don't have a fuel security issue and it also basically saw the carbon price as being the sole mechanism that they needed to implement. In fact during the process of implementing the carbon price they would get rid of a lot of other policies that are sort-of technology-oriented picking winners type policies... So for those reasons I didn't expect the government to come to the table. On top of that I knew that the airlines weren't going to invest significantly – all that really left was people who don't have a lot of money such as the small-scale refining technology developers who hold patents but don't have the funds to take the technology to the next step” (P. Graham, 2015, personal communication, 26 March).

Many of these aspects of the institutional context were also noted by a public servant who participated in this forum. He stated that “a general policy of not picking winners” had been adopted by the government department he worked for, and asked: “The appetite was to help new industries but how can you do that without picking winners?” (A. Verdier, 2015, personal communication, 16 April). An interviewed senior Federal government staff member also emphasised that the *Strategic Framework for Alternative Transport Fuels* (Australian Government 2011b) – published six months after the SAFRM forum report – aimed to be “market-driven” (Government informant, 2015, personal communication, 12 June). Regarding the potential provision of industry assistance, subsidies, etc., or introduction of new fuel mandate to aid the development of new industries, this staff member further added that “our [policy] framework was clear on that too [i.e. that these *weren't* to be provided].” The

⁴⁵ As part of the Clean Energy Futures package passed by the Federal Government in November 2011 the Australian Renewable Energy Agency (ARENA) and the Clean Energy Finance Corporation (CEFC) were created, however this has not provided or enabled commercialisation-scale investment in alternative transport fuels. ARENA is focussed on the pre-commercialisation research and development and aims to be “technology-neutral”. ARENA has co-funded some further feasibility studies and other projects related to pilot-scale plants. The CEFC didn't commence funding investments until two years after the forum report was published (this commenced on 1 July 2013). In principle the CEFC could assist with the financing commercial projects for alternative fuel production. However the capacity of the CEFC to provide commercial project scale investment is limited. From July 2013 – 30 June 2015 CEFC “made \$1.4 billion in investment commitments for projects over \$3.5 billion in value”, predominantly in wind and solar energy projects, with less than \$100million invested in bioenergy projects (<https://www.cleanenergyfinancecorp.com.au/investments.aspx>, last viewed 03/11/2016).

transport fuel policy area was viewed as having been “contaminated” by past and existing policies such as those supporting ethanol production and mandating its use (Government informant [non-attributable], 2015, personal communication, 12 June).

The *Strategic Framework for Alternative Transport Fuels* conveyed the Australian Government’s **beliefs about the role of the state**. This policy framework argued that government has a limited role in progressing the commercialisation of alternative fuels in Australia and in market development. The core stated roles are “correcting certain market failures where justified and to ensure suitable competition frameworks are in place” (p.39). Similarly, the Federal Minister for Resources and Energy’s views on the core role of markets in optimising outcomes in the energy sector informed the 2012 *Energy White Paper* (Ferguson 2011).

A participant from an aviation fuel supplier, Caltex Australia, argued that the Australian Government inadequately understood the complexity of transitioning to alternative low-carbon jetfuel, especially as a ‘change management’ problem: “There would be some people in government that do understand, but across-the-board there was a view that we’ll let industry sort it out” (M. Ridley-Smith, 2015, personal communication, 20 July).

Consideration of alternative possible commercialisation and uptake possibilities – such as the introduction of fuel mandates or other regulatory pathways – was limited during the forum. Participating government staff didn’t push this during the forum. Such measures were also not widely supported by forum participants and weren’t mentioned in the forum report (CSIRO 2011). The participating aviation fuel supplier, Caltex Australia, didn’t support mandating use of sustainable aviation fuels (M. Ridley-Smith, 2015, personal communication, 20 July). Consistent with this, meeting records state that “a mandate was also discussed however there is little support amongst industry to be imposed with such a stringent means of attaining sustainable fuel supply” (*Meeting 2 record, SAFRM Forum*). In these ways, the forum report reflected prevailing institutions (e.g. regarding the role of government in market development and industry development), whilst also calling for support.

The potential significance of this for the forum outcomes was emphasised by the main participant from Caltex (who weren’t in favour of fuel mandates):

“Without mandates at the moment it is unlikely that you would get an obvious change in the marketplace towards biofuels. That is simply because the economics are just not that compelling... Every biofuels producer is obviously going to campaign for mandates because otherwise they’ve got to compete by being significantly cheaper than fossil fuels” (M. Ridley-Smith, 2015, personal communication, 20 July).

Other institutional factors indicate other ways that this forum was shaped by the organisational and social contexts. Although the project leader from CSIRO wasn’t confident that the roadmap would be implemented their mostly non-interventionist, “hands-off” convening philosophy militated against taking a strong stand during the forum. In this important respect their convening approach can also be viewed as shaped by *behavioural scripts* that were tied to perceived social roles:

“With all forums I want the participants to own the report and its content... I don’t want to shut things down with my views which I might think are realistic but others would think is overly negative. I encouraged the government participants ... to let the group know how the report was being perceived and I tried to challenge things as any facilitator would but I would not have gone as far to say I don’t believe the roadmap is achievable” (P. Graham, 2015, personal communication, 26 March).

The *discursive context* also influenced the process. As was noted in Chapter 4, during the 2007-11 period the aviation sector was increasingly discussing potential shifts towards ‘drop-in’ biofuels (i.e. use of substitute liquid fuels which don’t require the adaptation of aircraft or associated infrastructure). The sector had adopted new goals for greenhouse gas emissions reduction – “carbon-neutral growth by 2020 and the halving of emissions by 2050” (International Air Transport Association 2010, p. 1) – and alternative fuels were viewed as essential for achieving these goals. Consistent with this, the central expectation that guided the forum was that “the industry would move towards using biofuels” (P. Graham, 2015, personal communication, 26 March). “The airlines and others brought arguments to the table as to why this was the only option for the industry” and – as observed by the project leader – “they didn’t want to do a bunch of other scenarios looking at a range of options” (P. Graham, 2015, personal communication, 26 March).

Some actors had high expectations for the commercialisation of new biofuels in the near-future. For example, some participants from airlines believed that emerging biofuels (in particular algae-derived biofuels) “could solve all their problems, soon, and cheap” (CSIRO informant, 2015, personal communication, 15 June). These expectations were consistent with

hype about such biofuels (Edye 2015), with high expectations being prevalent in many relevant *thought/epistemic communities*. A second aspect of the context was the strong focus on the sustainability of biofuels. This enabled CSIRO scientists with sustainability backgrounds to have a role in the forum and is reflected in the discussion of these aspects in the forum report (D. O’Connell, 2015, personal communication, 25 June).

One scientist from CSIRO stated that the differences between some of their conclusions and some of the prevailing hype and the views of some technology proponents led to strong pushback from some forum participants and proponents. Airline participants preferred an alternative source of oil (e.g. plant-based oils) which had key advantages – such as cheaper conversion technologies and existing fuel certification pathways – however research by CSIRO staff pointed to limitations and challenges in terms of volume constraints (e.g. for algal biofuels), cost, or other unsolved challenges such as for the use of seeds from pongamia plants (D. O’Connell, 2015, personal communication, 25 June). CSIRO staff emphasised related intense debates during the forum (when the research findings were shared with participants) which took up significant amounts of time which may have been more productively spent on other activities (D. O’Connell, 2015, personal communication, 25 June).

In sum, the forum process, roadmap construction (e.g. what potential commitments or actions participants were and weren’t willing to consider for inclusion in this roadmap), and subsequent uses of the forum outputs reflected the social conditions in consequential ways. Under different conditions the roadmap that was produced and the impacts may have been significantly different. The move away from providing industry assistance and towards a technology-neutral philosophy – a “laissez-faire, market economics type approach” (government informant, 2015, personal communication, 12 June) – appears to have been influential and reflected prevailing conventions regarding the role of government and industry development. Other aspects of the social context not explored above may also have influenced the impact (e.g. use of the forum report) such as by decreasing management attention, for example competition in the local air travel market, the related “capacity war” which intensified during 2013-2015 and resulting losses and cost reductions (in the aviation

sector), associated collaboration barriers, and difficulty accessing early-stage capital.⁴⁶

5.3.3 Future Grid Forum

CSIRO staff stated that they took their “hands-off philosophy” to “the extreme” in the Future Grid Forum and pointed to their related “reticence to impose something” on the forum (P. Graham, 2015, personal communication, 23 November). On the one hand, this was guided by the process goal of participants owning the outputs (see Chapter 3), such as whereby the scenarios are viewed as the industry’s scenarios and not CSIRO’s views. On the other hand, CSIRO staff also stated that they attempt to “stay at arm’s length” from contentious aspects of the forum processes such as any disputes or conflicts (P. Graham, 2014, personal communication, 6 June). In these and other ways the forum was institutionally structured by these *non-interventionist conventions*. For example, some participants argued that there was an inability to fully explore important but controversial topics (e.g. possibility of the asset bases of electricity network businesses being written-down).⁴⁷ A more interventionist convenor may have done more to enable fuller exploration of such topics. Not all participants were critical of this approach but it was seen as an important part of the forum, as expressed by the following participant from Grid Australia (a peak industry body):

“The FGF [Future Grid Forum] provided a thoughtful and respectful environment for addressing a diverse set of conditions, but stopped short of real engagement with challenging issues where diverse opinions are more strongly held, and would have been more strongly contested” (C. Popple, 2016, personal communication, 20 April).

⁴⁶ These factors were emphasised by industry participants (E.g. from Virgin Australia, Boeing, etc) and informants familiar with the biofuels sector and alternative fuels. For example, the founder and Chair of the Australian Initiative for Sustainable Aviation Fuels (AISAF) argued that “we were put into a holding pattern by the turbulence in the [Australian] aviation sector” (S. Pond, 2015, personal communication, 23 June). Dr Pond further argued that “if the environment people [at the airlines] around the table went higher up the organisation they got absolutely squashed... The airline public policy folks had so many other issues on the boil that the last thing they wanted was to raise another one with government”. Similarly, one of the main delegates from Boeing, William Lyons, argued that the capacity/pricing war which developed in the Australian air travel market meant that the local major Australian airlines (Qantas and Virgin Australia) “didn’t have the focus that they also need to have on this”, and, overall, contended that “you had two major stakeholder groups who were just not able to participate in any meaningful way” (W. Lyons, 2015, personal communication, 16 June).

⁴⁷ A mixture of industry and civil society participants pointed to this dynamic. For example, one interviewed industry participant pointed to “touchy subjects” which weren’t fully explored (B. Waters, 2016, personal communication, 29 January), and an NGO participant argued that important “sensitive topics” weren’t fully explored due the objections some industry participants (NGO informant [off-the-record], 2016, personal communication, 30 March).

Some participants argued that other aspects of CSIRO's approach were influential during the process (e.g. their consensus approach and organisational *conventions* related to being 'policy relevant but not policy prescriptive'), along with the organisational/sectoral mix that was present.⁴⁸ For example, forum participants made the following observations:

"We had four main recommendations but even calling them recommendations was too challenging for the forum. Maybe I'm being unfair because it was hard for everyone to agree.... However, I didn't get the impression that this [public policy recommendations] was something they [CSIRO] really, really wanted to push" (O. Kember, 2016, personal communication, 24 March).

"CSIRO are good at presenting the results but ... you almost need a political spin doctor to give the political version of the results in order to get it used in the political forums that matter in a sense... They had some good writers involved but I don't think they were sufficiently "political" to achieve higher impact" (D. Bowker, 2016, personal communication, 31 March).

"CSIRO seemed more comfortable focusing on aspects that they had modelled or measured, or which were more amenable to being modelled, and the more uncertain and qualitative aspects of the discussion got less attention. And part of that I think was because there were more policymakers and corporate representatives in the room focused on those standard cost issues as well. If you had stronger NGO representation they might have been able to force the group to reckon more closely with less traditional issues and assumptions" (O. Kember, 2016, personal communication, 24 March).

"CSIRO are highly focussed on consensus sometimes to the point where we go around in a quite a few circles without necessarily having the key debate that you need to have because different views are held... If I do have a concern about the modus operandi of CSIRO it's that one. I think there can be a bit too much focus on achieving consensus" (C. Popple, 2016, personal communication, 22 April).

Other interviewed forum participants also emphasised the perceived implications of the consensus orientation adopted by CSIRO staff:

"All the assumptions were argued over by the group and you could see ambition being sort of dragged down by more conservative assumptions during that process... all four of the scenarios are too conservative on stuff that's already happened [since the

⁴⁸ Similarly, regarding making recommendations, the meeting records state that "we must limit ourselves to "options"" (source: Meeting 6 record). Also see related process limitations that were criticised by some Victorian public servants who participated in the Future Fuels Forum (see Chapter 4).

forum]” (B. Waters, 2016, personal communication, 29 January).⁴⁹

“You’ve got a process which is really going to end up putting out what is the lowest common denominator of what people were prepared to agree. It’s impossible to get a group to agree with its most ambitious extreme member. It’s always going to be how many can you get to sign-off on something which therefore needs to be fairly safe... I kind of feel like there was an unavoidable amount of caution built into the process because of the need to get the group to agree on things. Possibly more effort could have been made to push us as a group to be more daring with what we wanted to say” (O. Kember, 2016, personal communication, 24 March).

The approach used by CSIRO was consequential for the analysis and modelling in other ways (see themes below). The project leader from CSIRO referred to *conventions* at a scientific organisation, arguing that “we have to be [conservative]” as employees of the national research agency (P. Graham, 2015, personal communication, 23 November). He elaborated:

“Because we’re a science agency concepts of evidence and proof and traceability are kind of in our DNA and the idea that we would have lots of unsubstantiated data and so on underpinning things just wouldn’t fit. When things are moving fast that turns out to be conservative. Just take something like solar. If you’re using the last published cost of solar from a reputable source that means that you’re likely to be two or three years behind where the actual cost of solar is currently when you’re talking about it. All of those sorts of things come into play when you have a very high standard for evidence” (P. Graham, 2015, personal communication, 23 November).

The process and scenarios “carry the imprint of their political, social, and organizational contexts of origin” (Garb, Pulver & Vandevveer 2008, p. 4) in many additional ways. The forum meeting records outline how the project leaders and participants were aware of many concurrent studies and policy reviews and frequently considered these. An activity run during most forum meetings – which was called the “group bulletin” – aimed to ensure that participants were aware of other studies and reviews and their key findings. National, local and international studies and reviews were all noted, such as Federal government agency studies and policies (e.g. the Australian Energy Market Commission’s [AEMC] *Power of Choice* review, the 100% Renewables modelling study by the Australian Energy Market Operator [AEMO], the Federal Government’s *Energy White Paper*), and State-level reviews/policies. The meeting records show that participants wanted to be clear on how the FGF analysis was aligned with

⁴⁹ Waters further argued that “by definition you were never going to get any extreme assumptions out of that sort of process, you’re going to head towards a middle or lower number”.

other studies, understand any differences, and draw on other assessments of the future which were viewed as credible or plausible. For example, some participants inquired into whether the forum modelling would be aligned with, or could be integrated with, other modelling. Example comments from the meeting records are shown below:

“Can we harmoniser [sic] AEMO and FGF modelling to 2030 and understand the differences?³” (*Meeting 2 record, Future Grid Forum*)

“Get in contact with the Ausgrid/SGSC [Smart Grid, Smart City] study and manage the differences in the approaches of the two studies” (*Meeting 7 record, Future Grid Forum*)

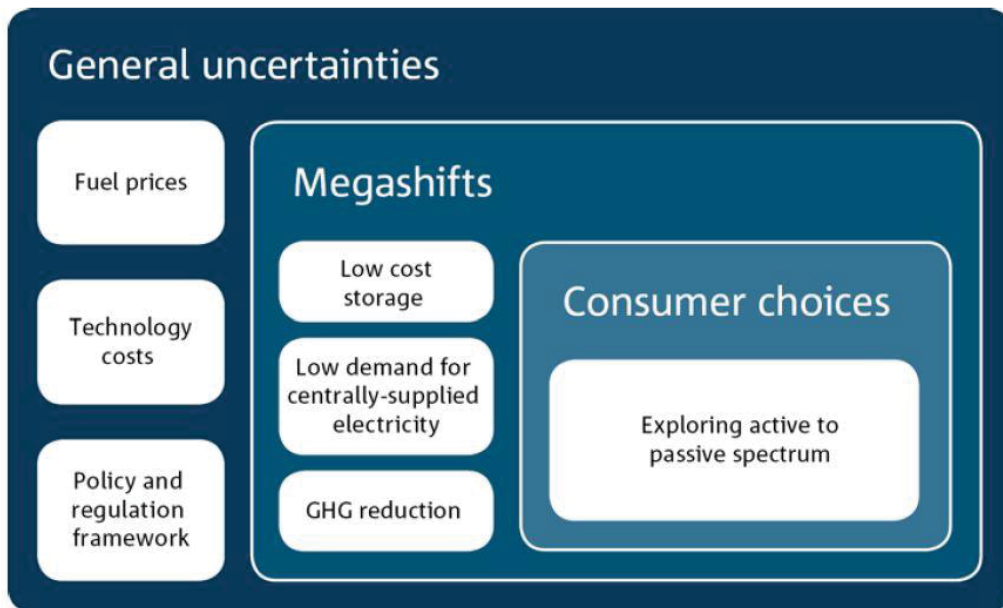
“The results presented are different to AEMO’s NTNDP results [National Transmission Network Development Plan]” (*Meeting 2 record, Future Grid Forum*)⁵⁰

“Check the Grattan Institute’s gas report for plausible gas price ranges” (*Meeting 7 record, Future Grid Forum*)

Several of the core themes in the forum report are consistent with the parallel reviews and studies. This is one way that the analysis and report can be interpreted as carrying the “imprint” of the context in which it was produced. For example, the emphasis on consumer choices and engagement in the scenario analysis (see *Figure 7* below) was consistent with other reviews. For example, the AEMC *Power of Choice* review emphasised consumer engagement and informed consumer choices along with related market reforms. The *Energy White Paper* emphasised related reforms in the domestic energy sector – regarding energy use, generation and management – including “educating consumers and offering innovative products to help meet consumer needs, particularly where demand-side products can be offered to help reduce peak load” (Australian Government 2012, p. xi) and the growth of distributed generation. The strong emphasis on peak demand management in some of the Future Grid Forum scenarios and in the forum report is also consistent with the strong focus on peak demand in reviews conducted during 2011-2013.

⁵⁰ The NTNDP “provides an independent, strategic view of the efficient development of the National Electricity Market (NEM) transmission grid over a 20-year planning horizon. AEMO publishes the annual NTNDP as part of its role as national transmission planner under the National Electricity Law, in accordance with clause 5.20.2 of the National Electricity Rules” (see: <http://www.aemo.com.au/Electricity/National-Electricity-Market-NEM/Planning-and-forecasting/National-Transmission-Network-Development-Plan>, last viewed 06/11/2016).

Figure 7: Future Grid Forum scenario development framework (CSIRO 2013a, p. 25)



Other aspects of the forum report addressed emerging issues and trends that were becoming a prominent part of the *discursive context*. For example, the potential for a high-level of customer disconnection from the electricity grid, and the related potential for utility “death spiral” style future outcomes, are discussed (CSIRO 2013a, pp. 37-40). Linked with these emerging issues, “the advent of low-cost electricity storage” and “sustained low demand for centrally-supplied electricity” are described as two of the three most important potential “megashifts” (CSIRO 2013a, p. 25). Some of the forum participants identified related dominant themes in the meetings, e.g.:

“I think there was a bit of groupthink when you got there [to the forum]. It was all going to be off-grid, it was all going to be solar. There was perhaps a preoccupation with climate change to some extent, not to the exclusion of everything else, but it was certainly driven to a large extent by that” (Government participant/informant [non-attributable], 2016, personal communication 18 March).

The forum modelling drew on future projections released by government agencies, some of which were forum participants (e.g. The Australian Energy Market Operator). This can be interpreted as a form of anchoring (anchoring in existing expectations); however, this may have also problematically influenced some of the forum analysis (see below). In particular, many of the assumptions – such for the main assumptions used for future electricity demand,

future carbon prices which were used “as a proxy for any type of targeted greenhouse gas reduction policy” (Graham et al. 2013), electricity generation technologies (e.g. capital cost assumptions), and for fuel costs – were based on, or derived from, projections published by government bodies and agencies such as the Australian Energy Market Operator, Bureau of Resources and Energy Economics (BREE), and the Commonwealth Department of the Treasury. Additionally, earlier modelling work by CSIRO and ACIL Tasman’s was also drawn on (CSIRO and ACIL Tasman led the forum modelling work).

In sum, this forum also reflects the social conditions in which it was run in several ways. Many of the focal issues and themes had become more prominent at the time of the forum, such as the potential for a large number of grid disconnections and related “death spiral” style outcomes, which motivated the participation of some actors and informed the forum’s analysis. Similarly, in other ways the forum was embedded in discursive processes. Like the convening approach taken by CSIRO staff in other forums, the approach of CSIRO staff appears to have been institutional structured in consequential ways. This approach was described by the project leader as a “hands-off philosophy which we took to the extreme” and as “conservative”, and it also avoided strongly prescriptive conclusions (P. Graham, 2015, personal communication, 27 November). This approach may have helped build credibility such as by linking the study with the previously published projections of other organisations (e.g. government agencies). However, as was also noted, the heavy emphasis on using published data and reputable sources, and the hands-off approach, also influenced the forum’s analysis in potentially consequential ways.⁵¹ In all these ways, and others, the products produced by the forum (e.g. the scenarios, modelling results, etc) cannot be divorced from the conditions of their production and the main actors who were involved. This influenced both the salience of the outputs (by addressing themes of interest to actors) and their utility (e.g. by not providing strong policy recommendations). Some participants also argued that the findings were shaped by “caution” (O. Kember, 2016, personal communication, 24 March) and “conservative

⁵¹ The 2015 “refresh” of the Future Grid Forum scenarios prepared for the Network Transformation Roadmap project provides some useful illustrative examples (Graham et al. 2015). Graham et al note that over the previous two years there had been strong changes to AEMO’s projections for electricity consumption and peak demand (now significantly lower), that the cost of battery storage technologies has improved faster than was anticipated, electric vehicle sales have been stronger, and, finally, that forecasted fuel prices (e.g. for oil and petroleum products, gas, etc.) are now lower for the next decade than was previously considered. In 2013 there were strong signals for or evidence of this (or indicating that such changes to forecasts could be justified); however, consideration of this may have been constrained by the preference for using published data and projections.

assumptions” (B. Waters, 2016, personal communication, 29 January).

5.3.4 Interpretation of the case: are PKPs social? If this is so, what is the significance?

This perspective on the case argues that PKPs and their impacts cannot be divorced from the conditions of their production and use, such as the social conditions which influenced involved actors (e.g. process convenors, participants, etc.). The case evidence provides strong evidence of the influence of social institutions and the embeddedness of actors (and the forums themselves) in discursive processes. There is evidence that this ‘embeddedness’ constrained thinking in some futures forums, such as core expectation of higher oil prices that shaped the Future Fuels Forum. Beliefs and norms about the roles of government in modern capitalism and the role of science, along with related institutions, also influenced each forum, the interpretation and use of the forum reports (e.g. how policymakers interpreted the SAFRM report and roadmap) and, therefore, the forum impacts. This perspective also provides a way of explaining the convening approach of CSIRO staff and how this influenced the forums, the analysis they did and the outputs (e.g. by adopting a conservative approach, being non-prescriptive, etc.), and some of the resulting outcomes. Similarly, other aspects of the process – such as the strong emphasis on remaining neutral and being objective – are consistent with current conventions regarding the production of knowledge as a “neutral ‘input’” to policy-making and decision processes (Turnhout, Dewulf & Hulme 2016, p. 70).

Importantly, the embeddedness of the actors and futures forums in discursive processes appears to both enable and constrain PKPs. As previous studies from the sociology of expectations have shown credibility, legitimacy, and salience are typically enhanced if outputs are consistent with currently prominent expectations, related credible images of the future and assumptions, and current policy agendas (van Lente 2012). There is evidence in the case that circulating images and arguments motivated participation in futures forums and informed judgments about the credibility of the outputs, thereby often enabling PKPs. Such factors can also be a constraint, such as by constraining thinking (e.g. during a futures forum), and they can reduce utilisation. For instance, aspects of the case are consistent with van Lente’s (2012, p. 779) related argument that surprising assessments of the future – i.e. those that deviate from the images of the future and arguments which are currently judged to be credible – tend to be “vulnerable and less forceful”. For example, key policymakers largely dismissed the peak oil-oriented scenarios published by the Future Fuels Forum. Studies have also shown that

related forms of cognitive inertia and ‘lock-in’ are often difficult to alleviate (Healey & Hodgkinson 2008; van Lente 2012) as was evident in the futures forums.

A stronger claim can also be made: PKPs can reproduce or reinforce the social context (in contrast to impact objectives which often are focussed on *intervening* in the social context). There is mixed evidence for this claim. The Future Fuels Forum and SAFRM forum provide the strongest evidence. For example, the aviation sector wanted to persuade governments to provide industry assistance to help enable the transition to alternative jetfuel (R. Chamberlain, 2015, personal communication, 9 April). In contrast, the process appeared to reinforce the Federal government’s existing ‘let industry sort it out’ policy position.

This is not to say that actors cannot “resist [social] structures and create alternative worlds” (Fligstein 2008, p. 6). But – as sociologists have long argued – actors are enmeshed in social structures and these structures influence their actions and resulting outcomes. In this respect, the chapter indicates that PKPs are no different from other practices.

Additionally, this perspective on the case emphasises responses to uncertainty which are consistent with sociological explanations for behaviour under uncertainty and decision-making (see *Table 21* below). This is an important way that PKPs can be influenced by social conditions. In particular the case provides strong evidence of script following under uncertain conditions. In each of the forums there was evidence that script following influenced the process and outcomes, i.e. the production, assessment and use/non-use of anticipatory knowledge. For example, in the SAFMR forum the approach of the federal Australian Government (of ‘let industry sort it out’ and related minimal State intervention) and the airlines (who argued that they should ‘stick to our core business’) can be interpreted as script following behaviour under uncertainty. A further example is the behaviour guided by the dominant convention of not ‘picking winners’. Such behaviour may also be influenced by the perceived level of uncertainty and whether it is possible to reduce key uncertainties by acquiring more information (this is discussed further below in *Section 5.4*).

Table 21: Alternative bases for decision-making (Beckert 2013b, p. 223)

Approach	Situation	Mode of operation	Basis for decisions
Rational expectations approach	Certainty and risk	Calculation	Rational expectations
Behavioural economics	Complexity and uncertainty	Cognitive biases	Heuristics
Sociological institutionalism	Uncertainty	Script following	Social macrostructures
Sociological fictionalism	Uncertainty	Imagination	Fictional expectations

Action, according to some sociological approaches which emphasise social institutions and cultural frames, is motivated by the desire to conform to norms, avoid related sanctions, and/or a desire to be seen as ‘normal’ (Beckert 2013b; Fligstein 2008, pp. 178-83). Whilst the capacity to probe motivations was limited in this study in the case there were examples of such behaviour such as conformity to organisational and scientific norms.

The participatory nature of the forum process also provided clear opportunities for “anchoring” (Beckert 2016) the analysis in the existing expectations of relevant actors (as well as opportunities to challenge such views as emphasised by some hypothesised mechanisms). This was most clearly seen in the Future Fuels Forum and Future Grid Forum. Consideration of such anchoring provides an alternative explanation for why the analysis was widely judged as credible. Similar to the sociology of expectations (see *Section 5.2*) this also emphasises the importance of discursive processes.

5.4 Implications for the intervention theories to-be-tested

The case explanation presented in this chapter can be further interpreted from two perspectives: (i) the potential implications for a refined understanding of the hypothesised mechanisms (e.g. are the case findings consistent with the working theories?); and (ii) new insights into contextual factors that influence the firing of relevant mechanisms. These are considered in turn below.

Three core implications for the current understanding of the mechanisms are suggested by this case analysis. One mechanism, the *provision of resources that can credibly support strategic decision-making (M2)*, may be enabled less by the hypothesised set of factors (e.g. the ‘balanced’ mix of actors and interests that are involved, transparent modelling processes, etc.) and more so by anchoring the analysis in the expectations of involved and/or influential actors,

and whether the analysis is aligned with existing repertoires (as per van Lente 2012). The former process has also been termed “epistemic participation” (Reichmann 2013). Second, the *reduction of uncertainty* (**M1**) may operate differently. The theoretical perspectives considered in this chapter point to other ways that actors try to reduce uncertainty in order to enable action (Beckert & Dequech 2005; van Lente 2010). Additionally, the participatory nature of the futures forum process could enable actors to reduce uncertainty “by reciprocally affirming which expectations should be given credence” (Beckert 2016, p. 235). This may particularly be the case when actors have the same or similar beliefs. The third implication is the need to more deeply consider the way that possible countervailing processes are addressed and minimised. For example, under highly uncertain conditions (**C1**) practitioners may need to be more aware of the likelihood of “script following” style behaviours (Beckert 2013b, p. 223) and the associated cognitive influence of institutions. In contrast, unconventional or bold behaviour may be enabled by challenging actors’ assumptions/beliefs (see **M3**), but opposing cognitive forces will also be operating. Another example is the influence of social factors on mental action – such as the influence of “mental membership” in different thought communities on cognition (Zerubavel 1997) – which can be barrier to the *creation of common understandings* (**M4**). These examples point to further contextual factors (see below).

Three additional important contextual factors are suggested by the case analysis: (i) fundamental uncertainty; (ii) the embeddedness of actors in discursive processes and thought communities; and (iii) institutional factors related to the approach of process convenors and facilitators. If actors are dealing with fundamental uncertainty – that is, situations characterised by significant indeterminacy – then such uncertainty “cannot be reduced by getting ‘information’” (van Lente 2010, p. 106) such as from a forum report. This context may trigger different mechanisms such as script following, or forms of herd behaviour when this indeterminacy is related to the “as-yet-undetermined actions of other actors” and it’s “important to take the same direction as others are taking” (van Lente 2010, p. 106). The embeddedness of actors in discursive processes and thought communities has been argued to militate against *critical reflection on actors’ assumptions and beliefs* (**M3**).⁵² As clearly evidenced by the case, actors frequently bring highly developed arguments and viewpoints to

⁵² Van Lente (2012, p. 778) argued that because a so-called ‘foresight’ exercise “necessarily draws from existing repertoires of expectations, it will not generate many ‘new’ expectations, although ‘new combinations’ between elements of the repertoires are possible”. He further argues that because these exercises “draw from the repertoire of circulating statements [about the future]” they will tend to reproduce the images and arguments that are already circulating (van Lente 2012, p. 779).

the table which they are committed to and are seeking to convince others' of (e.g. the peak oil activists that attended the Future Fuels Forum). This contextual factor may be partly addressed through diverse participation in participatory exercises like the futures forum process, so that actors can challenge each other's arguments and views, however like-minded actors can form homogenous subgroups as was seen in the Future Fuels Forum (also see Chapter 7). Finally, the case suggests that institutional factors which influence the approach of process convenors (and/or facilitators) are consequential. For example, achieving *informal dispute resolution (M6)* – one hypothesised generative mechanism for which there was little or no evidence – may have required a different convening approach which sought to engage more directly and fully with key contentious issues about which participants disagreed. Similarly, other practitioners may have been more willing to challenge participants.

5.5 Chapter conclusions

The case analysis presented in this chapter has argued that PKPs, and their eventual impact, tend to reflect (or be “marked” by) the contextual circumstances in which they're used. This is readily seen in the ways that the forum outputs reflect the social conditions (e.g. the scenarios and/or the roadmap constructed by forum participants). The argument that PKPs are social can help to explain additional aspects of this case. For example, it helps to explain why forum outputs were judged to be credible and by whom, along with related key dilemmas often faced by practitioners (see van Lente 2012). The limited nature of the consensuses that were typically enabled (or ‘produced’) by the futures forums was also socially conditioned, such as by the membership of actors in different thought/epistemic communities. (Additional factors are considered in Chapter 6 and Chapter 7).

The case also points to the influence of the contextual circumstances on the extent to which PKPs can be used as interventions. An illustrative example is the influence of contextual factors on whether PKPs enable critical reflection. To the extent that a situation is characterised by fundamental uncertainty actors may use strategies to reduce uncertainty which limit their critical reflection and constrain action, if this limits “the choice set of actors” (Beckert & Dequech 2005, p. 586) or contributes to “rigidity in the responses to changes in an uncertain environment” (Beckert & Dequech 2005, p. 585). In other words, the context may trigger different mechanisms which contribute to limited critical reflection.

These findings also point to a case explanation: the identified outcomes patterns reflect the social aspects of PKPs, in particular the ways that knowledge claims (about the future) – along with their use and downstream effects – are the *result* of social processes, along with the ways in which PKPs are marked by the contextual circumstances.

Regarding the intervention theories to-be-tested, the case evidence and analysis presented in this chapter provides alternative perspectives on ways that some of the hypothesised mechanisms operate and points to important contextual factors which need to be better considered. Much of the case evidence is also consistent with contrasting theorisation of what enables anticipatory knowledge to be credible, such as strong alignment with already-circulating images of the future and existing discourses, and the existence (and/or the development) of related cognitive fields (see Beckert 2016; van Lente 2012).

Additionally, the case evidence and analysis points to the need for a dual perspective: 1) considering how PKPs can reproduce or even reinforce the social context in which they occur (see the above arguments); and 2) considering how they can influence these contexts. The former process was emphasised by the analysis in this chapter through the emphasis on the social conditions under which the forums were conducted and how this influenced the firing of causal mechanisms. The latter process can occur through reinforcing existing discursive processes (e.g. as seen in the Future Grid Forum).⁵³ The influence of PKPs on the social context can also occur, in part, through the agency of involved actors, an aspect which is more strongly emphasised in Chapter 6 and Chapter 7.

⁵³ If this point is unclear an historical example may help to clarify this argument. As Carter' (2007, p. 43) notes the *Limits to Growth* report published by the Club of Rome in the early 1970s was a socially significant and impactful report but he also noted that "its pessimism also resonated with the contemporary 'survivalist' concerns ... about population growth". In other words, the pre-existing discursive context contributed to the report being widely read and impactful and, simultaneously, the report and the debates it prompted also reinforced these discourses.

CHAPTER 6: Prospective knowledge practices as political practices

6.1 Introduction

In contrast to Chapter 5, the case analysis presented in this chapter focusses on the involved actors, their strategic goals, their social relations and related interactions between actors in the futures forums. The analysis is also guided by Pawson's (2013) argument that participants in social interventions and other stakeholders should be considered active *agents* and evaluation research consequently ought to consider their volitions. Actors have desired ends and – in the case of this research – their participation in futures forums, willingness to fund or support such research, and the interpretation and use of the outputs may all be shaped by these ends. To examine these aspects of the case, this chapter uses a broad conceptualisation of 'politics' and 'political' (as is sketched in *Section 6.2* below).

The potentially political aspects of prospective knowledge practices (PKPs) were emphasised by CSIRO staff. For example, the project leader of each of the focal forums asserted that "everyone that gets involved in these processes hopes to come up with a result which could influence government policy in their favour" (P. Graham, 2014, personal communication, 2 June), a view which was partly confirmed by the survey data (see Chapter 4). However, further remarks by the same CSIRO staff member pointed to the potential for consequential tensions because CSIRO staff didn't want to "get into a position where CSIRO was seen as trying to drive policy". Past and current CSIRO staff involved with the futures forums made similar remarks about the forums such as about the goals of the aviation sector in the Sustainable Aviation Fuels Road Map Forum (R. Chamberlain, 2015, personal communication, 9 June). Similarly, a former CSIRO staff member who was involved with the Future Fuels Forum described it as "a political exercise" (D. Lamb, 2014, personal communication, 18 August).

Consistent with this view of PKPs some practitioner-scholars argue that scenarios are inherently "selective and political" (Selin 2006, p. 6) and that the creation of scenario stories "is an inherently political act" (Raven & Elahi 2015, p. 61). However, such scholars have not elaborated in detail what is specifically political about scenarios and scenario construction.

The chapter is structured the same as Chapter 5. The chapter initially outlines the theoretical perspectives used in the case analysis presented in this chapter. I then reconsider each of the

forums and the case as-a-whole and summarise the implications of this interpretation of the case for the intervention theories. The final section outlines the chapter conclusions.

6.2 Theoretical perspective and key concepts

The perspective and concepts used in this chapter are drawn on to develop and consider a political view of PKPs. As was outlined in Chapter 1 there is a need to consider the production, assessment and use of anticipatory knowledge such as by examining how and why the outputs from the futures forum exercises are used and to what effect. Politics is relevant to all of these types of PKPs.

Whilst the political is often viewed as solely pertaining to the State and the associated political institutions and arenas (e.g. parliaments), 'politics' can also be viewed as a process or activities which can take place in any context (Heywood 2013). The latter is the focus here, such as with respect to understanding actor behaviour in the futures forums. To lay out a conceptual framework for analysing PKPs as political practices the following elements are defined below:

- General political behaviour;
- Actor agency as an outcome of politics and political competencies;
- Actor learning and research utilisation as political processes; and
- Science as politics by other means.

General political behaviour

Broader definitions of politics (beyond simply the activities of politicians within a state) emphasise three aspects of politics and associated behaviour. Each is outlined below:

Controlling and reconciling diverse interests/preferences: Politics can be conceptualised as a "means of resolving conflict" and enabling action through "compromise, conciliation and negotiation, rather than through force and naked power" (Heywood 2013, p. 8). Similarly, Scruton (2007, pp. 534-5) notes that politics is sometimes seen as "the art of controlling and reconciling the diverse interests within a state". This perspective informs Pielke's (2007, p. 22) more general definition of politics as the process of "bargaining, negotiation, and compromise in pursuit of desired ends". As per this broad view of politics, political behaviours (both overt and covert) are forms of action that often seek to reconcile individual interests with collective

action and/or to achieve compromises that conciliate differing interests (also see bargaining games and processes below). Some see this as something that is achieved by actors via their political skills (Bacharach 2016); others contend that an authoritative entity is needed to effect conciliation between diverse interests (e.g. Scruton 2007).

Bargaining games and processes: Many scholars argue that bargaining processes are central to politics. For example, a model of governmental action used in an influential analysis of the Cuban missile crisis argues that such action is “a resultant of bargaining games among players” (Allison & Zelikow 1999, p. 6). Such actions are often substantially different from what the players originally intended because the decisions are *emergent* from the interaction of multiple actors and competing preferences within a decision arena (Allison & Zelikow 1999). Doron and Sened (2001, p. 6) similarly argue that “bargaining prevails in most aspects of the phenomenon we choose to define as ‘political’” because “it is necessary to bridge prevailing differences among the individuals involved. The bridge is necessary because the elements, over which these differences exist, whether tangible or intangible, are scarce and somehow bounded by particular constraints”.⁵⁴ Bargaining is thus a process where “because of the presence of others, the people involved in the process must accept outcomes that are less than ideal for them, or trade one possible favored outcome for another” (Doron & Sened 2001, p. 2). Bargaining processes are affected by a number of factors, including: the number of players; the differences of interests, preferences, values, or belief systems; time factors; interdependencies; and the rules of progress (see Doron & Sened 2001).

Gaining, retaining and/or using power: politics also relates to power as emphasised by other definitions of politics which centre on “the process of gaining and retaining power” (Roberts 2009, p. 202) and “the ability to achieve a desired outcome, through whatever means” (Heywood 2013, p. 10). Whilst this is most obviously evident in efforts to control a government and to exercise associated political power, it is seen in organisational politics (see below) and social change processes. This conceptualisation of political activity has also informed social studies of science, in particular the strategic alliance building seen in scientific fields and the

⁵⁴ Like Pielke, Doron and Sened (2001, p. 2) note that “the term ‘politics’ is often taken to mean engaging in activities involving tradeoffs, deals, and compromises between unlikely parties”.

efforts of scientists to enhance their credibility.⁵⁵

The above general aspects of political behaviour are evident in specific contexts (e.g. organisational politics) and specific actions (e.g. strategically influencing actor expectations).

Actor agency as an outcome of politics and political competencies

Social scientists have also studied organisational politics and the behaviours of leaders and managers in organisations. Similar to some definitions presented above politics in management teams has been defined as “the observable, but often covert, actions by which executives enhance their power to influence a decision” (Eisenhardt & Bourgeois 1988, pp. 737-8). This form of politics influences the agency of actors. Related behaviours include “behind-the-scenes coalition formation, offline lobbying and cooptation attempts, withholding information, and controlling agendas” (Eisenhardt & Bourgeois 1988, p. 738). Relevant to the present study such politics can be evident in the use of strategy tools (Jarzabkowski & Kaplan 2015). For example, tools can be used or adapted to create spaces in which actors define and negotiate their interests (Jarzabkowski & Kaplan 2015).

Related to these forms of politics, some scholars argue that successful leaders who are able to advance their agendas (i.e. those who have *agency*) are empowered by their political skills. For example, in *The Agenda Mover* Bacharach (2016) argues that leaders should adopt a political view of organisations and cultivate related micro-skills that enable them to build support for their agenda(s) such as through coalition building, by anticipating and addressing resistance, and getting their ideas validated and legitimated.⁵⁶ According to this view of politics, action is a political process of *agenda moving* where agency is managed and enhanced by building support for ideas and addressing opposition from those with competing agendas and/or interests (Bacharach 2016). This argument that actors need both managerial and political competencies is echoed by sociologists who point to the use of “social skill” by actors who

⁵⁵ As noted by Brown (2015, p. 12) this was a key theme in Bruno Latour’s early research (who is an influential science studies scholar): “Latour’s early studies linked the notion that ‘science is politics’ to a specific view of political activity as strategic alliance building. Latour and Woolgar (1979/1986) characterized scientists as ‘strategists’ engaged in a struggle for credibility, whose ‘political ability is invested in the heart of doing science’ (p. 213, see also p. 237)”.

⁵⁶ Specifically, Bacharach (2016, p. 21) argues that “organisations are political systems” and, related to this, he contends that “in virtually every organization, beneath the façade of cooperation, there is a cauldron of competing agendas and differing intentions” (pp.98-99).

seek to achieve collective action (Fligstein 2001, 2008).

Finally, related to the core focus of this study on anticipatory knowledge, expectation management and creation can be understood as a form of agency which is, in part, the outcome of political processes (Beckert 2013a, 2013b, 2016; Petersen 2011). Beckert (2013b) argues that theories of expectations and associated agency processes are also a theory of politics. He refers to the “fictional character” of expectations under conditions of uncertainty and argues that actors purposefully shape them and consequently influence decisions – i.e. have agency – through “a political game of negotiation and manipulation of the interpretation of a situation” (Beckert 2013a, p. 342).

Two related arguments are made by Beckert. That “the contingency of expectations ... is an entry point for the exercise of power” (Beckert 2016, p. 80) and this is an effective way to shape the decision-making of other actors. Second, actors will seek to influence expectations in line with their interests:

If expectations are contingent, if decisions depend on expectations, and if the decisions of others influence outcomes, then actors have an interest in influencing the expectations of other actors. How successfully actors are able to pursue this interest is an expression of the power they command (Beckert 2016, p. 80).

In other words, when expectations are contingent they are “open to interest-based politics” where actors seek to influence others’ expectations for personal gain and/or to advance their interests (Beckert 2014, p. 11). The power of actors – according to this perspective – is measured by the extent to which their expectations count (Beckert 2016). This, in turn, is a way that powerful actors have agency: they are able to make their “imaginary of the future become influential and mobilize others to turn it into the future present” (Beckert 2016, p. 85).

Actor learning and research utilisation as political processes

Actor learning in policy processes has also been argued to be political (Cairney 2015a, 2016). That is, such actor learning typically is “not a disinterested search for “truth”” (Jenkins-Smith & Sabatier 1993, p. 45) as per commonly-held scientific ideals. Political scientists studying actor learning in policy processes point to “the tendency to select, interpret, and sometimes distort information” (Weible et al. 2012, p. 8). For example actors in competing coalitions (e.g.

advocacy coalitions) develop and defend arguments related to their policy preferences and typically resist competing views (Cairney 2015a). Additionally, decisions to use or to not use evidence can be an exercise of power (Cairney 2016), such as when actors are seeking to influence which problem definition is used or is viewed as credible, or when actors are seeking to influence other actors' expectations (see subsection above).

Contrary to the forms of research utilisation often envisaged by scientists, research utilisation can be highly political or tactical such as when research is used as "political ammunition" (Weiss 1979). For example, Weiss (1979, p. 429) notes that when opinions have hardened (e.g. as seen in entrenched policy debates) research can be used as political ammunition:

It becomes ammunition for the side that finds its conclusions congenial and supportive. Partisans flourish the evidence in an attempt to neutralise opponents, convince waverers, and bolster supporters. Even if conclusions have to be ripped out of context (with suppression of qualifications and of evidence "on the other hand"), research becomes grist to the mill.

Overall, actor learning can be a political process whereby it is shaped by actors' interests and related preferences. This is relevant to the interpretation of new information, which is often influenced by actors' policy beliefs (Cairney 2015a), and to the use of information (e.g. for advocacy or policy-making purposes).

Science as politics by other means

More broadly, many Science and Technology Studies (STS) scholars argue that science and technology are *intrinsically* political (Brown 2015; Cozzens & Woodhouse 1996; Frickel & Moore 2006; Moore 2010).⁵⁷ This view is often expressed in polemical critiques of scientism (Brown 2015) and it informs analysis of the politics of knowledge (e.g. Scoones, Newell & Leach 2015). Whilst the argument that science is political and subject to politicisation depends in part on how politics is conceived – for example see the earlier subsections of this chapter and Brown (2015) – one useful characterisation of 'political' uses this term broadly to describe the origins, implications or effects of scientific research (Brown 2015).

⁵⁷ This was summarised by Moore (2010, p. 793) as follows: "if nothing else, the field has been loosely unified by opposition to the idea that science and technology are politically neutral and autonomous." Some STS scholars go so far as to argue that science and politics are mutually constitutive, adopting a "coproduction" theoretical perspective on the relationship between science and society (Jasanoff 2004).

Related to this, some STS scholars argue that science is political when it is viewed and used as a tool for advancing interests or contributing directly to the resolution of political conflicts (Pielke 2007). In other words, science is political when it is viewed and used as politics by other means (see Brown 2015). As noted by Pielke (2007, p. 10) science becomes a “servant of interest group politics” when it is “viewed as simply a resource for enhancing the ability of groups in society to bargain, negotiate, and compromise in pursuit of their special interests”. Similarly, Pielke notes that science often gets politicised when it is invoked “as a justification for selecting one course of action over another” (p.137) and when advocates selectively use scientific evidence to support their agenda (Pielke 2007).

The political perspective and key concepts outlined above can inform further analysis of the futures forum processes, use of forum outputs, and forum outcomes. This perspective offers another possible explanation of the main outcome patterns in which the production, assessment and use of anticipation knowledge are shaped by political behaviours and processes. *Sections 6.3 and 6.4* explore this further.

6.3 Case evidence and interpretation

6.3.1 Future Fuels Forum

The Energy Transformed Flagship (as it was then called) was the main initiator of the Future Fuels Forum (FFF). The inaugural Flagship Director was looking for research guidance and support from the initial two forums, the Energy Futures Forum and FFF (J. Wright, 2014, personal communication, 9 June). In doing so his actions provide an example of ***a leader whose political skills enhanced their agency***. As a political actor, he needed to navigate a power-laden and conflictual organisational context (see below) and the forums were a tool used to build support and overcome resistance. He noted that:

“I did it for my own selfish reasons, if you like. I needed a mechanism with which to defend the research and development we were doing in the Flagship, so I needed to be able to give very strong, cogent and positive reasons for why we were researching A rather than researching B within the Flagship... So I wanted some direction and I wanted some support” (J. Wright, 2014, personal communication, 9 June).

Additionally:

“It was also excellent for CSIRO management because these Flagships were pretty tightly controlled in the early days, it seemed every month I was in Canberra telling my management what the Flagship was doing” (J. Wright, 2014, personal communication, 9 June).

He saw the Flagship as “as a way of changing the energy focus at CSIRO” (e.g. focusing more on greenhouse gas emissions reductions) and he faced internal challenges in developing this research agenda (J. Wright, 2014, personal communication, 9 June). Key challenges included securing senior management approval of proposed research programs, accessing resources and staff in other research Divisions, and securing external funding (e.g. from industry partners). The Flagship had limited research staff and needed the support of the Divisional heads to access their staff and secure their involvement in the Flagship’s research programs. Additionally, internal conflict had increased because of the reallocation of funding away from the Divisions to the Flagships (J. Wright, 2014, personal communication, 25 August). The Divisional chiefs sought to get this funding back through work with the Flagships but they had their own research agendas which often conflicted with the Flagships.

The Flagship Director and other staff emphasised related goals such as building the Flagship’s and CSIRO’s reputation through publicly stated industry support (which one staff member argued “is worth actual cash to CSIRO” [D. Lamb, 2014, personal communication, 18 August]), building relationships with key stakeholders, and seeking to identify jointly attractive research opportunities. As noted earlier (in the introduction to this chapter), one senior Flagship staff member argued that this forum was primarily a “political exercise” due to the primacy of these aspects as opposed to contributing to tangible actions addressing the issues raised by the forum report (D. Lamb, 2014, personal communication, 18 August).

Some forum participants also had strategic goals and were grappling with similar challenges. General Motors (GM) Holden staff were dealing with internal tensions caused by proposed changes to their product mix and wanted to build support for their fuel diversification strategic direction (R. Marshall, 2014, personal communication, 23 October). Reputational goals were also a major motivator for GM Holden’s decision to host the launch of the forum report. Other participants such as Sasol Chevron, Biofuels Association of Australia and peak oil activists were seeking to engage policy-makers and hoped the forum would assist. These examples highlight

intended or desired instrumental goals (e.g. influencing policy-makers), which can be interpreted as the desired political effects of such research. For example, one of the participants from Sasol Chevron conveyed their goals as follows:

“I don’t think the expectation was that immediate benefits would become visible from this approach. It is just one of the seeds that we tried to plant in peoples’ minds for the longer-term... Strategically gas-to-liquids makes a lot of sense. It could make the nation more energy independent and self-sufficient. A forum like this can help to ensure that decision-makers [e.g. in the government] include gas-to-liquids as one of the viable options” (E. van der Wateren, 2014, personal communication, 30 October).

During the forum itself there were numerous debates about the core scenario set and additional ‘sensitivity cases’ that were modelled, including what technological options and government policy options should be considered or emphasised (e.g. market-based or ‘picking winners’?). Participant remarks indicate informal ‘quid pro quo’ style arrangements – which can be interpreted as the outcome of **bargaining processes** – where they were happy for other participants’ ‘pet’ scenario(s) to be included if the scenario they were advocating for was included. For example, participants didn’t strongly oppose scenarios which they doubted and some participants’ ‘pet’ concerns were addressed by ‘sensitivity cases’:

“I was very pleased that it considered the peak oil scenarios. That’s what I was pushing [for]... people who didn’t believe in peak oil could still have it there as a scenario. I don’t particularly believe in biofuels saving the day but it is there as a scenario” (B. Robinson, 2014, personal communication, 23 October).

“I was absolutely convinced of this future diesel problem and that got very little of the attention [e.g. in the core set of scenarios – it was subsequently addressed in a special ‘sensitivity case’ scenario on algal biodiesel in the modelling report]” (T. Beer, 2014, personal communication, 14 September).

“More than half of the scenarios in the study we wouldn’t have thought were credible and didn’t fit with our view of where the world is heading, but that wasn’t a problem... A consensus process doesn’t work if everybody only agrees to exactly what they want” (P. Hart, 2014, personal communication, 10 October).

The forum Chair and other participants also pointed to **processes of compromise, conciliation and negotiation** during the process, which for example led to nuclear power being excluded from main report and only being included as a ‘sensitivity case’ in the modelling report. Victorian Government attendees and the Australian Conservation Foundation (ACF) opposed

the inclusion of nuclear power as an option and stated that they couldn't sign-off on a report that included it (*Meeting 4 record, Future Fuels Forum*).⁵⁸ This was remarked on as follows by the forum Chair (Morozow) and another forum participant:

“Because it [consideration of nuclear power as an energy option] wasn't an absolute deal-breaker and because it was going to create some major issues I think it was sort-of discounted. Also in the first forum I think we lost the ACF, Pacific Hydro, Energen and OneSteel during the process for a variety of reasons and this time around we wanted to make sure that we didn't lose any of our participants... So there was a degree of flexibility and some compromise in that regard. It was one compromise I wasn't particularly happy with but that's the “realpolitik” of the situation” (O. Morozow, 2014, personal communication, 14 August).

“One of the silly things – although we didn't care too much, given we [General Motors Holden] are in automotive, so we didn't make a case about it – was the discussion about whether nuclear [power] will be included or excluded. My personal view was that it was quite ridiculous for some participants to flat-out refuse to have it in any scenarios. If you're looking at it from a technical point of view to get a better sense of what's possible then I think it should have been in the mix” (R. Marshall, 2014, personal communication, 23 October).

Additionally, whilst a general opposition to ‘picking winners’ was expressed during the forum (see Chapter 5) one such scenario was included in the ‘sensitivity cases’. A number of participants were interested in transport biofuel options – in particular algal biodiesel – and despite strongly expressed concerns about ‘picking winners’ a picking winners style scenario for algae-based biodiesel was included. This scenario modelling was judged to be relevant to consideration of the potential consequences of scaling up research in specific areas such as via greater government support (*Meeting 4 record, Future Fuels Forum*).⁵⁹ Inclusion of such as ‘sensitivity case’ can be interpreted as **reconciling the diverse interests within the forum** and thereby enabling action (e.g. jointly publishing the forum reports) – specifically, those with an

⁵⁸ Nuclear power is currently illegal in the State of Victoria in Australia (see the *Nuclear Activities (Prohibitions) Act 1983*). At the time of the forum the President of the Australian Conservation Foundation (ACF), Professor Ian Lowe, was one of Australia's most prominent and influential anti-nuclear power activists. Consequently, ACF would not have been willing to sign-off on a report including nuclear power as an option of Australia.

⁵⁹ The meeting 4 record states that there was “support for the algae scenario – what if research accelerated and algae biodiesel scaled up quickly”. The following mixed views on ‘picking winners’ are also recorded: “All uncomfortable with policy advocacy. We should not be picking winners but presenting range of options to inform their decisions. However, ‘picking winners’ scenarios would allow to show what the implications of relaxing constraints on e.g. biodiesel for algae by investing research would be – then this is a valid ‘what would the future look like if...’ question”. This scenario was included as a ‘sensitivity case’.

interest in advancing a particular fuel option and others whose interests are perceived to be served by remaining neutral and avoiding prescriptive advocacy.

Other actors' policy concerns and policy preferences were also addressed as 'sensitivity cases', such as modelling transport sector-specific policies (e.g. mandatory vehicle standards) and exploring the implications of whether travel behaviours and preferences also change.

Some participants reported that the process and results helped to legitimate or add credibility to current or proposed strategies and actions in their organisation (e.g. GM Holden, Woolworths, ACF and CSIRO). For example, the Flagship Director argued that jointly publishing a report (with the logos of each organisation in the inside cover) "is symbolically powerful" and that it demonstrated that "the direction that the report is going has a good chance of succeeding" (J. Wright, 2014, personal communication, 9 June). Related arguments were made by the Flagship Director which seeking to convince CSIRO management about the merits of proposed research programs. This approach is consistent with the argument that *idea validation* is a *political competency*, in particular providing "confidence that key stakeholders outside the team accept the direction they're heading" (Bacharach 2016, p. 133). The Flagship Director described his subsequent use of forum outputs as follows:

"I thought the outcomes were really quite robust, so why wouldn't I use them to their maximum extent to help get my programs, the Flagship's programs, approved? And that's what I did... There were some programs and projects which I thought were inherently a good thing to do, but you had to stand up in front of a very critical group [the senior management of CSIRO who controlled research funding] and put them forward" (J. Wright, 2014, personal communication, 25 August).

Other Flagship staff similarly used the forum results when justifying their research program on algal biodiesel (T. Beer, 2014, personal communication, 14 September) and transport biofuels more broadly (D. O'Connell, 2014, personal communication, 4 September). Staff also drew on the study when seeking to secure external research funding.

A CSIRO scientist reported that the forum helped to legitimate biofuels as an area of research, which enabled strategic pre-commercial funding to more fully assess whether biofuels provide a credible set of options, despite limited industry and government co-investment (D. O'Connell, 2014, personal communication, 4 September). During that period the then Flagship Director noted that "the Flagship was wide open for projects on alternative transport fuels" (J.

Wright, 2014, personal communication, 25 August). Transport biofuels research received increased and steady internal funding from 2008 through to 2012-13.

Finally, the forum outputs were used by many participants in contrasting ways which were often related to their policy preferences. In these ways **actor learning and research utilisation was a political process**. One example of this is the ways that the outputs were selectively used by biofuels advocates who sought greater government support. Scenarios which conveyed the potential risks of oil dependency and the potential impacts of alternative fuels not scaling-up in a timely fashion – i.e. before oil supply constraints emerge – were emphasised (e.g. Harrison 2008) and the non-peak oil scenarios that were developed were not communicated (G. Hughes, 2014, personal communication, 7 October).⁶⁰ Advocates utilised the forum’s analysis when lobbying for an extension to the fuel excise regime (a bipartisan commitment was reached in 2011 to extend it, however this was later revised).⁶¹

Forum participants from the participating State governments (Victoria and South Australia) reported that the forum had a little direct influence on policy. Victorian government staff involved in climate and transport policy – both of which were prominent policy issues in the 2007-10 period during the Brumby Government – reported some use of the forum reports to support policy recommendations, with relevant evidence “cherry picked out of the report” (H. Thomas, personal communication, 1 December) but, overall, limited influence on policy. Such a focus on evidence that supports policy references is **a political form of actor learning**. However, other factors such as considerations regarding the decreasing long-term viability of the automotive industry and the politics of fuel prices were a stronger influence on policy-making (K. Handberg, 2014, personal communication, 28 November).

A related ‘live’ public policy issue at the time of the forum was mandatory vehicle requirements (e.g. fuel efficiency or CO₂ emission standards for new vehicles). Some forum participants had pre-existing strong views on this issue and **used the forum outputs as political ammunition**. GM Holden used the forum analysis in this policy debates when it argued against

⁶⁰ Hughes further stated that “I can also remember using the \$8 litre scenario quite a bit with government in terms of trying to get engagement around what support they should be giving the industry. It was certainly useful in having that dialogue”.

⁶¹ The Gillard Government agreed to a ten-year moratorium and passed the *Taxation of Alternative Fuels Legislation Amendment Bill 2011*. The bill dealt with taxation and grant arrangements for ethanol, biodiesel, renewable diesel and methanol and also introduced new taxes on LPG, LNG and CNG.

introduction of mandatory standards.⁶² The forum reinforced GM Holden's view that demand-side approaches are needed and supply-side measures (such as mandatory vehicle standards) would be "quite unworkable" (R. Marshall, 2014, personal communication, 23 October). The company also pointed to "issues relating to consumer willingness and ability to pay for the various technologies which will be required to achieve the target" and negative impacts on "vehicles produced in Australia" (GM Holden 2008). In contrast, the Australian Conservation Foundation (ACF) argued that "mandatory standards are an essential tool in reducing greenhouse emissions" (Australian Conservation Foundation 2008). ACF (2008) acknowledged that the forum modelling indicated that mandatory vehicle standards "might actually result in an increase in GHG emissions in comparison to other complementary measures to a carbon price due to what is commonly referred to as the 'rebound effect'", but they interpreted the modelling as showing the need for a comprehensive approach which included other measures "which will counter any potential behavioural (rebound) effects".⁶³ Other forum participants such as CSIRO didn't publicly engage in this policy debate (although further modelling of such policies was done by CSIRO for the Climate Change Authority).

Ultimately, the Rudd Labor Government broke a pre-election promise and decided not to introduce mandatory standards. Growing pressures on local automotive manufacturing and resistance from the automotive industry were important factors (K. Handberg, 2014, personal communication, 28 November). Transport fuel was also later excluded from the Gillard Labor Government's carbon price (with heavy transport to be included later).

In sum, general political behaviours such as negotiation, compromise and bargaining and related conflict resolution attempts were evident and influential during the forum. The separate modelling report can also be viewed as a conflict management tool by providing a place to 'park' controversial topics and as an output that enabled actors to further their interests/agendas by including modelling related to these agendas. Similarly, the use and

⁶² For example, in its submission to the Fuel Efficiency Working Group GM Holden cited the forum modelling when arguing that: "introduction of any additional measures to reduce emissions from vehicles [i.e. supplementary to an emissions trading scheme] will not represent an efficient policy outcome"; that introduction of mandatory fuel standards may "leads to an immediate increase in CO2 emissions"; and, finally, that "the introduction of a mandatory fuel efficiency standard does not achieve long-term additional reduction in CO2 emissions and as such, is an inefficient policy option" (GM Holden 2008).

⁶³ Related to this argument, ACF also drew on the Future Fuels Forum modelling when arguing that behavioural change (related to travel behaviours) needed to be a core policy focus

influence of power mattered. For example, because many participants needed to get sign-off from more senior colleagues (i.e. signing-off inclusion of their organisation's logo in the front cover the report) the views and preferences of these colleagues needed to be considered. One illustrative example of this is that even if other ACF staff were in favour of further exploring the potential future role of nuclear power in Australia they would have been unlikely to do so given the anti-nuclear position of senior colleagues (e.g. the President of ACF). This gave their colleagues the ability to indirectly influence the forum report. Thus, the capacity of actors to **gain or exercise power through the forums** and associated political processes were evident. Finally, use of the results by actors frequently involved selective use and interpretation of the findings in relation to their goals or policy preferences. In these respects, actor learning, and associated PKPs, often were not a disinterested search for truth.

6.3.2 Sustainable Aviation Fuel Road Map Forum

The *Sustainable Aviation Fuel Road Map* (SAFRM) forum was largely initiated by Qantas and the Australian arm of the Sustainable Aviation Fuel Users Group (SAFUG) in collaboration with the CSIRO Energy Transformed Flagship. The core objective of the aviation sector of lobbying government – as noted by the forum Chair – can be interpreted as **viewing science as a political tool**:

“The term lobbying is right, I think that is really what the aviation industry wanted to do. They wanted to say here's a report from CSIRO, Australia's leading research organisation, which says what needs to be done and to then go and plonk that down on various government departments' desks and then receive funding for those activities” (R. Chamberlain, 2015, personal communication, 9 April).

Related tensions had to be dealt with during the initiation of the project as CSIRO staff wanted to remain an independent and – in Pielke's (2007, p. 10) terms – not be, nor be perceived as, a “servant of interest group politics” and “simply a resource for enhancing the ability for groups in society to bargain, negotiate and compromise in pursuit of their special interests”.

The airlines were dealing with a (then) emerging policy context of carbon pricing and carbon constraints. Carbon pricing was being introduced in Europe and a carbon price was expected to be imposed on international flights to and from Europe (e.g. by Qantas Airways), and it was the core climate change policy of the then federal Government (Rudd Government). The project

leader observed that the “global messaging” of the airlines was “we don’t want a carbon price what we want is help to decarbonise our fuel supply” and, linked with this, they may have hoped to convince policymakers that, for this sector, transitional support would be the more effective policy (P. Graham, 2015, personal communication, 1 December).

Alternative fuels policy had also become more contentious and related actor goals motivated forum participation. During the 2009-11 period the biofuels sector was lobbying against changes to fuel taxation (i.e. the sector sought to extend the existing excise arrangements). Some Federal Government staff contended that “the whole policy area was contaminated” (government informant, 2015, personal communication, 12 June), and the topic of taxation and industry assistance was conflictual throughout the forum. The core interest of the CEO of the Biofuels Association of Australia’s (BAA) in the forum was the legitimacy that biofuels may gain through the support of the aviation sector. This judgement was a **political judgement aimed at increasing agency**. The (then) CEO of BAA explained this as follows:

“The Board [of Biofuels Association of Australia] did not see much value in it [the forum]. They felt it was very focussed on next-generation biofuels and felt – and I think they would still say this – that there are lots of issues around first-generation biofuels that still need to be overcome before next-gen can be successful. So I probably took part against the desires of the Board. I thought that it was important that the BAA participated in anything that was related to biofuels, but I really felt that if the aviation industry was focussing on biofuels or on sustainable aviation fuels that those sorts of big brands could give a lot of legitimacy to alternative fuels where it was desperately needed” (H. Bone [Brodie], 2015, personal communication, 29 May).

Other participants such as Caltex Australia were also interested in biofuels policy – and broader transport fuel policies – and sought to inform and influence policy via the forum. The involvement of such participants, along with staff from State and Federal governments, contributed to a strong focus on policy. This is evident in two of the core six themes, and associated issues, identified at the first meeting (see *Table 22*). The role of government and carbon policies were widely seen by forum participants as crucial issues.

Table 22: Key themes and issues ranking data (SAFRM meeting record – meeting 1)

Ranking	Theme (# overall votes)	Issues (# votes)
1	Feedstocks (53)	<ul style="list-style-type: none"> ▪ Feedstock type (residual or solo), location, area, yield, fit (22) ▪ Price/ cost curve (8) ▪ Model's for sustainable, commercial production (7) ▪ Rural development (6) ▪ Conversion methods and competition (4) ▪ Co-products (2) ▪ Competitive use (2) ▪ Yield, temporal flow (1) ▪ Inputs, nutrients (1) ▪ Bio-security - regulatory risk (0)
2	Role of government (38)	<ul style="list-style-type: none"> ▪ Start-up support (risk capital) or regulation/mandates (15) ▪ Clarity and stability of policy and roles (7) <ul style="list-style-type: none"> ○ (carbon policy) (5) ○ (energy security) (3) ▪ Fuel tax policy - land transport (5) ▪ Public education (2) ▪ Rural development (1) ▪ Complementary state initiatives in national aviation framework (0)
3	Sustainability (33)	<ul style="list-style-type: none"> ▪ Criteria e.g. Roundtable on Sustainable Biofuels (17) ▪ Landscape scale and change (8) ▪ International patchwork (4) ▪ Public confidence/ licence to operate (4)
4	Business Models (29)	<ul style="list-style-type: none"> ▪ Vertical Integration (12) ▪ Business Cases (12) ▪ Targets (4) ▪ Urgency (1)
5	Global and National Carbon policies (23)	<ul style="list-style-type: none"> ▪ Level of carbon price projections (trajectories) (11) ▪ Global commitment and policy (8) ▪ National commitment (2) ▪ How aviation is treated post-Kyoto (2) ▪ Transaction (compliance) costs (0) ▪ Patchwork v coherent? (0) ▪ Offsets, availability (0)
6	Oil price and volatility (12)	<ul style="list-style-type: none"> ▪ Volatility drivers (china, politics) (9) ▪ Security drivers (3) ▪ Travel demand (0) ▪ Long term prices - International Energy Agency forecasts (0) ▪ Impacts (tipping point) (0) ▪ Heavy crude risk (0) ▪ Exchange rate (0)

Within the forum itself the project leader and other participants observed **power relations** whereby some actors had greater **ability to achieve desired outcomes** (in this case influencing the roadmap construction and research design). The project leader stated that “the aviation guys got a louder voice” (P. Graham, 2015, personal communication, 26 March). This observation is consistent with the assertion made by one participant that “a number of the

industry participants got together and basically rewrote the report because it wasn't going where they wanted it to" (R. Posner, 2015, personal communication, 11 June), which may be an overstatement but concerns were raised about the draft report (*Meeting 6 record, SAFRM Forum*) and mid-project about the scenarios, project focus, and progress (P. Graham, 2015, personal communication, 26 March). For example, some participants argued during meeting 3 that the "scenarios are still too negative" and "the industry will move faster" than was presented in them (*Meeting 3 record, SAFRM Forum*). From mid-project onwards, CSIRO worked more closely with the SAFUG group, for example by holding teleconferences with this group between forum meetings (*Meeting 4 record, SAFRM Forum*).

Major mid-project adjustments to the scenario structure were ***the outcome of related negotiation and conciliation***. A decision was made to focus more on the aviation industry's targets (e.g. for future use of bio-jetfuel) and incorporate a 'backcasting' element (*Meeting 3 record, SAFRM Forum*). To achieve this, a core "road map scenario" was defined and was the focus of the main report (which focussed on the future uptake of biofuels), and additional reference case projections and other scenarios were mainly presented in a separate modelling and assumptions report (see Graham et al. 2011). For example, a "level playing field scenario" was included in this separate report and is described as follows:

This scenario recognises that under current excise arrangements parts of the road sector enjoy a greater incentive to purchase biofuels than long haul transport mining, aviation and sea transport. Under the level playing field scenario the rebate to road biofuels is phased out. This action *is in no way advocated by CSIRO or anyone in the Sustainable Aviation Fuel Road Map study*. It is merely a modelling device to assess the extent to which current government interventions designed to encourage road biofuel use present a barrier to uptake of biofuels in the aviation sector (p.33, emphasis added).

The CEO of the BAA pointed to related group dynamics, arguing the process was "dominated by certain players who had particular outcomes they wanted to drive" such as receiving government subsidies (H. Bone [Brodie], 2015, personal communication, 10 April). Those "certain players" were from the aviation sector:

"I think that some key individuals in the room were unfortunately the best and the worst in the industry. It's a bit like the ethanol producer who if he wasn't there pushing it there wouldn't be an ethanol industry in Australia. But he's also the worst thing for the industry because of the way he goes about it, stomping around the halls

of parliament house and yelling at Ministers. He's the best and worst of the industry. I would say that these people from the airlines were similar – they were fundamental to aviation and pushing this process and making it happen but the way they went about it meant that they were also the worst people in the room" (H. Bone [Brodie], 2015, personal communication, 29 May).

Related to the goals and approach of some industry actors, some participants felt there was problematic conflict during the forum. Some participants perceived conflicts between CSIRO and industry participants (also see the discussion of methodological issues and institutional factors in Chapters 4 and 5). For example, a participant from The Climate Group provided the following observation which is consistent with tensions during the initiation of the project:

"The sense I got was that some of the industry participants had their views on what they wanted to achieve from it and the CSIRO had their objectives and they weren't always completely aligned. I think the issue is that the main client was the industry group/association [the Sustainable Aviation Fuel Users Group] and the CSIRO was basically providing a service to them and I'm not sure they always behaved in that manner" (R. Posner, 2015, personal communication, 11 June).

One participating NGO – the Worldwide Fund for Nature (WWF) – also quit the process and didn't endorse the report through inclusion of its logo. The international arm of organisation took the position that behaviour change (e.g. reduced flying) should be the core focus for greenhouse gas emissions reduction in aviation, not use of lower-carbon fuels.⁶⁴

The project leader also stated that the outputs were shaped by the aviation sector's preferences. The roadmap was described as deliberately "stretchy" (P. Graham, 2015, personal communication, 26 March), and presented an optimistic view of possible short-term and medium-term aviation biofuel industry development in which, if all key stakeholders act, "industry commences uptake of sustainable fuels by 2015" and by 2020 "the Australian and New Zealand aviation sectors achieve a 5 per cent bio-derived jet fuel share in their fuel use" (CSIRO 2011, p. 7). The fact that this perspective was a stark contrast to some participants'

⁶⁴ Paul Graham from CSIRO (the project leader) put this as follows: "they [WWF] were with us all the way until they're international group informed the Australian WWF team that they would be releasing a study about aviation which had a different message – that we should reduce airline travel as the main solution [for reducing greenhouse gas emissions]. Given the airlines would never agree to modifying the report to contain that message, that was when WWF had to step out of the process" (P. Graham, 2015, personal communication, 23 November). In contrast, the participating airlines and other actors such as General Electric Australia wanted aviation to be a growth industry.

expectations suggests *some actors' expectations counted more than others*.⁶⁵

The project leader argued that this roadmap and its optimistic outlook was a strategic judgement of the aviation sector. It also potentially presented a communications challenge, because “if this industry comes together and says that it can do it all then it might not be successful in getting any government support” (P. Graham, 2015, personal communication, 26 March). The approach adopted was expected to assist with getting support:

“They took the tactical view that we had to make this look like it was going to be... that it didn't need... that it was almost there, that it was a real goer. I can only speculate as to why they thought that was a good idea. I think they made the strategic assessment that it needed to look like it only needed a little bit of help to get going and then it would be off... That was their judgement, that a stretchier roadmap would help their cause” (P. Graham, 2015, personal communication, 1 December).

Other participants also argued that the aviation sector influenced the outputs in consequential ways. Although the final forum report doesn't explicitly call for government subsidies – some participants requested that the word subsidy be removed from an earlier draft report (H. Bone [Brodie], 2015, personal communication, 29 May) – some participants felt that the aviation sector's desire for subsidies “still comes through clearly” in the final report (H. Bone [Brodie], 2015, personal communication, 29 May). Different terms such as “government bioenergy industry support” (p.8) and “government support mechanisms” to assist commercialisation (p.44) are used and the report notes that if uncertainty is perceived as high a market failure could result and the industry could remain “fledgling” (CSIRO 2011, p. 36). The report asserts that “industry and investors will look to Government to ensure certainty around government support to overcome any potential market failures” (CSIRO 2011, p. 43).

Some of the modelling and related content in the main forum report also specifically addressed themes expected to be of interest to government, such as:

- Employment benefits (i.e. estimated job creation potential);
- Rural and regional development opportunities;
- Reduce jetfuel import requirements (a potential energy security benefit); and
- Contributions to greenhouse gas emission reductions.

⁶⁵ For example, as was discussed in the previous chapter, the project leader was not optimistic that the roadmap would be implemented. Similarly, multiple forum participants stated that they didn't think the forum identified a clear and/or plausible pathway forward for aviation biofuels.

Additionally, although business models were identified as a priority theme at the initial meeting, the aviation sector was not focussed on business model innovation (see Chapter 5). The terms business model and vertical integration do not appear in the report.

Some *policy-oriented actor learning* and associated *research utilisation* was also influential. In particular, there is evidence of actors selecting and interpreting information in ways that support their policy beliefs/agendas (and ignoring aspects that conflict with them). As was noted in the previous chapter, at the time the SAFRM report was published the guiding transport fuel policy intention was to continue moving away from providing industry support or other government assistance and to have a consistent “laissez-faire”, market-led approach to alternative fuel development. An involved policymaker judged the SAFRM study and associated industry engagement as “consistent with what we were doing” and argued it “dovetailed neatly into what we were doing” (Government informant, 2015, personal communication, 12 June), despite the key report message that government support is necessary. Additionally, this policymaker asserted that “one of the views we had was that aviation actually provided more opportunities” and further argued that:

“That work [the sustainable aviation fuels roadmap] meant that the aviation side of things, and the support from some of the major carriers such as Virgin, already had some runs on the board in a market that had fewer players and where they could see longer-term benefits compared to the complexity of some of the other markets” (Government informant, 2015, personal communication, 12 June).

The absence of any specific policies and programs for alternative aviation fuels in the *Strategic Framework for Alternative Transport Fuels* (Australian Government 2011b) is consistent with these beliefs and the judgement of involved policy-makers that industry could (or should) self-manage the transition to alternative jetfuels (Government informant, personal communication, 20 July). Additionally, there was little concern about energy security, a key potential benefit that was promoted by the forum. Several participants from the aviation sector expressed disappointment about the unwillingness of Australian governments to assist industry development to support commercialisation and change efforts. Other participants from the fuel sector also felt the transitional challenges were underestimated by many government staff (M. Ridley-Smith, 2015, personal communication, 20 July).

A number of factors influenced the way governments responded to the forum report (also see

Chapters 5 and 7), but the project leader stated that, on reflection, it's possible that the report presentation and 'stretchiness' of roadmap played a role: "they [the airlines] thought that the thing they had to prove to government was that it is all feasible... but the more economically feasible they made it sound the more they were pushing government out of the equation" (P. Graham, 2015, personal communication, 1 December).⁶⁶

In sum, the origins and many of the desired effects of this futures forum were political (in the sense of one of the aviation sector's main objectives and related views of some actors that a science organisation was a useful resource for achieving these objectives), the goals of many forum participants were related to concurrent public policy processes, and related tensions emerged regarding the roles and focus of the project and the scenario analysis. The production, and some uses, of the forum report were also shaped by political behaviours (e.g. to resolve conflict, etc.) and political processes, which may have had important unintended consequences. This forum also became a site of conflict which consumed significant time and resources. Whilst some of these conflicts appear partly caused by institutional factors which shaped the approach that was adopted by CSIRO staff (also see Chapter 5), many of them were directly related to the more explicitly political focus on this forum.

6.3.3 Future Grid Forum

The project leader from CSIRO viewed the Future Grid Forum (FGF) as less explicitly political and argued that "the lack of politics" was a key feature of the forum (P. Graham, 2015, personal communication, 23 November). The two main initiators of the forum – the CSIRO Energy Flagship (as it was then called) and General Electric (GE) Australia – could be described as **agenda movers** and, in the case of CSIRO staff, as actors who were seeking to enhance their agency, profile and competitive position. The core agenda related to advancing 'smart grid' approaches for decarbonisation and electricity grids and related research agendas for energy efficiency and demand management. A major motivator of the FGF for CSIRO staff from the Energy Flagship was to "reinsert ourselves into a leadership role in the [electricity] sector" and

⁶⁶ Notably relevant policies were being developed concurrently such as a new Federal Government *Energy White Paper* and a *Strategic Framework for Alternative Transport Fuels* (Australian Government 2011b). CSIRO staff and some forum participants pointed to government recognition of the importance of biofuels in such policy documents as an important outcome. Later new programs such as the \$15 million Advanced Biofuels Investment Readiness program "to build the investment case for significant and scalable pre-commercial demonstration projects" (Australian Government 2012, p. 128) were created. However, overall, the desired level of government support was lacking.

“claim the space” related to ‘smarter’, more efficient electricity grids and distributed energy (P. Graham, 2015, personal communication, 23 November).⁶⁷ Prior to the forum CSIRO was judged to have a marginalised position in electricity sector modelling and analysis. Related aims were emphasised by the project leader: “I think that was really our main motivation – to take the opportunity to claim a space that we sort of felt that we owned”.

The lead participant from GE Australia added that GE and CSIRO “had been in discussion for years about smart grids, had worked together on smart grid, smart cities projects, had seen the [electricity] decentralisation trend and yet were also seeing the business-as-usual approach by the industry” (B. Waters, 2015, personal communication, 1 January). A few years prior to the forum CSIRO and GE had also formed an alliance including “a five year \$20m joint research commitment across all areas but certainly including Ecomagination and low-carbon technologies” (B. Waters, 2015, personal communication, 1 January).

Additionally, ***dominant expectations voiced by other influential actors*** were viewed as a key barrier to change and building new research partnerships. The project leader from CSIRO argued that this is because partnerships require “confidence that this is something worth investing in” (P. Graham, 2015, personal communication, 23 November). The influence of “official” forecasts and major consultants were emphasised:

“[I]t starts to impact on us if we’re working on new technologies which people are saying won’t exist in the future... If we reach a certain point where we’re confident that this should be considered as part of the electricity future and the main market operator and all the major consultants just don’t include it at all in their modelling or analysis more broadly then that becomes a problem for us because we’re out there talking to clients about working with them on smart grid related projects and if it’s not there in the official forecasts from anyone then there’s this disconnect which can be a problem” (P. Graham, 2015, personal communication, 23 November).

The forum Chair from CSIRO also emphasised underlying (i.e. implicit) objectives, in particular building relationships and alliances with targeted industries: “One of the subtexts of the whole

⁶⁷ Related to this the Flagship was seeking to grow the ‘Grids and Energy Efficient Systems’ research program. As the project leader, Paul Graham, put it: “We’ve always had this section of the Flagship which has had different names over the years like local energy systems, and distributed energy systems, and at the moment it’s currently called grids and energy efficient systems... it has always been in the space of demand management, onsite generation, that whole space”. If this program was advanced by running a forum it would be judged to have contributed to achieving the Flagship’s goals.

process... has been developing more in-depth relationships between CSIRO, as the national science agency, and what is the critical industry for the nation [i.e. the electricity industry]... I guess we've seen value in being the trusted friend that an industry like that can benefit from" (M. Paterson, 2015, personal communication, 21 December).

For some other participants their involvement was related to their policy-related and other political goals. Some participants had an explicit policy-orientation such as think tanks, some research organisations and non-government organisations (e.g. Grattan Institute, The Climate Institute, Australian Council of Social Service [ACOSS], etc). This orientation influenced the needs and interests of some forum participants. For example, the Grattan Institute was working on energy sector reform ideas related to the forum and a senior staff member argued that their "real challenge" was learning "how to frame recommendations for today's policy makers" (T. Wood, 2016, personal communication, 12 February). The Climate Institute's main delegate was seeking to enhance their policy advocacy and to persuade other participants regarding emissions reduction and climate change adaptation imperatives, and to refine related arguments (O. Kember, 2016, personal communication, 24 March).

A number of the participants argued that the process was influenced by the ***differential power and interests of involved actors***, the political sensitivity of topics, and government relations in the context of a changing Federal government (see discussion below), all of which contributed to ***behaviours perceived as political*** during the forum.⁶⁸ For example, GE's main delegate stated that "the big fear of the networks obviously was asset write-downs which got discussed a couple of times but it was a very touchy subject, you couldn't talk about that but was in the back and front of their minds the whole time" (B. Waters, 2016, personal communication, 29 January). In some respects the forum outputs may have reflected the interests and influence of more powerful actors, as can be inferred from these observations:

"The outcomes of the scenarios didn't look cataclysmic for the network businesses. The transition is pretty gradual, it's like "that's useful but we don't need to panic" and that may well be the case. Even the "Leaving the grid" scenario didn't look too terrifying from a network point of view... There are plausible scenarios which involve much more rapid change than the biggest changes in the four scenarios they looked at" (Research sector informant, 2016, personal communication, 7 April).

⁶⁸ A Federal election was held during the Future Grid Forum and a new Federal government (the Abbott Government) was elected at the time the forum report was being developed

“It was an important forum for collecting the views of all stakeholders, but I felt that some options were not able to be explored because of the powerful presence of the networks, and on such an important topic it's important to examine all options... There was [also] limited ability to explore sensitive topics such as network write-downs and this appeared to be because of the objection of a small number of stakeholders” (NGO informant [forum participant], 2016, personal communication, 30 March).

Consistent with the analysis conveyed by the judgments/observations reported above, the national electricity grid continues to play important (but evolving) roles in all the scenarios developed by the forum. Similarly, potential outcomes such as a ‘death spiral’ (caused by increasing grid disconnections reinforcing such change) and stranded assets are alluded to, or noted, in the report but are they are not the focus of the scenarios. Others contend that more extreme outcomes such as a ‘death spiral’ are plausible “if the way electricity networks are priced and regulated does not change” (Wood & Carter 2013, p. 21) and they call for more radical actions by governments than those discussed in the forum report.

A policymaker further remarked that “the point was made to me that none of the scenarios modelled by the CSIRO involve widespread disconnection from the grid. One person said that CSIRO said this was not going to happen and my point was no they did not say that, it just wasn’t one of the scenarios they modelled [i.e. that the *participants* agreed or proposed]” (Government agency informant, 2016, personal communication, 4 March).⁶⁹

Parts of the analysis conducted for the forum also responded to the emerging policy context, for example see the following passage from the main forum report:

Recognising that Australia’s carbon price policy is not settled, the Forum also explored two additional sensitivity cases. The first is no carbon price. This is useful as a way of understanding the costs of greenhouse gas mitigation and the underlying trend in wholesale electricity price absent a carbon price signal. The second sensitivity case examines an uncertain carbon price case which does not assume a single carbon price projection, but rather examines how ongoing uncertainty across the entire future possible carbon price range impacts on the electricity sector (CSIRO 2013a, p. 28).

The forum report itself was shaped by the emerging policy context (also see Chapter 5) and the

⁶⁹ This quote also highlights the potential for the futures forum analysis to be misinterpreted: CSIRO describe the Future Grid Forum scenarios as the industry’s scenarios (i.e. that those participants principally defined) whereas others clearly view it as CSIRO’s analysis.

policy preferences of *some* forum participants. Four “potential approaches to addressing the issues identified in the scenarios” (CSIRO 2013a, p. 66) were emphasised, including electricity pricing reform (e.g. shifting to cost-reflective pricing schemes), “bipartisan agreement on the long-term (2050) greenhouse gas emission target and implementation mechanism for Australia”, and a “review Australia’s electricity consumer social safety net” to manage “consumers’ exposure to cost increases”. Importantly, other more ‘radical’ proposals, e.g. that governments should review and write-down the value of electricity network assets (Parkinson 2016; Wood & Carter 2013), were not explored or proposed **reflecting the interests** of some forum participants (e.g. electricity network businesses).

Controversial topics related to more radical proposals were judged to be unproductive areas to focus on. As the project leader from CSIRO put this, regarding asset write-downs, “there was no chance of achieving consensus on this topic so we didn’t waste precious meeting time on it” (P. Graham, 2016, personal communication, 6 September). Key actors such as the network businesses have argued against asset write-downs (Vorrath 2014).

Some participants who were favour of retaining a carbon price were critical of the report’s presentation of this climate policy issue and argued that the political context shaped this aspect of the forum and the report. In these important respects **the power of the incoming government** (which was elected two months prior to when the forum was published) can be argued to have shaped the process and report, even though it didn’t participate. For example, the main forum delegate from The Climate Institute argued that:

“The process was conducted during a period of incredible political danger around carbon pricing and the views in the room on this were by no means unified. For a lot of the groups represented there they were also very aware of other interests in things like maintaining a good relationship with the current government or with the incoming government. Everything about the topic was conducted with what felt like a huge amount of caution” (O. Kember, 2016, personal communication, 24 March).

The Climate Institute were also critical that although “everyone accepted that a carbon price, or some kind of carbon policy was basically inevitable ... nobody really wanted to come out and say that” (O. Kember, 2016, personal communication, 24 March).

Participants from CSIRO reported outcomes which can be interpreted as **enhanced agency enabled by a political process of agenda moving**. Flagship staff stated that the forum process

and its results helped to legitimate its work (e.g. its electricity sector modelling capabilities and related research programs) and enabled a new research partnership which thereby contributed to the expansion of the Flagship’s ‘Grids and Energy Efficient Systems’ research program. CSIRO’s post-forum media release emphasised the study findings that supported this research program (see *Table 23* below), such as the potential benefits of peak demand management for moderating electricity price rises.⁷⁰ This can be interpreted as somewhat selective actor learning in which the **outputs provided ‘ammunition’ which was then selectively mobilised** to advance their research agendas.

Table 23: Future Grid Forum findings emphasised in the CSIRO media release

Key findings emphasised in media release	Example findings not emphasised
<ul style="list-style-type: none"> • Potential for the “adoption of energy efficiency, peak demand management and on-site generation” to moderate future electricity bill increases and electricity distribution costs • Projected growth of on-site (distributed) electricity generation out to 2050 • Projected future disconnections from electricity grid and economic viability of related technologies (i.e. local energy storage with solar power) • New exploration of ways that consumers could “take greater control of how they consume and produce electricity” 	<ul style="list-style-type: none"> • Investment risks of carbon price uncertainty and its projected impact on future electricity prices • Variable greenhouse gas emissions reduction outcomes associated with the scenarios that were modelled • Potential benefits of including nuclear power in the electricity generation mix (e.g. in terms of emissions reduction or electricity bill outcomes) • Policy issues raised by emerging issues (e.g. protecting vulnerable consumers, electricity pricing reforms, etc) • Projected medium-term electricity price changes for large commercial users

Similar **actor learning** and **ammunition gathering** was also evident (for more details on the utility of the forum for argument construction and argument evaluation see Chapter 7). For example, in contrast to the emphasis of CSIRO staff on the potential benefits of on-site generation, a participant from the peak industry body Energy Networks Australia (ENA) emphasised the modelling outcomes that it claimed highlighted the risks of “irrational over-investment” in on-site generation.⁷¹ ENA’s CEO used the report to argue that tariff reform is the way to limit costs, rather than, for example, write-downs to network assets. The interpretation and use of the modelling and other findings by other participants was also influenced by their perceived utility in existing debates and policy processes. Actors who were

⁷⁰ Media release published 05/12/2014 see: <http://www.csiro.au/en/News/News-releases/2013/Electricity-but-not-as-we-know-it>, last viewed 29/06/2017

⁷¹ Future Grid Forum report launch/Q&A transcript (event held on 06/12/2013), transcript available at http://www.csiro.au/news/transcripts/YouTubeTranscripts/2013/Dec/Future_Grid_Forum.html (last viewed on 29/06/2017)

actively engaged in policy processes – such as The Climate Institute and Grattan Institute – assessed the relevance of the analysis for their policy analysis and advocacy activities. For example, the modelling of the potential impact of carbon price uncertainty was used by policy advocates at The Climate Institute. However, as was noted in Chapter 4, many other forum participants judged the analysis to have limited utility for policymaking.⁷²

In sum, in contrast to “the lack of politics” observed by the project leader, there is evidence that some of the forum’s analysis and some uses of the forum outputs were strongly influenced by actors’ interests, the ability of actors to influence forum outcomes (i.e. the unequal power of participating actors) and other political considerations. The forum report itself did not strongly advocate particular policies (consistent with a less ‘political’ orientation), but some participants drew on modelling results and other aspects of the forum report which were judged to offer useful political ammunition. Some of the policy-oriented actor learning enabled by the forum was also political in the sense of interpreting and presenting the results from the perspective of their own interests and making related claims in public policy debates. Finally, there is strong evidence that the agency of CSIRO staff was increased as an outcome of politics and political competencies. Like the Future Fuels Forum, the forum findings were successfully presented as demonstrating support for their current research directions and the forum was leveraged to increase their traction and legitimacy.

6.3.4 Interpretation of the case evidence: PKPs as political practices?

The case evidence and analysis presented in this chapter indicates several ways that the production, assessment and use of anticipatory knowledge can be political and the ways that related activities can become a site of politics. This political perspective is similar to the argument commonly made by science studies scholars that scientific knowledge should be understood “as a negotiated product of human inquiry” (Cozzens & Woodhouse 1996, p. 534). Processes of negotiation, conciliation and compromise were often evident in key decisions made during the analysis conducted in and for the futures forums.

⁷² The project leader and forum Chair cited post-forum examination of regulatory frameworks for electricity networks (via the COAG Energy Council) and stronger relationships with government agencies and bodies such as ARENA and the Australian Energy Market Operator as examples of policy-related uptake and impact, though the tangible impacts of this are currently unclear.

Beyond these initial key interpretations what do the perspectives and the case evidence and analysis presented in this chapter add to the case explanation? One important aspect the perspectives help to illuminate is why the futures forums were held and why organisations participated, i.e. actor motivations. The origins of the SAFRM forum were the most explicitly political; however, many participants in other forums had a strong policy-orientation and hoped that the forum would assist them in their policy advocacy. Additionally, when broader views of politics are adopted – such as those related to power, agency processes (Bacharach 2016), and strategies used to gain greater influence over decisions (Eisenhardt & Bourgeois 1988) – other potentially political aspects of PKPs come into view. For example, at the time of the FFF the Flagship Director was seeking to influence the decisions of CSIRO management and needed to manage other internal constituencies. He viewed the forums as providing useful *support* which helped him to achieve these internal goals.

Second, this perspective can help to explain why the outputs and other aspects of forum processes can be different to what was expected, intended, or desired (depending on the actor). For example, peak oil activists stated that they were surprised that peak oil focussed scenarios were included in the core FFF scenarios. This can, in part, be explained by the context in which this forum was run, given the debates caused by rising oil prices and debates about possible near-term supply constraints. The evidence presented in this chapter suggests that decisions regarding the scenario structure and content can also be partly explained as the result of political behaviour during forums (e.g. bargaining games), as well as the desire of the CSIRO staff as process convenors to minimise conflict and avoid a situation similar to the earlier Energy Futures Forum in which some participants quit the process mid-way through (O. Morozow, 2014, personal communication, 14 August).

A further illustrative example, which wasn't discussed in *Section 6.3.3*, is the ways that the outputs from the FGF differed from the intended outputs.⁷³ The project proposal stated that this forum would produce a roadmap for Australia's electricity system; however, the forum didn't produce one. The forum Chair stated that a recurring issue during the first half of the forum was questioning of the core intent of the process, i.e. questions "from the floor of 'hang on a minute, is that what we're really here to do?'" (M. Paterson, 2014, personal

⁷³ The project leader also suggested that some goals should be primarily viewed as sales terms rather than firm commitments. Some of these may also have been advanced in subsequent projects such as the Network Transformation Roadmap project.

communication, 17 June). Related tensions around the purpose of the forums and the need to manage diverse interests and agendas often emerged during other futures forums. The FGF forum Chair also contended that the move away from producing a roadmap reflected judgements regarding what would be feasible – and associated negotiation and compromise – given the diverse range of participants which had varying interests and policy preferences (M. Paterson, 2014, personal communication, 17 June).

Further key aspects of the case that a political perspective helps to explain are actor learning and utilisation of the forum outputs. The case evidence also presented compelling evidence that policy-oriented actor learning is rarely a “disinterested search for “truth”” (Jenkins-Smith & Sabatier 1993, p. 45), as noted by policy process scholars. However, it is important to note that when research is used as “political ammunition” to “support a predetermined position” (Weiss 1979, p. 429) it is not necessarily the case that findings are being distorted or misinterpreted by actors. More typically actors are selective in their use and interpretation of forum results (e.g. only mentioning the scenario[s] that can support their policy advocacy, and/or only presenting one interpretation of the techno-economic modelling results when multiple interpretations are plausible and could have been communicated).

‘Adoption’ of forum outputs can also be reinterpreted where action is seen as a political process of agenda moving (Bacharach 2016). A broader political perspective also highlights the ways that PKPs can be a tool for agenda movers, where the process and/or outputs are used strategically for such purposes. The attempts of CSIRO staff to create and grow their research programs by building internal and external support for these research agendas and the efforts of actors to promote alternative fuels are examples of this. This perspective points to the need for actors to negotiate political arenas (e.g. organisations) in which there are competing agendas and interests, as well as the importance of strategic communication. For example, Bacharach (2016, p. 120) argues “politically competent leaders are careful not only in how they view the situation but also in how they present it to others”, a dimension most clearly seen in the SAFRM forum and commented on by some participants in other forums. For example, some FGF participants argued that the key conclusions presented in the report were too cautious and that the impact of the study was reduced by the lack of political ‘spin’. This aspect may help to explain the limited influence on policymaking.

6.4 Implications for the intervention theories to-be-tested

Similar to the analysis in Chapter 5 the case explanation presented in this chapter can be further interpreted from two perspectives: (i) the implications for a refined understanding of the hypothesised mechanisms; and (ii) new insights into contextual factors such as those that influence the firing of relevant mechanisms. These are considered in turn below.

A different perspective on *the provision of resources that can credibly support strategic decision-making (M2)* is suggested by a political perspective. As discussed earlier in this chapter, a political research utilisation perspective suggests that these resources (e.g. the modelling results) can be interpreted as political ammunition which is then mobilised by actors as part of their ongoing efforts “to neutralise opponents, convince waverers, and bolster supporters”(Weiss 1979, p. 429). This process can help to enable strategic decision-making in very different ways to those currently theorised by this mechanism. This perspective is similar to the view of agency outlined by Fligstein and McAdam (2012) which emphasises the importance of inducing cooperation and framing actions against opponents. Additionally, as Weiss (1979, p. 429) further argues, if research legitimately “support the position of one group, it gives the advocates of that position confidence, reduces their uncertainties, and provides them an edge in the continuing debate”. Consequently, where the resources are interpreted as supporting a pre-existing position of involved actors it may enable strategic decision-making through enhanced confidence. The provision of resources via forums which are viewed as consistent with actors’ views is thus also another way *reduction of uncertainty (M1)* could occur. However, as discussed earlier, these interpretations of the forum findings may be selective and/or a distortion of these results (Weible et al. 2012).

Related to these insights the case provides strong evidence that scenarios are frequently viewed as strategic resources that are actively created and mobilised by actors for related purposes. There is limited evidence in the case that scenarios are neutral and/or disinterested explorations of possible futures. This helps to explain the claim that scenarios are ‘political’.

The case analysis also suggests that one hypothesised mechanism not yet included in a CMOc statement – *social validation (M11)* – may operate differently and be more important than was hypothesised. This mechanism was hypothesised to operate through enhanced actor confidence when/if other actors agreed with their strategic ideas. Instead, social validation

may operate through enhanced legitimacy and/or credibility where important stakeholders are perceived to support an idea, thus helping to *legitimate* an agenda. There is evidence that actors used the forum reports in these ways to gain more traction, as these reports could be used to demonstrate that stakeholders support a proposed action or direction.

Regarding contextual factors, to the extent that the firing of mechanisms requires the open sharing of views (e.g. **M3**) this may be influenced by the power of actors and the relationships between actors. The seniority of staff attending a forum appears highly influential along with the extent to which participants' views differ from more senior colleagues' views. One forum participant put this as follows: "[a] problem with it [the forum] is that because the people in the room were not the heads of the organisations they were constrained by what they felt their senior people would allow them to say and think" (O. Kember, 2016, personal communication, 24 March). However, there may be trade-offs regarding the amount of time actors have for participating in such activities and their seniority.

Additional contextual factors regarding the political skills and capacities of agenda movers are also relevant (Bacharach 2016). If, as Bacharach (2016, p. 159) argues, "in all arenas, innovation and change are dependent on agenda movers" then the pre-existing political skills of forum participants and other actors is likely to strongly influence the resulting outcomes. As was noted in *Section 6.2* some sociologists have similarly examined the importance of actors' social skill to social outcomes. This will be taken up further in *Part 3*.

A final factor revealed by this analysis is the expectations of powerful actors and whether they are a barrier to advancing innovation and change. This was seen regarding some challenges CSIRO staff perceived for advancing their research. The analysis suggests that this may be one factor that drives actors to seek resources that can influence decision-making (see CMOc-1).

6.5 Chapter conclusions

The case analysis presented in this chapter has argued that PKPs are political practices and that this perspective helps to explain important aspects of the case. There is strong evidence that political behaviours and processes were influential during each of the focal futures forums and that the resulting anticipatory knowledge and other outputs are intensely negotiated products. This conclusion has wider implications for how the outputs of such prospective exercises

should be interpreted and used.

These findings also point to a case explanation: the outcome patterns emerged because the futures forums, their outputs, and their effects were enabled and constrained by politics. This includes what motivated forum participation, political dynamics during the futures forum process, and, in some instances, the influence of political factors on how the outputs were interpreted and/or used.

Regarding the intervention theories, these conclusions also suggest that new theoretical perspectives can strengthen the intervention logics underpinning PKPs and may enhance their impact. Beyond the perspectives noted in this chapter, theories from fields such as political science, political sociology, and policy process research may be mobilised for this purpose.

Finally, the political aspects of PKPs appear to help explain the difficulties that researchers from a formal scientific organisation can face when convening such exercises and conducting forward-looking studies. As others similarly note (e.g. Miller 2013; Miller 2015b; Pielke 2007) scientists often seek to both be free of politics *and* to influence political action (e.g. government policy). Politics can be seen as a risk to the epistemic authority of scientists and the autonomy of science (e.g. Miller 2013). The politics of PKPs also raises the potential for conflicting goals such as conflict between epistemic goals and other goals which may be the focus of participants. This issue is taken up in later chapters.

CHAPTER 7: An alternative perspective on reasoning relevant to prospective knowledge practices

7.1 Introduction

This chapter focusses on the reasoning processes of key actors (e.g. forum participants) and related cognitive processes and group dynamics. Starting from the apparent importance of reasoning and human reason to the impacts of social interventions and to related uses of PKPs – as was suggested by initial cross-forum theme analysis – the analysis presented in this chapter applies a theory of reasoning and a related perspective on human reason: the argumentative theory of reasoning which contends that reasoning is a social device that is primarily a tool used in social interaction (Mercier & Sperber 2011, 2017). This theory is based on an interactionist view of reason which views it as “first and foremost a social competence” which functions best “*through interaction with others*” (Mercier & Sperber 2017, p. 11, emphasis added), in contrast to the dominant intellectualist view which views “reason as a means to improve individual cognition and arrive on one’s own at better beliefs and decisions” (Mercier & Sperber 2017, p. 330). This focus on reason is also consistent with the strong emphasis on reasoning in realist evaluation (Pawson 2013; Wong et al. 2012).

Many interviewees referred to aspects of the futures forums which convey the relevance of this reasoning theory. Some interviewees described the futures forum process itself as an argumentative setting – that is, a context in which they made arguments to try to persuade others and, in some cases, sought to learn to refine their arguments (e.g. those used for policy advocacy). Some participants brought ‘to the table’ highly developed arguments for debate and interpreted the forums as an opportunity to influence the views of other attendees. For example, at the Future Fuels Forum peak oil activists advocated consideration of peak oil scenarios (B. Robinson, 2014, personal communication, 23 October) – i.e. these participants tried to persuade other attendees that they are plausible futures – and saw the forum as an opportunity for “influencing people directly just by being involved in those discussions” (P. Hart, 2014, personal communication, 10 October). The project leader of the Sustainable Aviation Fuel Road Map forum stated that “the airlines and others brought arguments to the table” which they used to persuade others about “why this [biofuel] was the only option for the industry” (P. Graham, 2015, personal communication, 26 March). A participant at the

Future Grid Forum from The Climate Institute similarly stated that the forum was “an opportunity for us ... to make our arguments in front an important group of stakeholders” (O. Kember, 2015, personal communication, 24 March). Their delegate hoped that attending the forum would also help her to “refine our arguments and policy positions”.

To deepen consideration of these argumentative dimensions and their potential utility for explaining the case and further theorising mechanisms a relevant theory of reasoning was identified and applied (the argumentative theory of reasoning and associated interactionist view of reason). Although it is a relatively new theory, it is grounded in empirical studies conducted by psychologists over many decades (see Mercier & Sperber 2011, 2017).

The chapter proceeds by first outlining the argumentative theory of reasoning and related concepts and cognitive processes such as myside bias and motivated reasoning. I then reconsider each of the futures forums and the case as-a-whole and summarise the implications of this interpretation of the case for the intervention theories. The final section outlines the chapter conclusions.

7.2 Theoretical perspective: the argumentative theory of reasoning and associated interactionist view of reason

The argumentative theory of reasoning (ATOR) was developed by Mercier and Sperber (2011). This theory contends that the human capability for reason evolved to produce and evaluate arguments – that is, reasoning is “a mechanism that finds and evaluates reasons” (Mercier 2012, p. 260) – and that the evolution of this unique cognitive capability is linked to the communication needs of human beings and related challenges:

Reasoning ... enables communicators to produce arguments to convince addressees who would not accept what they say on trust; it enables addressees to evaluate the soundness of these arguments and to accept valuable information that they would be suspicious of otherwise. Thus, thanks to reasoning, human communication is made more reliable and more potent (Mercier & Sperber 2011, p. 72).

A further framing perspective is that “individual reasoning is rarely if ever objective and impartial as it should be if the intellectualist approach were right” (Mercier & Sperber 2017, pp. 330-1). The theory advances three related claims: (i) the *production* arguments is mostly

biased and lazy, often primarily looking for reasons that support the reasoner's point of view (also see 'myside bias' below); (ii) the *evaluation* of arguments made by others is more demanding and objective; and (iii) as a social competence evolved for dialogic conditions, strong reasoning is only expected when a reasoner faces strong 'pushback' and during a clash of ideas (Mercier & Sperber 2011, 2017) .

The ATOR has further 'how', 'why' and 'where/when' components related to this core perspective on reasoning. The ATOR contends that the "arguments exploited in reasoning are the output of an intuitive inferential mechanism" (p.58) which *unconsciously* delivers intuitive inferences about reasons.⁷⁴ Mercier and Sperber contend that reasoning proper involves going beyond "intuitive beliefs" and arriving "at a belief through reflecting on our reasons to accept it" (p.58). They further postulate the existence of a metarepresentational cognitive mechanism "for representing [mentally] possible reasons to accept a conclusion – that is, for representing arguments and evaluating their strength". Some of the main argumentative aspects of reasoning are further elaborated as follows:

The mental action of working out a convincing argument, the public action of verbally producing this argument so that others will be convinced by it, and the mental action of evaluating and accepting the conclusion of an argument produced by others correspond to what is commonly and traditionally meant by reasoning (a term that can refer to either a mental or a verbal activity) (Mercier & Sperber 2011, p. 59).

As already indicated, the ATOR theorises both the production and evaluation of arguments and the contexts in which reasoning optimally functions (and conversely where it is expected to perform poorly). As per the operation of an inferential mechanism which is unconscious the theory argues that all arguments are grounded in intuitive judgments and these "intuitions about arguments have an evaluative component: Some arguments are seen as strong, others as weak" (p.59). Additionally, although the production and evaluation of arguments is often biased or flawed (see discussion of this below), the ATOR predicts that stronger reasoning performance will tend to occur in optimal argumentative contexts in which reasoners have access to multiple, diverse arguments and they are engaged in "real debate" (p.62), that is contexts where arguments are challenged and improve over-time.

⁷⁴ Where only a page number is provided the source is Mercier & Sperber (2011)

The 'why' is viewed in terms of biological functions that explain why a trait evolved and persisted. The ATOR contends that "reasoning is best adapted for its role in argumentation" (p.59) and that the related functions of reasoning are primarily *social*, not what is more commonly claimed (e.g. enhancing solitary cognition). This core argumentative function can enhance communication by enabling people to exchange arguments, exercise a degree of "epistemic vigilance" to "avoid being victims of misinformation" (p.60), and enhance the "quantity and in epistemic quality the information humans are able to share" (p.60). Thus, the focus of the ATOR is on the role of reasoning in social interaction and related core functions. For example, through their reasoning capacity "people are better able to support their positions or to justify their moral judgments" (p.68). However, these goals can be served at the expense of epistemic benefits (Mercier & Sperber 2011).

More recently Mercier and Sperber (2017) further clarified that the ATOR posits two core functions: justifying beliefs and actions, and convincing others through argumentation.

Regarding the 'where/when', the ATOR is a naturalistic perspective which observes that reasoning is "most naturally used in the context of an exchange of arguments" (p.66) – that is, under dialogic conditions (Mercier & Sperber 2017) as per the underlying interactionist view of reason – and argues it evolved to perform best in such a context.⁷⁵ An optimal group setting for reasoning is thus posited to involve exchanges of diverse strong arguments. Mercier and Sperber (2011, p. 63) also specify nonoptimal settings such as where "all group members share an opinion" because in such settings "arguments will not be critically examined". The ATOR can consequently also be used to explain group effects such as group polarisation (Mercier & Sperber 2011).

Finally, the ATOR is a meta-theory that provides an overarching explanation for a wide range of empirical findings such as from studies on motivated reasoning and reason-based choice (i.e. studies of decision-making). These claims are outlined below.

⁷⁵ In contrast to the intellectualist view of reason, the ATOR further posits two typical outcomes from *solitary* uses of reason: (i) if the lone reasoner has a strong opinion (about the matter at-hand) then further reasoning is likely to reinforce or strengthen this view; (ii) if the lone reasoner doesn't have a strong opinion or has conflicting views then "reason will drive her toward whatever choice happens to be easier to justify" (Mercier & Sperber 2017, p. 10).

Myside bias (and related studies of confirmation bias): myside bias is a cognitive process through which reasoning tends to systemically find reasons supporting the reasoner's own ideas and reasons against the ideas they oppose (Mercier & Sperber 2017). Studies of confirmation bias similarly identified a cognitive bias whereby evidence is interpreted (or sought) "in ways that are partial to existing beliefs, expectations, or a hypothesis in hand" (Nickerson 1998, p. 175). The term usually refers to "unwitting selectivity in the acquisition and use of evidence" (Nickerson 1998, p. 175). According to the ATOR confirmation bias should further be understood as a "consequence of the function of reasoning and hence a *feature* of reasoning when used for the production of arguments" (Mercier & Sperber 2011, p. 63 emphasis in original).⁷⁶ That is, when people are trying to convince others "we should be looking for arguments in favor of our viewpoint rather than in favor of hers" (Mercier & Sperber 2011, p. 61). Consistent with the discussion of context above, confirmation bias is also argued to have further contextual drivers: "When one is alone or with people who hold similar views, one's arguments will not be critically evaluated. This is when the confirmation bias is most likely to lead to poor outcomes" (Mercier & Sperber 2011, p. 65).

Motivated reasoning: Motivated reasoning occurs when peoples' goals or preferences affect the reasoning process, for example by biasing cognitive processes (Kunda 1998). According to the ATOR some research on motivated reasoning can be reinterpreted as identifying "proactive" reasoning. That is, reasoning can be motivated when done *proactively* "in anticipation of situations" (p.68) such as situations where an actor expects to have to defend their opinion or actions (and consequently reasoning is done in preparation for this), and/or when they anticipate the need to convince others. Motivated reasoning can have a number of consequences including biased evaluation of evidence, attitude polarisation, bolstering, overconfidence, and belief perseverance (Mercier & Sperber 2011, pp. 65-8). These potential consequences of motivated reasoning are summarised in *Table 24* below.

⁷⁶ Mercier and Sperber (2011, p. 59) also note that "there is considerable evidence that when reasoning is applied to the conclusions of intuitive inference, it tends to rationalize them rather than to correct them", i.e. post-hoc rationalisation.

Table 24: Potential consequences of motivated reasoning (from Mercier & Sperber 2011)

Consequence	Process/phenomenon	ATOR perspective on the process
Biased assimilation / evaluation of evidence	Identification of strengths or flaws (in evidence) depends on its conclusion. That is, arguments with favoured conclusions are rated as sounder and more persuasive.	People are producing arguments to either support or rebut the argument that they are evaluating.
Attitude polarisation	Being exposed to a counter-attitudinal conclusion (i.e. which goes against one's own beliefs or preferences) has the opposite effect to what was intended by the arguer: it strengthens the other actor's existing beliefs.	Knowledgeable people are better able produce arguments rebutting the argument they are evaluating. They can produce counterarguments and identify flaws thereby reinforcing their views.
Bolstering	Generation of thoughts and beliefs that are consistent with an attitude resulting in formation of stronger attitudes.	Reasoning becomes more biased after a reasoner has stated an opinion due to increased pressure to justify it.
Overconfidence	Motivated reasoning leads to a focus on reasons that can support their views, contributing to overconfidence.	People tend to spontaneously think of reasons supporting their views (not reasons to doubt their views).
Belief perseverance	Retention of a belief after it has been shown to be flawed.	Selective use of evidence which only supports favoured belief(s) – i.e. find arguments supporting these views.

More generally, Mercier and Sperber contend that the empirical evidence shows that argumentative goals are often better served by motivated reasoning than epistemic or moral goals. For example, reasoning motivated by the goal of defending ones' opinions or actions can distort the evaluation of evidence (e.g. resulting in belief perseverance) and enable moral hypocrisy.

The role of reasoning in decision-making: The ATOR also makes predictions about the use and roles of reasoning in decision processes. According to the ATOR “the main function of reasoning [in decision-making] is to produce arguments to convince others rather than to find the best decision” (p.61). Consequently, in the context of decision-making the theory predicts that “reasoning will drive people towards decisions for which they can argue – decisions that they can justify – even if these decisions are not optimal” (p.61). A related claim is that “when a more easily justifiable decision is not a *good* one, reasoning still drives us in the direction of ease of justification” (p.71). Such reasoning can be another form of proactive reasoning which is done to defend decisions. As Mercier and Sperber (2011, p. 69) note these claims about the role of reasoning are a “sharp contrast to the classical view that reasoning about possible options and weighing up their pros and cons is the most reliable way – if not the only reliable

way – to arrive at sound decisions”.

The ATOR also points to important contextual factors such as group composition, the extent to which participants are committed to an opinion/position, how knowledgeable participants are (e.g. see the phenomenon of attitude polarisation in *Table 24*), and social factors such as accountability where the forum participants may be motivated to identify justifications for their positions or actions. The ATOR argues that solitary and group reasoning situations are themselves important contexts, with the optimal group setting being one in which members are exposed diverse and strong arguments which promotes good reasoning performance. In contexts where arguments are not challenged Mercier and Sperber (2011, p. 62) argue that “it makes sense to be satisfied with seemingly superficial arguments”. They also note the social psychological research on accountability which has examined the influence of social context on judgement and choices. For example, demands for accountability (i.e. where a belief or decision taken needs to be justified to others) promote confirmatory thought processes similar to confirmation biases (e.g. Lerner & Tetlock 2002; Tetlock 1985).

7.3 Case evidence and interpretation

7.3.1 *Future Fuels Forum*

The actors that attended this forum held different views on oil supply risks (e.g. actors concerned about peak oil and skeptical about peak oil) and advocated a range of fuel supply and greenhouse gas emissions reduction options (see *Appendix 1*). Many of the forum attendees also viewed the forum as an argumentative setting in which they could voice their arguments and try to influence the views of other participants. Consequently, a ***strong argumentative context*** was established in which forum attendees were exposed to diverse arguments and viewpoints (although some process decisions may have weakened this context – see discussion below). Such a context was, in part, enabled by the intensifying dispute regarding the timing and reality of peak oil and the decision of CSIRO staff to invite actors from both sides of the debate to participate.

Prior to the forum many forum participants had developed strong beliefs and formed policy positions and were seeking to convince others of their merits. Some of these contextual aspects were discussed in the previous chapter, such as the desire of the management of the

CSIRO Energy Transformed Flagship (e.g. the Flagship Director) to convince CSIRO management and other important stakeholders of the merits of conducting greater liquid fuels research; GM Holden staff adopted a fuel diversification approach and an anti-mandatory vehicle standards positions and were seeking to both persuade others and deal with internal tensions; and actors who had different beliefs about peak oil threats wanted to convince others such as policymakers and forum participants.

Related case evidence can be interpreted as, in part, evidence of *motivated reasoning and/or myside bias* which influenced the ways actors interpreted the forum discussions and results and how this informed subsequent action. For example, whereas the anxieties of some participants were *reduced* by the forum (e.g. regarding fuel security threats or climate change action), the Flagship Director's concerns were amplified. Related to this the results were interpreted in ways that helped the Flagship Director to *identify reasons* why their proposed liquid fuels research should be supported/funded:

“I always did have a concern that whenever government talked about Australia and transport fuels they were not giving it the weight that I thought it should have... What happened with the Future Fuels Forum is that it made me realise, and I think other participants too, just how fragile we are... If anything, the way the Future Fuels Forum impacted my own thinking was on the need to be a little bit better prepared for such an eventuality [i.e. in which there is a disruption to imported fuel supplies such as due to peak oil]. If you take that logic through then we need to setup some projects and programs in liquid fuels in this country that act somewhat as an insurance policy” (J. Wright, 2014, personal communication, 25 August).

The Flagship Director further stated that “the Forum didn't get rid of those issues at all [i.e. the liquid fuel vulnerability issues he was concerned about]”. His summary of the forum results was that it “confirmed the direction that we thought the transport fuels situation should go” (J. Wright, 2014, personal communication, 25 August).

A state government employee working in road network planning (who represented Engineers Australia at the forum) provides a contrasting example. This participant stated that the forum *reduced* his anxieties and helped to resolve related ethical dilemmas (C. Mottram, 2014, personal communication, 10 October). This participant stated that the forum reduced his concerns about peak oil – though he'd “always been sceptical” – and, second, he interpreted the results as showing that greenhouse gas reductions are *not* “contingent on not building new

roads". As the following quotation demonstrates, he *identified supporting reasons* why his road network planning work could be consistent with climate change action:

"You can get greenhouse gas reductions through new vehicles. Building roads does create some greenhouse gas emissions, but with the actual use of roads you can anticipate you would get reductions in emissions with more efficient vehicle technology. So even with our economy we don't need to totally change the way that everyone travels, such as the approach whereby everyone takes the train or tram to work" (C. Mottram, 2014, personal communication, 10 October).

As was noted in last chapter, participants often interpreted the results as supporting their views such as on the merits of mandatory vehicle standards and other potential policies. Some examples provide evidence of *biased assimilation (related to motivated reasoning)*, which served to confirm their initial intuitions regarding the merits of such policies (also see Chapter 6). The main participant from Australian Conservation Foundation (ACF) indicated that confirmatory thought processes were dominant when she stated that "it helped us to prosecute a position that we had" (as opposed to prompting adoption of a new policy position), such as regarding their advocacy of new vehicle standards mandating improved fuel efficiency (M. Richter, 2014, personal communication, 13 October). In contrast, a forum participant from GM Holden elaborated as follows:

"Coming back to our specific needs and wants one of the things that I found particularly useful was that process of using scenarios to test various possible policy tools. For example, at that time there was quite a bit of discussion about the mandatory fuel economy targets. So it was quite important to have some good data to substantiate why we were pushing a particular direction on mandatory fuel economy targets [that is, substantiating their case for why they shouldn't be introduced]" (R. Marshall, 2014, personal communication, 23 October).

Several aspects of the process design are also relevant to actors' reasoning processes. The first workshop may have contributed to *biased reasoning due to "bolstering"* (see Table 24) by requiring many forum participants to give presentations in which they stated their opinions on transport fuel issues, fuel supply options and/or futures.⁷⁷ Second, as was discussed in Chapter 5, at the first two-day workshop participants formed like-minded subgroups that defined

⁷⁷ See the phenomenon of "bolstering" in Table 24. Mercier and Sperber (2011, p. 67) contend that "according to the argumentative theory, reasoning should be even more biased once the reasoner has already stated her opinion, thereby increasing the pressure on her to justify it rather than moving away from it". This suggests that the emphasis on sharing views early in the futures forums (e.g. participant presentations at the first meeting) could lead to bolstering and militate against critical reflection.

contrasting scenarios (in particular with respect to future oil supply constraints and focal policy/response options) and then proposed these scenarios to the rest of the group when constructing the core scenario set.⁷⁸ This decision **limited the range of arguments accessible** to members of each subgroup and plausibly contributed to the strengthening of opinions within each subgroup and related **group polarisation**.

The reasoning done by many participants during the futures forum process would likely have been **proactive reasoning in anticipation of situations** (e.g. reasoning done in anticipation of future situations where they would need to justify their beliefs and/or actions). Many of the following examples have been covered in previous chapters or noted above but are briefly covered here to substantiate this observation along with the plausible links to reasoning processes involved in the production and/or evaluation of arguments:

- The Inaugural Flagship Director was seeking to get its proposed liquid fuels programs approved by CSIRO management and needed to develop a persuasive justification to defend their proposed research and development choices. The Director thus needed to find reasons that could persuasively justify this research program. This motivated reasoning reinforced his pre-existing beliefs about fuel security risks;
- Alternative fuels advocates were seeking to convince others, notably Federal and State governments, to provide greater support to enable their development and/or uptake, and sought to support their claim that such fuels could play major future roles. This focus on producing persuasive arguments influenced their evaluation of forum outputs (e.g. the scenarios) and related data, and was a barrier to epistemic vigilance. Nonetheless, these argumentative functions were judged as useful by advocates;
- Policy officers and policy-makers in the Victorian state government were seeking to find justifications for proposed policies (see the brief discussion of “cherry picking” in chapter 6). Policymakers typically need to provide reasons for policies and associated cognitive process (e.g. the biased evaluation of forum outputs) likely supported the policy learning discussed in Chapter 6; and
- Industry players and NGOs were trying to convince others that their claims about policies and proposed government actions were valid. These actors were focussed on identifying and producing better arguments in order to persuade others. Associated evaluation of the modelling results (see the examples in Chapter 6) is a consequence

⁷⁸ One subgroup proposed peak oil-focussed scenarios, the other proposed non-peak oil scenarios, and then these were combined into a scenario set that was modelled (see Chapter 5).

of the motivated reasoning that often occurs in these circumstances.

Relevant self-reported impacts were also detailed by participants. One commonly self-reported impact of the process was *reinforced* beliefs. A minority of surveyed participants (33%) stated that the forum challenged their assumptions/beliefs, which can be interpreted as *evidence of myside bias* given the wide range of scenarios and transport fuel and policy options that were discussed and the high level of uncertainty being grappled with at the time (see Chapter 4). Further supporting evidence is that many forum participants (as well as other key actors) judged scenarios that were aligned with their beliefs to be more plausible – and often emphasised those scenarios after the process – and discounted the other scenarios.⁷⁹ This pattern is consistent with *biased assimilation* where evidence that supports favoured conclusions is judged to be more robust (in this case scenarios consistent with favoured conclusions are judged to be more robust). Consistent with this interpretation of confirmatory thought processes no surveyed participant stated that they ‘made different strategic decisions and/or created different policies’ because of this forum.

Related evidence is provided by the utilisation (or ‘adoption’) patterns which can be interpreted as being, in part, a *consequence of motivated reasoning* (e.g. biased evaluation of evidence). Some examples alluded to above and in earlier chapters include the following:

- Assessing the scenarios and modelling results to confirm participants’ pre-existing views (rather than objectively). There is evidence that some participants (e.g. peak oil activists) and non-participants (e.g. policymakers) assessed the outputs in this way, which involved finding reasons to either accept or reject the forum’s conclusions;⁸⁰
- Producing related arguments that support or rebut the argument being evaluated which influences whether outputs are ‘adopted’. For example, a peak oil activist rejected the biofuel scenarios because he doesn’t believe that them “saving the day” is plausible (B. Robinson, 2014, personal communication, 23 October); and
- More generally, refuting undesirable evidence (e.g. evidence and arguments for near-

⁷⁹ For example, participants concerned with peak oil emphasised the peak oil-oriented scenarios that were modelled and weren’t persuaded by the broader scenario analysis. Similarly, actors who weren’t concerned about peak oil tended to emphasise the non-peak oil oriented scenarios and related findings.

⁸⁰ Consider the response of Victorian policymakers and politicians to the peak oil-oriented scenarios. The response to that analysis “was ‘well that’s just the views of that group [the Association for the Study of Peak Oil and Gas]’. It has no weight, we can’t produce any evidence or analysis that proves that it’s the right thing to be using, we should therefore approach the whole thing with skepticism, with some grains of salt” (Government informant, 2014, personal communication 17 October).

term peak oil in the case of actors who didn't wish to believe this was plausible) and finding reasons that support desirable conclusions (e.g. related to ways of reducing greenhouse gas emissions without reducing personal mobility).

Regarding subsequent decision-making, there is evidence that the forum provided materials (or 'resources') ***used for argument construction or argument evaluation related to decision-making***, and secondly that such reasoning process influenced subsequent decision-making. As noted in Chapter 4 (and Appendix 1) two-thirds of surveyed participants stated that they made more confident strategic decisions which – in formal organisational contexts – typically requires constructing justifications. Many forum participants stated that they used the forum outputs for this purpose (e.g. CSIRO scientists, policy officers/policy-makers, and industry actors). Consistent with this predicted role of reasoning processes, a number of CSIRO staff and forum participants interpreted the forum modelling results and other forum findings in ways that helped them to formulate such justifications. This provides evidence that these reasoning processes strongly mediate the impact of such exercises.

In sum, there is good evidence of proactive reasoning (and associated situational factors and motivated reasoning) and myside bias related to argument production and evaluation (e.g. related to the goal of convincing others and the evaluation of evidence). As part of this, the interpretive flexibility of the outputs enabled actors to use them differently when finding supporting reasons or evaluating arguments. This provides a complementary explanation for some aspects of the case examined in Chapter 6, emphasising micro-level processes. Biased evaluation of the process outputs also provides an explanation for the process effect of increased polarisation which was identified in Chapter 4 where, for example, some actors who were concerned about peak oil became more concerned and some who weren't concerned became less concerned. The high knowledge level of most forum participants supports this explanation. There is also some evidence that process choices influenced actors' reasoning and associated outcomes (e.g. whether the forum challenged or reinforced actors' beliefs and assumptions). Such choices may have reduced the benefits of convening such a diverse group of participants in terms of the group's reasoning performance.

7.3.2 Sustainable Aviation Fuels Road Map (SAFRM) forum

Most actors that attended this forum held similar views, which consequently established a

weaker argumentative context (although one participant attempted to change this – see below). As discussed in previous chapters, the aviation sector participants and others held similar views about biofuels and their importance (e.g. for enabling the industry to grow whilst reducing greenhouse gas emissions) and they had developed supporting arguments.⁸¹ The main participant from Virgin Australia also recalled that “at the time there was a sense of increased optimism, it was a bit of a spike” (D. White, 2015, personal communication, 1 June). This context may have reduced the **range of arguments available at the forum**. Similarly, the CEO of the Biofuels Association of Australia (BAA) observed that many forum participants had similar beliefs about the requirements for commercialisation and uptake of bio-jetfuel. For example, she argued that discussions about these aspects “came back to ‘we need subsidies, we need subsidies...’ It was like this mantra in the room” (H. Bone [Brodie], 2015, personal communication, 29 May). Many participants also shared a preference for a local production approach (e.g. via ‘hubs’ around airports) rather than importing biofuel.⁸²

One participant (the CEO of the BAA) responded to this situation by inviting Caltex Australia to give a presentation as the second meeting on the company’s perspective on the aviation fuel market and key challenges that needed be recognised and overcome such as infrastructure use and/or creation. Subsequently, a senior Caltex staff member attended the rest of the forum.

Some aspects of the process design are also relevant to actors reasoning processes. As per the approach followed at the previous forum, at the first meeting several participants gave presentations in which they stated their opinions on aviation fuel options, priorities and and/or futures. The first workshop may have contributed to **biased reasoning due to bolstering** (also see footnote 77 on p.198). That is, the reasserting of optimistic assessments by aviation sector participants during the mid-late periods of the forum may have been, in part, due to a perceived need to justify opinions that were stated at earlier meetings. At

⁸¹ The project leader stated that the aviation sector didn’t want to explore any other options at the forum: “The airlines and others brought arguments to the table as to why this [biofuels] was the only option for the industry and they didn’t want to do a bunch of other scenarios looking at a range of options” (P. Graham, 2015, personal communication, 26 March).

⁸² Consistent with this many interviewees pointed to the importance of developing localised supply chains and ‘hubs’ around airports, including forum participants from General Electric Australia, Boeing and Qantas. The delegate from Qantas stated that the focus on domestic fuel supply was, in part, because of “links to the third plank which is economic and regional development”, and this was seen as being attractive to government (N. Williamson, 2014, personal communication, 6 November). Related to the emphasis on a local approach, the forum report argued that “[e]stablishing a local commercially viable supply chain is the major challenge needing to be addressed” (CSIRO 2011, p. 5).

subsequent meetings, other forum participants also gave presentations.

Some participants stated that they felt the process was hampered and/or made challenging by a lack of open-minded thinking on fuel commercialisation and market development. The following observations point to these claimed dynamics during this forum:

“I recall a fellow from CSIRO, Paul, would try to prompt thinking about what else was out there and could be explored [with respect to actions/policies for commercialising bio-derived fuels], but inevitably it would get back to statements that ‘it’s not fair’ and ‘we need subsidies’, ‘it’s not fair that biodiesel and ethanol get subsidies’... I think that we would have got some different results if there had been more willingness to delve further into that” (H. Bone [Brodie], 2015, personal communication, 29 May).

“The airlines were so aggressive... I remember one meeting in particular when I said for the tenth time these algae numbers they’re just not looking too good. Similarly for pongamia, which we thought had potentially a bright future but it needs a 20 year research program and not a \$100,000 grant for two years. And this is the bucket of waste oil, it’s tiny. Here are the options. The participant said ‘you’re so negative, we’re sick of working with CSIRO, you’re not looking for solutions all you do is point out problems’” (Forum participant [off-the-record], 2015, personal communication, 25 June).

A bioenergy industry informant (who wasn’t a participant) suggested that CSIRO staff authoring the report exhibited a form of *motivated reasoning in arriving at some conclusions* which emphasise research needs: “the main criticism I’d have of the document is that it comes from a group that doesn’t think very far beyond research... many recommendations [are] favouring, or reflecting the mindset of, a research group” (bioenergy industry informant, 2015, personal communication, 22 May). Related statements were made by this industry informant about the participant mix at the forum:

“Even when they [CSIRO] say they are [thinking beyond research] they’re really coming from a fairly low base. It [therefore] would have been good to have more industry participation and more industry development rather than technology and R&D focus... perhaps one the big consultancies involved with industry development, like a Deloitte or KPMG, or overseas groups such as NREL [U.S. National Renewable Energy Laboratory] or DuPont or European or American aviation groups. Something to break the research focus and parochialism...”.

Some participants were seeking to *evaluate arguments through the forum*. In particular, some

forum delegates from the participating airlines indicated that one of their motivations for participating was to better evaluate arguments being put to them by potential biofuel suppliers. For example, the main participant from Virgin Australia stated that “we wanted to do something because we were hearing a lot about it [alternative fuels] and we were getting companies approaching us about being able to sell us renewable fuels and making all sorts of promises” (D. White, 2015, personal communication, 1 June). In order to evaluate these promises (i.e. the arguments put to them) they needed greater knowledge.⁸³

Case evidence indicates that some forum participants were also seeking to **find reasons to develop persuasive arguments**. Similar to the Future Fuels Forum the reasoning done by many participants at the forum would likely have been **proactive reasoning in anticipation of situations** (e.g. where they sought to convince others). Examples discussed in more detail in earlier chapters include:

- Renewable fuels advocates in airlines selling the idea “up the chain” i.e. within their organisations (D. White, 2015, personal communication, 1 June);
- Other advocates within the broader aviation sector who wanted to secure more high-level government support to help enable industry development; and
- Policy officers in state government departments were considering whether to advocate for policy/programs related to biofuels within their department.

According to the ATOR **proactive reasoning in the above situations is expected to promote motivated reasoning** related to belief formation and belief reinforcement. Related to this responses to the conclusions reached by the forum provide evidence of how the forum and its outputs were evaluated by actors. The case provides **evidence of related biased evaluation** where the participants who were in favour of, or were promoting, use of biofuels tended to emphasise the learnings and conclusions which are supportive of this position, and others who were skeptical of the near-term prospects of aviation biofuels tended to emphasise learnings which reinforced this position. With respect to the former (advocates or supporters) many participants’ initial beliefs – the “increased optimism” referred to earlier – may have been insufficiently reflected on. For example, pro-biofuel participants emphasised the following learnings and aspects which supported arguments for associated actions, e.g.:

⁸³ A participating CSIRO scientist stated that some alternative fuel proponents had falsely argued to airline staff that they “could solve all their problems, soon, and cheap” (forum participant [off-the-record], 2015, personal communication, 15 June).

- **Feedstock (biomass) availability:** “a big requirement was to be able to get enough of it in a reasonable timeframe. The modelling showed the different availabilities and locations... lignocellulosic biomass can more than supply the requirements” (D. White, 2015, personal communication, 1 June)
- **Technical viability:** “It provided me with a lot of information on the chemistry of biofuel production and its feasibility [e.g. as a ‘drop-in’ replacement for current liquid fuels]” (R. Stanier, 2015, personal communication, 11 April);
- **Range of alternative fuel options:** “we started to realise that there are a wider variety of fuels that you can actually work with in aviation, for refined fuels, such as green diesel from treating animal fats and vegetable oils which can be turned into fuel” (W. Lyons, 2015, personal communication, 16 June); and
- **Identification of research and development needs:** “[it] established R&D gaps that we along with CSIRO sought to fill. So it steered us in value-added R&D directions” (M. Lakeman, 2015, personal communication, 9 July).

In contrast, participants and informants who were skeptical of the near-term prospects of aviation biofuel emphasised the following learnings and aspects:

- **Limited customer support, including unwillingness to pay higher fuel costs:** “if the customers’ desire [as voiced at the SAFRM forum] had been stronger than I thought, or if the imperative for the customer was a lot stronger and they were prepared to meet some of the commercial hurdles, then that would be fine. Separate to this forum early on I met with the chief fuel purchaser for Qantas and asked how much extra Qantas is prepared to pay for bio-based aviation fuels and their response was not 0.1 of a cent” (M. Ridley-Smith, 2015, personal communication, 20 July);
- **Fuel distribution challenges and customer risk:** “I said this to Qantas, if you can convince everybody, all of the airlines, and they’re comfortable with that and are going to sign-off on that then that will be OK. What we don’t want is that we suddenly put biofuels into the system and our foreign customers say we don’t want to do that we don’t have approval for that... What could overcome that, and this may be a bit draconian, is the government says this is the way it’s going to be if you want to land in Australia this is a requirement [i.e. via the introduction of a biofuel mandate]” (M. Ridley-Smith, 2015, personal communication, 20 July);
- **Perceived lack of clear ‘driver’:** “Show me a driver. Who is going to use that roadmap to drive somewhere... If you look at the recommendations of the roadmap I think

you'll find everybody other than the Queen's mother listed next to potential action items" (Industry informant, 2015, personal communication, 22 May).

- **Perceived bias towards research and development opportunities/needs:** "[Example comment made regarding recommendation #5 in the roadmap – 'Assess the potential of new biomass resources, particularly plant oils that are lesser known':] It's got bugger all bearing on anything that is going to happen this decade [i.e. to enable commercialisation in line with the roadmap timeline] and it's more reflective of CSIRO's perception that they've got strength in that area and that it's good research" (Industry informant, 2015, personal communication, 22 May); and
- **Lack of involvement of, and/or commitments from, major overseas players commercialising bio-jetfuel technologies:** "I suppose you'd call it the isolated arrogance of saying this is a technology play... [and the lack of] acknowledgement that the industry cannot be built without significant involvement of major overseas players" (Industry informant, 2015, personal communication, 22 May).

Related to the above issues, which were all perceived as being problematic or unresolved, the main forum participant from Caltex Australia stated that "I cannot recall that there was a clear pathway forward as a result of the report" (M. Ridley-Smith, 2015, personal communication, 7 May). Similarly, a senior CSIRO staff member remarked that "in the end the question is really often a question around paying the additional costs and who takes the additional risks around doing an initiative like that" and further indicated that the aviation industry viewed these aspects of the change process as "a role for government" rather than themselves (Forum participant [off-the-record], 2015, personal communication, 7 May).

Related evidence is provided by the utilisation (or 'adoption') patterns which can be interpreted as being, in part, a **consequence of motivated reasoning and myside bias** and, in some case, linked to associated **roles of reasoning in decision-making process**. An example alluded to above and in earlier chapters is the utilisation of the outputs by advocates within local airlines. The following interpretation of the main conclusions conveys this: "it basically says that it is possible and that was a big boost, obviously, and something our senior managers took note of... It was easier to sell up the chain with it" (D. White, 2015, personal communication, 1 June). The report and modelling were used for this purpose. However, as some of the issues raised by those more skeptical of the near-term prospects indicate, the process and findings were also interpreted as *not* showing that it is possible. This utilisation

can be interpreted being influenced by both *cognitive biases* and *motivated reasoning* where the desire to reach a certain conclusion influenced how the results were interpreted.⁸⁴

Other key utilisation patterns in policymaking contexts were summarised in earlier chapters, in terms of whether the process and its conclusions were perceived to support existing or proposed government actions (e.g. the Federal Government's approach to alternative fuels development detailed in the *Strategic Framework for Alternative Transport Fuels*). The ATOR perspective suggests that these interpretations of the futures forum process and its outputs were often, in part, the result of *myside bias* (e.g. whereby actors' interpretations of the forum and/or its findings tended to support or reinforce their prior beliefs).

Regarding subsequent decision-making there is evidence that the forum was drawn on by participants to support argument construction when making or defending decisions. The majority of participants (60%) stated that they made more confident strategic decisions which the above case evidence indicates is partly due to focussing on learnings and/or outputs which were perceived to support their beliefs and the associated decisions. Consistent with the predicted role of reasoning in decision processes, a number of participants interpreted the forum findings in ways that helped them to formulate justifications to convince others (e.g. convincing their colleagues in senior management).

In sum, there is good evidence of proactive reasoning (and associated situational factors and examples of motivated reasoning) and of widespread actor focus on evaluating and producing arguments. The tendency for participants to have many of their pre-existing views reinforced may also be evidence of *myside bias* and motivated reasoning, even though the majority of surveyed participants stated that the forum challenged some of their assumptions and beliefs (e.g. about the viability of some alternative fuels such as algal fuels). Many of these reasoning processes are consistent with the ATOR and somewhat inconsistent with classical theories of

⁸⁴ Whether one of these interpretations was the correct interpretation of the results is debateable; however, for the purposes of the analysis presented here it is not essential to establish this. More important is to note that 1) participants preexisting views were often confirmed (e.g. those who were skeptical about the near-term prospects of alternative fuels remained skeptical); and 2) interviewed advocates of alternative fuels at local airlines interpreted the results as showing 'it is possible' whereas the Caltex participants (who weren't pushing for change) reached contrasting conclusions. Given that motivated reasoning involves arriving at conclusions that people are motivated to arrive at (e.g. influenced by one's preferences or goals) the interpretation of the findings by alternative fuel advocates could be judged to be influenced by motivated reasoning.

reasoning. There is evidence that the impacts and, related to this, the interpretation and utilisation of forum outputs (e.g. by advocates at airlines) was influenced by these cognitive processes, along with political judgments as was discussed in Chapter 6. Finally, aspects of the process likely promoted confirmation bias (e.g. due to the participation of many actors holding similarly optimistic views) and, more speculatively, may also have contributed to bolstering effects; however important ‘interventions’ were made by some forum participants (e.g. the CEO of the Biofuels Association of Australia) and some CSIRO staff.

7.3.3 Future Grid Forum

Many participants in the Future Grid Forum (FGF) held similar views about key issues and options discussed at the forum such as a transition to a ‘smarter’ electricity grid. For example, in addition to the forum participants attending from the initiating project partners (i.e. CSIRO and General Electric Australia staff) roughly one-fifth of FGF participants (see *Appendix 3*) worked for an organisation focussed on smart grid technologies and related opportunities such as Smart Grid Australia, Landis+Gyr, Ericsson, Telstra or in a role focussed on changes towards a smart grid (e.g. some of the participants from electricity network businesses such as SA Power Networks, Western Power and Energex). A wide range of participants were also focussed on similar issues such as decarbonisation of the electricity sector.⁸⁵ Related to this a senior State government attendee was concerned about a high level of groupthink at the beginning of the forum: “It was all going to be off-grid, it was all going to be solar. There was perhaps a preoccupation with climate change to some extent, not to the exclusion of everything else, but it was certainly driven to a large extent by that” (Government informant, 2016, personal communication, 18 March). On other issues there was a greater mix of opinions, such as regarding emerging network utilisation issues, the causes of increases in household electricity prices (e.g. claims of “gold-plating” the electricity network businesses), and the future mix of centralised and distributed electricity generation. This can be interpreted as a ***moderate argumentative context*** with a moderately diverse range of viewpoints and some core beliefs that were widely held by most participants.

Like the previous futures forums at the first meeting several participants gave presentations in

⁸⁵ Within this broad agreement on the decarbonisation imperative (amongst the forum attendees) there were different views on necessary rate and scale of actions, for instance research and advocacy groups promoting deeper and faster reductions.

which they stated their opinions on electricity sector issues, options and/or futures, which may also have encouraged **bolstering** and, consequently, reduced critical reflection. Additionally, thematic working groups were established at different stages of the process focussed on particular issues (e.g. electricity demand/demand management, pricing reform, and regulation). Participants self-nominated for working groups in response to invitations to participate that were sent to all participants. The diversity of opinion within some of these small groups was likely to have been smaller than in the whole group (e.g. many members of the pricing group likely held similar views on the benefits of cost-reflective pricing, which according to ATOR is expected to result in a strengthening of opinion).

Like the previous forums the reasoning done by many participants at the forum would likely have been **proactive reasoning**. The examples noted to substantiate this point have largely been covered in previous chapters, but need mentioning briefly again along with the plausible links to reasoning processes involved in the production and/or evaluation of arguments:

- Staff from network businesses anticipating arguments about asset values and network investment regulations in the context of electricity price rises and emerging network utilisation issues. This may have motivated a search for reasons why, for example, network (grid) utilisation should be maintained and on-site generation minimised (see further discussion of this issue below);
- Policy-oriented think tank staff sought to refine their proposals for reforming the electricity sector or electricity markets. Similarly, climate change action advocates (e.g. from research organisations such as ClimateWorks and other institutes) anticipating related arguments both during the forum process and afterwards such as climate policy arguments with a new Federal Government (Abbott Government). Such actors are seeking to produce arguments to convince others (e.g. policymakers) and will be motivated to identify supporting reasons. Such motivations are relevant to their interpretation of the forum outputs (also see Chapter 6); and
- CSIRO staff from the Flagship were aware of the need to defend their related research choices needed, i.e. to define “why CSIRO is playing in this space” (M. Paterson, 2015, personal communication, 21 December). Such motivations were relevant to their interpretation and use of the forum outputs (see Chapter 6).

Arguments were also circulating and developing (at the time of the forum) **which participants needed to evaluate**. For example, arguments about the potential for a “death spiral” in the

electricity sector were being made and related potential threats to generators and network businesses had become prominent. The project leader put this as follows:

“The talk in the industry is “networks are dead”; or there’s the talk of “death spirals”. This is the kind of language that is floating around out there. Another phrase you hear is “the network model is broken”... The pointy end is really around the future of networks. But it affects everyone along the supply chain” (P. Graham, 2014, personal communication, 2 June).

Additional arguments were circulating about recent declines in electricity consumption and in aggregate peak demand (which had historically risen inexorably with economic growth), rising electricity prices and the implications of emerging technologies. Related speculation was comprised of arguments and counterarguments about what is feasible or conceivable in the future such as cost effective full disconnection from the electricity grid by large numbers of households, on-site power generation and/or local energy storage becoming the norm, the mix of local and centralised generation that is feasible, and the futures roles of energy storage (e.g. peak demand management usage, etc.), amongst others.

The following comments by a senior executive from a network business who participated in the Future Grid Forum clearly convey this context and some of the perceived benefits (e.g. better judging what changes are likely):

“Fundamentally at the time we could see that peoples’ use of electricity was changing. One of the challenges we had was considering whether that was just a temporary change or was it actually the start of something different? From the 1960s onwards we’d seen electricity demand increase typically 2-% per annum until around 2009 and then through to 2012 we’d seen a dip. But was that a one-off, which would then return to the long-term trend [i.e. growing consumption]? Or was it the start of something different?” (Industry informant, 2016, personal communication, 18 April).

“It provided some boundaries. Some scenarios showed limited change going forward, such as “Set and forget”, compared to others which projected significant change in the utilisation of our networks. Then if these are plausible scenarios it gives you some bounds to work with. It’s a case of I can see these things happening but how to quantify what the potential impact would be? So that was one of the benefits of the modelling the guys did” (Industry informant, 2016, personal communication, 18 April).

Much of the analysis conducted for the forum is consistent with *actors’ efforts to evaluate arguments* about current and potential changes such as a “death spiral”. The analytical and

modelling work completed for the FGF had a strong focus on these topics, such as: examining the potential future economic viability of households fully disconnecting from the electricity grid⁸⁶ and emerging network utilisation issues;⁸⁷ modelling future electricity demand profiles taking into account possible new sources of demand (e.g. charging electric vehicles) and potential demand moderators (e.g. energy efficiency improvement, demand management); and modelling future household electricity bills under different scenarios.

The scenario analysis also *prompted* further evaluation of claims such as those made in the scenario set (i.e. interrogating their feasibility), as outlined by this industry actor:

“It raised some scenarios which you force yourself to look at and to think about whether they’re realistic... having it there to work with has probably forced me to think about things I might not have thought about otherwise and to draw my own conclusions about them even if I don’t agree... [for example] some of the Future Grid Forum scenarios have a pretty significant proportion of customers leaving the grid. I think we’ve done a lot more work on that which would suggest that that’s a lot harder and a lot less likely than was envisaged, at least over the medium-term. In other words the fact that some assumptions were made and related outcomes were included in the scenarios forced us to then go and do some more analysis to try to further examine how realistic and likely they are” (C. Popple, 2016, personal communication, 22 April).

Related case evidence can be interpreted as, in part, evidence of *motivated reasoning*. Like the other forums the findings were interpreted quite differently by some participants. Some participants felt that much of the analysis was conservative, in part due to the consensus orientation of the forum process and/or the interests represented in the room.⁸⁸ In contrast,

⁸⁶ This economic viability was defined as “when independent power systems are expected to be able to match retail prices” in particular through falling battery costs (CSIRO 2013a). Implicit in the analysis is the argument that economic factors (e.g. cost parity) will tend to determine decisions to fully disconnect from the electricity grid. The modelling report discusses these assumptions and acknowledges the limitations of the analysis (Graham et al. 2013).

⁸⁷ One core FGF scenario strongly emphasises declining network utilisation (“Leaving the grid”) and in the three other core scenario the utilisation slowly declines from 2020 onwards due to the growth of on-site generation. The “Leaving the grid” scenario incorporates the argument that current regulations and policy setting could enable a “death spiral”. Part of the scenario reads as follows: “A trickle of disconnections becomes an avalanche because, in a self-reinforcing cycle, all other things being equal, retail prices must continue to rise as the system becomes more and more underutilised with each disconnection” (CSIRO 2013a, p. 15). In Scenarios 1, 2 and 4, network utilisation “initially improves because peak demand is reduced at the same time as consumption is growing” (CSIRO 2013a, p. 39).

⁸⁸ E.g. O. Kember, 2016, personal communication, 24 March; B. Waters, 2016, personal communication, 29 January. Similarly, an interviewed energy sector expert argued that “there are plausible scenarios which involve much more rapid change than the biggest changes in the four scenarios they looked at” (research sector informant [off-the-record], 2016, personal communication, 7 April).

some participants from the networks sector and other senior executives in these organisations conveyed views indicating that there is significant skepticism in the sector regarding the plausibility of some changes presented in the scenario set (e.g. large-scale grid disconnection) and the supporting analysis (industry informant, 2016, personal communication, 24 March). These interpretations may be evidence of motivated reasoning if some players within the networks sector don't *want* to believe such changes are plausible and this has influenced their consideration of the forum's analysis. One network business executive made related remarks about the views of senior executives in the electricity network sector:

“They're very network-centric and focussed because of the fact that back then and even now they don't believe that someone else is going to go build another electricity network. The basic view is that solar panels are great but you're not going to get all of your electricity from them, and batteries are still in their early days, there may be some great stuff occurring but they're not there yet. They're basically seeing the future in black and white terms and customers will always want to be connected as the only reliable source of power” (industry informant, 2016, personal communication, 24 March).

This informant also pointed to limited engagement with the scenarios in the network business that he works for:

“The rest of the [network] business didn't engage anywhere near as closely with the CSIRO work as I did [as a participant in the Future Grid Forum]... They still just stayed with what they were doing they didn't change tack in any way. It's only been recently, over the past 2 years, where people will reference the CSIRO work and point to a particular scenario such as 'Set and Forget' but they never dive into the detail of it. It's just 'CSIRO did some work...'. It's not like there is a tangible link back to what our strategy says now. It's very hand-wavey, directional, that sort-of-thing” (industry informant, 2016, personal communication, 24 March).

A number of forum participants also drew on the forum's analysis *when producing arguments* (e.g. to justify past decisions or proposed courses of action), which was influenced by their capacity *to find supporting reasons and critique other opposing reasons*. For example, as was examined in the last chapter, the CEO of the peak body representing the electricity networks industry interpreted the scenarios as highlighting the dangers of “irrational over-investment in

on-site generation”.⁸⁹ Additional examples were discussed in Chapter 6, along with perceived limitations of the study (e.g. for proposing or justifying public policies). The following examples (some briefly restated) are illustrative of how some forum participants used the outputs and the ways in which actors reasoning processes appear to have mediated the links between knowledge production and subsequent actions:

- A CSIRO staff member argued that the forum “provided the broad strategic metanarrative as to why CSIRO is playing in this space that then makes the individual project proposals and discussions much more coherent”. Emerging changes and modelling findings related to the ‘Grids and Energy Efficient Systems’ research program were featured in the report (see further details in Chapter 6);⁹⁰
- The modelling was used when articulating justifications for proposed policies such as carbon price advocacy by The Climate Institute. The Head of Policy at The Climate Institute stated that she “came out of it [the forum] thinking that the strategic policy asks that we had were totally reasonable” and had “more of a knowledge base to make the arguments” (O. Kember, 2016, personal communication, 24 March). They identified supporting reasons which informed their advocacy efforts;
- Some change advocates within network businesses and other companies (e.g. AGL Energy, GE Australia, Stockland, etc.) used the forum’s analysis when making the case for change and assessing strategic opportunities; and
- Research organisation staff were learning how to better frame their arguments and pitches: “For use it’s very important to understand the business perspective. What are some of the key drivers for action? What are some of the challenges that they’re facing? Where do they come from when they make decisions? It’s very important to understand this” (A. Denis, 2016, personal communication, 15 March).

In sum, as an argumentative setting this futures forum wasn’t optimal (e.g. in some respects there was limited diversity of opinions and argumentation) but the case evidence clearly shows

⁸⁹ Future Grid Forum report launch/Q&A transcript (event held on 06/12/2013), see: http://www.csiro.au/news/transcripts/YouTubeTranscripts/2013/Dec/Future_Grid_Forum.html (last viewed 29/06/2017).

⁹⁰ For example, the following issue and options are included in the main summary table in the final forum report: “As a result of increasing whole-of-system costs, by 2030 residential electricity bills are projected to be 2–9 per cent above 2013 levels... However, the combined effect of adoption of energy efficiency, on-site generation, and general wages growth means, for the average wage earner, the electricity share of income is projected to be slightly lower than 2013 in 2030 and return to similar levels by 2050 (between 9 per cent below, and 14 per cent above, 2013 across the scenario range)” (CSIRO 2013a, p. 8).

that the evaluation and production of arguments was a prominent aspect of the Future Grid Forum, the context, and output utilisation. As per the argumentative theory of reasoning, actors were frequently seeking to find and evaluate reasons (e.g. to help them to convince others) such as evaluating claimed reasons why a “death spiral” style future could occur. Some evidence indicates that motivated reasoning and confirmatory thought processes (such as myside bias) were prevalent in the forum and influenced actors’ interpretation and use of the forum outputs (also see survey data in Chapter 4 showing that the majority of surveyed participants reported that the process *didn’t* challenge their beliefs and assumptions and other participant feedback on the forum’s analysis that is summarised in that chapter). These findings are complementary to findings presented in Chapter 6.

7.3.4 Interpretation of the case evidence

The argumentative theory of reasoning (ATOR) provides a relevant way of further interpreting the context of each futures forum, the related ways the processes and their outputs were interpreted and used by actors (e.g. motivated reasoning done in anticipation of debates), and the underlying functions of the futures forums (e.g. social functions associated with the use of forum outputs as resources for convincing others, as was done and attempted by many actors). Related to this, this perspective on reasoning (the production and evaluation of arguments in dialogic contexts) is highly relevant to the futures forum process. The case evidence indicates that this theoretical perspective can help to explain some unintended process effects (e.g. the evidence of increased polarisation).

Most fundamentally the ATOR challenges classical views of reasoning. The ATOR suggests that forum outcomes were, in part, caused by reasoning for argument production and evaluation, rather than helping to “correct misguided intuitions” (Mercier 2012, p. 259). There is evidence that this both enabled and constrained impact. For example, based on developments since the Future Fuels Forum (i.e. over the past decade) it appears that liquid fuel vulnerability threats were overstated, at least over the medium-term, and that some participants who were concerned about liquid fuel vulnerability should have taken the non-peak oil oriented scenarios more seriously. That is, this interpretation suggests that their “misguided intuitions” were not corrected by the forum. However, the forum did help them to produce arguments that supported action (e.g. by the Energy Transformed Flagship Director). Similarly, there is evidence that the SAFRM forum tended to confirm initial beliefs, which informed

argumentation, sometimes at the expense of epistemic soundness.

Related to this the case provides evidence that both participant learning and the utilisation of forum outputs were influenced by the reasoning processes predicted by the ATOR. Strong evidence of biased evaluation was identified where participants had a preexisting opinion and subsequently either supported or rebutted the arguments they were evaluating depending on whether they were aligned with these views. There is strong evidence that proactive reasoning was also common and this is consistent with the strategic focus of many actors on convincing others. There is some evidence that related cognitive processes can contribute to the misinterpretation of forum findings such as the perception that the SAFRM forum outcomes were aligned with the *Strategic Framework for Alternative Transport Fuels*.

Additionally, regarding consequential contextual factors, the ATOR suggests that the argumentative setting that is established by a forum is crucial to the reasoning performance of forum participants – in terms of whether the situation *activates* reasoning (Mercier & Sperber 2011) – along with the associated characteristics of the group that is convened. For Mercier (2012, p. 262) a crucial related contextual factor is whether the “proper circumstances” for reasoning are in-place; that is, the participation of “people who disagree but are ready to change their mind when confronted with good arguments”.⁹¹ There is evidence that some group characteristics were influential such as the open-mindedness of forum participants, the diversity of views, and the knowledge level of participants.

In other words, whilst the ATOR predicts stronger collective reasoning performance (e.g. in groups) than individual reasoning performance the characteristics of groups matter. The types of reasoning task also matter. Stronger reasoning in groups is expected for tasks that “have a demonstrably valid solution” (Mercier & Sperber 2011, p. 72). This may also help to explain some of the case findings given that the main goal of many tasks in a futures forum is not to identify a correct answer (i.e. the truth) and, instead a battle of arguments must be resolved through other means.

The ATOR also predicted that the core role of reasoning in decision-making will be to produce

⁹¹ It’s debateable whether the participants in some forums met these criteria. For example, participants with diverse views attended the Future Fuels Forum but the available evidence indicates that the open-mindedness of some was limited (e.g. as per the strongly-held views of peak oil activists).

arguments and that this encourages making those decisions which can be justified convincingly. In all the forums, many participants were seeking to produce arguments to persuade others of a proposed course of action and of related views (see proactive reasoning) and/or participants were defining actions which they felt they could reasonably justify (e.g. proposed research agendas). The futures forum processes often contributed to the reasoning processes which led to these justifications.⁹²

This interpretation of the case also suggests a reconceptualisation of the futures forum process as having core argumentative functions. That is, a forum process can help actors to produce and evaluate arguments. These reasoning processes are a tangible link between forum processes and subsequent action (or inaction). This interpretation further suggests that the research and ‘work’ done in and through a futures forum will be oriented towards producing and evaluating arguments and that the process design could be enhanced by more formally incorporating this. This interpretation also suggests that forum participants will seek to influence the process so that it provides them with relevant resources (e.g. the outputs) for their argument production and/or argument evaluation, such as the emphasis on evaluating arguments about potential grid disconnections that emerged in the Future Grid Forum. However, as argued by Mercier and Sperber (2011), there can be a tension between argumentative functions and epistemic soundness where argumentative goals are primary rather than a concern with the truth (e.g. forming accurate beliefs). This interpretation and tension is also relevant to the political perspective examined in Chapter 6.

7.4 Implications for the intervention theories to-be-tested

The analysis presented in this chapter indicates a need to consider the overall compatibility of the intervention theories with relevant understandings of reasoning processes and capacities along with the functions of reasoning (what/why) and associated contextual factors

⁹² Dr Tom Beer’s decision to focus on algal biodiesel fuels research is an interesting example of this. Some CSIRO Energy Transformed Flagship staff “reached the conclusion that if Australia is going to have a diesel supply problem in the future it was more important to do research on alternative sources of diesel supply than alternative sources of petrol supply” and the Future Fuels Forum contributed to this conclusion and the public justifications of this research focus (T. Beer, 2014, personal communication, 14 September). From an ATOR perspective the important points are that the research decisions were, in part, ones that CSIRO staff felt confident *justifying* and, second, earlier Flagship research had pointed in a similar direction and confirmatory thought processes reinforced this emerging research direction. Dr Beer also emphasised the frequent need to publicly defend their R&D choices.

(where/when good reasoning performance is likely). More specifically, consistent with the last two chapters, there are implications for some hypothesised mechanisms and contextual factors.

The most obvious implications are regarding the first CMOc statement (credible strategic and decision-making guidance under uncertain conditions) and the two hypothesised mechanisms: *provision of resources that can credibly support strategic decision-making (M2)* and *reduction of uncertainty (M1)*. The ATOR suggests that the firing of the former depends on the production of resources that are useful for producing and/or evaluating relevant arguments and, consequently, enhanced reasoning performance and social action. Consistent with this a peak oil activist stated that the Future Fuels Forum “gave us good material to work with”, in particular “a credible scenario where petrol is \$8 litre” (P. Hart, 2014, personal communication, 10 October). The ATOR also suggests that *reduction of uncertainty* could also operate through myside bias (or confirmation bias) and/or motivated reasoning and, if this is case, then this mechanism may not always support good decision-making.

To the extent that motivated reasoning is a driver of reduced uncertainty there is also a need to consider what aspects of futures forums (and similar processes) help to enable it, aside from the circumstantial or contextual factors (also see *Section 7.3*). One possibility is that ambiguity is an enabler. The results of the futures forums can be open to multiple interpretations which may assist biased evaluation of the findings. For example, the notion of scenarios implies that there are multiple plausible accounts and/or positions, which participants or actors may give more-or-less weight to. Where there is more than one plausible interpretation motivated reasoning may promote a focus on a favoured interpretation. For example, the SAFRM report can be interpreted in multiple ways. It may be interpreted as communicating that major actors were seeking change with a view to the commercial uptake of alternative jetfuel in the short-term future (with limited role for government) or as conveying a set of difficult challenges that require major governmental action. In reality, some participants weren’t pushing for change and thought the core goals were unrealistic (e.g. Caltex Australia’s main participant) or had become aware of barriers (e.g. technology proponents such as UOP LLC).

Regarding contextual factors, the previous section pointed out that the ATOR suggests that a truly argumentative setting is crucial for reasoning performance. These contextual factors may also be important for the firing of mechanisms such as *critical reflection on actors’ assumptions*

and beliefs (M3). For example, Mercier and Sperber (2011, p. 63) note previous studies which have shown that “the behavior of the group can be predicted on the basis of the direction and strength of the arguments accessible to group members”. When group or subgroup members all agree on a certain view then arguments are unlikely to be critically examined or refuted and consequently a strengthening of the initial opinions of group members can be expected through a process termed group polarisation (Bond 2015; Mercier & Sperber 2011; Sunstein 2009). This effect of group dynamics can thus work against *critical reflection on actors’ assumptions and beliefs* (also see CMOc-2).

Finally, the ATOR predicts that the level of prior knowledge of forum participants can hamper *informal dispute resolution (M6)*. The intervention theories need to consider that highly knowledgeable participants are therefore more likely to polarise.

7.5 Chapter conclusions

The case analysis presented in this chapter has argued that the argumentative theory of reasoning and associated interactive view of reason is able to explain important aspects of the case and provides an important perspective on the functions of futures forums. This analysis is also consistent with the emphasis on reasoning in the conceptualisation of mechanisms in realist evaluation and can add theoretical depth to consideration of such cognitive processes.

These findings also point to a case explanation: the outcome patterns can, in part, be explained by the functions and tendencies of human reasoning and the conditions under which this reasoning occurs (e.g. during the futures forums, etc.). The case provides strong evidence of actors seeking to produce and evaluate arguments and related cognition and process effects.

With respect to the intervention theories, the most important aspects of the ATOR are the theorised functions of reason, the contextual factors the theory foregrounds (e.g. those situations where strong reasoning performance is more likely), and the cognitive mechanisms it emphasises (e.g. myside bias, etc.). The theory can also better ground existing hypothesised mechanisms – e.g. the cognitive mechanisms which can contribute to reduced uncertainty (**M1**), a reasoning perspective on critical reflection (**M3**), etc. – and it provides a theory-informed understanding of potential countervailing processes.

A further important finding is that much of the case evidence is also consistent with the contextual factors theorised to promote or militate against stronger reasoning performance in groups. The emphasis placed on the participation of a “balanced group of interests” (see Chapter 3) could assist with this, but a stronger emphasis on viewpoint diversity and efforts to avoid the formation of like-minded subgroups (as occurred in the Future Fuels Forum) also appears necessary to create an ‘argumentative situation’. Alternatively, CSIRO staff could provide strong alternative arguments to challenge forum participants as occurred in the SAFRM forum.

Finally, if the core functions of human reason are social then the futures forum process – to the extent that it enables enhanced reasoning – should be expected to have related effects. A key social function is more potent communication where powers of reason are deployed to convince others. The case evidence in this chapter suggests that, for some actors, the futures forums enabled more potent communication. Mercier and Sperber (2011, p. 71) also emphasise that a reasoning capability “allows people to anticipate the need to justify their decisions to others”. Consistent with this the forums and participation in such exercises was often motivated by such needs.

Part 3: Discussion and conclusions

CHAPTER 8: Discussion of the implications of the research findings for the intervention theories

8.1 Introduction

In earlier chapters I argued that the case evidence revealed the limited validity and explanatory power of the intervention theories and pointed to the explanatory power of formal social scientific theories. These findings have implications for the intervention theories such as modifications to the mechanisms and the context-mechanism-outcome pattern configurations (CMOc) statements which may be inferred from the case findings. Some such implications were noted in the previous chapters; this chapter brings them together and considers whether the case findings can inform new or refined intervention theories.

The chapter is structured as following to address five aims related to the case study findings. The first aim is to consider a counter-argument to the intervention theory-related conclusions presented in Chapter 4 (see *Section 8.2*). If there is strong evidence for this then this would raise questions about the claims that were made about the validity of the intervention theories and suggest that the case primarily reveals challenges putting the theories into practice. The second aim is to review the case findings on key contextual factors and further consider their importance for the intervention theories and outcome patterns (*Section 8.3*). This aim is informed by the claim made by realist evaluators that it is necessary to deeply consider the precise circumstances under which a theory “holds” or doesn’t hold (Pawson 2013). Third, the chapter bring together the case findings on the intervention theories to-be-tested and aims to discuss related claims about the implications, such as regarding the necessary theoretical underpinning of futures forum intervention theories (see *Section 8.4*). Insights into alternative intervention theories such as new or refined CMOc statements can be inferred from the case. The fourth aim is to present these and further discuss how formal theories can provide practitioners with relevant resources (see *Section 8.5*). The final aim is to discuss the transferability of these intervention theory insights (*Section 8.6*).

8.2 Putting the theories into practice: Do implementation or process issues explain the findings, or are there fundamental problems with the intervention theories?

As noted, a possible counter-argument to claims about the validity of the intervention theories is that the findings can be better explained by issues related to the challenges of putting them into practice (e.g. process limitations), rather than issues to do with theory validity.

A logical starting point for this subsection is the two Context-Mechanism-Outcome-pattern-configuration (CMOc) statements which had the least supporting evidence: CMOc-4 (*a safe space enabling informal dispute resolution in the context of conflict/contention*) and CMOc-3 (*enhanced coordination and coalition formation in the context of collective action problems*).

Regarding CMOc-4, a core aspect of the claimed causal processes is the proposition that achieving greater clarity or agreement regarding disputed facts or other contested knowledge (or contested claims) contributes to solving or minimising related disputes. In the case, there was little or no evidence for this proposition other than some disputes or conflicts of a more technical nature that additional scientific information and analysis could address (e.g. regarding whether there is sufficient biomass to supply aviation fuels and whether this will impact food production). Whilst a different convening approach or different facilitation strategies – such as those which more directly tackled contentious issues rather than focussing on areas of potential agreement/consensus – may have achieved different results, the case is consistent with other research which has critically examined contemporary expectations of the role of science and scientists (e.g. Pielke 2007; Sarewitz 2004). For example, Pielke (2007) argues that the level of values consensus (or values conflict) and the level of uncertainty determine the roles of science. For example, in situations of values conflict Pielke (2007, p. 42) argues that “the relevant information is not scientific information”. Related to this he observes that “the reduction of scientific uncertainty does not necessarily compel a political consensus” (p.54). Where there is conflict regarding desired ends and means, Pielke further argues that it is necessary to “engage in political behavior” to enable decision-making and action (Pielke 2007, p. 29). Such conclusions are consistent with the case findings.

Two illustrative examples from the Sustainable Aviation Fuel Road Map (SAFRM) Forum support this analysis. Participants from the Worldwide Wildlife Fund (WWF) quit this forum because of conflicts with the organisation’s advocacy of reduced air travel (as the main way to

reduce greenhouse gas emissions from aviation instead of more technical changes). Technical scientific information on the viability and potential benefits of alternative fuels couldn't solve this conflict. Related to this, different views on the roles of technology in addressing environmental problems have been linked by many scholars to values conflict. Some environmentalists are concerned about environmental action being reduced to a technological fix rather than creating a new transformed 'ecological order' (Dryzek & Schlosberg 2005; Princen 2010; Symons & Karlsson 2015).⁹³ A second example is the dispute at the forum regarding industry development and commercialisation processes. As was discussed in earlier chapters there was conflict regarding the role of government that aviation sector actors wanted to advocate for and their focus on securing government support (e.g. subsidies). Such disputes were of a political nature which reduced the ability of CSIRO staff to act as an independent arbiter and influenced the role of scientific information.

Regarding CMOc-3, which centres on enabling collective action to address a shared collective action problem, the project leader for the CSIRO futures forums stated that no specific process or exercise was included in the futures forum process for coalition formation or enabling collaboration: "[we] assume that if people spend enough time with each other and reach a certain level of consensus it will happen organically" (P. Graham, 2015, personal communication, 6 May). This may suggest that process limitations are the primary issue. However, notably, where collaboration and/or new or expanded coalitions *did* develop they tended to be amongst participants who shared core policy beliefs and/or had interests which were aligned or sufficiently shared. This suggests significant contextual factors are currently missing from this CMOc statement, which points to theoretical deficiencies.

This perspective, and associated process convening dilemmas, were also alluded to by the Chair of the Future Grid Forum (FGF), Mark Paterson. Paterson noted that this forum failed to produce a shared roadmap for Australia's future electricity system, a goal emphasised in the project proposal (M. Paterson, 2014, personal communication, 17 June). Such a 'roadmap' would have contributed to enhanced coordination and collective action if it was viewed as attractive by multiple participants with shared priorities. Paterson argued that the diversity of

⁹³ For example, Symons and Karlsson (2015, p. 175) point to long-standing debates between "technophilic rationalists" and "technophobic romantics" and related tensions between competing environmental values. Like Pielke, they also contend that "it is unlikely that division ... can be bridged by rational analysis" – and the case is consistent with this.

forum participants, and their differing preferences and interests, was a barrier to roadmap development along with concerns about “picking winners”:

“We certainly didn’t deliver what I would say was a roadmap. I think probably the full reality dawned on us and others in the process of the complexity of what we’re dealing with... I think what we did with the four scenarios was, with the very diverse participants that we had, achievable. At all times, we pointed out that we’re not trying to “pick a winner” we’re trying to explore what are the credible possibilities. I think if we then tried to transition into a roadmap-style exercise it is quite possible that you wouldn’t want to have all the same people from those same organisations in the room because a roadmapping exercise requires some points of decision. If, for example, we’re thinking now about 2025 as a mid-point on en route to 2050, or 2030 or whatever, we need to make some decisions about what sort of characteristics would a more optimal mid-point future look like and those kinds of decisions come down to the beauty being in the eye of the beholder [e.g. electricity retailers, network businesses, etc.]” (M. Paterson, 2014, personal communication, 17 June).

Paterson also compared the FGF to the mix of participants that attended the SAFRM forum (which produced an output which was closer to a shared roadmap):

“I imagine in the aviation forum [the SAFRM Forum] something like that would be far, far more achievable in the time available because I think that we were dealing with a qualitatively different thing in terms of a much more finite area of focus, a much more finite number of participants from my understanding. We’re talking about a whole industry of many different parts and very complex economics and regulatory systems and all the rest of it compared with a particular part of an industry”.

There was more, but variable, support for CMOC-2 (*reduction of inertia in the context of a destabilising ‘structural break’*) and CMOC-1 (*credible strategic and decision-making guidance under uncertain conditions*). For these CMOC statements process factors or process limitations plausibly reduced the amount of support for these propositions. However, there is more evidence for intervention theory issues such as insufficient incorporation of contextual factors.

On the process side of things, decisions regarding subgroup formation and group convening choices are relevant to CMOC-2 mechanisms such as *critical reflection on actors’ assumptions and beliefs (M3)* and *creation of common understandings (M4)*. For example, process choices such as the formation of like-minded subgroups at the Future Fuels Forum may have limited the critical reflection on actors’ assumptions and/or beliefs. The process choice to not define action or policy prescriptions (which may have been unachievable in some cases) appears to

have reduced the level decision support (see CMOc-1), in particular for governmental actors (e.g. for participants involved in policy-making activities).

Nonetheless, where there is evidence that the futures forums contributed to reduced inertia this evidence suggests it mainly occurred for reasons which were inconsistent with the intervention theories (e.g. due to belief *reinforcement*). Evidence for contrasting causal mechanisms is further discussed later in this chapter.

The additional case analysis in *Part 2b* also presented evidence of contrasting ways that the futures forums contributed to decision-making and additional reasons why the outputs from a forum were judged to be credible and/or salient (see CMOc-1). In some instances, these findings point to theory deficiencies. In others, they provide different explanations for why the future forum can provide decision guidance which is judged to be credible.

Finally, as alluded to above, the research on the sub-cases also pointed to contextual factors that are inadequately factored into the intervention theories (see *Section 8.3*).

In sum, although there is credible evidence that implementation and process issues are relevant to fully explaining the case study findings, theoretical deficiencies appear to provide a stronger explanation for the limited and variable achievement of expected outcomes. This is not an either/or argument: both types of potential limitation are consequential. However, the findings do suggest that if CSIRO staff were guided by more rigorous intervention theories – such as regarding the determinants of coalition formation and/or the role of scientific knowledge in decision-making – then the outcome patterns may have been closer to those predicted by the CMOc statements. This chapter now turns to discussing the contextual factors which influenced the identified intervention outcomes.

8.3 Contextual factors revealed by the case analysis

As summarised below, the initial analysis of the intervention theories considered the extent to which the forum contexts were consistent with the contextual factors specified in the theories and the additional case analysis identified further contextual factors. *Table 25* below outlines these for each CMOc statement. Key factors are discussed following the table.

Table 25: Contextual factors identified in the focal case

CMOc statement	Contextual findings in Part 2a	Contextual factors identified in Part 2b
CMOc-1: Decision-support under uncertain conditions	<ul style="list-style-type: none"> • Variable extent to which forum participants were grappling with major decision-making challenges under uncertain conditions (often higher for industry participants) • Whether this uncertainty remained post-forum (e.g. post-Future Fuels Forum oil prices dropped and alternative unconventional oil supplies grew more rapidly than many participants expected) 	<ul style="list-style-type: none"> • Level of uncertainty being faced, e.g. fundamental uncertainty and/or irreducible uncertainty • Institutional structures influencing behaviour under uncertainty • Concurrent discursive processes (e.g. related discourses and associated beliefs viewed as credible) • Political competencies, power and goals of forum participants • Decisional context of participants (e.g. pre/post related decisions) • Institutional factors shaping process convening and facilitation
CMOc-2: Reduced inertia in the context of structural break(s)	<ul style="list-style-type: none"> • Variable extent to which the existence (or perception) of existential threat(s) motivated participation or action • Whether inertia is a current barrier to the ‘adoption’ of a new technology pathway 	<ul style="list-style-type: none"> • Degree to which participants are committed to an opinion prior to forum (strongly/weakly-held beliefs) • The open-mindedness of forum participants (e.g. are they ready to change their minds if confronted with good arguments?); related circumstances for reasoning • Strength and range of arguments accessible to forum participants • Institutions influencing technology and industry development • Membership of participants in related communities (e.g. thought communities, etc.)
CMOc-3: Enhanced coordination and coalition formation in the context of collective action problems	<ul style="list-style-type: none"> • Limited focus of participants on collective action problems 	<ul style="list-style-type: none"> • Extent to which participants shared core policy beliefs and/or have interests which aligned • Institutional structures which influence actors’ responses to such problems (e.g. the available ‘choice set’); related norms and beliefs (e.g. regarding the role of government) • Political competencies and goals of involved and relevant actors
CMOc-4: Safe space enabling informal dispute resolution in the context of conflict	<ul style="list-style-type: none"> • Contentious issues or other disputes related to potential energy transitions were present at the time of all forums • Kind of disputes being debated: technical disputes, or non-technical disputes (e.g. moral conflicts, policy disputes, etc.) 	<ul style="list-style-type: none"> • Degree to which participants are committed to an opinion prior to forum (strongly/weakly-held beliefs) • Degree to which participants have competing interests and/or preferences relate to focal issues; related institutional factors • The open-mindedness of forum participants (e.g. are they willing to change their minds if confronted with good arguments?); related circumstances shaping use of reason

As per the table above, additional relevant contextual factors relevant to the CMOc statements were identified by and inferred from the case analysis. Similar to the contextual layers outlined by Pawson (2013)⁹⁴, these factors can be grouped under three categories:

- Characteristics, goals, and competencies of individual participants and stakeholders;
- Characteristics and dynamics of the convened group; and
- Contextual factors related to broader social conditions (prior to, during, and after a forum)

Below I consider each category and discuss some of the related case study findings.

8.3.1 *Characteristics, goals, and competencies of participants and stakeholders*

As was noted in Chapter 7, reasoning situations are influenced by the extent to which each participant is open-minded and, related to this, how strongly-held actors' views are. This contextual factor is most relevant to CMOc-2 and CMOc-4. Beyond this, these characteristics also influenced the scenarios and/or roadmap that were constructed in the forums, the assessment of these outputs (e.g. judgements of scenario plausibility), and participants' goals. Regarding the latter, participants with strongly held beliefs often primarily sought to convince others which some evidence indicates also militated against critical reflection on actors' assumptions and beliefs (CMOc-2, **M3**) and influenced their use of the outputs. Similar to Weiss's idea of research as "political ammunition" (see Chapter 6), the behaviour of some such participants can be interpreted as seeking and/or using resources "to neutralize opponents, convince waverers, and bolster supporters" (Weiss 1979, p. 429). The processes outlined by Weiss appear particularly relevant in the context of strongly-held beliefs.

Additionally, these cognitive characteristics may militate against novel thinking (such as 'outside the box' creativity). Such thinking may be necessary for a futures forum to enable action or effectively analyse strategic issues.⁹⁵ Scenario construction and scenario exercises

⁹⁴ Recall Pawson's (2013) four I's framework (individuals, interpersonal relations, institutional settings and 'infrastructure'). I've added goals to the individual category; included a category more specific to the forum process (the characteristic and dynamics of the group that's convened); and institutional settings and 'infrastructure' are components of the broader social conditions category.

⁹⁵ As noted by Cerulow (2006) such thinking may also require breaking with established conventions (see the discussion of broader social conditions such the intuitional context later in this subsection) and shifting "from routinized cultural and cognitive connections and to establish new ones" (p.218). She argues novel thinking requires actors to overcome the barriers to "cognitive deviance".

are often claimed to enhance creativity (e.g. see de Brabandere & Iny 2013), however, as some other researchers have concluded (e.g. Bradfield 2008), the cognitive barriers to such creative cognition may be underestimated.

The level of commitment to opinions can also contribute to polarisation (Mercier & Sperber 2011), as was evident in some forums (e.g. see relevant evidence from the Future Fuels Forum). As Mercier and Sperber (2011, p. 67) have argued, “when participants [in a reasoning exercise] are committed to an opinion, thinking about it will lead to a much stronger polarization”. This can be due to the greater ease with which supporting reasons come to mind and related thinking that is done when articulating justifications for viewpoints. The argumentative context within a forum may also mean that a futures forum will contribute to polarisation in these ways.

A further contextual factor related to the goals of participants is the decisional context and timing of the process with respect to policy-making processes they are involved in (e.g. whether the forum occurred pre-or-post key decisions). Some CMOc statements (particularly CMOc-1) implicitly assume that the forum occurs before major decisions and, therefore, can provide an input into these decision-making processes (e.g. strategy or policy decisions). In contrast, some forum participants stated that policy agendas or positions had largely been determined before the forum. These participants often sought to justify or further advance these agendas/policies (see Chapter 6 and Chapter 7), rather than an “input”, for example by cherry picking the forum findings that supported their favoured policy or using the findings to build internal support for past strategy decisions. This indicates ways in which the decisional context can influence the goals of futures forum participants.

The final identified contextual factors – in this category – are the political competencies and unequal power of participants and other actors (see Chapter 6). In many instances, forum impacts were related to the capacity of participants and other actors to influence others. An important example discussed in Chapter 6 was the Inaugural Flagship Director’s ability to use the outputs from the Future Fuels Forum to help gain management approval for research programs and secure the support of other internal stakeholders. In doing so he exhibited the necessary political competence to be an agenda mover (see Bacharach 2016). The findings from Chapter 6 also suggest that the Flagship staff and others (e.g. hired facilitators) also

needed political competencies to manage contention during the forums such as through sophisticated ‘dissensus management’ strategies.

If action is frequently a political process of agenda moving (as was explored in Chapter 6), then a crucial contextual factor is the political skills and orientations of involved actors. For instance, politically competent actors – as defined by Bacharach (2016) – are actors who have a strong ability to build coalitions (which is relevant to CMOc-3), recognise the need to strategically generate consensus, and seek to legitimate their ideas. Related to this the distribution of power and resources can also be consequential (the latter is discussed in the next subsection). Although the case analysis did not involve a formal assessment of actors’ political competence and its consequences, some case evidence can be interpreted as indicating that is an important contextual factor. For example, some forum participants in advocacy-oriented roles demonstrated their capability to strategically interpret and mobilise forum outputs when seeking to legitimise their agendas. Some NGO participants also demonstrated political competence when they leveraged a forum process for coalition building. There is also evidence that some Flagship staff viewed the forums as a tool for supporting their agenda moving efforts, whether it be securing support for proposed research programs (e.g. Future Fuels Forum) or advancing existing programs (e.g. Future Grid Forum).

8.3.2 *Group characteristics and dynamics*

One important group characteristic is the level of viewpoint diversity and, related to this, the strength and range of arguments that are available to forum participants (see Chapter 7). This characteristic is relevant to the consensus-orientation of the futures forum process, the potential for such processes to enhance confidence (see the reduction of uncertainty and social validation mechanisms), and whether a forum prompts reflection of actors’ assumptions/beliefs. For example, if the forum participants hold the same opinions then the views that are expressed will tend to convey arguments consistent with these views and, consequently, limit the level of critical analysis that occurs. In extreme cases, where all group members (or subgroup members if these are formed during a process) share an opinion, discussion can be expected to strengthen preexisting opinions of group or subgroup members

(Mercier & Sperber 2011; Myers 2012; Sunstein 2009).⁹⁶ Such a causal process could plausibly contribute to reduced uncertainty (**M1**, CMOC-1), or social validation (**M11**), but it would militate against critical examination of views/beliefs (**M2**, CMOC-2).

This characteristic also implies tensions between the consensus-orientation of the futures forum process and the hypothesised critical reflection mechanism, although process designs could aim to achieve different goals at different stages of the process. Where diverse and equally strong arguments are available (i.e. participants who hold diverse views are present and given equal opportunity to express these contrasting viewpoints) this may encourage critical reflection whilst also making consensus more difficult.⁹⁷ The SAFRM forum provides an interesting example. Whilst the majority of surveyed participants agreed that this forum challenged their assumptions and/or beliefs, actors' core policy beliefs and core assumptions were often retained or reinforced (see the discussion in Chapter 5 and Chapter 7). The attendance of many participants who held similar or the same views meant arguments in favour of those beliefs and assumptions were often voiced.

A second key group characteristic is the degree to which participants have competing interests and/or preferences (see Chapter 6). This contextual factor has already been substantively described in *Section 8.2*. Diverse groups – as per the 'balanced group of interests' targeted by Flagship staff (see Chapter 3) – may require sophisticated dissensus management which can, in turn, enable completion of the process and/or subsequent actions. This implies different intervention strategies (in contrast to those focussed on producing a consensus) and different intervention theories guiding the reconciliation of diverse interests/preferences.

The above potential group characteristics also imply the potential for substantially different group dynamics. For example, where there is low viewpoint diversity and forum participants have shared (or overlapping) interests and preferences it is likely to be easier to reach agreement (see **M4**) than if the group has high viewpoint diversity and strongly competing interests. The closest example to the former group type was the SAFRM Forum although there

⁹⁶ Social psychologists describe this general process as group polarisation where group discussion tends to strengthen the initial inclination of a group (see Myers 2012). This group effect is typically most pronounced in groups that only contain like-minded people (Sunstein 2009).

⁹⁷ On this point, the project leader from CSIRO stated that a limited form of consensus is targeted: "The consensus we look for is about the range of plausible futures and options for addressing their associated challenges at a high level" (P. Graham, 2016, personal communication, 6 September).

was some viewpoint diversity. The closest example to the latter group type was the Future Fuels Forum. Additionally, the remarks of the Chair of the Future Grid Forum – see extended quotations presented in *Section 8.2* – indicate that the characteristics of the convened group influenced what outputs could be created.

8.3.3 Broader social conditions (prior to, during, and after a futures forum)

The case analysis presented in Chapter 5 suggests that there is a need for greater specificity regarding the level and type of uncertainty along with contextual factors related to whether uncertainty is reducible via research or the futures forum process (see **M1**). These contextual factors are especially relevant to the reduction of uncertainty mechanism (see CMOc-1) given the inherent assumption that futures forums reduce uncertainty. For example, other studies have found that in some contexts uncertainty can be “fundamentally irreducible” (Pielke 2007, p. 67) and that such indeterminacy has also implications for how actors try to reduce uncertainty (Beckert & Dequech 2005; Dequech 2003; Pielke 2007; van Lente 2010).⁹⁸ These contextual factors can influence both the futures forum process itself and the utility of a forum. For example, if key uncertainties are related to the possible choices of other actors then the participatory aspects of the futures forums may help actors to understand the intentions, preferences and likely actions of others (e.g. via the group discussion and debate about issues, scenarios and future options). For these participants, this may be a more significant contributor to reduced uncertainty than other components of the forums (e.g. the techno-economic modelling or other research conducted by CSIRO).

There is evidence that some participants sought to use the forums to address uncertainties related to actor intentions. For example, Caltex’s representative at the SAFRM Forum used it to better understand the intentions and views of the local aviation sector and whether these

⁹⁸ Three factors are highlighted by Pielke (2007): 1) chance (uncertainties associated with random processes, termed aleatory uncertainty); 2) epistemic uncertainty “associated with incomplete knowledge of a phenomenon – and incomplete knowledge of the limits of one’s knowledge” (p.68); and 3) contingencies associated with purposive decision-making. In the latter case, irreducible uncertainty may be due to the ability of human actors to change outcomes. Van Lente (2010) emphasises uncertainties related to new and emerging technologies, in particular: 1) technological feasibility, especially regarding future technological change; 2) demand uncertainty (i.e. market uncertainty); and 3) strategic uncertainties regarding the broader environment (e.g. legislative or regulatory uncertainty). Van Lente further notes that the third type “relates to an indeterminacy derived from as-yet-undetermined actions of other actors”, as per the third factor highlighted by Pielke. He asserts that in such contexts uncertainty “cannot be reduced by getting ‘information’” (p.106).

had shifted (M. Ridley-Smith, 2015, personal communication, 20 July). In other instances, participants sought to influence other actors. For example, Sasol Chevron sought to “plant in peoples’ minds” (e.g. government participants) the concept of gas-to-liquids fuels and their potential benefits (E. van der Wateren, 2014, personal communication, 30 October).

Importantly, uncertainties differ with respect to whether research can be done to reduce them. In some instances – such as the research done to estimate the volume potential of different biofuels and potential feedstocks – CSIRO scientists did reduce actor uncertainties. Other issues and gaps were inherently difficult to address such as regarding technology costs and feasibility (e.g. in emerging technologies costs frequently change and credible real-time data is rarely publicly available due to commercial sensitivities).

Some of the case evidence presented in Chapter 5 emphasises the potential importance of such social conditions. Responses to uncertainty can constrain innovation processes and, linked with this, the influence of an intervention like a futures forum. Van Lente’s (2010, p. 104) argument that efforts to reduce uncertainty can also lead to “rigid routines that hinder innovative new options” (van Lente 2010, p. 104) clearly conveys this idea. The case analysis also further suggests that institutions can “limit the choice set of actors” (Beckert & Dequech 2005, p. 586) and supports Bradfield’s (2008, p. 210) conclusions that in situations where “there is a multitude of inherently uncertain and complex situations and issues to consider” cognitive barriers are also a major issue.

An additional key contextual factor identified in Chapter 5 is the institutional context. The influence of social institutions was clearest in relation to roadmap construction and the ways other actors interpreted the roadmap. The creation and/or adoption of new technology pathways (see CMOc-2) may also require significant creativity which can be hampered or enabled by rule-following behaviour. For example, the main delegate from the Australian Conservation Foundation (ACF) who attended the Future Fuels Forum emphasised ACF’s tradition of working “collaboratively with unusual allies” which supported creative action (M. Richter, 2014, personal communication, 13 October). Richter sought to leverage the forum and subsequent communications activities when developing coalitions.

Chapter 5 also emphasised the influence of discursive contexts and processes, in particular the way “expectations circulate within and between groups” (van Lente 2012, p. 777) and the

influence of the images of futures which are perceived to be credible at the time of the futures forum. Judgements regarding the credibility of the analysis – that is, whether a forum produces resources for supporting decision-making which are judged to be credible (**M2**, CMOc-1) – can be influenced by whether the analysis is consistent with circulating expectations. Van Lente’s (2012) argument that “foresight exercises” have social vulnerabilities that limit their efficacy also conveys this. Related concepts were also used in Chapter 5, such as the idea of mental membership in thought communities (or epistemic communities). These concepts point to the potential influence of these social groups/entities.

Finally, the case illustrates the importance of contextual factors in the external environments that influence action post-forum. For example, numerous factors influence which issues receive senior management attention, the potential for collaboration, and the focus of relevant policy-makers. For example, the founder and Chair of the Australian Initiative for Sustainable Aviation Fuels argued that number contextual factors constrained follow-up action following the SAFRM Forum such as the intensifying pricing/capacity war in the Australian aviation market (S. Pond, 2015, personal communication, 23 June).

Consistent with key realist evaluation principles the above contextual factors are consequential for whether the intervention theories held. This suggests that it is possible for practitioners to target appropriate or supporting circumstances and to purposefully assess these contextual factors (also see *Section 8.4.1.1* below). It also implies that practitioners using theories like those elicited in this study need to consider contextual limitations. For example, the ability for futures forum-like processes to reduce uncertainty (**M1**) appears contingent upon the nature and type of the uncertainties that are faced by the participants. Another illustrative example is the influence of actor interests, beliefs and preferences on whether it is possible for participants to reach agreement and the influence of these contextual factors on the firing of mechanism (e.g. creation of common understandings [**M4**]).

8.4 Implications of the case study findings for the existing CMOc statements and for improved intervention theories

8.4.1 Potential modifications to the intervention theories and their significance

Before reconsidering the CMOc statements, further relevant insights regarding hypothesised mechanisms can be inferred from the case analysis and case evidence. These insights can be grouped under two categories: insights into the hypothesised causal processes, and alternative causal processes relevant to the mechanism (see *Table 26*).

Table 26: Potential refinements to, or reformulations of, hypothesised mechanisms

Mechanism	Additional insights into operation of each mechanism	Alternative causal processes identified by the case analysis
M1: Reduction of uncertainty	<ul style="list-style-type: none"> • Reduction of uncertainty can occur through the provision of modelling findings (or other resources) which are interpreted as being consistent with actors' views • Reduction of uncertainty appears to occur in ways specific to particular sources of uncertainty (and limited to these), e.g. getting a stronger understanding of other actors' intentions 	<ul style="list-style-type: none"> • The futures forums can enable reduction of uncertainty through reciprocal affirmation of which expectations are credible or not credible (Chapter 5). • Myside bias and/or motivated reasoning can influence the ways forum results are interpreted and reduce uncertainty (Chapter 7) • Strengthening of views by being exposed to similar viewpoints and arguments (Chapter 7)
M2: Provision of resources that can credibly support strategic decision-making	<ul style="list-style-type: none"> • The status and perceived credibility of forum participants was often viewed as an important determinant of the provision of credible resources for decision-making – not only (or rather than) broad participation, credible methods/modelling, etc. • A consensus on plausible futures (e.g. on set of credible alternative scenarios) can be less important than inclusion of specific scenario(s) aligned with an actor's beliefs and/or preferences 	<ul style="list-style-type: none"> • Anchoring analysis in participants' existing expectations and/or already circulating images/arguments that are perceived as credible can be an enabler of credibility (Chapter 5) • Political models of research utilisation suggest that resources (e.g. modelling results) are viewed as possible "political ammunition" which are then mobilised to support a preferred course of action (see Chapter 6) • Participants ensuring that resources are created which are specifically useful for producing or evaluating arguments related to specific decision process (see Chapter 7)
M3: Critical reflection on actors' assumptions and beliefs	<ul style="list-style-type: none"> • NONE 	<ul style="list-style-type: none"> • Open-minded participants being exposed to diverse, strong arguments under ideal reasoning conditions (Chapter 7; NOTE: little evidence of this in the case)

M4: Creation of common understandings	<ul style="list-style-type: none"> • This process can be dependent on open, in-depth deliberation, such as regarding contentious issues on where there are different viewpoints. Evidence indicates that unequal power can hamper this, along with facilitation choices 	<ul style="list-style-type: none"> • High-quality group reasoning processes leading to the formation of reflective beliefs. This may reduce the level of viewpoint diversity through opinion/belief convergence on the strongest argument. (see Chapter 7; NOTE: little evidence in the case)
M5: Diffusion of ideas	<ul style="list-style-type: none"> • NONE 	<ul style="list-style-type: none"> • Perceived social validation (see below) may also promote diffusion
M6: Informal dispute resolution	<ul style="list-style-type: none"> • Case study findings are mostly inconsistent with this mechanism • Processes are different for different kinds of disputes (e.g. technical disputes, moral disputes and policy/political disputes). 	<ul style="list-style-type: none"> • NONE
M7: Enhanced coordination	<ul style="list-style-type: none"> • Some findings emphasise the ways in which shared expectations have coordination functions • Process can be aided by shared (or overlapping) interests and policy/action preferences. Related contextual factors thus need to be considered 	<ul style="list-style-type: none"> • NONE
M8: Participation is an affecting experience	<ul style="list-style-type: none"> • NONE 	<ul style="list-style-type: none"> • Viewpoint diversity can enable the airing of different arguments and views which places more attention on threats (see Chapter 7) – this appears to have been the case in Future Fuels Forum, e.g. see the discussions of threats related to potential oil supply constraints
M9: Advocacy / action informed by more holistic understanding	<ul style="list-style-type: none"> • Process is somewhat dependent on open, in-depth deliberation, such as regarding contentious issues. Evidence indicates that unequal power and facilitation decisions at times hampered this regarding some issues 	<ul style="list-style-type: none"> • NONE
M10: Appropriation	<ul style="list-style-type: none"> • NONE 	<ul style="list-style-type: none"> • Unequal social power can enable some actors to shape and leverage process (to some extent) for their own ends (see Chapter 6)
M11: Social validation	<ul style="list-style-type: none"> • NONE 	<ul style="list-style-type: none"> • Social validation can be a function of legitimacy where important stakeholders are perceived to support an idea, (a component of “agenda moving” – see Chapter 6). There is evidence that some actors used the forum reports to try to legitimate their agendas.

The above findings can also be interpreted in two important ways: (i) with respect to modifications to the hypothesised mechanisms and CMOc statements that were developed (see *Section 8.4.2* below), for instance developing possible modifications that incorporate contextual factors revealed by the analysis (*Section 8.3*); and (ii) with respect to general intervention theory implications (e.g. on the relevance of, or need for, formal theory). Before outlining possible modifications, I note overarching implications.

The following general intervention theory implications are suggested by the case:

- Intervention theories can be enhanced by incorporating formal psychological theory (also see Chapter 7) and related cognitive assumptions;
- Intervention theories can be enhanced by incorporating social mechanisms and further addressing the socio-political dimensions of PKPs (see Chapter 5 and Chapter 6);
- Intervention theories need to better consider what's required to fire mechanisms and potential tensions (or trade-offs) between causal mechanisms;
- Intervention theories may be enhanced through more targeted causal mechanisms that are limited in scope and ambition; and
- Intervention theories should consider possible countervailing processes.

With respect to the relevance of psychological theory, the hypothesised mechanisms emphasise cognitive processes (as per the focus on reasoning in realist evaluation). Some hypothesised mechanisms also have reasoning components. Psychological research has also identified contextual factors which influence these reasoning processes and relevant cognitive mechanisms (Mercier & Sperber 2011, 2017) as was discussed in Chapter 7.

As was suggested by Chapter 5, the emphasis on reasoning in realist evaluation problematically underplays social mechanisms and related factors. Several important social mechanisms and factors were identified in the case analysis (see *Table 26*). Some of these social aspects are discussed later in this chapter (see *Section 8.4.2* on '*Insights and resources for alternative intervention theories*') in proposed case-informed theories.

Some of the findings also have process and facilitation implications due to potential tensions (or trade-offs) between mechanisms. For example, in practice there may be tensions between creating credible resources (see CMOc-1) and other mechanisms. Consider Beckert's (2016, p. 234) argument that forecasts are made "more legitimate", and therefore more credible,

through “anchoring ... in expectations that already exist”. This suggests that the futures forums are well-placed to generate credible resources by drawing on participants’ expectations. However, this process of anchoring is likely to militate against critical reflection (**M3**), particularly if such reflection entails questioning existing circulating expectations. Other possible trade-offs are implied by the case. For example, participant and viewpoint diversity is likely to support developing a more holistic understanding (**M9**); however, it may also be barrier to generating common/shared understandings (**M4**).

The case also suggest that the intervention theories are too ‘broad-brush’. An example is the need to shift from a general reduction of uncertainty mechanism to more specific mechanisms that address specific sources or forms of uncertainty (**M1**). A second example concerns informal dispute resolution (**M6**). Little or no evidence was found of CSIRO staff (or the futures forum process) assisting in the resolution of disputes, such as via CSIRO’s hypothesised capacity to be a credible convenor who can act as an “independent arbiter”.⁹⁹ However, there was some evidence that credibility of CSIRO staff and the organisation enables CSIRO staff to intervene in technical disputes (e.g. see the aviation biofuels forum).

Finally, the case suggests that intervention theories must explicitly consider possible countervailing processes. Two illustrative examples will help to convey this. One aspect of the theoretical perspective considered in Chapter 5 was theorisation of behaviour under uncertainty. Such behaviour can be shaped by prevailing institutions. Some sociologists term this process “script following” (Beckert 2013b, p. 223). The analysis in Chapter 5 argued that such behaviour can hamper the development and adoption of new technology pathways (as per the focus of CMOc-2) and it can, therefore, also be conceptualised as a possible counter-mechanism.¹⁰⁰ A second example, from Chapter 7, is the influence of biased cognitive processes such as myside bias and some effects of motivated reasoning (e.g. biased evaluation of evidence). These processes can be a counter-mechanism to some of the hypothesised mechanisms such as critical reflection on actors’ assumptions and beliefs.

⁹⁹ This term was used by the project leader. He argued that “CSIRO can cast itself as an independent arbiter”, in part because it claimed to be independent (“we don’t have a role in the policy process”) and has “convening power” (P. Graham, 2014, personal communication, 2 June).

¹⁰⁰ Related to these observations, Tetlock (2000, p. 295) has argued that “it is often socially rational for decision makers confronted by complex or unfamiliar choice problems to select the most readily justifiable options [e.g. those consistent with prevailing conventions/institutions], even if that means violating basic consistency axioms of rational-choice theory” (also see Tetlock 1992).

It is possible to infer from this brief discussion some process and facilitation implications. The findings suggest that choices made by process convenors and facilitators influence the likelihood that different mechanisms will fire. Contextual factors can also be influenced by process convenors, such as the level of viewpoint diversity. Salient characteristics of the process convenor (CSIRO) were also noted in Chapter 5 (e.g. the degree to which CSIRO staff felt the need to err on the side of caution and to be 'conservative'). These findings also point to the potential agency of process convenors given the ways that they can influence who is involved in such forums. It may also be possible to assess some contextual factors before a forum through a pre-process survey or via participant interviews.

Further implications are informed by the findings about the informal dispute resolution (and CMOc-4). The lack of evidence for this mechanism and CMOc statement raises questions about whether process convenors should be seeking to resolve such conflict and suggests that less of a consensus orientation may also sometimes be desirable. Similar themes are addressed by science in society scholars. For example Hulme (2014) has argued that scientists and others incorrectly assume that if they "forge a consensus around facts" then "decisive political action will naturally follow". This basic assumption is similar to part of the logic that underpins the hypothesised dispute resolution mechanism.

The chapter will now outline possible improvements to the CMOc statements and then shift focus to discuss insights into alternative intervention theories suggested by the case and resources which may inform improved theories (e.g. actor theories).

8.4.1.1 Potential improvements to the CMOc statements and related research findings

The following summary synthesises key findings with respect to each CMOc statement and findings relevant to practitioners which can be inferred from the case analysis.

CMOc-1: Credible strategic and decision-making guidance under uncertain conditions

Summary of key findings and potential refinements: Actors are seeking different kinds of guidance or support depending on the specific uncertainties they face and the level of uncertainty, and the futures forum process and CSIRO staff are more or less able to address different sources/types of uncertainty (e.g. for which scientific information may be more or less important). These findings imply important contextual factors; in addition, contextual

factors influence the mechanisms (see below). A revised CMOc statement (or multiple statements specific to different sources of uncertainty) needs to address this, and should also incorporate key social factors which influence the credibility of anticipatory knowledge and whether and how it is used.

Additional key findings and practitioner implications:

Salient contextual factors that need to be considered for each mechanism:

Mechanism	Salient contextual factors
M1: Reduction of uncertainty	<ul style="list-style-type: none"> • Source/type of uncertainty: e.g. indeterminacy related to other actors' intentions and possible actions, technological uncertainty, etc. • Viewpoint diversity in the convened group and/or subgroups (low diversity groups likely to promote processes of reciprocal affirmation which lead to stronger convictions)
M2: Provision of resources that support strategic decision-making	<ul style="list-style-type: none"> • Perceived credibility and status of participants • Credibility and social prominence of related circulating images of the future and discourses • Actors' decisional context • Political competencies and goals of participants

Possible countervailing processes that should be considered:

- Uncertainty may be reduced by actors in different ways (e.g. script following) which may result in less impact on decision-making than expected. For example, this may contribute to actors interpreting the process or outputs in ways that limit impact.

Additional/related practitioner guidance informed by the case:

- Consider the suitability of the process with respect to specific salient sources of uncertainty – related to this, consider what should be given greater or less emphasis during the process (e.g. techno-economic modelling, or deliberative group processes, etc.);
- Practitioners could survey participants pre-process to understand the main sources and/or drivers of uncertainty which are salient for participants and level of viewpoint diversity in the convened group;
- Practitioners could limit level of viewpoint diversity to encourage reduced uncertainty (i.e. via processes of reciprocal affirmation); and
- Practitioners should be aware that psychological processes can contribute to reduced uncertainty which negatively impact decision-making

CMOc-2: Reduction of inertia in the context of a destabilising ‘structural break’

Summary of key findings and potential refinements: In addition to a context of discontinuous change and major perceived threats, there is a need to consider a range of individual-level and socio-cultural contextual factors that can reinforce inertia such as the embeddedness of actors in prevailing social institutions and relations. Where processes of change are assumed to be enabled by critical reflection on actors’ assumptions and beliefs the level of viewpoint diversity is an important contextual factor and may introduce trade-offs with other mechanisms such as the production of common understandings. (Note: there was evidence of contrasting processes of change – see Section 8.4.2 below). Key potential refinements are greater emphasis on viewpoint diversity and the influence of institutions.

Additional key findings and practitioner implications:

Salient contextual factors that need to be considered for each mechanism:

Mechanism	Salient contextual factors
M3: Critical reflection on actors’ assumptions and beliefs	<ul style="list-style-type: none"> • Degree of commitment to current opinions and the open-mindedness of forum participants • Level of viewpoint diversity in the convened group (low diversity less likely to promote critical reflection) • Strength/influence of prevailing social institutions • Unequal power relations and its influence on whether there is open sharing of views and arguments
M4: Creation of common understandings	<ul style="list-style-type: none"> • Level of viewpoint diversity in the convened group • Shared or competing interests and preferences
M8: Participation an affecting experience	<ul style="list-style-type: none"> • Level of viewpoint diversity (e.g. this may lead to some actors highlighting new/different threats during a forum)

Possible countervailing processes that also should be considered:

- Conformity to existing conventions/institutions under uncertainty (“script following”)

Additional/related practitioner guidance informed by the case:

- Practitioners need to assess relevant social conditions that may reinforce inertia and/or limit consideration of strategic options and challenges during a forum). This may involve conducting pre-process interviews with some participants

CMOc-3: Enhanced coordination and coalition formation in the context of collective action problems

Summary of key findings and potential refinements: As discussed earlier, more characteristics of the problem of cooperation needs to be incorporated into this proposition. There is a need

to consider how easy or difficult cooperation between forum participants is likely to be – that is, the extent to which their interests are in common or competing, and whether preferences are shared. The proposition could be rewritten to be specific to the level of actor alignment that exists in a situation (e.g. weak, some or strong) and, potentially, also to address situations where social power may need to be exercised to induce cooperation where there is limited alignment. At the level of individual participants, political competencies shape coalition building. In terms of broader social conditions, also influential is the extent to which the context features what Green (2013, p. 15) terms “competing tribal moralities”.

Additional key findings and practitioner implications:

Salient contextual factors that need to be considered for each mechanism:

Mechanism	Salient contextual factors
M7: Enhanced coordination	<ul style="list-style-type: none"> • Level of viewpoint diversity in convened group • Degree of pre-existing alignment between participants: common or competing interests and preferences? • Extent to which expectations are shared by participants • Political competencies of forum participants and other actors
M4: Creation of common understandings	<ul style="list-style-type: none"> • Level of viewpoint diversity in convened group • Degree of pre-existing alignment between participants
M5: Diffusion of idea	<ul style="list-style-type: none"> • Political competencies of forum participants

Possible countervailing processes that also should be considered:

- The forum process may, instead, result in greater attitudinal polarisation (on this process see the discussion earlier in this chapter and in Chapter 5 and Chapter 7). Process designs will need to counter this if the process aims to enable common understandings (which, in turn, inform collective action)

Additional/related practitioner guidance informed by the case:

- Practitioners have some control over relevant contextual factors (e.g. the degree of viewpoint diversity), but it is also necessary to consider the potential conflicts with other change processes (e.g. as per CMOC-2)

CMOC-4: Providing a safe space which enables informal dispute resolution in the context of conflict/contention

Summary of key findings and potential refinements: The capacity of scientific information and the futures forum process to resolve major disputes and debates (or contribution to such

resolution) is limited. A more narrowly framed CMOc statement needs to be developed which focusses primarily on technical disputes and specifies a limited role in other types of dispute.

Additional key findings practitioner implications:

Salient contextual factors that need to be considered for each mechanism:

Mechanism	Salient contextual factors
M6: Informal dispute resolution	<ul style="list-style-type: none"> • The open-mindedness of forum participants and other relevant stakeholders/actors • Level of viewpoint diversity in the convened group • Institutional and ideological factors related to the available options for problem resolution and/or that may constrain actor responses in other ways

Possible countervailing processes:

- Like CMOc-3, the forum process may, instead, result in greater attitudinal polarisation. Related to this, the tribalistic tendencies of forum participants (and other actors) may reinforce existing conflicts (Greene 2013).

Additional/related practitioner guidance informed by the case:

- Practitioners need to be aware of the potential for these processes to reinforce and/or contribute to polarisation (see above); and
- Practitioners could survey or interview participants pre-process to understand the level of viewpoint diversity and types of disputes that may arise during the process.

This chapter now turns to consider insights and resources for alternative intervention theories.

8.4.2 Insights and resources for alternative intervention theories

8.4.2.1 Alternative theories for the targeted intervention outcomes

One set of insights address the same outcomes that are theorised by the existing CMOc statements (e.g. reduction in inertia that's preventing the adoption of new technology pathways). These insights suggest different mechanisms, salient contextual factors, and related outcomes.

Belief reinforcement

Participant self-assessments of the process suggest that belief reinforcement is an important mechanism that can influence subsequent decision-making and multiple expected outcomes (see *BOX 8.1* below): adoption of new technologies (as per CMOC-2), and enhanced decision-making confidence (as per CMOC-1 outcomes). For example, a participant from Woolworths Limited in the Future Fuels Forum stated that “the report and process reinforced our thinking on alternate fuels and helped build internal consensus on trialling new fuels for our fleet” (A. Booth, 2014, personal communication, 29 September). Similarly, a senior executive from an electricity network business that participated in the Future Grid Forum stated that the process and outputs “just provided further confidence that we were headed in the right general direction”, which informed subsequent network planning and investment decisions (Industry informant, 2016, personal communication, 18 April). As a third example, which militated against intended impacts, a participant from Caltex in the SAFRM Forum stated that “to some extent the report confirmed Caltex’s internal position that material changes towards sustainable aviation fuel were still some way off” and “confirmed our position of devoting scarce resources to this challenging problem at the time” (M. Ridley-Smith, 2014, personal communication, 7 May). Many participants made similar statements such as “I don’t think my views were changed, just reinforced and understood in some more detail” (J. Le Cornu, 2014, personal communication, 6 August), and “it did more to confirm my beliefs [than challenge them]” (J. Jarvinen, 2016, personal communication, 10 February).

We can infer from this, regarding CMOC-1, that belief reinforcement can also be a process that reduces uncertainty (see **M1**), and, regarding CMOC-2, that decisions related to new technology pathways can either be supported or hampered by belief reinforcement.¹⁰¹ There is some supporting evidence for this theory from the survey responses: more participants agreed that they “made more confident strategic decisions” because of the forum they attended (64% of respondents agreed) than agreed that they “made different strategic decisions and/or created different policies” because of a forum (38% agreement). This suggests that the futures forums were more likely to reinforce participants’ strategic ideas than to prompt significant reconsideration. Related to this, in two of the three focal futures forums a minority of

¹⁰¹ As noted earlier in this chapter, where group or subgroup members hold similar or the same views this process can be conceptualised as reciprocal affirmation (Beckert 2016).

surveyed participants agreed that the process challenged their beliefs and assumptions (33% of Future Fuels Forum participants, 39% in Future Grid Forum).¹⁰²

In some cases, belief reinforcement supported adoption of new technology pathways (e.g. by Woolworths Limited); in other cases, it was a barrier (e.g. Caltex Australia's decision to devote few resources to the commercialisation or production of aviation biofuels).

BOX 8.1: Alternative CMOC statements centred on belief reinforcement

The following two alternative CMOC statements can be inferred from the case evidence:

CMOC-1b: Enhanced decision-making confidence due to belief reinforcement

In the context of internal consideration of emerging strategic issues and related options in an organisation – along with perceived uncertainties which complicate consideration of these issues and their strategic options – the futures forum process and findings reduce actors' uncertainty by reinforcing their existing strategic ideas (via *belief reinforcement* [M12]) and, consequently promotes related decision-making. This process leads to more confident strategic decision-making (rather than making *different* decisions and/or creating *different* policies).

The example of the participant from Caltex (SAFRM Forum) conveys this process. The forum reinforced their pre-existing views on aviation biofuels which informed their recommitment to their current position (on such fuels) and related decision-making.

CMOC-2b: Strategic inertia reduced by belief reinforcement

In the context of increasing consideration (in the organisation) of possible new strategies and/or alternative strategic directions – due to emerging discontinuous change and major perceived threats (see CMOC-2) – the forum findings and outputs promote *new/different* strategic choices by reinforcing emerging beliefs about the need for change and/or emerging beliefs about the required responses (M12). Consequently, the forum and use of the outputs contribute to a reduced commitment to current strategies (i.e. reduced strategic inertia) and new actions, particularly when participants have sufficient power to influence decisions.

¹⁰² The vast majority of surveyed participants in the Sustainable Aviation Fuel Road Map Forum (73%) agreed that this futures forum '*challenged my beliefs and assumptions about future aviation fuels and options for managing related fuel supply challenges*'. As was discussed in earlier chapters these assumptions and beliefs were often about specific alternative fuel options (e.g. algae-derived biofuels), rather than core policy beliefs or their core assumptions (e.g. about the viability of producing/using alternative jetfuels). Nonetheless, there may be lessons to learn from thus, such as regarding the role of CSIRO staff during the futures forums. During this forum CSIRO staff presented research on fuel options and their conclusions challenged the beliefs of some attendees.

The example above of the network business executive (who participated in the Future Grid Forum) conveys this process. The forum reinforced the rethinking that *preceded* the forum (on network planning and investment) and informed a *shift* in planning/investment.

As per the above high-level sketches, to the extent that the forum process increases confidence – as is claimed by the CSIRO staff member who has been the project leader for the three focal forums (P. Graham, 2014, personal communication, 2 June) – the case evidence suggests it is often for different reasons than was hypothesised.

More targeted CMOc statements

More targeted CMOc statements can also be inferred from the case; that this, causal processes pertaining to specific actors in specific circumstances (also see *BOX 8.2*). These propositions are consistent with the realist evaluation question: “what works for whom in what circumstances and in what respects, and how?” (Pawson & Tilley 2005).

Enhancing the credibility or legitimacy of strategic ideas

Frequently the circumstances of participants and other actors (as described in interviews) was one in which major strategic ideas had been chosen or were already viewed as opportunities but they needed to be sold to *others* to enable action (e.g. convincing internal stakeholders and colleagues). This is a more specific context than currently incorporated into CMOc-1. For these participants a key reason why a forum was frequently judged to have ‘worked’ or been valuable was if it enhanced the credibility or legitimacy of those ideas, such as by providing supporting information or through social validation (see *Table 26*).

A few examples will help to convey this. Staff at Virgin Australia stated that one key goal was to help sell the concept of aviation biofuels (e.g. internally within the airline) and that the SAFRM forum and its outputs helped them to “sell up the chain”. This impact contributed to management approval of a renewable fuels strategy proposed by internal biofuel advocates. At the time of the Future Fuels Forum GM Holden staff were dealing with internal concerns regarding major proposed product changes towards “fuel diversification” and seeking to persuade governments not to implement related mandatory vehicle standards (R. Marshall, 2014, personal communication, 23 October). Their main forum delegate stated that a key benefit of forum and its outputs was that it “added credibility to the diversification agenda ...

both internally and externally”. Similarly, CSIRO staff were able to use the forums to increase the credibility and legitimacy of their ideas (see Chapter 6).

Related to this process there is also evidence of actors drawing on the forums and their outputs to rationalise their intuitive beliefs. Forum discussions and findings were often drawn on to construct justifications for actors’ beliefs which they hoped would be persuasive. In previous chapters, examples were provided on CSIRO staff and others drawing on the forum results in this way. For example, the Inaugural Flagship Director had already determined that the Flagship should have an alternative liquid fuels research program and he interpreted and used the findings of the Future Fuels Forum in ways that helped him to justify this position and convince senior management (at CSIRO) to fund the research. This is one important way that the forums influenced decision-making following the forum process.

Strategic engagement with key actors/stakeholders

A second common circumstance, and related actor focus, was the need to understand or influence the decisions of other actors (e.g. external stakeholders). The potential utility is related to the “forum” aspect of the futures forums: each forum meeting provides an opportunity for participants to influence other actors and “probe” their views. The available evidence suggests that this was a major part of the forums, not simply information sharing or general conversation. This was particularly the case if an organisation faced uncertainties related to future choices by external stakeholders. Examples were stated or alluded earlier in the discussion of contextual factors. In this circumstance, a futures forum has worked for the participant – and thereby provided strategic decision-making support – if it resulted in one or more of the following: (i) the futures forum provided additional insight into possible future decisions that may be made by significant actors (e.g. Caltex wanted to better understand the likely decisions of local airlines); or (ii) the futures forum provided an opportunity to influence the decision-making of other actors. In all three of the focal futures forums there were examples of such utility/value for some of the participants.

Informing policy advocacy

Some participants were also involved in policy processes and were making decisions regarding what policies to advocate or how to promote them. For them, the information produced by a forum was judged to be useful if it was interpreted as providing credible insights into the validity of *specific* policies or other insights relevant to policy advocacy (e.g. ways of framing

policies). For example, a climate policy advocate stated that “I came out of it [the Future Grid Forum] thinking that the strategic policy asks that we had [in particular carbon pricing] were totally reasonable” which led to more confident advocacy (O. Kember, 2016, personal communication, 24 March). This impact-related process relied on producing outputs that were relevant to the policy concerns of actors. However, as outlined in earlier chapters, participants’ interpretations of the policy implications of forum findings were also frequently different (see Chapter 6) including regarding their relevance for policy-making.

BOX 8.2: Alternative more focussed intervention theories informed by the case analysis

Three alternative CMOC statements were inferred from the case evidence:

CMOC-5: Justifying an agenda and securing buy-in

When an actor (the “agenda mover”) has chosen a new strategic idea and/or has identified an opportunity but needs to convince others (e.g. colleagues/internal stakeholders in their organisation), a futures forum enhances the credibility and legitimacy of this idea when it is perceived to provide *social validation* (M11) and/or informs a persuasive justification (*rationalising and/or justifying pre-existing intuitive beliefs* [M13]). These processes and outcomes depend, in part, on the political competencies of the agenda mover and on actors’ social power – i.e., their capacity to ‘make things happen’.

The example of the participant from Virgin Australia (SAFRM Forum) conveys this process. Their main delegate drew on the forum when persuading colleagues: the outputs were used to “sell up the chain” and convince management of the merits of a new strategy.

CMOC-6: Reduced uncertainty related to other actors’ intentions and choices

When actors face major uncertainties related to the intentions and choices of other actors – particularly external stakeholders – the futures forum process can provide insight into possible future decisions by other significant actors (*understanding other actors* [M14]) and/or provides a valuable opportunity to influence their decisions (*influencing other actors* [M15]) if these actors attended the futures forum. These social learning and influencing processes provide useful strategic decision support.

The example of the participant from Caltex (SAFRM Forum) conveys this process. Their main delegate used the forum to check their understanding of the views and intentions of participating airlines (e.g. Qantas) and to influence the expectations of key stakeholders

This CMOC statement could be viewed as another variation on CMOC-1, however the generative mechanisms are different to those in CMOC-1.

CMOc-7: Enhanced policy advocacy

Some forum participants are involved in policy processes and making decisions regarding what policies to advocate and/or how to campaign for these policies. The futures forum process provides participants with additional credible insights into the validity of *specific* policies or future scenarios related to these policies (*provision of credible resources [M2]*), and/or other insights relevant to policy advocacy. Additionally, these participants interpret the forum process findings and outputs from the perspective of current policy debates and strategically mobilise resources provided by the forum that are judged to be relevant to shaping those debates.

There were fewer examples of this in the three forums that were studied, but some delegates (such as from The Climate Institute) argued that the forums had such utility.

The above discussion also suggests alternative ways of approaching the convening and design of futures forums to enhance their impact. For example, practitioner choices could target different mechanisms (e.g. belief reinforcement) or processes (e.g. agenda moving).

8.4.2.2 Revisiting the formal theoretical perspectives (Part 2b) and case explanations

The case study can also be used to contrast the formal theory-informed case analysis with the practitioner intervention theories that were elicited (see *guiding question 2*). Formal theories can provide resources for theory-building and inform critiques of the practitioner theories.

As a starting point, the case analysis presented in *Part 2b* suggests that there is a need to consider whether the intervention theories adequately consider the ways in which prospective knowledge practices (PKPs) are social activities (Chapter 5), political practices (Chapter 6), and influenced by actors' reasoning capacities and associated contingencies (Chapter 7).

Whilst the intervention theories do consider the importance of social conditions (e.g. contextual circumstances, etc.) and reasoning, they appear to underestimate the extent to which PKPs and their effects are both socially conditioned and involve complex social processes such as processes of negotiation (also see Camic, Gross & Lamont 2011a; Hulme & Dessai 2008; Ramirez & Wilkinson 2016). The perspective on reasoning that informs the intervention theories is also more consistent with an intellectualist view of reason (see Mercier & Sperber 2017). Adopting an "interactionist" view of reason could enable practitioners to enhance group reasoning and related process outcomes.

The conceptualisation of PKPs as political practices presents the largest departure from the intervention theories. The intervention theories present PKPs as neutral practices/activities which provide “inputs” to decision processes (e.g. CMOc-1). Consequently, moving more in this direction would require the most significant change, some of which is likely to be incompatible with a formal scientific organisation. However, it would be consistent with recent research by management scientists and political scientists (e.g. Cairney 2016; Jarzabkowski & Kaplan 2015). For example, Jarzabkowski & Kaplan (2015, p. 554) have argued that strategy tools “should not be perceived as neutral objects that can eliminate politics from strategy making”. It would also explicitly address the challenges raised by convening diverse groups, which points to the need to incorporate causal mechanisms through which conflicting interests and/or preferences may be reconciled such as bargaining games and the use of power (see Chapter 6). In this context, these prospective exercises may need to be retheorised as oriented towards dissensus management where most participating actors get what they need whilst minimising conflict and avoiding the collapse of such processes.

We can also consider Pawson and Tilley’s (1997b) concept of blocking mechanisms to identify additional ways of considering these perspectives. Pawson and Tilley argued that social interventions need to fire blocking mechanisms; that is, causal mechanisms which act to *counteract* existing social processes, particularly those processes which are contributing to a focal problem and/or hampering action. The case analysis suggests that for the futures forums (and similar exercises) practitioners need to be aware of social and cognitive processes they need to counteract such as those which “create rigidity in the responses to changes in an uncertain environment” (Beckert & Dequech 2005, p. 585), e.g. script following. Incorporating blocking mechanisms to counter existing processes may be a further way of creating more robust intervention theories.

Formal theorisation of social and cognitive mechanisms can also provide theory-building resources. This includes general mechanisms theorised by sociologists such as institutions, power and reflexivity (Dobbin 2004; Roberts 2009), as well as those more specific to PKPs such as mechanisms of group dynamics and of mental/cognitive processes. A further opportunity is thus to incorporate ‘formal’ causal mechanisms in intervention theories.

8.4.2.3 *Theories of the actor (microfoundations)*

Finally, the case analysis suggests that actor theories can provide practitioners with resources for enhancing intervention theories. If this point is unclear then consider the arguments presented in chapter 5. Much of sociological theory presumes the “social-ness” of human actors (Fligstein 2001; Fligstein & McAdam 2012; Little 2014). That is, human actors are understood to be both “socially situated and socially constructed” (Little 2014, p. 73) and these social factors are expected to influence their thoughts and behaviour. For example, Little (2014) argues that individuals are embedded in social relations and institutions, and Fligstein and McAdam (2012) posit an “existential function” of the social.

A further relevant aspect that some actor theories emphasise is motivation. Tetlock’s (2000, 2002) framework of ideal type actors conveys this well, particularly the following four ideal types: the “intuitive politician” who is motivated by a desire to gain or maintain the approval of constituencies they feel accountable to and social approval more generally; the “intuitive economist” guided by cost-benefit analysis style thinking and who resembles a ‘rational actor’; the “intuitive scientist” who is motivated to “achieve cognitive mastery of their world” (Tetlock 2000, p. 294); and the “intuitive prosecutor” who seeks to enforce social norms. For example, acting to secure and/or maintain the approval of important constituencies can, for example, be an important part of agenda moving (see CMOc-5).

An important issue raised in this literature is that common perspectives on human actors are “superficial and misleading” (Little 2014, p. 59) such as rational choice theory and a means-ends rationality view of action.¹⁰³ Similarly intervention theories thus may also be grounded in superficial or misleading understandings of actors. Conversely, intervention theories may be made more robust useful by being informed by sophisticated actor theories.

New directions in sociological theory – which Little (2014) terms the ‘new pragmatism’ – also point to ways of overcoming related limitations. Such theories include new action theories, emphasise socially-created habits, and generally “takes issue with models of deliberative rationality” (Little 2014, p. 64). These possibilities are taken up in Chapter 9 and Chapter 10.

¹⁰³ A useful term for this view of human actors is ‘Homo Rationalis’ (Schermer 2011, p. 343). ‘Homo Rationalis’ is the largely mythical “species of human who carefully weighs all decisions through cold, hard logic and rational analysis of the data” (p.343).

8.5 Considerations regarding the transferability of the intervention theory findings

The critical realist philosophical position that informs realist evaluation and this study (see Maxwell 2012) suggests that transferability is most likely in saliently similar contexts. For example, where the contextual factors are the same as, or sufficiently like, those identified in this study other practitioners could expect the same social and mental processes to influence those interventions. For example, the case study findings regarding group characteristics – and the associated process convening choices and trade-off lessons – may be widely transferable. Some identified lessons may be more specific to formal scientific organisations such as CSIRO and therefore be less transferable to practitioners working in other organisational contexts (also see the Conclusion chapter).

Further contextual considerations address the extent to which the case study findings are specific to the Australian context and/or transitions related to energy and climate change. Some scholars examining energy transitions have argued that actors in energy discourses increasingly hold “strong and often fixed views about the feasibility of various pathways” (Floyd 2016), which has implications for some contextual factors. Additionally, the influence of institutions on the impacts of futures forum processes (or similar forward-looking exercises) may be more significant in the Australian context, and this may have related specific implications. However, studies by other scholars suggest that this is unlikely to be the case, at least with respect to technological change and associated innovation processes (e.g. Mazzucato 2014, 2015). These considerations are also further explored in the next chapter which considers socio-technical transition processes.

8.6 Chapter summary and concluding observations

This chapter has discussed the intervention theory findings (including whether the findings reflect process or theoretical deficiencies) and associated potential refinements to the intervention theories that were elicited. Given the limited explanatory power and limited empirical validity of the existing intervention theories, the chapter focussed mainly on possible ways of improving the intervention theories. In this respect, a general key conclusion is that it is possible to infer from the case useful lessons regarding the validity of intervention theories and insights that can be used to improve them.

As *Section 8.3* and *Section 8.4* clearly conveyed, the case study identified additional important contextual factors and additional case-informed possibilities for developing refined intervention theories and associated practitioner guidance. These insights could be used (by CSIRO staff or others) to design and convene the futures forums (or similar prospective exercises) in ways that make the intended outcomes more likely. The findings also point to the need to incorporate formal theory into intervention theories, including social and cognitive mechanisms and the theories of human actors developed by social scientists.

These insights imply a need for complex and nuanced intervention theories. The theories presented in Chapter 3 are simple which would make using them easier. However, they don't consider myriad factors and potential trade-offs, and likely overstate some functions of PKPs. More complex theories will clearly be much more challenging for practitioners to use but they should be more valid.

The broader validity of these insights needs to be further examined in other cases in which similar exercises are conducted in similar or appropriate contexts. Contextual factors regarding contemporary sustainability-related transitions (particularly energy transitions) also need to be considered. The next chapter addresses this and related topics.

CHAPTER 9: Discussion of the functions of prospective knowledge practices and their use and roles in sustainability-related socio-technical transitions

9.1 Introduction

The previous chapter addressed themes specifically related to the intervention theories to-be-tested. In contrast, this chapter aims to synthesise further insights into the uses and roles of prospective knowledge practices (PKPs) evidenced by the focal case and to further consider the transferability of such insights. These insights therefore necessarily go beyond intervention theories (though insights related to these will be noted in passing) and re-interpret the focal case with respect to the roles, uses and effects of PKPs. The chapter considers what the case may tell us about the uses and potential roles of PKPs in socio-technical transition processes, considering the production, assessment, and the use (or non-use) of anticipatory knowledge and to what extent these findings may be specific to the case. Given further interpretation of the case is required to achieve these tasks, additional perspectives that are relevant to the case analysis and can be used to synthesise key findings are also considered including socio-technical transition theory and pragmatism (see below).

Thus, this chapter has additional key tasks. The chapter relates the case and case analysis to socio-technical transition concepts and theories. For example, the case findings may provide supporting evidence for existing transition theories and concepts, and such concepts and theories may be useful for deepening the case interpretation (see *Section 9.4* and *Section 9.5*). Secondly, pragmatist philosophy and related pragmatist action theories are introduced and used as a means of further clarifying and deepening the case interpretation and considering the implications. In doing so I recognise, as McDermid (n.d., p. 367) asserts, that there is “no neat list of articles or essential tenets endorsed by all pragmatists and only by pragmatists”. Nonetheless, sociological interpretations of pragmatist philosophy (see Gross 2009; Gross 2010; Joas & Beckert 2001; Little 2014) and recent clarification of pragmatist positions (e.g. Misak 2013; Misak 2016) provide useful guiding ideas that can be mobilised for such case interpretation, in particular recent conceptualisations of pragmatist action theories (see

Section 9.3. and Section 9.6).¹⁰⁴ Pragmatists also developed relevant ideas about inquiry and knowledge claims which are relevant to knowledge practices and may be useful for further explaining the impacts and roles of futures forums. For example, pragmatists recognise the “cognitive weight” of the background beliefs that people accumulate (Misak 2016, p. 282) and suggest that inquiry and knowledge necessarily proceeds “in a piecemeal fashion” (Misak 2016, p. 74). Similarly, as will be further considered later in the chapter with respect to forum participants’ responses to forum findings, some classical pragmatists argued that:

the justificatory status of beliefs is partly a function of how well they cohere or fit with entrenched beliefs or theory. Since the range of “facts” we can countenance or acknowledge is accordingly constrained by our body of previous acquired beliefs, no “fact” can be admitted into our minds unless it can be coherently assimilated or harmonized with beliefs we already hold. This amounts of a rejection of Locke’s suggestion that the mind is a blank slate, that is, a purely receptive and patient *tabula rasa* (McDermid n.d., emphasis in original).

Before proceeding I should say a few more words about how ‘pragmatism’ is understood and used here. Pragmatism is a living philosophical tradition which comes in multiple flavours. It is understood here to be a naturalistic philosophy (Misak 2016), providing an account of inquiry, belief and truth developed by philosophers which is “premised on their anthropology [study of human beings]” (Gross 2009, p. 367). For instance, as discussed later in this chapter, much pragmatist thought contends that the aim of inquiry is “to solve problems and, thereby, to act successfully” (Misak 2016, p. 280) and addresses “the mind’s relation to the world [which] is not straightforward or unmediated... [arguing] we do not passively receive the world as it is in itself” (Misak 2016, p. 140). Sociologists such as Gross (2009) subsequently built on key themes in classical pragmatism to develop new sociological action theories.

The substantial agenda of this chapter will now be addressed in the following five main sections. *Section 9.2* summarises the core identified patterns regarding the roles and use of PKPs in the focal case and the consistency of these findings with earlier studies. *Section 9.3* builds on these patterns to consider in substantially more detail the functions of PKPs in

¹⁰⁴ For example, Neil Gross has drawn on ideas from the classical American pragmatism tradition (e.g. associated with John Dewey, William James, amongst many others) and developed a sociological explanation of human action informed by classical pragmatist ideas (Gross 2009). Daniel Little has surveyed the ideas of many contemporary sociologists he terms the ‘new pragmatists’ (e.g. Neil Gross), such as their emphasis on theories of human actors and related action theories which he contrasts with other models of human action (e.g. the rational calculation of means to ends).

sustainability-related socio-technical transition processes, and interprets these from additional key perspectives (e.g. pragmatist action theory). The transferability of these insights is then discussed, asking whether these are specific to contemporary energy transition processes (particularly energy transitions related to mitigating climate change) or whether they could be reasonably expected to be transferable to other kinds of sustainability-related socio-technical transitions. This will provide the basis for a brief discussion in *Section 9.5* of the implications for theorising socio-technical transitions, for practitioners (e.g. CSIRO staff) and for transition researchers. Finally, the chapter presents a pragmatist synthesis of the main case findings and related themes discussed in this chapter (see *Section 9.6*).

9.2 Revisiting the case evidence of the roles and use of prospective knowledge practices

A logical place to begin this discussion is the pattern presented in previous chapters that the futures forums *tended* (with important exceptions) to contribute to action by reinforcing, and/or helping to justify or rationalise, the existing convictions or intuitive beliefs of actors.¹⁰⁵ Related to this, as noted in Chapter 8, the available case evidence suggested that attending a futures forum was more likely to reinforce participants' strategic ideas than prompt major reconsiderations (e.g. the participants who stated that the process and/or report reinforced their thinking or confirmed their existing position on an issue). In fewer instances, the futures forums also contributed to action by helping participants to identify other actors who shared their convictions or beliefs (e.g. other actors who held similar beliefs about peak oil, or who shared their beliefs about the need for new localised supply chain models for aviation biofuels, etc.). There was less evidence of other commonly claimed and hypothesised roles such as enabling a major cognitive shift (e.g. see the limited evidence for the hypothesised critical reflection on actors' assumptions and beliefs mechanism [M2]). These themes also suggest key ways that PKPs can "translate into action" (Miller et al. 2014, p. 243), such as by helping actors to convince others and thereby influencing decisions.

¹⁰⁵ The important distinction between "intuitive beliefs" and "reflective beliefs" made by Mercier and Sperber (2011) was noted in Chapter 7. They define an intuitive belief as "beliefs held without awareness of reasons to hold them" (p.58). During or through a futures forum process the participants (and others) can identify or reflect on reasons for holding their beliefs. Consistent with the observations of the common roles and functions of PKPs discussed in this chapter, Mercier and Sperber (2011, p. 59) also note that "there is considerable evidence that when reasoning is applied to the conclusions of intuitive inference, it tends to rationalize them rather than to correct them".

There were important exceptions to these patterns. Illustrative examples of where attending a futures forum *altered* the existing convictions and/or intuitive beliefs of actors are noted later in this chapter (see *Section 9.3.2*), and their implications are discussed.

Depending on the actor, his/her conviction(s), and other situational or contextual factors, these process effects variously: (i) contributed to change-related action (e.g. by informing the justifications for change that were constructed, or by contributing to enhanced confidence which supported decision-making, etc.); (ii) reinforced the status quo (e.g. by reinforcing beliefs related to existing government policies); or (iii) reinforced prevailing disputes (e.g. by actors who interpreted forum findings as supporting different sides in a debate, etc.). These diverse effects also highlight that PKPs are used for diverse purposes and, in real-world cases, these purposes can be conflicting.

A range of explanations were given for the tendency of PKPs to have these functions and associated effects. For instance, previous chapters noted the “forceful presence” of circulating expectations (van Lente 2012, p. 773) and the institutional context (see Chapter 5 and arguments in this chapter regarding the ways PKPs are socially conditioned), and considered the evidence of biased evaluation of futures forum findings related to motivated reasoning (Chapter 7).

In addition, the frequent ambiguity of anticipatory knowledge and forward-looking inquiry may contribute to these effects. If this is correct, it points to specific aspects of PKPs which contribute to these patterns. For example, the uncertainty inherent to a set of scenarios or related modelling can also support or contribute to different interpretations of the results, and such interpretative processes demand that actors do further “temporal work” (Kaplan & Orlikowski 2013). Related to this, forum participants often interpreted forum findings or outputs very differently, such as when their judgements about a set of scenarios or modelling results and their implications depended, in part, on their alignment with their existing beliefs. Some findings from psychological research support this analysis. Studies have found that ambiguity can prompt cognitive processes that bias perception and reinforce other cognitive biases (Greene 2013), and being exposed to uncertainty can prompt unconscious efforts to enhance certainty due to the “need to feel certain” (Crisp 2015, p. 23).

As will be discussed later in the chapter, the pragmatist theory of action (Gross 2009; Joas &

Beckert 2001) and the related philosophical tradition of pragmatism (Joas 2001; McDermid n.d.; Misak 2016; Rescher 2013) can be drawn on when interpreting these findings. Much like the observations of classical pragmatists (see the quotation presented on p.254), the case evidence indicates that participants' responses to the scenarios and other forum outputs and findings were often shaped by mental processes whereby they were either assimilated (or harmonised) with existing beliefs or rejected.

9.2.1 Alignment of case findings with claimed functions of PKPs

Some of the identified case patterns are inconsistent with many of the claimed or espoused functions of similar PKPs such as scenario planning processes and scenario exercises. Key examples outlined in the introductory chapter included commonly claimed cognitive benefits, such as enabling people to “think more broadly about futures” (Parandian & Rip 2013, pp. 2-3), counteracting biases (Schoemaker 1993), reframe a strategic situation (Ramirez & Wilkinson 2016), or enabling a cognitive shift “from closed to more open and more flexible” (Ramirez & Wilkinson 2016, p. xiv). The focal case suggests that these functions need to be seen as more difficult to achieve (than how they're often presented in literature) and as requiring efforts to overcome cognitive and social barriers to their realisation.

The findings are also somewhat inconsistent with the broader potential roles of PKPs emphasised by sustainability-related scholars. There is only limited support for Miller et al.'s (2014, p. 241) claim that these practices enable “explicit treatment of the normative, ethical and political issues that are often obscured by descriptive analysis”. The case suggests that consideration of such issues is influenced by the intention or willingness of convenors and facilitators to deeply explore contentious issues and ‘encourage’ the participants to do so. Political issues were often raised during a futures forum however many weren't examined deeply. Energy policy issues and other issues related to energy transitions are often contentious and politicised (Raven et al. 2016; Scoones, Leach & Newell 2015; Sovacool, Brown & Valentine 2016) and are frequently a source of intense disagreement, which implies an important need to engage with highly contentious issues in energy transition contexts. The limited evidence for these broader functions may also be due to the limited normative focus of the futures forum process, although some normative goals (e.g. reducing greenhouse gas emissions) were considered and the Sustainable Aviation Fuel Road Map Forum also

incorporated a backcasting dimension focussed on the aviation industry's goals.¹⁰⁶

In other respects, the findings are similar to other studies of forward-looking research such as previous studies of energy forecasting. As summarised by Robinson (1988, p. 329), these studies revealed a distinction between the “ostensible neutral information-providing role” of energy forecasting and its “actual legitimizing role”. Similarly, CMOc-5 (*justifying an agenda and securing buy-in*) outlined ways in which the case evidence indicates that the futures forums helped some participants to legitimise their position and/or strategic ideas. The influence of actors' interests and preferences on the futures forums and learning processes also indicated several ways in which the futures forums and use of the outputs weren't neutral.¹⁰⁷ This raises issues for scientists who wish to remain neutral or to convey neutrality (see further discussion on this important point later in this chapter).

The emphasis placed on context-dependency by Robinson is also echoed by the present study:

It is fairly well-recognized that, like scientific analysis in general, modelling and forecasting techniques embody a set of assumptions about the nature of the world, theories of human behavior, social values, institutional and disciplinary presuppositions... As a result, modelling and forecasting are part craft, rather than scientific, activities, dependent upon the institutional, disciplinary and individual context in which they are performed (Robinson 1988, p. 327).

9.2.2 Alignment with the intervention theories to-be-tested

These findings on the main identified functions of PKPs in the focal case can also be related to the intervention theories. When a futures forum reinforced, and/or was used to justify or

¹⁰⁶ In contrast, a more explicitly normative process could, for example, have emphasised or incorporated a visioning process (for examples see Eames & McDowall 2010; McGrail, Gaziulusoy & Twomey 2015; Wilkinson & Mangalagiu 2012) or incorporated a stronger focus on transition goals. The project leader argued that participant diversity prevented development of a shared vision in most futures forums (with the partial exception of the SAFRM Forum). He argued “they [forum participants] never would have agreed to one [a common vision]” (P. Graham, 2014, personal communication, 2 June).

¹⁰⁷ Contrasting claims in the literature include Segal's (2007, p. 61) argument that the power of scenario techniques lies in their “inherent capacity to look dispassionately at issues and options”, i.e. enabling participants to adopt such a viewpoint. The focal case in this thesis provides limited evidence of such dispassionate analysis. The modelling component of the process has some potential to enable such analysis, however, the results are rarely reviewed dispassionately. The modelling results, and their meaning and significance, were often considered with respect to the specific agendas, preferences and interests of participants which militated against the approach claimed by Segal.

rationalise, the existing convictions or intuitive beliefs of actors it often provided decision-support (see CMOC-1, and CMOC-1b *'Enhanced decision-making confidence due to belief reinforcement'*) and, in some instances, contributed to the adoption of new technologies (see CMOC-2b *'Strategic inertia reduced by belief reinforcement'*). On the other hand, this function militated against the expected processes of inertia reduction (CMOC-2) and the resolution of major disputes/conflicts (CMOC-4). These findings can be used to further consider the roles of PKPs in socio-technical transition processes (see section below) as well as challenges that can limit intervention efficacy.

It should also be noted that the case findings on the situationally contingent nature of the causal processes is consistent with a critical realist ontology (Maxwell 2012). Related factors were discussed in the last chapter – such as the open-mindedness of participants (individual level factor), unequal social power (a group dynamics factor), and the “forceful presence” of expectations (van Lente 2012, p. 773) circulating in relevant networks and communities (social conditions level). The reader is referred to this chapter for more detail.

9.3 Prospective knowledge practices and socio-technical transitions: reconsidering the case evidence of their functions in this context

We're now in a better position to adequately consider what the focal case suggests are the main functions of PKPs in sustainability-related socio-technical transition processes, and other potentially impactful functions for which there was less evidence or that the case implies are plausible. Where additional *potential* functions are implied we can consider their feasibility.

9.3.1 Identified main functions of PKPs in socio-technical transition processes

Related to the main identified functions of PKPs outlined in *Section 9.2*, one common set of specific behaviours in the case was attempts by actors to convince others of the merits of *proposed* actions, strategies or policies related to energy transitions. As discussed elsewhere in this thesis, actors often were seeking to develop a persuasive justification for a proposed agenda or actions (and for other supporting beliefs) and PKPs formed part of their approach. Modelling results and other findings could be drawn on to find or construct reasons supporting their position(s), a behaviour that is commonly seen in policy processes (Denniss 2015; van der Steen 2008). In these ways and others, PKPs were often used to reinforce or support a

preexisting position. Many of the examples detailed in previous chapters also indicate that participants and others tended to *interpret* and communicate forum results in ways that were consistent with their views. This finding is similar to other analysis of forward-looking methods such as economic modelling (e.g. see Denniss 2015, 2016).

This description of an important function of PKPs in socio-technical transition processes can also be deepened by noting similar research findings in studies conducted by psychologists and management scientists. Psychologists have found that human beings often do reasoning to “put a rational face on” their intuitive beliefs (Greene 2013, p. 321) or other convictions (Haidt 2001, 2013; Mercier & Sperber 2011). In these ways, strategic reasoning often *follows* intuitions, in contrast to the classical view of reasoning (see Chapter 7). Similarly, research on strategy tools has found that such tools are often used to *convey* rationality and to some, but often less, extent seek rationality (Jarzabkowski & Kaplan 2015). For example, such tools can be mobilised as evidence of the claimed rational basis of a decision which was taken for different reasons. Jarzabkowski & Kaplan (2015, p. 543) further note that quantitative tools such as modelling methods are often viewed as “attractive because numbers can signal rationality due to their association with accuracy”.¹⁰⁸ Both of these lines of inquiry support the underlying idea that knowledge practices are frequently used to reinforce or justify existing convictions and intuitive beliefs of actors, whether these be related to strategy-making (Kaplan & Orlikowski 2014) or myriad other judgements (Greene 2013; Haidt 2013). This function can also enhance the agency of these actors, as seen, for example, in the focal case where actors secured greater buy-in or legitimised proposed research programs.

Closely related to the above, the case also clearly demonstrates that arguments often have to be put forward to *defend* a decision or other action (Mercier & Sperber 2011) and PKPs are often also used for this purpose. A key example discussed in Chapter 5 and Chapter 6 was the Federal Government’s use of the SAFRM report and other forward-looking studies (e.g. commissioned assessments of energy security risks) to support the government’s approach to transport fuel policy and related decisions to move further away from interventionist policies (e.g. ‘picking winners’ style policies). To the extent that a more interventionist approach is

¹⁰⁸ Similarly, the Inaugural Flagship Director stated that “we got some numbers out of the forum [Future Fuels Forum] which is better than being qualitative about this. You know when people say ‘what’s the issue?’ we can point to plausible scenarios and look at what the consequences are” (Dr J. Wright, 2014, personal communication, 25 August). He also argued that “hard numbers are always appreciated [by industry participants]” (Dr J. Wright, 2014, personal communication, 9 June).

required to enable transitions to low-carbon technologies – which was argued by some forum participants, and is argued by some scholars (e.g. Mazzucato 2014; Mazzucato 2015) – this example illustrates that the use of PKPs can also hamper transitions.

A further specific function that can be inferred from the use of PKPs in the case and other already identified functions is the management of expectations (also see Beckert 2013a, 2016). This is primarily seen in efforts to influence other actors' expectations. As Bacharach (2016) discusses, a common challenge facing “agenda movers” – strategic actors who are proposing change and seeking to enable innovation – is the uncertain outcomes of such initiatives and the related fears and concerns that such uncertainty can stimulate. Consequently, success (however defined) must be viewed as “within the realm of reasonable possibility” (Bacharach 2016, p. 101) by relevant actors. The futures forums provided resources that could be used to influence such expectations and enhance confidence.

The perceived central message of the SAFRM Forum report that was highlighted by Virgin Australia's main forum participant conveys this function. He used the forum report to influence the expectations of senior management and secure greater buy-in:

“It [the report] basically says that it is possible and that was a big boost, obviously, and something our senior managers took note of. It was easier to sell up the chain with it... Yep, this is possible. There are challenges to overcome still but, you know, we can do it” (D. White, 2015, personal communication, 1 June).

The scientific credentials of CSIRO were cited as important by other Virgin Australia staff, as part of their efforts to understand “what the potential is for a country based on scientific research [i.e. the national biofuel production potential], particularly if a firm sets targets for using a certain percent of renewable fuels” (R. Boyd, 2015, personal communication, 25 June). In these ways, the research shaped assessments of possibility.

The other side of this function is attempts to increase the level of attention placed on risks and thereby make the status quo (or the present) appear riskier. In the focal case, there were numerous examples of actors doing this when articulating a justification for change, such as biofuel industry actors and proponents who emphasised fuel security issues. For example, these participants and related actors prominently used the peak oil-related scenarios and their projected consequences when lobbying policymakers.

9.3.2 *Other less common functions*

Other functions are revealed by some of the exceptions to more typical roles (i.e. those which were reported in *Section 9.2* and *Section 9.3.1*). The clearest examples were evident in the SAFRM Forum and its effects. More participants in this forum reported that the process challenged their views and beliefs such as about alternative fuels. For example, a policy officer who participated stated that “I attended with a strong belief that bio-derived aviation fuels were a possibility and the results of the forum deeply challenged that perception” (A. Verdier, 2015, personal communication, 10 April). This process was described as follows:

“For me it was an eye-opener. CSIRO is very good in laying down the state of affairs, putting people together and getting at the nitty gritty of things and the issues. It’s when you put all that together that it comes apart for me... [CSIRO] put a model in place, the model gives results, you comment on the results, and that’s all part of the scientific process. But as someone who is part of a policy-making process that’s where I’m starting to scratch my head and say, then what? Because of the uncertainty attached to fuel price, to this, and to that, you know, as much as you want to do this with the kind of means we would have been able to put on the table can you really influence outcomes against some external factors?” (A. Verdier, 2015, personal communication, 10 April).

The above quotation vividly conveys this participant’s experience of being confronted with a wide range of uncertainties related to aviation biofuels and, consequently, having reduced confidence that it could (or should) be supported by government policy.

Several forum participants from participating airlines and aviation organisations also reported that the process also altered their understanding of fuel options and their viability. A key example discussed in Chapter 5 was the confidence of some actors that novel fuels such as algae-derived biofuels would soon provide a substitute source of oil. Related to this, this forum was – for some participants – an antidote to what Scott (2002, p. 22) terms “excessive certitude”. This function was achieved by revealing, and/or placing greater attention on, relevant uncertainties and limitations. The examples from the SAFRM forum illustrate that such effects can have two very different consequences: (i) it can lead to less transition-related action (e.g. if policy officers subsequently decide not to advocate for new government policies); and (ii) it can contribute to better informed action which can help to enable a

transition (e.g. stronger knowledge led some airlines to shift focus to other biofuels).

In contrast to the reduction of uncertainty mechanism, and associated cognitive processes (Crisp 2015; Mercier & Sperber 2011), this function involves becoming more aware of uncertainties and *altering* related beliefs. In the case of the SAFRM Forum, this was a conflictual process in which participating CSIRO scientists repeatedly conveyed to forum participants key issues and challenges to persuade them to alter their beliefs. One participating scientist argued that it took very 'strong' interventions from CSIRO staff to shift these debates (D. O'Connell, 2015, personal communication, 25 June). These findings also point to convening and facilitation implications (on the point see *Section 9.5* below).

Finally, the identified core functions illustrate that the individual and social functions of PKPs can have diverse consequences for socio-technical transitions. Much of the literature implicitly assumes that forward-looking studies will either have impacts that support a transition or no impact (e.g. Quist 2007; Weaver et al. 2000). However, the focal case suggests that a more nuanced perspective is needed that also recognises the potential for diverse unintended consequences.

9.3.3 Primacy of argumentative or epistemic functions?

Many of the identified functions suggest that PKPs – to use Mercier and Sperber's (2011) terms – are often mobilised more for argumentative reasons than epistemic reasons and, secondly, that there can be tensions between argumentative and epistemic functions. Related to this, the case suggests that actors can be more interested in convincing others or defending their position(s) than reaching more accurate beliefs or 'better' decisions.

The case suggests that these tensions can contribute to conflict between actors who have different objectives. For example, one participant in the SAFRM Forum argued that there were strong tensions during the process between the advocacy aims of industry participants and the efforts of others (e.g. CSIRO staff) to convey accurate beliefs about the feasibility of shifting to using bio-jetfuel and/or related challenges (R. Posner, 2015, personal communication, 11 June). Some Future Grid Forum participants also argued that biases (e.g. towards preferred technological options) influenced the capacity of the forum to produce accurate analysis of the viability of different approaches such as understanding this in terms of what would be the

most economically efficient or rational approach (State government representative [off-the-record], 2015, personal communication, 18 March). The behaviour of peak oil activists – some of whom were highly sceptical of the capacity of CSIRO staff to do reliable modelling but were happy to use the outputs – as it was interpreted as providing “good material to work with” such as the projection of \$8/litre fuel in one scenario (P. Hart, 2014, personal communication, 10 October) – suggests a secondary interest in epistemic validity.

Similar to these findings on the apparent primacy of argumentative functions, other scholars have observed that expectations are frequently “deployed strategically” in socio-technical change processes (Truffer, Voß & Konrad 2008, p. 1362), and also argued that actors have to do related “strategic work” to enable transitions (Raven et al. 2016). CSIRO staff also are not immune to such dynamics and cited the need to deploy expectations in a similar manner:

“If we’re working on new technologies which people are saying won’t exist in the future... [t]hat can become a problem for us. If we reach a certain point where we’re confident that this should be considered as part of the electricity future and the main market operator and all the major consultants just don’t include it at all in their modelling or analysis more broadly then that becomes a problem for us because we’re out there talking to clients about working with them on smart grid related projects and it’s not there in the official forecasts from anyone then there’s this disconnect which can be a problem...

...It’s a bit like how the coal industry relies on the International Energy Agency forecasts showing that coal has a future. It’s the “go to” thing in a way, as you have to have the evidence that the world thinks this is going to be there in the future. It works in reverse too. If you’ve got a new technology and people are, in effect, showing that it doesn’t exist in the future that can be a problem” (P. Graham, 2015, personal communication, November 11).

9.3.4 Additional potentially impactful functions of prospective knowledge practices

Other potentially impactful functions can be considered in a more speculative way by probing the scope for intervention by convenors and facilitators during such exercises, reconsidering that different approaches may have altered the roles and impacts of the futures forums. This discussion can further inform evaluative judgements about the contribution of the futures forums to socio-technical transitions and whether these could have been enhanced.

An important potential role is suggested by the debates about actor roles which occurred in

the SAFRM Forum. Chapter 5 discussed how the airlines narrowly defined their primary role as an end customer for alternative fuels. Participants from these companies defended the basic position that they should stick to their 'core business'. CSIRO staff subsequently suggested that the unwillingness of local airlines to directly invest in the creation of new supply chains and play related roles was an important factor which limited the impact of the forum. Like the interventions made by CSIRO scientists regarding participants' assumptions about the near-term viability of some alternative fuels, CSIRO staff could also have been a more *interventionist* convenor in other respects. For example, CSIRO staff could have challenged participant assumptions about actor roles during transitions. This suggests a potential function whereby process convenors and/or facilitators can provide an independent evaluation of the arguments made by participants to encourage deeper reflection. This would require a less "hands-off" philosophy than espoused by some CSIRO staff. However, CSIRO staff are an example of a credible actor who could perform such a function.¹⁰⁹

Notably, actor roles were also a major topic in other forums. For example, in the Future Fuels Forum some participants sought greater government consideration of more interventionist roles in fuel markets and the wider transport and fuels sectors. At the same time, concerns were expressed about being seen to 'pick winners' or advocate such an approach. Like the SAFRM Forum there is little evidence that the Future Fuels Forum prompted significant reflection on actor roles. The forum report presented options (e.g. alternative policy approaches that emphasised picking winners and market-based approaches) and little specific guidance (CSIRO 2008a). Whilst institutional barriers can be a major constraint, a more interventionist convenor may have achieved different results.

A further potential function of PKPs is enabling actors "to critically reflect on the available, circulating expectations" (van Lente 2012, p. 778). This function and its potential importance is suggested, on the one hand, by how CSIRO scientists challenged the views of some SAFRM Forum participants and related algal-fuel hype, and, on the other hand, by possible critiques of the other CSIRO futures forums.

An illustrative example can be considered from the Future Grid Forum. The scenario analysis

¹⁰⁹ A more general process facilitator/convenor who doesn't have the status/credibility that can be gained through institutional affiliation may not be able to perform such interventionist role during a process. For example, their opinions may not be respected by the participants.

and modelling focussed strongly on the potential use and growth of battery storage technologies (e.g. for on-site energy storage in residential homes). This focus was consistent with the increasing interest in energy storage over the 2012-2013 period, in particular battery storage systems. In contrast, other studies have concluded that other forms of energy storage are more cost effective and consequently may be a more important aspect of Australia's future electricity grid than battery storage technologies (e.g. see Blakers & Fulton 2014; Dargaville 2016; Forcey & Dargaville 2015; Hearps et al. 2014). To the extent these studies are correct – which will only be revealed in time as per the evolution of related technologies and the electricity grid – this indicates risks when a process is participant-led. Like the SAFRM forum, CSIRO staff could have critically examined or challenged the prevailing expectations and challenged the focus on batteries. Or, alternatively, during this forum the convenors could have identified and invited additional participants who held different views on energy storage and its roles in future electricity grids. In these ways, the epistemic outcomes of a forum could be enhanced by adopting an approach that reflects John Stuart Mill's arguments about the importance of disagreement and diverse viewpoints: "Since the general or prevailing opinion on any subject is rarely or never the whole truth, it is only by the collision of adverse opinions that the remainder of the truth has any chance of being supplied" (Mill 1975).

Mill's claims about the epistemological importance of "the collision of adverse opinions" points to the potential functions of debate and dialogue during futures forum processes. Whilst the futures forum processes contained open debate amongst participants with different views and interests, CSIRO staff steered these processes away from matters of deep disagreement. A stronger focus on enabling the collision of adverse opinions and exploration of contentious issues could have enabled what Allenby and Sarewitz (2011, p. 174) term "productive conflict", a process which is similarly driven by "contests: of ideas, of peoples, of interest groups". They point to a balancing act which process convenors could keep in mind, arguing that "humans are most adaptive, and most creative, in periods of bounded conflict — that is, when there isn't too much conflict (which brings chaos and destruction) or too little (which results in social stasis and a slow slide to irrelevance)".

On this point, the project leader from CSIRO received some related participant feedback:

"When a controversial idea comes up and we have these arguments and debates, sometimes a really robust debate, in a plenary session at the end of the session what people will often say is 'hey, we had a really good conversation there' and get quite

excited, animated and quite happy, even though it may have been uncomfortable. In the moment sometimes it's actually quite uncomfortable. But what they'll sort of say is 'now we're really talking'" (P. Graham, 2014, personal communication, 6 June.)

The above functions could – if effort is made to enable or enhance them – enable PKPs to be what Falk (2012, p. 47) terms “reflexive technologies”. That is, practices which “extend institutional or individual capacities for reflexivity” (Falk 2012, p. 47), where reflexivity is understood to refer to attributes of human consciousness and culture “which transmits and transforms the pattern of human memories, traditions, aspirations and practices” (Camilleri & Falk 2009, p. 34).¹¹⁰ For example, dialogue during forum processes could promote such self-conscious reflection on conventions, traditions and aspirations. Additionally, Camilleri and Falk (2009) argue that the contemporary capacity to build complex computer models that help to anticipate the consequences of human action is a technology which has the potential to promote greater reflexivity, including the expanded “temporal and spatial frame of reference” (p.537). However, as shown by the focal case in this thesis, this depends on the modelling process and how such studies are interpreted and used.

Contextual issues that influence the feasibility of these possible functions were explored in previous chapters. For example, the case illustrates that institutional structures influence the choices made by convenors and facilitators and the extent to which taken-for-granted routines are reflected upon (Chapter 5). Nonetheless, the case highlights that process convenors, facilitators and participants make consequential choices. It is possible that the futures forums could have had greater (or less) impact if different choices had been made. Related key implications are discussed in *Section 9.5* and the conclusion chapter.

9.3.5 A preliminary pragmatist interpretation of the functions of prospective knowledge practices

As was foreshadowed in the introduction to this chapter, the observations and considerations discussed in the chapter may be deepened by considering a sociological action theory

¹¹⁰ Similar to this definition, others make a useful distinction between “social reflexivity” and “technical reflexivity” (Sankowska & Söderlund 2015), and argued that social reflexivity “includes reflection upon social processes, values, assumptions, norms, identities and roles” (p.982). Sankowska and Soderlund (2015, p. 982) further argue that social reflexivity is “about social values, games of power and the assumptions that frame and reframe practical problems”.

informed by classical pragmatism (Gross 2009, 2010) and developed by the ‘new pragmatists’ (see Little 2014). This section presents a *preliminary* pragmatist interpretation of the case study findings which is deepened in *Section 9.6* and the Chapter 10.

As Gross outlines (2010, p. 338), the pragmatist theory of action centrally posits that “human beings act in the service of solving practical problems they confront in the course of their daily lives” and, secondly, that responses to the problem situations they encounter (e.g. the perceived need to counter incorrect and/or prevailing expectations as outlined in the quotation presented on p.264) involve “mobilizing more or less habitual responses, in conjunction with the various resources at their disposal” (Gross 2010, p. 338).¹¹¹ Such habitual forms of action are anchored in unreflective beliefs (Joas 2001). Due to the “resistance of the world” (Joas 2001, p. 11958) action also “involves an alternation between habit and creativity” (Gross 2010, p. 352) which may result in new ways of acting.

This is a highly relevant perspective for interpreting the case and the case study findings. Forum participants and other actors (e.g. CSIRO staff) often confronted practical problems, such as the problem of securing management buy-in for a proposed strategy or a proposed research program, or the problem of securing policy-maker support for a desired policy change, etc. The forums were a resource, and also provided resources, that actors could mobilise for such problem-solving efforts. Alternation between habits and creativity was seen in the behaviour of participants, the choices made by the process convenors and facilitators, and the ways the outputs were interpreted and used. In all the futures forums habits shaped the actions of CSIRO staff (along with some improvisation), and such habits were “more or less ingrained ways of solving problems” (Gross 2010, p. 348), such as learned conflict management strategies (see the arguments in Chapter 6).

Pragmatist action theories also seek to move sharply away from simplistic notions of rationality, consistent with recent psychological research on cognition (Gross 2010; Little 2014), reasoning (Mercier & Sperber 2011, as discussed in Chapter 7) and related issues raised in Chapter 8. As Gross has argued, the influence of cognitive-affective habits emphasised by pragmatist philosophers is consistent with more recent insights into “the automaticity of cognition” (Gross 2010, p. 338) and studies of the influence of heuristics and biases. Chapter 7

¹¹¹ Gross (2010, p. 343) uses this action theory to construct a causal mechanism formula which he terms “A-P-H-R chains” which stands for “actor, problem situation, habit, and response”.

detailed the need to consider such cognitive habits and aspects, some of which were linked to “practical problems that arise in the course of life” (Gross 2009, p. 366) and the situational factors that managers and other actors had deal with and interpret.

Additionally, ‘pragmatism’ can also be interpreted as prescribing a grounded focus on practical ends. This suggests that the utility of PKPs will be judged in terms of whether they help to guide effective present (or future) action related to these practical ends (see Baumeister, Vohs & Oettingen 2016). Similar arguments about forward-looking inquiry have been made by Voros (2007) and Wilkinson et al (2013). Voros (2007, p. 74) argues that “futures research [his term for PKPs] cannot be regarded as simply a pure conceptual academic exercise, disconnected from practical action”. Similarly, Wilkinson et al (2013, p. 702) assertion that “scenarios are pragmatic rather than positivistic” is consistent with this perspective. It implies that the main goal is to help actors to interpret the situations they face and thereby assist effective action in the present (see Ramirez & Wilkinson 2016), not accurate prediction.

Much of the case evidence was consistent with this pragmatist perspective. To briefly recap three key lines of evidence: (i) forum participants and other actors frequently faced problem/action situations they hoped to address via the forums; (ii) critical participants (in the ‘didn’t work’ category) often argued that the process and/or the outputs had limited utility for the activities and practical ends they were focussed on (e.g. framing public policy recommendations, securing research funding, assessing the adequacy of regulatory frameworks, etc.); (iii) those who made positive remarks about the value of a forum (e.g. those in the ‘worked’ category) often emphasised the perceived pragmatic utility of the process and/or the outputs. Previous chapters highlighted the importance of related contextual factors and institutional structures. Contextual factors influenced whether a futures forum was relevant to the specific practical ends that an actor was focussed on; whether PKPs influenced other actors’ behaviour (which was a common participant objective); and whether actors’ goals were aligned with the intervention theories (e.g. whether forum participants were seeking to build coalitions or were seeking decision-making support, etc.).

A deeper pragmatist perspective, informed by both ‘classical’ and ‘new’ pragmatism, can also be considered. I return to this in the final section of this chapter, following consideration of the transferability and broader implications of the case study findings.

9.4 Functions of prospective knowledge practices in energy transitions, or functions in socio-technical transitions more generally?

A key question, concerning the *external* validity of the research findings, is whether the insights are likely to be specific to contemporary energy transitions related to mitigating climate change. Below I briefly consider the case for specificity and the case for transferability.

Some transition scholars have argued that the energy domain has unique characteristics which place a greater requirement on actors to do strategic “socio-political work” and limit generalisability (Raven et al. 2016). Specifically, Raven et al (2016, p. 178) contend that “changing energy systems inherently requires substantial infrastructural, institutional and policy reforms, which makes it a case-in-point for studying socio-political work of technology advocates, but essentially limits its generalisability to empirical fields with substantially different features”. Gaede and Meadowcroft (2016), who also studied the energy domain, argue that “most actors realize that politics ‘mediate’ the production and discussion of the futures” (p.623) such as those presented in energy futures reports like the International Energy Agency’s *World Energy Outlook* reports. Additionally, analysis by other scholars examining “regime resistance” by fossil fuel incumbents (e.g. Geels 2014) suggests that issues related to actor power and interests may be particularly pronounced for prospective low-carbon energy transitions. In sum, low-carbon energy transitions may have four somewhat unique dimensions: more actors with a political orientation (e.g. those seeking to achieve policy change to support new technologies); the importance of institutions and institutional change; the ‘politics’ (broadly defined) of images of the future; and greater incumbent power. These dimensions are also prominent in the case examined in the present study.

On the other hand, sustainability-oriented transition scholars have made arguments which suggest transferability, such as regarding the “expectations work” which has been found to be a common in transitions (see Farla et al. 2012), the politics of sustainability transitions (Avelino et al. 2016), and the need to reconceptualise the social roles of actors during transitions (Wittmayer et al. 2017). The consistency of these arguments with the case suggests greater external validity.

Some of the above aspects and arguments need further examination. The first key aspect that needs to be recognised is the politics of energy. Given the strong focus of politicians and the

public on energy costs (both electricity and fuel prices) and energy security, along with the roles of government policy in historical and prospective energy transitions (Jasanoff & Kim 2009, 2013; Raven et al. 2016), the claim that energy transitions are more political may be correct. Furthermore, to the extent that societal choices about energy transitions and how they are advanced are primarily political *choices* – that is, decisions that don't have technically determinable 'right' answers and are strongly shaped by actors' interests and/or political beliefs in a particular socio-political context – it logically follows that a main function of PKPs will often be to justify or rationalise actor preferences. This view of PKPs is consistent with many of the case study findings (see *Section 9.3*), such as the common use of PKPs to rationalise their past decisions and/or their beliefs, and/or to help justify proposed actions and related convictions. Similarly, some of the case study findings on PKPs as political practices (see Chapter 6) may be, in part, specific to energy transitions.

However, the broad conceptualisation of politics that was used in Chapter 6 is likely to be transferable. For example, the use and functions of PKPs beyond this context are also likely to be shaped by unequal actor power and issues related to the need to control or reconcile diverse interests and preferences, particularly if a participatory approach is used. This argument is consistent with the findings of management scientists on the use of strategy tools and the politics of strategy-making in organisations (Jarzabkowski & Kaplan 2015).

A second key consideration is that many earlier studies identified the strategic expectations work done by actors in the energy and transport sectors (see Farla et al. 2012), similar to the present study. It may be the case that the identified functions of PKPs for the management of expectations are somewhat specific to these sectors either in form or importance, for example related to long time horizons relevant to energy infrastructure asset life-cycles and investment. The counterargument to this is that other scholars have found that expectations, and influencing others' expectations, are of more general importance to agenda moving (Bacharach 2016), agency in capitalist economies (Beckert 2013a, 2016), and any sector or domain in which new and emerging technologies are prominent (Borup et al. 2006; van Lente 2012; van Lente & Rip 1998). This supports external validity claims.

Similarly, it is reasonable to conclude that the finding that the key functions of PKPs for actors are pragmatic is generalisable to diverse transition processes. For instance, some of the practical exigencies highlighted by the case are common needs (e.g. convincing colleagues of

the merits of a position or proposed action, defending a decision, assessing what actions may be required to achieve an outcome). This conclusion is also grounded in the pragmatist action theory which was originally formulated in anthropological terms based of diverse observations of human behaviour and the functions of cognition in action (Gross 2009).

A final set of considerations address identified potential functions of PKPs in socio-technical transitions. Some of these findings are consistent with recent findings reported by transition scholars. In particular, Wittmayer et al (2017) proposed that “fundamental changes in the roles of actors and in their relations with others are a vital element of any transition”, and argued that the concept of social roles (of actors) is a central concept for understanding transitions. Whilst claims of identifying social ‘laws’ of transition processes should be viewed sceptically (see the claim of being “vital” to “any transition”), if major changes to actor roles are commonly an important part of transitions then enabling reflection on roles may be a widely transferrable function. Additionally, other transition scholars have asserted that an underlying challenge for actors during socio-technical transitions (broadly, not only energy transitions) is navigating uncertainty (Geels, Elzen & Green 2004). Logically, actors cannot consciously navigate uncertainties they’re not aware of, so if PKPs function as an antidote to excessive certitude (see *Section 9.3.2* above) then they can help actors to address this general challenge. These findings suggest that if practitioners can better target these potential functions they can further aid actors during transition processes.

Overall, there is a strong case for broad transferability (i.e. to other sustainability-related socio-technical transitions), with some specificity with respect to the politics of energy.

9.5 Broader implications of the case study for theory and practice

9.5.1 Implications for theorising socio-technical transitions

The case findings can also be related to current debates and theory-building efforts in sustainability transition studies, building on the earlier discussion. A few brief points are made on this below, before moving on to the implications for practitioners and theorisation of PKPs.

A number of transition scholars have called for more actor-oriented and agency-sensitive theories of sustainability-oriented transitions (Farla et al. 2012). Some of these scholars have

also begun to conceptualise related strategies such as that are used to enhance the legitimacy of low-carbon technologies such as ‘socio-political work’, e.g. constructing future-oriented “socio-political narratives” (Raven et al. 2016), and ‘expectations work’. The present study suggests that a stronger understanding of PKPs and related action theories can enhance these theory-building efforts. For example, we can better understand when and why relevant actors do expectations work, the use and role of PKPs as part of this ‘work’, and its consequences for sustainability-related transition processes.

However, it is important to also note the case study findings on the ways PKPs are socially conditioned and constrained (see Chapter 5) and the ways actors respond to problem situations in more or less habitual ways (see the pragmatist theory of action). This implies a need to also consider meso-level causal structures and broader factors, which would be consistent with other theoretical perspectives on socio-technical transitions such as the Multi-Level Perspective (Geels 2002, 2011). The “practice” perspective, however, also challenges a rigid conceptualisation of multiple levels of reality evident in such transition theories (Camic, Gross & Lamont 2011b). The way theorists of knowledge practices put this point is to argue that “practices ... generally enfold and meld together factors that nonpractice scholars have tended to assign to very different levels of the social world” (Camic, Gross & Lamont 2011b, p. 7), such as the main levels of “niches”, “regimes” and the “socio-technical landscape” that are posited in the Multi-Level Perspective. The examination of knowledge practices presented in this study is consistent with this in the sense that within a focal PKP we see the influence of factors typically assigned to multiple “levels” of reality.

The case also provides empirical support for emerging transition theories. In particular it supports those emphasising actor roles (Wittmayer et al. 2017) and agency processes (Farla et al. 2012).

9.5.2 Implications for practitioners and related theorisation and use of prospective knowledge practices

With respect to practitioners such as CSIRO staff three key implications concern: (i) convening and facilitation approaches, especially with respect to their consequences for the contribution of such exercises to transitions; (ii) the need to reflect on how practices are institutionally structured; and (iii) the construction of intervention theories. Each is addressed below.

Implications for convening and facilitation approaches have been alluded to earlier in this chapter and in previous chapters. To avoid repetition the details won't be repeated, but a core theme – in the words of the project leader from CSIRO – was the “reticence to impose something” on a futures forum process (e.g. ‘imposing’ their views about what scenarios or options are plausible), which the project leader argued is “key ... to the whole process” (P. Graham, 2015, personal communication, 27 November), and their related non-interventionist convening philosophy. The value of a stakeholder-led approach was considered in earlier chapters, such as with respect to ownership of the outputs. In contrast, this chapter has noted the importance of some of the more ‘interventionist’ moments during the forums (e.g. when CSIRO scientists challenged the assumptions of some participants and faced, but withstood, participant pushback) and speculated about other ways CSIRO staff could have been interventionist. This suggests that further reflection of the role of convenors, process facilitators and other CSIRO – as well as possible trade-offs – could help CSIRO staff and others to have greater impact with respect to transitions.

Transition researchers who conduct participatory modelling exercises with the aim of contributing to socio-technical transitions (see Holtz et al. 2015) can learn related lessons from the case. Chapter 3 detailed the many similarities between the ideas and assumptions of transition modellers and the intervention theories that were constructed. Consequently, many the case insights will be relevant to transition modellers who use participatory approaches and methods.

Related to the above implications, previous chapters detailed the institutional structuring of PKPs. This points to a second key implication: the need to practitioners to consider how their approach is institutionally structured, the consequences of this, and whether adjustments are warranted. This is not an easy task, given it demands a very high degree of reflexivity (Sankowska & Söderlund 2015). Similarly, transition researchers from the Dutch Research Institute for Transitions (DRIFT) recently argued that researchers involved in transition processes need “to question, be reflexive and to challenge our own roles as ‘transition researchers’ in the ‘transitions in the making’ that we are engaging in” (Wittmayer et al. 2017). Whilst the interviewed CSIRO staff didn't specifically define themselves as ‘transition researchers’ they were, nonetheless, engaged in potential transitions in-the-making and needed to consider their role or position vis-à-vis this. The perceived imperative to remain

neutral shaped their approach and all aspects of the forums (e.g. focussing forum processes and reports on *alternative* future options rather than being prescriptive, letting forum participants define the scenarios, etc.). This approach is also consistent with the common belief that scientists should stick to ‘science’ and leave policy (or ‘politics’) to others.¹¹²

Regarding the theorisation of PKP and intervention theories, consideration of the case from a pragmatist perspective (also see *Section 9.6* below) suggests that the most useful gains can be made by explicitly incorporating formal action and actor theories (Gross 2009, 2010; Little 2014). Such theories – which, for example, provide “an account of the ways the individual represents the world, the things that motivate him or her, and the ways that he or she arrives at actions or plan based on these features of practical cognition” (Little 2014, p. 55) – critique, and provide alternatives to, assumptions that are commonly made about “rational, purposive agent[s]” (Little 2014, p. 65). Related sociological scholarship informed by pragmatism suggests that the production, assessment and use of anticipatory knowledge is unlikely to ever fully meet rationalistic ideals such as what Little (2014, p. 57) terms the “Aristotelian ideal of means-end rationality”. Consistent with this general sociological understanding, the case also supports rejecting overly-simple theories of the actors using PKPs. Practitioners may consequently need to alter their expectations and approaches.

Additionally, the argument that many core functions of PKPs are pragmatic has several implications for the construction of intervention theories. This perspective suggests that the main problems with the intervention theories identified in this study are related to insufficient attention to three aspects emphasised by a pragmatist perspective: (i) the practical ends actors were focussed on and the related problem/action situation that actors are confronting; (ii) the ways “action, as a response to problem situations, involves an alternation between habit and creativity” (Gross 2009, p. 366); and (iii) the finer details of actors’ present context (related to the previous two aspects), which would help to avoid too general and too generic mechanisms. The first aspect is also supported by the additional intervention theories discussed in Chapter 8, many of which specify practical ends that were of interest to participants. Related to this point, many pragmatists have argued that the ideal for inquiry and knowledge is that it is

¹¹² Related to this point, it’s important to note that the public forum reports were published by CSIRO (with participant details and their logos included in the reports) – so they were a report published by Australia’s peak research agency – and needed to conform to their standards. Sociologists have noted a related norm of “post-political” climate change research (Dunlap & Brulle 2015).

“adequate to the needs of practice” (Rescher 2013, p. 2), and scenario planning practitioner-scholars have recently called for the reconceptualisation of such practices as *purposeful* practices providing a ‘learner-centric’ means to specified ends which should be ascertained *before* the process (Ramirez & Wilkinson 2016). The second aspect suggests a need to consider to what extent habituality is a barrier to intended or desired outcomes.

Finally, it important to note that a pragmatist perspective on PKPs also suggests that epistemic outcomes (e.g. reliable anticipatory knowledge) are only of importance if they contribute to other pragmatic benefits such as guiding effective action. This perspective also helps to explain issues that are commonly faced by scientists when conducting forward-looking studies. Scientists often focus on epistemic aspects – such as the quality and novelty of the knowledge creation outcomes – whereas other actors involved in prospective exercises often have more pragmatic orientations for which these epistemic considerations are of lesser or secondary importance. Similar arguments were made by Baumeister et al (2016, p. 4) regarding what knowledge is pragmatic, and Stehr and Grundmann (2012) regarding the concept of “practical knowledge”. Knowledge can be understood as practical if it is *actionable* but this aspect of knowledge is also contextual (Stehr & Grundmann 2012). Similarly, knowledge can be judged as “pragmatic” if “it is useful for helping the person to act or not to act in the present or to decide how to respond in the future” (Baumeister, Vohs & Oettingen 2016, p. 4).¹¹³

9.6 A deeper pragmatist synthesis?

This chapter began by reconsidering the focal case with respect to the main, less common and potentially impactful functions of PKPs and the related functions of PKPs in socio-technical transition process contexts. This differed from the intervention theory analysis presented in the previous chapter in that I sought to explore and discuss the potential for more transferable claims based on the focal case, though several insights are relevant to the intervention theories.

The interpretation of the case findings explored later in this chapter implies that many of the identified functions of PKPs will only be perceived to have utility if they contribute to other

¹¹³ Related to this, Stehr and Grundman’s (2012, p. 32) definition of knowledge is consistent with pragmatist philosophy: “we suggest defining knowledge as the capacity to act (or capability of taking action), as the possibility of “setting something in motion”.”

pragmatic functions (e.g. influencing or enabling effective action). Furthermore, consistent with the claim that pragmatic functions may therefore be the *ultimate* functions of PKPs – in which action-guiding and practical aims are the core focus (related to the practical ends of interest to involved actors) – many participants made pragmatic judgements about the benefits of futures forums. Beyond these initial high-level understandings – which could be summarised as “pragmatic utility” or a “pragmatic prospection” theory (these are the terms used by Baumeister, Vohs & Oettingen 2016) – a deeper pragmatist synthesis is implied by the theories and perspectives considered in this chapter.

The preceding discussion suggests that such a pragmatist synthesis of the case themes and implications (regarding the functions and theorisation of PKPs, and the practitioner implications of these case findings) can be formulated in relation to at least four core aspects: (i) the pragmatist theory of actors, including the cognitive dimensions (e.g. aspects that emphasise the automaticity of cognition, unreflective aspects of most beliefs, etc.); (ii) the pragmatist action theory; (iii) pragmatist epistemology; (iv) and pragmatist theories of social mechanisms (both individual and collective mechanisms). Each aspect is briefly expanded on below, summarising the relevant aspect of pragmatist theory and related claims, their relevance, and the overall contribution of such a perspective.

Pragmatist theory of actors: as is implied by the discussion in this chapter, pragmatists articulated a view of human nature, the related core functions of human thought (Gross 2009), and a view of human beings as *actors*. Particularly important are their claims about:

- (i) The centrality of “the employment of semiotic and cognitive habits” (Gross 2010, p. 339);
- (ii) Humans being inhabiting “worlds of meaning” (Gross 2009, p. 369) which shapes the ways that problem situations are interpreted and responded to; and
- (iii) That thought is geared towards guiding action primarily “in the service of solving practical problems” (Gross 2009, p. 366).

Such accounts of human actors and thought “anticipated remarkably well psychological work on the twenty-first-century research front, where cognitive scientists emphasize the automaticity of cognition” (Gross 2010, p. 338, also see Chapter 7). Related to these claims, pragmatists also argue that it’s human nature to establish and unreflectively repeat culturally-mediated habits of action (also see the pragmatist theory of action below) and to interpret

problem situations “through cultural lenses” (Gross 2009, p. 367). This understanding of human actors helps to explain forum process observations and responses to forum outcomes (for example see Chapter 5). Additionally, there was evidence that consideration of forum findings and outputs was constrained by existing beliefs and related cognitive processes (see Chapter 7). The case demonstrates that the characteristics of human actors influence the functions and effects of PKPs (e.g. those claimed by pragmatists).

Pragmatism-informed action theories: action theories which presuppose autonomous actors who are purposefully calculating the means to fixed ends have been critiqued by sociologists who draw on the classical pragmatist tradition (see Gross 2009; Joas & Beckert 2001; Little 2014). More sophisticated action theories are relevant to understanding what actors are doing, and why, when they use PKPs and, related to this, their behaviour when convening or participating in such exercises. To briefly recap, the pragmatist theory of human action proposes that “actors confront problematic situations with cognitive and corporeal habits acquired through individual and social experience (along with resources), engaging in innovative behavior when existing habits prove inadequate” (Gross 2010, p. 342). These habits are learned “ways of doing things” enacted with some degree of creativity or flexibility in the situation (Gross 2010, p. 344). Additionally, pragmatists emphasise “emergent situational dynamics” which “point actors toward new and unexpected goals” (Gross 2010, p. 342). In these ways, situations are also *constitutive* of action (Joas & Beckert 2001). This perspective on human action further illuminates behaviour during the forums, the approach of the convenors (CSIRO staff), as well as the behaviour of other actors. A pragmatist action theory is also consistent with argument that impactful use of PKPs will frequently require targeted *interventions* (e.g. to challenge participants’ learned habits). This, in turns, reinforces the need for practitioner reflexivity regarding their habits and their consequences.

Pragmatist epistemology: The case also clearly showed that futures forum participants and other actors were not practically disengaged from many of the things that were discussed and explored during the forums (see Chapter 6). For example, actors often had position they wanted to defend or advance, interests to consider, etc., all of which influenced each futures forum and the outputs in more or less subtle ways. Pragmatism’s critique of the “spectator theory of knowledge” – which is a major theme in pragmatist epistemology and argues inquirers are *agents* (McDermid n.d.; Rescher 2013) – is consistent with these aspects of the case and further illuminates them. For example, the related pragmatist critique of claims of

“passive impartiality” (see McDermid n.d.) can be mobilised to highlight the influence of convenors and facilitators have even when they try to remain neutral or adopt a “hands-off” approach/philosophy. The case clearly shows that process convenors have an impact even when they try to avoid them, and they too can have interests at stake. In sum, these arguments usefully call attention to the importance of considering the ways that the outputs from a futures forum (or a similar forward-looking processes/activity) are shaped by those who are involved and the differing agency and power of involved actors (Chapter 6).

Other relevant aspects of pragmatist epistemology concern their claims about knowledge and truth, such as their fallibilistic position. Pragmatists argue “we must make do with *plausible information* ... adequate to the needs of practice” (Rescher 2013, p. 2, emphasis in original). That, is pragmatists critique the quest for certainty. Many pragmatist philosophers also argue that “knowledge is not the reproduction of reality but an instrument for dealing with it successfully” (Joas 2001, p. 11959). In these ways, such an epistemological position conveys important aspects of the knowledge actors seek via PKPs, its limits, and the roles played by such knowledge and related prospective thought, though classical pragmatism’s roots in empiricist views of knowledge (Godfrey-Smith 2001) is poorly aligned with some aspects of PKPs. The emphasised links between thought, knowledge and action can also be read as a key focus for both examining the use of PKPs and enhancing them.

Pragmatist theories of social mechanisms: previous chapters noted the limitations of the focus on the reasoning of individual actors in realist evaluation (e.g. as per Pawson 2013), both in terms of the core focus on *conscious* reasoning processes and individual-level mechanisms. Consideration of a pragmatist theory of mechanisms both reemphasises and addresses these limitations (Gross 2009). Firstly, as Gross’s concept of individual cognitive-affective habits emphasises, mechanisms can be unconscious and result from “psychosocial experience or their biological endowments or propensities” such as the tendency to “employ ... [particular] cognitive schema” (Gross 2009, p. 370). The reasoning processes theorised by Mercier and Sperber (2011), which emphasises evolutionary perspectives, are biological propensities as per evolved human capabilities (see Chapter 7). Secondly, habits can be both individually and collectively enacted (Gross 2009). Gross’s observations about collective actors such as organisations is consistent with much of the analysis presented in Chapter 5, along with the routines and rule-sets theorised by transition scholars (e.g. Geels 2002):

Social mechanisms that affect collective actors (e.g., firms, states, or organizations) can be analysed in the same way. Collective actors also face problem situations and respond in habit-bound, culturally mediated ways, and social mechanisms involving collective actors consist of chains or aggregations of such responses, whether or not there is explanatory value in further decomposing them into individual-level action (Gross 2009, p. 369).

Sociologists mobilising pragmatist ideas about human action also use these ideas to develop more macrosocial perspectives (Beckert 2016; Joas 2001; Joas & Beckert 2001). These theories and perspectives are relevant to theories of PKPs and transition processes.

These four aspects, considered together, provide a theoretically-grounded basis for considering PKPs and synthesising and deepening many of the case study themes and insights. A deeper pragmatist perspective can enable a more integrated explanation of the focal case (whilst allowing for theoretical pluralism, as per the diverse sociological, psychological, and science studies perspectives drawn on in this thesis) and, secondly, it can inform the development of better theories of PKPs and improved intervention theories. Some of the main implications of such a pragmatist perspective and synthesis have been briefly noted in the current chapter. These will be greatly expanded upon in the concluding chapter, along with the other main evaluative insights and case study conclusions.

CHAPTER 10: CONCLUSION

10.1 Introduction

10.1.1 Introductory outline of chapter and core theses

The evaluative case study presented in this thesis had two central analytical tasks: (i) to examine the focal object, i.e. prospective knowledge practices (PKPs), within the context of sustainability-related change processes and potential transitions; and (ii) to contribute to enhanced theoretical and empirical knowledge of PKPs by developing an explanatory analysis of a focal case in which these practices were used. By conducting such analysis, I also sought to elicit and contribute to utility-focused theories and related understandings of forward-looking inquiry (Pirainen & Gonzalez 2015). This analysis addressed a three-part overarching question: How and why are PKPs used in sustainability-related socio-technical transition contexts, with what effects, and how could their use and theorisation be enhanced?

To briefly recap, two related research lenses guided this inquiry: the realist evaluation lens, which concentrated on intervention theories and examined related functions claimed by practitioners from CSIRO, and the knowledge practices lens. The knowledge practices lens usefully complemented the intervention theory-focused analysis in three ways. The emphasis placed by practice studies on “on-the-ground work” (Camic, Gross & Lamont 2011b, pp. 6-7) and day-to-day actions suggested paying further attention to the social processes that played out *during* each forum and that can influence the way that forum outputs such as modelling results are interpreted and used. This lens also emphasised the ways that the futures forums involved complex *work*, such as work done to secure participation, to protect (or demonstrate) scientific credibility, and to manage conflict. Second, a practice lens suggested examining the ways that PKPs involve routinised modes of action (habits in the terminology of the pragmatism) and nonregularised action. Finally, a practice lens suggested paying attention to the ways that PKPs and their effects are socially patterned (see Chapter 5). Social knowledge practice theorists were inspired by studies of the natural sciences which concluded that “the knowledge-making practices of natural scientists are thoroughly configured by the social worlds that they inhabit” (Camic, Gross & Lamont 2011b, p. 10).

The findings and discussion presented in previous chapters suggest a central thesis and related

core claims and arguments. Specifically: the use of PKPs and their influence on transition processes is strongly mediated by prevailing social conditions (e.g. institutional settings, concurrent discursive processes, etc.), inherent and/or emergent politics, and cognitive mechanisms and related traits (or psychological ‘drives’), and these factors had the net effect of *constraining* the impact of the futures forums and the roles they played in transition processes.¹¹⁴ The case demonstrates the influence of such factors on assessments of the outputs (e.g. actors’ judgements of the credibility and salience of forum findings) and the complexities of mobilising PKPs in transition contexts. Similarly, the politics of the situation influences these exercises and use of the outputs, raising dilemmas for practitioners from scientific organisations (also see the institutional structuring of PKPs).

Whilst the focal case provides evidence that PKPs are valuable for actors in transition contexts (e.g. for those actors who could leverage the process or its outputs to address a situation), there is little evidence that the futures forums had a significant material impact on energy transitions in Australia.¹¹⁵ Process and intervention theory lessons may be able to be drawn from this (also see the concluding statements later in this chapter).

Related arguments are supported by the case evidence and analysis presented in earlier chapters:

- 1) Intervention theory deficiencies impair practice and partly explain the limited and variable outcomes (see Chapters 3 and 4), e.g. due to insufficient consideration of how “looking forward is ... socially conditioned” (Ramirez & Wilkinson 2016, p. 23);
- 2) Enhanced intervention and utility theories can be grounded in theories of mechanisms, human action and actors and related supporting philosophical foundations. (On the philosophical dimensions see the pragmatist prescriptions

¹¹⁴ Clearly such a summary statement obscures a lot of nuance and complexity. One example will illustrate this point: these factors appear to have contributed to more extreme scenarios being considered by the Future Fuels Forum (e.g. where enormous increases in the price of transport fuel emerged over the medium-term future) which, on the one hand, contributed to impact by generating significant media attention but this also constrained impact by leading some important actors to question the credibility of the forum report and findings. Regarding the latter, a government informant stated that this led senior governmental actors to view the report more dismissively.

¹¹⁵ The strongest evidence is probably the continuing attempts of the Australasian airlines and other aviation sector actors (e.g. Boeing) to encourage a shift towards low-carbon jet-fuels which may eventually bear fruit. However, at the time of writing, material change towards the commercial production and use of such fuels has been limited. Additionally, as noted in an earlier chapter, the Future Grid Forum contributed to major follow-up projects such as the Network Transformation Roadmap study which may in-time have a larger impact on energy transitions.

presented later in this chapter in *Section 10.2.2*);

- 3) These theories, and the use of PKPs (such as prospective exercises), must address the social, political and reasoning dimensions of such practices, particularly with respect to their impact and factors influencing how they translate into action;
- 4) Practitioners face related choices and dilemmas with respect to these mediating factors and associated mechanisms. Their choices and ‘interventions’ are shaped by prevailing routines and their philosophical positions;
- 5) Related to the above arguments a prospective exercise (e.g. the futures forums) can also be described as an institutionally structured interpretive process which is frequently conflictual – particularly in transition contexts – given the influence of institutions and the conflicts which often emerge (see Chapters 5 and 6). The case evidence of the influence of institutions on process design, convening approaches and intervention theories supports this argument; and
- 6) To the extent that future-oriented inquiry is primarily for *doing* (e.g. justifying our actions and/or beliefs and convincing others of their merits, etc.), as suggested by much of the case, a social-functional perspective on PKPs is often more accurate and insightful than a truth-oriented perspective (which assumes that the core goal is gaining knowledge *of* the future).¹¹⁶ This helps to explain inherent and emergent politics. Utility theories must consider such functions.

This concluding chapter will further elaborate the above central theses and associated arguments by summing up what has (and hasn’t) been learned. In doing so, it draws out what can be learned from the focal case whilst being aware of, and acknowledging, the limitations of such studies. Such case studies cannot inform detailed universal prescriptions, nor the universal truths often sought by scholarly research. For instance, as demonstrated by earlier chapters, much depends on context and, as part of this, the goals and characteristics of involved actors. To give one example related to the intervention theories that were examined, if the use of PKPs seeks to stimulate critical reflection on actors’ assumptions and beliefs (**M3**) then much depends on how strongly-held those beliefs and assumptions are and participants’ open-mindedness. Furthermore, it makes little sense to argue that there is a “correct” and “incorrect” way of doing prospective exercises or other uses of PKPs.

¹¹⁶ On this point see William James’ pragmatist dictum that “thinking is for doing” (James 1890).

Still, important lessons may be learned from the case regarding the convening, design and facilitation of prospective exercises such as from the perspective of considering their use to understand or influence transitions and associated intervention theory learnings. Such arguments are inevitably both somewhat conjectural and subjective, and depend on answers to other key questions such as ‘what is a prospective exercise for?’. Depending on the goals, different intervention theories and approaches will be more or less valid.

In addressing the third part of the overarching research question, this concluding chapter argues for adopting a pragmatist approach to the use of PKPs (also see Chapter 9). These high-level prescriptions (which are not recipes) also address factors which the case study suggests constrained the impact of the futures forums on transitions (given the limited impact of the CSIRO futures forums). Before outlining these prescriptions and answers to the four guiding case analysis questions, this chapter first recaps what motivated the study. These motivating needs will also be addressed later in the chapter by statements on the contributions of the study and recommendations for future research.

10.1.2 Recap of the need for this study

The introductory chapter surveyed relevant trends and claims in a range of literatures which pointed to the need for this study. Identified motivating needs centred on theory gaps and practice challenges with respect to PKPs, transitions research, and related societal challenges (e.g. the problem of energy transitions to mitigate climate change).

The first set of needs are focussed on the theoretical foundation of PKPs such as prospective exercises. The introductory chapter noted related issues and claims. For example: the analysis of Science and Technology Studies (STS) scholars provides a cautionary perspective that highlights the limitations of studies considering the longer-term future of technology and its social consequences; and management scientists have identified cognitive barriers (e.g. Bradfield 2008) and strategy-making considerations (e.g. see Rumelt 2011), amongst many other issues which raise questions about the likely value of such studies. Scholars in other fields such as futures studies have highlighted theoretical deficits.

This is also a practitioner issue given that those designing and facilitating such exercises are guided by working assumptions (e.g. about the best ways to convene such exercises, about

what contributes to a successful outcome, etc.). Whilst there is a need to avoid simple ‘what works’ style conclusions partial knowledge can be gained (Pawson 2013).

Sustainability transition researchers have also identified some of the challenges noted above (e.g. Turnheim et al. 2015). Given the “prospective disposition” (Turnheim et al. 2015, p. 247) of much transition analysis, improved understanding of the utility and limitations of PKPs may enhance this research. Case studies can inform this, along with consideration of additional theoretical perspectives from other fields and disciplines.

Related to this need, anecdotal evidence suggests there has been a significant increase in forward-looking studies, particularly with respect to energy futures and climate change action. At present, there is a poor understanding of the effects of such analysis on sustainability-related transitions. Additionally, there has been limited consideration of whether transition contexts introduce special considerations for practitioners. This may hamper the ability of such research to contribute to action addressing these societal challenges.

Finally, compared with the extensive social scientific attention that has been placed on the natural sciences and methods used by such scientists, there have been far fewer studies of social knowledge making tools, ‘technologies’ and associated practices (Camic, Gross & Lamont 2011a). Therefore, the case study research can contribute to the emerging literature on social knowledge practices.

10.2 Answers to the case analysis questions and associated insights into the use of prospective exercises in socio-technical transition contexts

The following answers provide empirical case conclusions and outline associated evaluative insights and judgements. *Section 10.2.2* shifts to more conjectural claims and conclusions which address the third part of the overarching research question (i.e. how could the use and theorisation of PKPs be enhanced?).

10.2.1 Answers to the guiding case study research questions

10.2.1.1 Guiding question 1: *How and why were prospective knowledge practices mobilised in the focal case (e.g. by CSIRO staff working at the Flagship/Energy Division), and what outcomes resulted from these activities?*

The case included three central instances of a focal PKP (i.e. prospective exercises) as well as other PKPs where actors assessed or used the outputs from these exercises. The study was thus able to consider larger ‘interventions’ and other PKPs within a single case.

The case provides strong evidence that PKPs are mobilised in ways which are strongly institutionally structured. As per the knowledge practices research lens, routines and associated norms become institutionalised and shape PKPs. In the case, one important example of this was the ways that convenors and facilitators conduct and design prospective exercises. Over the past 10-15 years the futures forum process became increasingly routinised – though some improvisation and adaptation were also evident in some forums – and CSIRO staff developed a related convening philosophy which was believed to contribute to desired outcomes. The case study found that these routines often had unintended consequences, such as hampering the realisation of such outcomes (e.g. where the non-prescriptive approach was perceived to limit the policy relevance of the forums and lessen their decision-support). Moreover, the case suggests that there is a need to more carefully check the contextual suitability of such routines. A second key example is the way institutions shape actors’ thinking during such exercises and their use (or assessment) of the outputs.

Such institutional structuring can be both a constraint and enabler. As already noted, the case evidence revealed that the approach of CSIRO staff in the futures forums was constrained by existing institutions such as in relation to their self-described conservative approach, non-prescriptive approach, and intended neutrality. Aspects which become taken-for-granted can also be a major barrier to process innovation and improvisation (see Chapter 9). This structuring of the forum process itself and the behaviour and views of participants, as well as other actors, is an important part of the case explanation. On the other hand, such structuring can also be an enabler in the sense that institutions help to guide or legitimise action under uncertainty (Dequech 2003). The complexity of social reality can demand ways of reducing uncertainty in order to avoid paralysis (Beckert 2013b, 2016).

Further key aspects of the ‘how’ and ‘why’ centre on the social nature of PKPs and related ways that they are mobilised. For example, the case clearly conveys the ways that PKPs are

often mobilised in ways that actors hoped would *influence* others and provide support in the context of their interactions with other actors.¹¹⁷ This was one of the original motivations for running futures forums (J. Wright, 2014, personal communication, 9 June). Indeed, the Inaugural Director of the Flagship viewed the forums as a tool that could provide him with support and guidance, in the context of needing to manage internal constituencies, influence managerial decisions, and defend decisions about research priorities. In other words, PKPs were often viewed as what Fligstein terms “strategic action tools” (Fligstein & Vandebroek 2014), where such tools are strategically mobilised in more-or-less skilful ways “to induce cooperation in others” (Fligstein 2001, p. 112).¹¹⁸ The case demonstrates that PKPs are social in a second key sense: their use and mobilisation is subject to social forces, with social conditions and factors influencing participants and other actors. Whilst all human behaviour is subject to such forces (at least to some extent), as documented by social scientists, the case analysis of PKPs as social activities suggests that PKPs are especially strongly subject to social forces (also see related explanatory analysis in *Section 10.2.1.3* below).

The question of ‘why?’ is also related to actors’ specific circumstances and how these were interpreted. Important patterns were evident. Forum participants and other actors frequently sought to justify or advance their position(s) or convictions and these actors often mobilised PKPs for related purposes. This case evidence indicated that far fewer actors were seeking to critically examine their convictions or positions. A further pattern was that participation in the futures forums and exploration of possible futures was often motivated by actors’ present exigencies/needs (see Chapter 9 and a pragmatist perspective).

The outcome patterns identified in the case research indicate that the futures forums, overall, had a low-moderate societal impact, but they also suggest the outcomes were significant for some participants and other actors (e.g. some CSIRO staff). The Inaugural Flagship Director’s experience of being enabled to be a more effective ‘agenda mover’ (see Bacharach 2016) was an important example. This agenda moving resulted in greater internal funding for related research programs. Similarly, other CSIRO staff argued that the Future Grid Forum enhanced their standing and influence in the Australian electricity sector and cited stronger funding for

¹¹⁷ A formal way of putting this point is that PKPs were often mobilised primarily for instrumental reasons rather than epistemic reasons (e.g. seeking accurate or reliable knowledge).

¹¹⁸ On this point, elsewhere (with Riedy) I have sketched a view of scenario planning which further develops this observation by using social field theory (McGrail & Riedy 2015).

smart grid and distributed energy-related research along with associated electricity sector modelling work. However, the study also found that some participants reported little or no benefit. These mixed, and often limited, impacts make reaching *overarching* evaluative judgements inherently difficult, aside from judging the overall contribution to energy transitions (the available case evidence suggests this was limited).

Importantly for the intervention theory testing component of the study, many identified outcome patterns diverged significantly from those specified in the elicited theories. For example, there is little evidence that the futures forums helped to resolve major disputes or produced greater consensus. Some case evidence suggests that the futures forums *reinforced* disputes. A general important outcome pattern was varying levels of decision support for participants in different sectors, with many public sector participants arguing the forums provided little decision support (e.g. policy-making guidance). Process feedback articulated by some participants indicate causal links between the process design, convening approach and these outcome patterns. (See *Section 10.2.1.3* below regarding identified process effects with respect to socio-technical transition processes and related case findings)

Evaluative judgments are also complicated by context-dependent aspects of these outcomes – that is, the ‘for whom?’ and ‘in what circumstances?’ aspects of realist evaluation. Three general categories of contextual factors were identified (see Chapter 8): (i) the characteristics, goals, and competencies of individual participants and stakeholders; (ii) the characteristics and dynamics of the convened group (e.g. the level of viewpoint diversity); and (iii) factors related to broader social conditions prior to, during, or after a forum. Under certain circumstances the focal PKPs may have had greater impact, such as if they were used in a different institutional context, or if participants’ views tended to be more weakly held (e.g. this may have enabled greater critical reflection), or if the reasoning circumstances had differed (see Chapter 7). CSIRO staff often had limited control over such contextual factors. Other contextual factors regarding transitions are addressed in *Section 10.2.1.3* below.

10.2.1.2 Guiding question 2: *In this case, what social processes, and associated contextual and cognitive factors, influence the production, assessment and use of anticipatory knowledge? How do these compare to the intervention theories that guide CSIRO staff?*

Chapters 3-7 considered the intervention theories to-be-tested and formal theoretical

perspectives. The theoretical perspectives used in *Part 2b* presented strong evidence that a range of social and cognitive processes influenced the futures forums and related PKPs. These perspectives further suggested that, at a *minimum*, PKPs can be understood as social activities; as political practices; and as being strongly influenced by actors' reasoning capacities and associated situational contingencies. These perspectives can also enhance the theoretical underpinning of PKPs (see *Section 10.2.1.4* below).

Regarding how these understandings of PKPs compared to the elicited intervention theories, the case findings suggest that practitioner intervention theories need to better consider the mechanisms and associated factors specified by the formal theories. For example, given the many ways future-oriented inquiry is socially conditioned, intervention theories and practices could be enhanced by either explicating and working with such social processes or by incorporating sufficiently strong 'interventions' to influence such conditioning. For example, these social factors were clearly evidenced by "the forceful presence of expectations" in actor networks (van Lente 2012, p. 773). These findings on the influence of such social factors convey both the potential value of PKPs – e.g. if thinking is 'freed up' by enabling the participants to critically reflect on the expectations circulating in their networks – and they convey the challenges that are often faced when seeking to achieve such effects in-practice. Similarly, the argument that PKPs are institutionally structured conveys ways that exercises that look forward are socially conditioned. A second illustrative example is the need to more explicitly consider whether a social intervention works with or against cognitive mechanisms and tendencies, such as the tendency for reasoning to justify prior intuitions (Greene 2013; Haidt 2001, 2013) as was frequently identified in the case. The case demonstrated that such tendencies can both enable and constrain the impact of PKPs.

Two further set of implications can be inferred from the case research: (i) the formal theoretical perspectives point to alternative causal processes for some of the hypothesised mechanisms; and (ii) they indicated barriers to envisaged change processes that can prevent mechanisms from firing (i.e. potential countervailing processes).

Regarding the former, many examples were specified in *Part 2b* and Chapter 8. An important illustrative example pertains to uncertainty reduction (**M1**) and behaviour under uncertainty. There was strong case evidence that cognitive processes such as myside bias and motivated reasoning contributed to reduced uncertainty. Chapter 5 also considered the influence of

institutions (e.g. script following). Such findings are consistent with psychological studies which found that the brain constantly seeks to reduce uncertainty (Crisp 2015).

There was also evidence that such mental processes, and their consequences (e.g. biased evaluation of evidence, belief perseverance), militated against hypothesised mechanisms such as informal dispute resolution (**M6**), critical reflection on assumptions and beliefs (**M3**) and the creation of common understandings (**M4**). Such processes were countervailing processes.

Part 2b of the thesis and Chapter 8 further identified additional important cognitive and social factors which influenced deliberative and creative processes (during the forums) and how the outputs were interpreted and used. Two especially important cognitive aspects were dogmatism and, conversely, open-mindedness (i.e. how strongly-held participants' beliefs were and their readiness to change one's mind if confronted with a good arguments and/or good evidence);¹¹⁹ and further social factors were related to the ways the use of knowledge practices is *situated*. For example, Chapter 7 discussed reasoning done in anticipation of a situation (e.g. anticipating the need to defend one's opinions) and presented evidence for the influence of this on the assessment and use of anticipatory knowledge. Such cognitive and social factors need to be incorporated into intervention theories.

10.2.1.3 Guiding question 3: *What additional conclusions can be drawn from the case regarding the use and utility of prospective knowledge practices in the context of sustainability-related socio-technical transitions, including regarding what enables and constrains scientists as agents of change?*

This question was explored in-detail in Chapter 9 with respect to the dominant and potential functions of PKPs for which there is evidence and good theoretical reasons to consider. The case suggests that the focal prospective exercises tended to contribute to action by reinforcing, and/or helping to justify or rationalise, actors *existing* convictions and intuitive beliefs, unless, for example, strong efforts were made to intervene such as by a credible actor (e.g. by CSIRO scientists).¹²⁰ Related to this the futures forum processes and their outputs

¹¹⁹ As Floyd (2016) asserts strongly-held beliefs about energy transition pathways may be a particularly important aspect of contemporary transition contexts. On the other hand, this could just be an extension of cognitive limitations. Cognitive scientists Sloman and Fernbach (2017, p. 16) argue that "instead of appreciating complexity, people tend to affiliate with one or another social dogma".

¹²⁰ The example of CSIRO scientists challenging aviation sector actor expectations of algae-derived biofuels is an important example of this and related tensions which can emerge.

tended to be interpreted in ways that enabled actors to formulate and/or refine reasons for their prior beliefs. In some instances, the resulting action was transition-enabling and in others it was transition-hampering. Additionally, some case evidence indicates that such outcome patterns can reinforce existing disputes and conflicts.

Although external generalisability claims are conjectural, identified case patterns can be interpreted as being causally linked to transition contexts and related reasoning and actor-learning processes. Frequently actors were either grappling with decisional or problem situations characterised by significant uncertainty – which can be defined as a situations of fundamental uncertainty (Beckert 2013b) and irreducible uncertainty (Pielke 2007) – or they were oriented towards defending and promoting pre-existing position(s) and preference(s). Regarding the latter, actors were often seeking to convince others of the merits of a proposed policy or course of action and sought “ammunition” for use in debates (Weiss 1979). When actors are focussed on persuading others the case suggests that the core utility of PKPs will be their argumentative functions (not epistemic functions), as actors will be seeking to identify or produce convincing arguments (see Haidt 2013; Mercier & Sperber 2011).

Related explanatory conclusions follow from further consideration of the importance of socio-technical transition contexts to the use of PKPs and the social nature of PKPs (see *Section 10.2.1.1*). Two key aspects logically follow from common aspects of transitions; that is, from the fact that transitions typically feature significant novelty, have related emergent properties, and therefore are inherently uncertain (Geels, Elzen & Green 2004; Turnheim et al. 2015). Firstly, it follows that many claims and beliefs regarding a potential transition are *non-provable* ex-ante and therefore can only be described as being more-or-less credible (or more-or-less plausible) compared with other claims and beliefs.¹²¹ Such claims are at least partly fictional (see Beckert 2013b, 2016). If many claims and beliefs have these characteristics, then actors can be expected to be looking for ways to bolster or rationalise them given that they can't *prove* them empirically. We saw many examples of this in the case, where actors sought justifications and other support to enhance the credibility of their claims and arguments, along

¹²¹ Illustrative examples include claims about the future costs and benefits of a potential socio-technical transition, claims about impact of proposed government policies (which are often based on modelling exercises and associated assumptions which get built into a model), or claims about future technology costs and trajectories. Bacharach (2016) raises similar issues regarding claims made by agenda movers.

with related forms of learning.¹²² Secondly, as Beckert (2016) has shown regarding social influences on expectations, if a claim is non-provable ex-ante then actors' beliefs will be more strongly subject to social forces. The case provided evidence that the use of PKPs in transition contexts is strongly shaped by such social forces. In these additional ways, in the case we can see how aspects of the context influence both the utility of PKPs and their use.

A further conclusion that is suggested by case themes is that such an orientation (towards justification) can conflict with the reflexivity that a situation may demand. An illustrative example in the case was arguably evident in relation to transitions to low-carbon fuels, such as where actors sought to defend existing positions/views rather than explore alternative approaches to commercialisation and industry development. Practitioners working in transition contexts therefore need to be aware of the likely orientations of actors and consider how this could influence both the process and its outcomes. (On these conclusions, and the need it suggests for *influencing* culturally-mediated interpretations of the focal situation, see the pragmatist prescription outlined later in this chapter).

The focal case also conveys the socially-defined roles of researchers (employed by CSIRO), and related routines and organisational norms, and the ways these can both enable and constrain scientists as agents of change. An example of this in the case was the CSIRO norm of being policy relevant but not *prescriptive*. The project leader from CSIRO further argued that their associated focus on maintaining impartiality and neutrality was essential for their "convening power", i.e. their ability to organise and convene processes like the futures forums (P. Graham, 2016, personal communication, 6 September). However, the case also provides evidence that such routines and norms resulted in lower impact. For example, some actors sought greater policy guidance and others queried the epistemic validity of participant-led analysis in the forums. Similarly, the reticence of some CSIRO staff to "impose something" on a forum (P. Graham, 2015, personal communication, 23 November) – and their associated 'hands-off' convening philosophy/approach – may have resulted in reduced impact whilst at the same time contributing to participant ownership of the outputs.

¹²² Many examples were also consistent with findings in studies of strategy-making – one important context in which PKPs were used – which consider challenges related to an uncertain future. For example, one relevant study identified the "temporal work" done by actors in strategic management contexts to develop strategic accounts that are widely judged by managers (or executives) to be plausible, logically coherent and acceptable (Kaplan & Orlikowski 2013). These three criteria recognise that the correctness of any proposed strategy *cannot* be proven ex-ante.

These enabling and constraining factors point to further social factors influencing the production and use of anticipatory knowledge (also see *Section 10.2.1.2 above*). Similar to sociological perspectives on climate change-related research – which have critically analysed the tendency of studies to focus on politically ‘safe’ issues and emphasise consensus (e.g. see Dunlap & Brulle 2015) – the futures forum processes were convened in ways that sought to minimise conflict and CSIRO staff sought to focus discussions on potential areas of agreement (i.e. those topics and issues for which reaching consensus was judged to be plausible). Such choices may have constrained the ability of CSIRO staff to be change agents, consistent with post-political norms in climate change research (Brulle & Dunlap 2015).

10.2.1.4 Guiding question 4: *How can theory-driven evaluative research contribute to the empirical and theoretical underpinning of prospective knowledge practices that are used as interventions?*

This study demonstrates and points to several roles that can be played by theory-driven evaluation. Additionally, the novel combination of realist evaluation and knowledge practice lenses points to ways such research can inform and enhance the use of PKPs.

The empirical aspect of evaluative case study research is an important way that social scientific research can contribute to the evidence base regarding the use of PKPs as interventions. Many large claims have been made about the utility and effects of PKPs (for examples see Chapter 1), but too little research has examined these claims and their external validity (e.g. contextual factors which need to be further considered). There is also a need to better understand the likely consequences of different practitioner choices. The study demonstrates that theory-driven evaluation research is one way of conducting such analyses.

Realist evaluation is an explicitly theory-driven approach which aims to enhance the theoretical underpinning of social interventions. Such evaluation research can make four kinds of contributions (see *Table 27*) to enhance interventions (see McGrail 2014):

- 1) Testing and refining intervention theories;
- 2) Enabling learning (rather than demonstrating accountability);
- 3) Providing decision-support (e.g. informing intervention design and delivery); and
- 4) Mapping and informing consideration of complexity (e.g. contextual factors).

The approach adopted in the present study focussed initially on eliciting and assessing the validity of practitioner ‘folk’ conjectures (their theorising about intervention logics/outcome patterns) and then considered formal theories relevant to important aspects of the focal case (see role one above and below in *Table 27*). The study shows that such research has the potential to inform practitioner reflection and inform improved practice such as by being guided by more robust intervention theories. The study also produced new theoretically-informed statements about PKPs. Many of the resulting insights can provide decision support and may be transferable to other uses of prospective exercises and PKPs.

Table 27: Contributions of the theory-driven evaluative research

Potential role	Contribution of the study
Testing and refining transferable intervention theories	<ul style="list-style-type: none"> • The study elicited intervention theories, collected and analysed data relevant to empirically assessing them, and sketched refined theories • Identification of contextual factors which can aid and hinder realisation of outcomes (e.g. participant characteristics). These understandings can inform refined intervention theories. • Identification of formal theory (e.g. theories of social and cognitive mechanisms) that can enhance these theories. Such theory can be used to better consider social mechanisms • Literature review identified similar guiding ideas (e.g. in the transition research community) which supports transferability
Enabling learning	<ul style="list-style-type: none"> • The study can inform reflection on (i) the roles of futures forum-like exercises and other PKPs in transition contexts; (ii) how and why their roles/utility can differ from the functions reported in other contexts, and (iii) related practitioner assumptions • Insights into the factors and processes that influence the production, assessment and use of anticipatory knowledge can also inform new understandings of the impacts of prospective exercise (and other PKPs) – including where these differ from practitioners’ expectations and their guiding intervention theories • Evaluation research – such as the present study – can also shed greater light on the limitations of PKPs (and related challenges) and thereby inform cost-benefit assessments by practitioners • The study points to lines of enquiry regarding the ways that psychological and social processes can enable and constrain the use of PKPs and their impacts

Decision-support	<ul style="list-style-type: none"> • Case study findings are relevant to intervention design and implementation, e.g. case insights can be used to inform: <ul style="list-style-type: none"> ○ <i>Process convening choices</i>: e.g. decision-makings about the group/actors who are involved or invited to participate; ○ <i>Process design decisions</i>: e.g. allocation of time and resources to different tasks (e.g. modelling work or other tasks/activities), goal definition/agreement aspects, etc.; and ○ <i>Facilitation decisions during these exercises</i>: e.g. decisions about subgroup formation during forums, etc. • The study can inform process design approaches which target causal mechanisms which – in salient contexts – produce desired outcomes • Identified contextual factors and consideration could inform decisions regarding whether to initiate such exercises • The case highlights the importance of particular decisions (e.g. choices regarding the role/remit of the process convener[s])
Mapping and informing adequate consideration of complexity	<ul style="list-style-type: none"> • The study identified a range of contextual factors and related considerations in prospective exercises (e.g. see Chapter 8) – this can inform mapping and consideration of complexity • Implications for intervention theories were identified which highlighted the limitations of ‘simple’ intervention theories (like those which were elicited). The case can therefore inform the creation of more nuanced intervention theories

Third, evaluation research tends focus on and articulate *judgements* about the merit or worth of something (Scriven 1994, 2004) such as a focal policy or intervention. The present study reviewed judgements articulated by forum participants and CSIRO staff as a way of understanding the utility of PKPs, in combination with other outcome pattern-related data. Such analysis contributes to our understanding of PKPs used as interventions by providing a richer sense of actors’ goals, whether and how the focal PKPs were perceived to assist them (or not), and why. The analysis presented in previous chapters shows that this can contribute to empirical and theoretical understandings of PKPs.

A final set of insights is related to the *knowledge practices* lens and how this can be fruitfully combined with evaluation research. The case analysis shows that evaluation can contribute insights relevant to reflection on the routines that are central element of knowledge practices and are often taken-for-granted. Such evaluation research is one way of revealing such routines and their consequences, such as their influence on the impact or perceived utility of a PKP (e.g. whether desired outcomes are produced). Unless practitioners are prompted to critically reflect on such routines they are likely to remain taken-for-granted. The case study documented important aspects of the futures forum process, its perceived utility and associated effects, which could inform reflection by CSIRO staff.

10.2.2 Pragmatist prescriptions for the use and theorisation of prospective exercises in socio-technical transition contexts

The case study findings and discussion chapters can also be drawn on to consider what could or should be done to enhance the use and theorisation of prospective exercises, building on the pragmatist synthesis proposed in Chapter 9. The following set of broad prescriptions have three foci: enhancing utility and impact, enhancing intervention theories, and prescriptions for practitioners. None are law-like in the sense of arguing that specific actions under condition ‘X’ will always produce outcome ‘Y’. The intent is to derive starting points for high-level guidance which are informed by the case study findings and pragmatism.

The argument which underpins these ‘prescriptions’ is that pragmatism, as a philosophical position and grounding perspective for related theories (see Joas 2001; Little 2014), can inform improved conceptualisation and use of PKPs in transition contexts. Drawing on the knowledge practices lens, the prescriptions also emphasise reflection on routines.

10.2.2.1 General/orienting perspective

The question “what is a prospective exercise for?” must be a central consideration for any set of such prescriptions. Guided by the case discussion in Chapter 9, and underlying ambitions conveyed by practitioner intervention theories, these prescriptions assume that the primary goal is to guide or enable action in the problem situations actors are facing.

The focal case illustrates the relevance of pragmatism-inspired social science theory and this philosophical position. Six key guiding principles can be derived from ‘classical’ and ‘new’ pragmatism (Godfrey-Smith 2001; Gross 2009, 2010; Joas 2001; Little 2014):

- 1) Action involves alternation between habit and creativity;
- 2) Humans try to solve problems by enacting habits (e.g. by enacting “routine responses to life situations” (Little 2014, p. 63)) but they have the capacity for creativity “when preexisting habits fail to solve a problem” (Gross 2009, p. 366);
- 3) Human actors are stimulated to action by real problem situations;
- 4) Human action is contingent on, and partly constituted by, the structure of the situation (e.g. it entails dynamic processes of goal and action formulation);

- 5) A central role of inquiry and thought is guiding action (e.g. by relieving doubts), often in the context of an indeterminate situation; and
- 6) Inquirers/knowers are active human agents (not passive 'spectators').

The prescriptions that follow call for greater focus on enabling reflection on habits of thought and action and less strongly routinised approaches to prospective exercises.

10.2.2.2 Prescriptions for enhancing the utility and general use of prospective exercises

Consistent with the pragmatist action theory proposed by Gross (2009), in transition contexts actors frequently confront problem situations which are novel and, to some extent, indeterminate. The case provides evidence that actors often seek to address such situations by enacting habits. For instance, under uncertain conditions "script following" (Beckert 2013b) often influences action.

A pragmatism-informed approach to PKPs must recognise the habitual aspects to action which shape interpretations of situations and study findings – due to habits of thought (i.e. cognitive-affective habits) and behavioural habits – and the associated alternation between habits and creativity which shapes action. Such an approach would recognise the difficulty of influencing habits through deliberation and analysis (this may justify more interventionist approaches) *and* the potential value of enhancing actors' flexibility to handle new situations.

Therefore, one prescription is greater focus on enhancing the alternations between habits and creativity that typically shape human action. The analysis presented in this thesis suggests this requires attention to the circumstances for reasoning which are established by a prospective exercise, such as the level of viewpoint diversity in a convened group (Mercier 2012; Mercier & Sperber 2011), and a less 'hands-off' convening and/or facilitation approach. The latter may, for example, entail purposefully influencing the composition of the convened group and/or a willingness to challenge participants' views.

A second set of prescriptions can be derived with respect to the question of whether and how prospective exercises "translate into action" (Miller et al. 2014, p. 243), as queried by some sustainability transition researchers, and how such 'translation' processes may be enhanced. The pragmatist perspective considered here suggests that contributions to action can be

enhanced by: (i) recognising that problem/action situations often demand new ways of thinking and acting (Joas 2001), i.e. creativity; and (ii) greater attention to practical ‘problem situations’ which stimulate or demand action, which some pragmatists term “the needs of practice” (Rescher 2013). Regarding the former, this highlights the dangers of a participant-led process, given participants are less likely to move beyond their habits of thought and habitual forms of action and are more likely to seek justifications for their beliefs and/or actions.¹²³ Regarding the second aspect, several forum participants questioned the relevance of the forum process and its outputs to the tasks they were focussed on (though such utility judgements are themselves also influenced by habits of thought).

The so-called pragmatic maxim, which suggests *meaning* (e.g. the meaning of techno-economic modelling results) should be assessed with respect to consequences for action, is also relevant to such prescriptions. Though many philosophers who identify as pragmatists are “sceptical about the maxim and its applications” (Hookway 2015) the maxim can usefully frame greater focus on practical consequences. For example, the translation of prospective exercises into action may be enhanced by placing greater emphasis on articulating and debating the perceived consequences of forum findings for action.

A third prescription is to abandon some aspects of the neutrality aspiration (e.g. in process convening and facilitation), consistent with the pragmatist critique of the ‘spectator theory of knowledge’. Pragmatists argue that inquirers/knowers are *agents* (Godfrey-Smith 2001; McDermid n.d.) and, consistent with this, process convenors and facilitators inevitably make consequential choices. CSIRO staff themselves not only sought to learn from the futures forums and had impact goals, but they also shaped the forum even when they tried not to intervene.¹²⁴ A pragmatist prescription has two parts: (i) acknowledge and purposefully shape this influence; and (ii) consider alternative perspectives on the role of knowledge beyond (as

¹²³ Sociologists studying the role of imagined futures in economic action and the formation of expectations have reached similar conclusion: Beckert (2016, p. 270) found that “when outcomes are uncertain, actors are *required to pretend* they can anticipate outcomes in order to make justifiable decisions [emphasis added]”.

¹²⁴ If this point is unclear then consider the following example from the Sustainable Aviation Fuel Road Map (SAFRM) Forum. A number of SAFRM Forum participants stated the aviation sector participants had a stronger voice – that is, the unequal social power of actors influenced the process and its outcomes. CSIRO staff could have sought to influence this dynamic by being a stronger ‘player’ during the forum and/or sought to use their influence to help give other voices more space. By remaining neutral and not intervening more strongly this influenced the process by helping powerful actors to dominate.

conveyed by CSIRO staff in interviews) being “merely a neutral ‘input’” to decision/policy-making (Turnhout, Dewulf & Hulme 2016, p. 70).

An example of the former highlighted by the case is the ways process convenors influence the mix of participants and the consequences of this. For instance, for the futures forums CSIRO staff targeted a balanced group of interests, partly to avoid the perception (or reality) of being unduly influenced by a particular interest group. Broader possibilities are highlighted by the case. For example, Chapter 7 discussed reasoning the circumstances such as the range of the arguments available to participants. (For an example of the potential roles of ‘interventionist’ convenors see the discussion of the Future Grid Forum in Chapter 9 – *Section 9.3.4*).

The pragmatist critique of the spectator theory of knowledge also points to broader considerations when assessing or using anticipatory knowledge. It highlights the need to critically interpret such ‘knowledge’ given that the involved human inquirers do not “survey or contemplate things from a practically disengaged and disinterested standpoint” nor do they do so with “passive impartiality” (McDermid n.d.).

10.2.2.3 Prescriptions for enhanced intervention theories

The pragmatist synthesis proposed in Chapter 9 highlighted three main problems with the elicited intervention theories (consistent with *Section 10.2.2.2*): (i) insufficient consideration of habits of thought and action and associated interventions which may be necessary (e.g. to generate impact); (ii) limited attention to problem/action situations of actors and related current ‘needs of practice’; and (iii) insufficient attention to the finer details of actors’ contexts and human actors which weren’t adequately conveyed by general high-level intervention theories. Several possibilities follow.

One prescription is to incorporate pragmatist action theories. For example, where intervention theories theorise causal processes producing reduced inertia (see CMOc-2) they could be enhanced by incorporating such action theories and the ‘habituality-creativity continuum’ regarding actor responses to real problem situations (Gross 2009, 2010). Such theoretical advancement can also inform changes in practice, such as the prescriptions in *Section 10.2.2.2*.

An additional prescription related to cognition is the need to consider formal human actor theories. For example, such theories make important assumptions about cognitive abilities and limitations and their consequences. As Little (2014, p. 65) has outlined, theories proposed by ‘new’ pragmatists provide alternatives to commonly-made assumptions about “rational, purposive agent[s] considering options and choosing outcomes”.¹²⁵ Case study findings presented in this thesis also point to a need to reject simplistic theories of rational actors using PKPs and to consider alternative theories of reasoning.

Pragmatist theories further emphasise characteristics of practical cognition which have also been revealed by recent psychological studies, such as those related to the automaticity of cognition (Gross 2009, 2010). As discussed in earlier an chapter, cognitive processes can be biased and lazy without humans being aware of this, for example due to the influence of myside bias and motivated reasoning (also see Kunda 1998; Mercier & Sperber 2011, 2017) and the influence of culture on cognition (Sloman & Fernbach 2017). The related prescription is to explicitly address how an intervention is theorised to *intervene* in, and to be shaped by, such cognitive processes. This includes considering the ways such forces can limit the influence of an exercise (e.g. by influencing how the findings are interpreted); and, secondly, considering how cognitive processes may enable impact. Intervention theories may also be improved by considering how specific tasks undertaken during prospective exercises (e.g. a scenario exercise) are influenced by cognitive abilities (Bradfield 2008).

The pragmatist synthesis proposed in Chapter 9 also emphasised the importance of *social* mechanisms (i.e. not only cognitive mechanisms, which realist evaluation is focussed on). A further prescription is thus to draw on theories of social mechanisms. Where realist evaluation approaches are used, this is a corrective to its focus on individual-level mechanisms.

A final aspect inadequately incorporated into the elicited intervention theories was the role of CSIRO staff in enabling change in and through the futures forums. Pragmatist epistemology suggests that the intervention theories need to more deeply theorise the ways that the process convenors and facilitators are themselves *agents*.

¹²⁵ Such actor assumptions have also been described as *Homo rationalis* (Schermer 2011)

10.2.2.4 Prescriptions for practitioners

Pragmatism implies that practitioners themselves need to reflect on their own habits, related routines, and how this shapes prospective exercises. This includes process convening or facilitation habits and related problem-solving routines (e.g. the conflict management and avoidance habits). This reflexivity prescription is also consistent with the need to consider how knowledge practices include both routinised forms of action and improvisation.

The pragmatist argument that all inquirers are agents also implies a broader need for practitioner reflection and purposeful practice. For example, several case themes were related to CSIRO as a formal scientific organisation, associated norms, and how practitioner choices influenced the futures forums, their outputs and the downstream effects of each forum. Such influences can be analysed with respect to whether they help to enable (or constrain) the achievement of intended outcomes and, secondly, whether the knowledge practices meet the pragmatist ideal of producing “plausible information ... [which is] adequate to the needs of practice” (Rescher 2013). Whilst involved actors (e.g. CSIRO staff) may have limited ability to depart from norms and their routines, nonetheless the room for creativity and innovation can be explored and such analysis may militate against unreflective habits.

Furthermore, as discussed in *Section 10.2.2.2*, the pragmatists’ critique of the spectator theory of knowledge raises questions about current regulative ideals such as neutrality which guide CSIRO staff. The case suggests that forward-looking exercises rarely (if ever) meet such ideals. This implies a need to adopt the pragmatic position of acknowledging and purposefully *shaping* ones’ influence. In other words the pragmatist’s critique of claims of “passive impartiality” (McDermid n.d.) also applies to forward-looking exercises and implies the need to explore and adopt different epistemological positions. This prescription may be difficult for scientific actors to follow but it logically follows from the case.

Finally, practitioners need to recognise that the process goals, design and implementation should partly be contingent on the situation being faced (rather than adopt a ‘standardised’

approach).¹²⁶ This includes basic aspects like consideration of participants' goals and the extent to which there are common goals (or if the participants have conflicting goals, which is more likely). Additionally, the mix of methods used (and their relative emphasis), the targeted mix of participants, etc., may also need to be reviewed.

10.3 Contributions, implications and limitations of the study

10.3.1 Contributions to knowledge and practice

One contribution is the development of the concept of prospective knowledge practices and associated insights into their use and effects. This extends earlier work on social knowledge practices (Camic, Gross & Lamont 2011a) and 'techniques of prospection' (Mallard & Lakoff 2011). Mallard and Lakoff similarly suggested that such techniques should be studied with respect to instrumental and epistemic functions. Knowledge practice studies can contribute to the fields in which those practices are used (e.g. transition research).

The evaluative case study research also helps to clarify why PKPs are used, in addition to practitioner-oriented contributions. In some respects, the examination of longer-term futures is puzzling in transition contexts, because socio-technical transition processes are typically highly uncertain and dynamic and any actor foresight is consequently likely to be limited at best. The present study clarifies that PKPs are often mobilised more for their perceived utility in guiding or enabling action (their instrumental value) than for their epistemic validity. Such integration of inquiry and action is one reason why pragmatism is a relevant philosophical foundation. However, the case suggests that the effects of such studies can be limited and unintended, which suggests that practitioners and intervention theories must better consider the causal processes which may operate in transition-related contexts.

The pragmatist synthesis and prescriptions add to these insights. It provides a sophisticated model of human action – and associated “action-theoretical assumptions” (Gross 2009, p. 359) – which many aspects of the case were consistent with. This also helps to explain why, in most

¹²⁶ For a similar argument regarding the use of scenario planning interventions see Ramirez and Wilkinson (2016). Approaches such as transition management could be criticised for being too formulaic, such as with respect to the norm of identifying and involving 'front runners' (rather than seeking the involvement of a situation-specific mix of actors).

respects, the impacts of the futures forum were limited as well as the potential utility of PKPs. A pragmatist view of PKPs can enhance intervention theories (*Section 10.2.2.3*).

With respect to knowledge of sustainability-related transition processes, some case study findings are also consistent with the increasing emphasis on agency and institutions in sustainability transition research (e.g. Farla et al. 2012; Geels et al. 2016). This includes illustrating how the use of PKPs is currently a frequent part of efforts to exercise or gain agency and, secondly, illustrating the influence of institutions on research and action related to transitions. The case also suggests that transitions may demand greater institutional change than has to-date been suggested by transition scholars.

The findings can be interpreted from the perspective of existing theories of transitions and related concepts (Chapter 9). For example, the case provides evidence of the vast array of expectations work done in transition processes (Farla et al. 2012). Associated habits are also revealed by the case regarding the production and use of anticipatory knowledge.

A final contribution to sustainability-oriented research concerns the philosophical foundations of such research. This issue has received some recent attention in transition research (e.g. Geels 2011) and sustainability science (e.g. Miller 2013, 2015b). The pragmatist synthesis of the case analysis (see Chapter 9) and prescriptions (this chapter) suggests that pragmatism is aligned with the intended roles of knowledge in transition research.¹²⁷

Two further motivators of the study were to conduct research relevant to societal imperatives related to addressing climate change and contributing to practice. A potential contribution concerns the role of scientists in change processes. The study provides insights into how researchers and scientists based at formal scientific organisations view their role, related perceived constraints, and how this influences their contributions to action. Scientists' capacity to be change agents is enabled and constrained by factors revealed by the case. On balance, the available case evidence indicates that a 'post-political' approach to prospective exercises

¹²⁷ In general "pragmatists stress the role of knowledge in solving practical problem" (Godfrey-Smith 2001, p. 11954). 'Classical' pragmatists such as John Dewey further argued knowledge should be viewed as an *instrument* for dealing with reality as actors confronted real-world situations and determined ways of 'transforming' them. This also led Dewey "to reject what he called the 'spectator theory of knowledge,' the view that the ideal knower is someone who registers what is going on but does not intervene" (Godfrey-Smith 2001, p. 11956).

(as per the CSIRO futures forums) tends to constrain contributions to action more than be an enabler (also see Dunlap & Brulle 2015).

The potential contributions of the study to practice concern the use of PKPs by CSIRO staff and other practitioners. The case can inform subsequent uses of the futures forum process by CSIRO staff and the development of refined intervention theories. Some insights are likely to be more widely transferable such as with respect to the potential functions of such exercises. Additionally, the pragmatist prescriptions and key insights derived from the use of a knowledge practices lens may make broader contributions to practice – though, at this point, this is best considered a hypothesis to-be-tested.

Consideration of intervention theories informed by realist evaluation concepts can also frame new approaches to practice that: (i) theorise and/or target specific causal mechanisms related to outcomes of interest; and (ii) address potential countervailing processes (e.g. script following under uncertainty). The test of the realist evaluation approach in the present study also suggests that it's a promising way to contribute to practitioner reflection. For example, other practitioners could similarly describe how they believe their interventions contribute to change (or targeted actions) and empirically assess these theories.

The case study also contributes to knowledge on the challenges researchers face when leading or conducting forward-looking research related to transitions. Transition scholars have tended to emphasise analytical challenges such as those related to limited predictability, complexity and the normativity of transitions (e.g. see Turnheim et al. 2015). Similarly, the literature on participatory modelling conducted by transition researchers gives scant attention to the socio-political aspects that have been emphasised by this thesis (e.g. see Holtz et al. 2015). This thesis also raised other issues with respect to the ways forward-looking studies are socially conditioned, are political practices, and how they're shaped by reasoning processes.

10.3.2 Implications

The most direct implications concern practitioners, how they approach and use PKPs, and their guiding intervention theories. The energy division at CSIRO (the former Flagship), as the case study partner for this study, can draw on the findings to refine their intervention theories. More fundamentally, consideration of case themes and case analysis may present

opportunities for further reflection and innovation which can enhance their use of PKPs and its contributions to energy transitions in Australia.

The case also suggests that practitioners need to re-examine what outcomes they expect from their work and associated habits and routines. An illustrative example from the case is the common expectation that PKPs function as ‘cognitive devices’ (Healey & Hodgkinson 2008) and broaden actors’ thinking on possible futures, as per claimed “enlightenment function[s]” (Parandian & Rip 2013, p. 3). In contrast, the case suggests belief *reinforcement* is often more likely. Similarly, as others have reported, the excitement that is often associated with forward-looking studies is frequently matched by a similar level of disappointment afterwards concerning limited use of the outputs and limited impact (Chermack 2011; Erdmann, Sichel & Yeung 2015; Quist, Thissen & Vergragt 2011; von Stackelberg & Jones 2014). To some extent the futures forums examined in the present study were consistent with this common experience and picture. The study identified a range of contextual factors which practitioners need to further consider (e.g. institutional structures, etc.).

Finally, the knowledge practices perspective implies a need for all practitioners to be aware of how aspects of such inquiry can become routinised and taken-for-granted in consequential ways. Consideration of this should be seen as part of reflective practice.

10.3.3 Limitations and future research needs/opportunities

Several limitations were reviewed in the methodology chapter. To minimise repetition, I limit this section to limitations that are instructive for future research. Firstly, the case interpretation was limited by data availability, and these limitations should also constrain interpretation of the case study findings. For example, the available process data was largely limited to written records and other recollections of interviewees that in many instances were shared many years after the fact. It is well known that all meeting records are partial records (e.g. due to errors of omission, author bias). One opportunity is therefore to conduct research in ‘real-time’ during forum-like processes to gain access to richer process data.

Secondly, outcome evaluation and related causal analysis (e.g. addressing questions like, ‘did the futures forum cause this outcome or were other factors more responsible?’) is inherently complex for social interventions. Future studies could improve the outcome assessment by

using pre and post measurements for specific indicators (Pawson 2013). The inability to do in the present study was another limitation of examining historical projects, given the absence of baseline data. Causal attribution may also be improved by involvement in real-world projects or situations (e.g. management scientists have used research approaches that combine being embedded in management teams with traditional research methods).

A third key limitation of the study was the inability to rigorously test the transferability (or specificity) of many findings. A related need is to conduct comparative studies which address these questions, such as by comparing the use of PKPs in multiple kinds of transitions, or by comparing projects run by practitioners from scientific and non-scientific organisations.

The pragmatic prescriptions presented in this chapter could also be examined in a follow-up study using one of the above approaches. For instance, a comparative approach would compare uses of PKPs which are more or less aligned with these prescriptions.

Future research is also needed to further probe specific issues and challenges regarding the use of PKPs in sustainability-related transition contexts. For example, similar to Miller's (2015b) arguments about tensions between scientists' needs and practices (e.g. the perceived need to protect their epistemic authority) *and* the increasing desire of scientists to contribute to desired social outcomes, key tensions were revealed by the case study. A further dynamic which could be further examined is the desire of strategic actors to influence present action via the use of PKPs and its consequences. This could, for example, lead actors to place less emphasis on epistemic soundness and more emphasis on those projected futures expected to influence others, thereby reducing the reliability of anticipatory knowledge.

Similarly, future research could further probe specific findings about the ways in which PKPs are "patterned activities" (Camic, Gross & Lamont 2011b, p. 7).¹²⁸ For example, in the present

¹²⁸ An illustrative example examining the International Energy Agency (IEA) World Energy Outlook (WEO) reports was recently published by Gaede and Meadowcroft (2016). Though the "patterned" aspect of PKPs wasn't the focus of this study, the case study argues that WEO report content is political in the sense of being subject to "constraints associated with its institutional context" (e.g. the views of IEA member states) whilst also aiming to "negotiate those constraints" (p.619). IEA staff must consider stakeholders, the political context and external perceptions (e.g. allegations of bias). Gaede and Meadowcroft (2016, p. 622) further suggest that interpretations of WEO reports must consider the "role and place of the IEA in the broader global multi-stakeholder energy governance system". The WEO case also highlights relevant habits of action, such as the former emphasis in these reports on conservative

study it was only possible to lightly touch-on CSIRO's organisational culture and norms and how this influenced the practices of CSIRO staff and how this, in turn, also shaped CSIRO's contribution to energy transitions in Australia and their social impact.

Finally, the research also points to the potential for broader studies of (i) the use of knowledge practices in sustainability transition-related contexts (e.g. not only forward-looking research activities), and (ii) the knowledge practices of sustainability transition scholars and others researching transitions. An example guiding research question is: what knowledge practices have transition-expediting effects (and/or which knowledge practices hamper such change), why, and under what conditions? Many evaluation approaches could be used in such research. Similar to how a practice lens has contributed to enhanced understandings of strategy-making and strategic management in organisations (e.g. see Jarzabkowski & Kaplan 2015; Kaplan & Orlikowski 2013), such a practice 'turn' could contribute to enhanced understandings of transition dynamics and usefully inform sustainability transition research.

10.4 Concluding discussion and statements

This study aimed to produce empirically robust findings and insights that would be both relevant to the case study partner (i.e. CSIRO staff) and others using similar forward-looking methods. Whether the goal of informing the use of PKPs at CSIRO is achieved depends on many factors, some of which are related to arguments made in this thesis. In particular, if PKPs are as *patterned* as I have claimed then major deviations from existing habits and practices will be difficult to embrace. If this turns out to be the case then it will be further evidence that PKPs are strongly institutionally structured.

Additionally, the study has altered my view of prospective exercises (and related practices). Examination of the real-world exercises – as well as the findings from other studies – suggests that they are not unambiguously 'transition enabling' (nor unambiguously 'transition disabling') and have diverse effects. Perhaps this is unsurprising as few actions are unambiguously 'transition enabling' given the complexity of such change. However, some aspects of the case do challenge the rosier pictures that are often presented. Whilst I do believe that some identified outcomes can be partly attributed to process and intervention

"reference" scenarios (such scenarios assume that no new policies are introduced) which aimed to prompt action by projecting the potential consequences of inaction.

theory deficiencies, other aspects of the case study point to fundamental social, political and cognitive mechanisms and processes which both enable *and* constrain prospective exercises and raise questions about their potential contribution to transitions.

In a more positive sense, the evaluative case analysis and pragmatist synthesis point to ways of philosophically grounding and using prospective exercises in transition contexts which may be more transition enabling. That is, studies like the one reported in this thesis may lead to a more critical view of PKPs *and* point to ways of addressing the issues it raises.

It seems appropriate to close this thesis with some concluding discussion of the approach used by CSIRO staff in the focal case, the identified beliefs that inform this approach, and what the case tells us about PKPs. Two pragmatist arguments are relevant to this discussion: the argument that beliefs are “connected to our actions and expectations” and, secondly, that beliefs can therefore “be evaluated in terms of whether those actions are successful and those expectations are met” (Misak 2016, p. 282). Some CSIRO staff conveyed to me that they felt their actions (as per the design and convening of the futures forums, related modelling work, etc.) were successful, such as with respect to its utility in defining or advancing research agendas, subsequent projects and action, relationship building, or simply completing each of the futures forums given the complexities and challenges they often faced. These CSIRO staff may therefore be justified in thinking that such outcomes validate their beliefs (e.g. those reported in Chapter 3). The present study doesn’t strongly contradict these views, though it does point to more mixed and weaker forum outcomes (e.g. with respect to research funding, relationship building, etc.). Staff from CSIRO (or elsewhere) could therefore continue to use such an approach to PKPs with the expectation of achieving some positive outcomes which may – from their perspective – justify the investment of time and resources.

However, the study also suggests that their existing beliefs, and the actions they are connected to, constrain the contribution of CSIRO staff to sustainability-related transitions. The thesis presented evidence indicating that some expectations are unrealistic, such as those related to futures forum processes contributing to dispute resolution (particularly the resolution of non-technical disputes) and evidence questioning the level of critical reflection on actors’ beliefs and assumptions. Moreover, the available case evidence suggests that other habitual ways of acting contributed to these outcomes patterns (e.g. convening approach habits) and these too were connected to their beliefs. This provides grounds for critically examining such beliefs –

and related intervention theories – particularly if CSIRO staff wish to have a stronger influence on energy transitions. Furthermore, this will be necessary if CSIRO staff embrace the set of pragmatist prescriptions outlined in this chapter.

The case also tells us that PKPs can be highly valuable to actors in transition contexts even if they do not strongly influence transition outcomes and processes. In other words, the case suggests that efforts to understand and enhance the utility of PKPs in such contexts must look beyond shorter-term material impacts – those occurring over the short-term or medium-term future, given the typically long timeframes of socio-technical transitions – and consider the actual circumstances of involved actors. Actors needs were often different to the goals espoused in related literature (e.g. few forum participants, if any, sought a more ‘open’ sense of the future or to have their core assumptions and beliefs challenged, etc.).¹²⁹ Attending to actors’ needs will require more attention to how PKPs “cash out” in experience and with respect to present exigencies (as some pragmatist philosophers put it). Numerous examples in the focal case point to related ways that PKPs can contribute to action.

The case also tells us something important about the use of PKPs in energy transition contexts and related efforts to expedite transitions. Given that energy transitions are frequently “messy, conflictual, and highly disjointed” (Meadowcroft 2009, p. 323) we should not be surprised when PKPs in such contexts have some of these characteristics. Furthermore, any consensus-oriented process (like the CSIRO futures forums) must squarely face the significant barriers to producing greater agreement on energy issues given the many deep-rooted causes of contention which tend to make the energy domain one of conflict not consensus (see Sovacool, Brown & Valentine 2016). More instructive are the findings about the importance of habits of thought – and the associated influence of what Sovacool et al (2016, p. 332) term “subjective frames” – as well as related habitual ways of acting. These findings pointed to the relevance of developing a pragmatist approach to PKPs (see *Section 10.2.2*) whilst remaining cognisant that deep-rooted disagreements won’t ‘magically’ disappear.

¹²⁹ Diverse practitioners using forward-looking methods emphasise challenging actors’ assumptions and beliefs, for instance Hines (1995, p. 24) argues forecasts “are useful if they have shaken your conception of the future” and Inayatullah (2015, p. 245) argues “foresight is about challenging assumptions”. This emphasis on challenging assumptions is like the ‘critical reflection’ mechanism in the identified intervention theories (**M3**). The goal of developing a more “open sense” of possible futures – though it’s not addressed in the intervention theories – is often emphasised in the scenario planning literature (e.g. Ramirez & Wilkinson 2016, p. 138).

Most important, perhaps, the case highlights the many forms of PKPs through which anticipatory knowledge is produced, advanced, assessed, and, sometimes, put to use by actors and, secondly, it highlights the ways that these practices and their effects are marked by the contextual circumstances in which they occur and the cognitive capacities and tendencies of human beings. These findings point to new lines of inquiry which could enhance sustainability transition research, practitioners' theories and their interventions.

APPENDICES

Appendix 1: Overview of the Futures Fuels Forum and research undertaken on this forum

Forum description (Future Fuels Forum)

1. Introduction

In late 2007 the CSIRO Energy Transformed Flagship (hereafter the Flagship) convened the Future Fuels Forum (FFF). The FFF was related to one of the Flagship's main research themes, low emissions transport. The FFF was a nine month long "structured scenario development and analysis exercise" which involved a wide range of cross-sectoral actors (CSIRO 2007b). In total 62 delegates participated in the FFF representing 31 organisations. In June 2008, the FFF released a public report, "Fuel for Thought" (CSIRO 2008a) and an accompanying technical report (Graham, Reedman & Poldy 2008). The FFF focussed on the Australian context and Australia's options for sustainable fuel supplies.

The overarching stated goal of the FFF (stated in the project prospectus) was "to bring together transport fuels stakeholders from community, industry and government to determine plausible scenarios for the future of transport fuels in Australia and examine their implications" (CSIRO 2007b). In this forum participants contributed to, and drew on, detailed techno-economic modelling outputs "to articulate the major challenges for Australia in arriving at a secure and sustainable transport fuel mix to 2050" (CSIRO 2007b).

1.1 Forum objectives

The following five objectives were outlined in the project prospectus:

1. Facilitate dialogue between a diverse set of transport fuels sector stakeholders;
2. Identify plausible scenarios for the future transport fuel mix in Australia to 2050;
3. Quantitatively assess the characteristics of the scenarios using techno-economic models;
4. Discuss, analyse and report on the major environmental, social and economic implications and challenges identified; and
5. Provide information to the participants, CSIRO and external stakeholder organisations that can support policy-making and investment decision-making.

Related to these objectives the forum also aimed to provide: networking opportunities and related benefits from stakeholder interaction; reputational benefits to the forum participants, in particular contributing to an enhanced public reputation "as a transport fuels industry leader"; and an opportunity to co-develop "strategic information", in particular "ensuring that their organisational perspective is included in input to key external stakeholders" (CSIRO 2007b).

External communications were a priority, which included a public report launch event (hosted by General Motors [GM] Holden) and arranging for formal presentations to government bodies and other stakeholders. These activities were seen as ways to "facilitate wide adoption of the views developed by the Future Fuels Forum so they achieve the necessary momentum

required to support the investment and policy decision making” (CSIRO 2007b).

1.2 Internal (Flagship) objectives

The Flagship also had internal objectives. The Flagship Director wanted to ensure that the Flagship’s research was relevant (and that it was viewed as such internally), and he saw the futures forums as a way to:

- Help ensure that the Flagships research agenda and activities are guided by the views of industry and a joint view of how transport fuel issues could develop in the future;
- Better understand issues directly related to transport emissions and the development of sustainable fuel supplies, given that “the [transport] fuel area was one that we really didn’t have a great deal of vision on where it was going to go, and where it could go” (J. Wright, 2014, personal communication, 15 August); and
- Defend, and secure support for, the Flagship’s research and development priorities (J. Wright, 2014, personal communication, 9 June and 15 August)

The Flagship Director more fully stated the first internal objective as follows:

“We needed to dig somewhat deeper than the first forum [the Energy Futures Forum], this time specifically into the transport fuel issue to shape our future research activities based on what the industry believed and thought” (J. Wright, 2014, personal communication, 15 August).

The Flagship Director further outlined the third objective as follows:

“I did it [the futures forums] for my own selfish reasons, if you like. I needed a mechanism with which to defend the research and development we were doing in the Flagship, so I needed to be able to give very strong, cogent and positive reasons for why we were researching A rather than researching B within the Flagship... So, I wanted some direction and I wanted some support. That was really the reason we put this together” (J. Wright, 2014, personal communication, 9 June).

Other Flagship staff also had objectives. The leader of the transport biofuels research ‘Stream’ wanted to achieve a shared view of research and development priorities: “the hope is always that there is a collective realisation of what research needs to be done, and that this collective realisation is so strong that the stakeholders suddenly throw dollars at you to then make it happen” (T. Beer, 2014, personal communication, 14 September).

2. Description of the forum and its outcomes

2.1 Contextual conditions

This CSIRO and wider process context is outlined below. Pawson and Tilley’s (1997b) 4 I’s context framework is used when outlining the latter: individuals (e.g. participants); interpersonal relations; institutional settings; and the wider “infrastructure” (i.e. the wider socio-economic or political context surrounding the intervention).

CSIRO Energy Transformed Flagship context

The Flagship was created in 2003 and established three major research ‘Themes’ – low-emission electricity (the focus of the first forum, the Energy Futures Forum run in 2004-06), low-emission transport, and low-emissions distributed energy – and an additional underpinning theme of energy futures (Sandland & Thompson 2012). Flagship management decided in mid-2007 to convene a second forum related to the low-emission transport, the Future Fuels Forum (FFF).

In the 2006–07 budget the Australian Government announced additional funding for the CSIRO National Flagships. This including expansion of the Energy Transformed Flagship in the area of alternative transport fuels (CSIRO 2007a, p. 7), with additional appropriation funding of \$59.6 million for research into alternative fuels. In the 2006-07 Annual Report CSIRO management asserted that “the National Research Flagships are now part of the fabric of CSIRO” (CSIRO 2007a, p. 7).

Nonetheless, the internal context remained challenging for then-Flagship Director (Dr J. Wright, 2014, personal communication, 9 June and 15 August). In 2007 the Flagship remained closely monitored by CSIRO’s senior management. All new research programs had to first be approved by CSIRO management, which required the Flagship Director to provide a detailed justification for this proposed spending (J. Wright, 2014, personal communication, 9 June). Relations with CSIRO Divisions also remained strained and Director had to put significant effort into securing their cooperation (J. Wright, 2014, personal communication, 15 August).

Individuals

The largest group of participants in the forum were representing government bodies and agencies, with 45% of core delegates being public servants (see *Table 28*). Other participants were from a mixture of other sectors. Most of the attending public servants were policy advisors or middle-level bureaucrats who didn’t have decision-making authority and couldn’t speak on behalf of the government but could share their personal views. Corporate sectors participants were a mixture of senior executives (e.g. Richard Marshall from GM Holden) and middle management (e.g. Alan Booth from Woolworths).

Table 28: Overview of sectoral participation in the Future Fuels Forum

Sector	Number of core forum delegates (%)	
Government department / agency	28 (45%)	State agency / body: 60% (17)
		Federal agency / body: 40% (11)
Corporate sector (representative of a firm, industry association)	13 (21%)	
NGO / issue advocate	10 (16%)	
CSIRO	5 (8%)	
Interest groups	3 (5%) (NRMA Motoring and Services, Australian Automobile Association)	
Consultancy / Advisors	3 (5%)	

Interpersonal relations

Some participants were part of existing social networks. Before, and around the time of, the FFF several other events on biofuels and alternative fuels were held, which led to relationships between biofuels organisations, NRMA and related groups (G. Hughes, 2014, personal communication, 7 October). Additionally, representatives from the biofuels industry had pre-existing relationships. Prior to the FFF an active group had developed across the Victorian Government (an inter-Departmental committee) that was dealing with future transportation issues and members of this pre-existing within-government group attended the FFF (government informant, 2014, personal communication, 17 October). Additionally, Woolworths and Caltex had formed a fuel retailing joint venture in 2003.

Other individuals and groups didn't have pre-existing relationships. For example, prior to the FFF the Australian Conservation Foundation (ACF) wasn't connected to transport-related organisations (M. Richter, 2014, personal communication, 13 October).

Institutional settings

The organisations and other bodies represented at the forum can be characterised according to their interests in alternative transport fuels and related activities, as per the following categories:

- *Large player with major interests in existing conventional fuel supplies:* Caltex Australia Ltd;
- *General interest in transport fuel issues including diversification away from petroleum-based transport fuels and reducing of emissions:* GM Holden, NRMA, Woolworths Limited;
- *Biofuels producer and/or interests in biofuel development:* Biofuels Association of Australia, Caltex Australia Ltd (retailer), Regional Development Victoria, Rocky Point Distillery;
- *Producer, user or promoter of other alternative transport fuels:* Sasol Chevron (gas-to-liquids fuel supply); EDay Life Ltd and Future Climate Australia (electricity as a transport fuel); and
- *General concern with oil depletion and car dependence:* Australian Conservation Foundation and the Australian Society for the Study of Peak oil and Gas (ASPO-Australia).

The Flagship specifically targeted participants in six categories (see *Table 29* below). As per the above outline, and further detailed in the table below, most private sector participants, along with some public sector forum participants, had a pre-existing interest in alternative fuels. The Flagship was particularly pleased that Holden, Caltex, Sasol Chevron and ACF participated (CSIRO 2008b).

Table 29: Future Fuels Forum mix participants and non-participants

Category	Participants	Non-participants
Fuel producers, retailers and refiners	<ul style="list-style-type: none"> • Biofuels Association of Australia • Caltex Australia Ltd (inc. Caltex Refineries Pty Ltd) • Rocky Point Distillery • Sasol Chevron • Woolworths Ltd (joint venture with Caltex) 	<ul style="list-style-type: none"> • International oil majors who operate in Australia e.g. Shell, BP, Exxon Mobil, Chevron • Local industry bodies: APPEA, Australian Institute of Petroleum
Major end-user groups	<ul style="list-style-type: none"> • Australian Automobile Association • NRMA Motoring and Services • Woolworths Ltd <p><i>(Also Queensland Rail, listed under government)</i></p>	<ul style="list-style-type: none"> • Trucking sector, e.g. major trucking firms, peak industry bodies (Truck Industry Council, Australian Trucking Association) • Aviation sector • Shipping sector, peak bodies
Vehicle, engine and parts manufacturers	<ul style="list-style-type: none"> • EDay Life* • GM Holden <p>*NB. Not a vehicle manufacturer; a lower-emissions vehicle firm (e.g. electric vehicles) who is involved in the design and importing of low-emission vehicles</p>	<ul style="list-style-type: none"> • Other local manufacturers: Ford Australia, Toyota, Mitsubishi • Other automotive firms • Industry bodies: Federal Chamber of Automotive Industries, etc
Community and environment groups	<ul style="list-style-type: none"> • Australian Conservation Foundation (ACF) • Australian Society for the Study of Peak oil and Gas (ASPO-Australia) • Engineers Australia • Future Climate Australia • Public Interest Advocacy Centre 	<ul style="list-style-type: none"> • Climate Institute • Other major environmental groups (e.g. WWF-Australia)
Government	<ul style="list-style-type: none"> • Australian Bureau of Agricultural and Resource Economics (ABARE) • Bureau of Infrastructure, Transport and Regional Economics (BITRE) • Commonwealth Treasury • Federal Department of Resources, Energy and Tourism • Queensland Rail • South Australian Government and Departments (Transport, Energy and Infrastructure; and Environment Protection Authority) • Victorian Government, Agencies (Regional Development Victoria), and Departments (Business & Industry; Primary Industries; Sustainability and Environment; and Department of Transport) 	<ul style="list-style-type: none"> • Most state governments (New South Wales, Queensland, Western Australia, Tasmania) • Territory Governments (Northern Territory, Australian Capital Territory)
Banks and investors	<ul style="list-style-type: none"> • NONE 	<ul style="list-style-type: none"> • Banking sector
Other (e.g. consultancies)	<ul style="list-style-type: none"> • ARRB Group Ltd • Sligar and Associates 	

The institutional context of Caltex Australia Limited (CAL) was more complex: whilst global oil major Chevron holds a 50 per cent interest in CAL, and Chevron operates Australia's largest oil

field (i.e. Caltex has formal ties with local and global oil production through this ownership structure), “Caltex operates independently of Chevron” (Caltex Australia Limited 2014). At the time of the forum CAL was the leading fuel refiner-marketer in Australia with an associated focus on oil refining (around 35% of Australia’s oil refining capacity) and retailing petroleum-based fuels. Additionally, at the time of the forum, CAL was also the leading biofuels marketer in Australia amongst the majors.

A number of issues had promoted GM Holden to focus more attention on fuel and energy diversity. These include: brand perception concerns, in particular the perception that Holden only made “gas guzzlers” (i.e. didn’t take fuel economy or related running costs seriously); and launching the new VE Commodore product into a high fuel price environment and associated negative publicity (R. Marshall, 2014, personal communication, 23 October).

Some government bodies – in particular the Victorian Government – were also increasingly grappling with emerging issues in the automotive industry and this motivated participation in the FFF (K. Handberg, 2014, personal communication, 28 November). At the time of the FFF Victoria chaired relevant committees in the Australian Transport Council.

Finally, a cross-sectoral mix of participants attended the FFF: public sector body representatives, private sector bodies (including industry associations and other peak bodies), and NGOs.

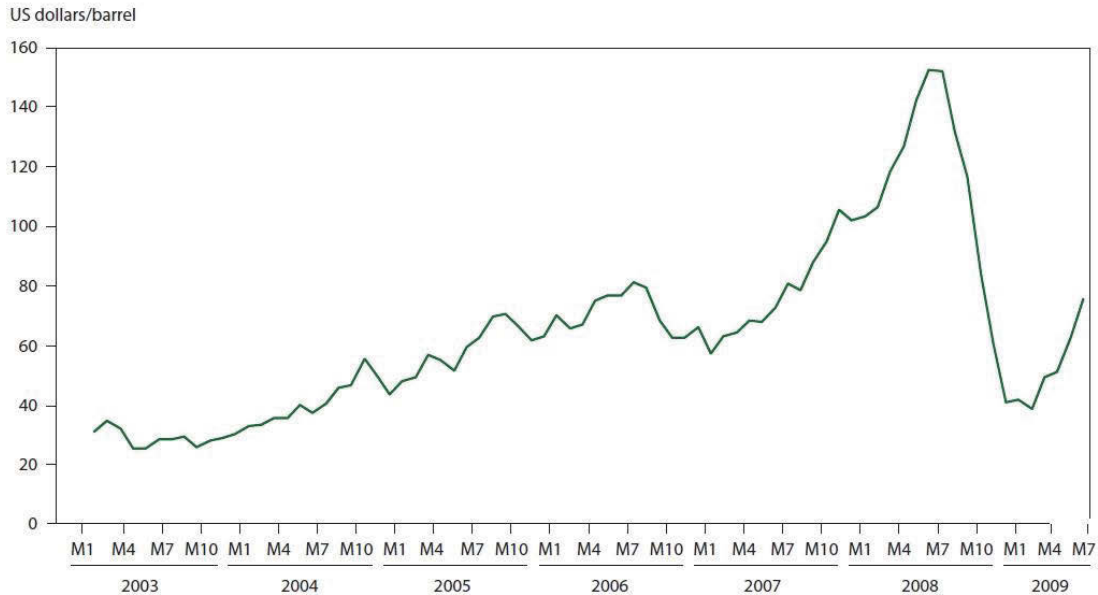
Infrastructure: the wider political, economic, etc., contexts

The first core aspect of the 2007-08 contexts was increasing focus on climate change policy, in particular the roles and introduction of carbon pricing. In July 2007, the former Howard Government established a bipartisan consensus on the introduction of an emissions trading scheme (ETS), following the commissioning of the Ross Garnaut Climate Change Review in April 2007. The election of a new Federal Labor Government in November 2007 increased the prominence of the Garnaut Climate Change Review, in preparation for the planned introduction of an ETS during Kevin Rudd’s first Prime Ministerial term. The Garnaut Review was conducted concurrently to the FFF and also reported initially in mid-2008 (draft released in July) and released its final report in September 2008.

Rising fuel prices was the second core contextual factor. From 2003-04 onwards oil prices began to rise, reaching ~US\$90/barrel when the FFF began and reached a record high of US\$147/barrel on the day the public report of the forum was released on July 11 (see *Figure 8* below). Speculation and concern increased throughout 2007, which led the US Energy Information Administration (EIA) to release in November a supplement to their energy outlook seeking to address the question of ‘Why Are Oil Prices So High?’ (Kreil 2007). The context of rapidly rising fuel prices led to more contention regarding whether the main cause was resource scarcity (i.e. reaching a physical limit), fundamentals (i.e. of demand and supply), or the financialisation of commodity markets resulting in greater speculation and momentum trading and, consequently, a bubble (Khan 2009). Additionally, a related aspect of the context was increasing discussion of peak oil – in particular the peaking of conventional oil production

– and its implications, frequently expressed as ‘the era of cheap oil is over’.

Figure 8: Trends in oil prices (West Texas Intermediate), 2003–09 (from Khan, 2009)



WTI = West Texas Intermediate
Source: US Department of Energy.

The third important contextual factor was the increasing political and public attention on the future of the automotive industry. Following Mitsubishi’s announcement in February 2008 that it will close its last Australian manufacturing plant (in Adelaide), the Federal Rudd Government announced the Bracks Review of the Automotive Industry. The Bracks Review noted many of the pressures on the industry including the appreciation of the Australian dollar, higher fuel prices, international competition and emerging carbon emissions requirements. Major local players such as Holden and Ford Australia were negatively impacted by a major shift towards smaller, lower fuel consumption vehicles and, overall, a significant drop in the sales of Australian-made vehicles. The announcement of the Bracks Review in February 2008 is indicative of the increasing uncertainty – at the time of the forum – regarding the longer-term viability and sustainability of the industry. As the Bracks Review noted, the long-running dominance of large- and medium-sized passenger vehicles had shifted over the previous five years as preferences shifted to small vehicles and SUVs.

A final important contextual factor was increasing advocacy of alternative transport fuels and related technologies. For example, in 2006 NRMA initiated a national Alternative Fuels Summit to address what it called “Australia’s fuel crisis” and founded the Jamison Group to advocate for new public policies for developing alternative fuels. A Federal Senate Committee on ‘Australia’s future oil supply and alternative transport fuels’ was initiated and reported in February 2007. The Committee concluded that “more needs to be done to reduce Australia’s oil dependency in the long term” and recommended reviews of biofuel research (e.g. on lignocellulose ethanol) and to “increase funding where appropriate”. In some states, in particular Victoria, new policies were introduced to support investment in biofuels such as the

Road Map and Action Plan for the Development of the Victorian Biofuels Industry announced at the Ethanol 2007 conference that was held in Melbourne.

The FFF project prospectus emphasised the first two contextual factors in making the argument that “now is an ideal time for Australia to consider its fuel choices”. It also emphasised “uncertainty about the future world price of oil against a backdrop of declining domestic oil production”. The third factor was also gaining increasing political attention. The shifts in the automotive industry were, in part, related to the other two factors.

Post-forum context

During the six-month following the forum (July-December 2008) oil prices dropped rapidly, reaching a low of \$30/barrel in late December, and then the oil price slowly climbed again in 2009 (see *Figure 8*). Additionally, the financial crisis “reached its zenith in September 2008 when US securities company Lehman Brothers went into bankruptcy, and the large insurance company AIG was rescued by the US Government along with the two large mortgage agencies, Fannie Mae and Freddie Mac” (Reserve Bank of Australia 2010). The effect of the crisis on Australia was considerably less than in many other countries, but issues such as risk aversion did emerge (Reserve Bank of Australia 2010). Finally, the Rudd Labor Government sought to advance its climate policy agenda, releasing the *Carbon Pollution Reduction Scheme* white paper in December 2008 (two months after the final Garnaut Review report) and introducing legislation in May 2009. As documented elsewhere (e.g. Chubb 2014) the Rudd Government was ultimately unable to pass its climate change legislation.

2.2 Overview of the forum process and its outputs

Process summary

During the initial convening phase the Flagship approached relevant bodies and transport sector stakeholders and invited them to participate. When it was felt that adequate coverage of participants had been achieved, meeting the process goal of convening a group of “Australian transport stakeholders that represent a balanced group of interests” (CSIRO 2007b), a decision was made to proceed.

A total of five meetings were held from November 2007 to May 2008 progressing through a further five phases: (i) an information sharing phase, including presentations by relevant experts (e.g. from CSIRO) along with presentations from government agencies and other forum participants (e.g. by ABARE and ASPO-Australia); (ii) a scenario brainstorming phase which focussed on drivers of change and related policy assumptions; (iii) consideration of modelling results developed by CSIRO (which were informed by the scenario brainstorming phase and participant expectations); (iv) group identification and consideration of future ‘strategic challenges’; and, lastly, (v) forum report preparation and review tasks.

The process used in the forum gave participants significant control over the research process. This included determining the scope of the scenarios that were modelled and specifying the implications of the modelling and related trends, which were written-up in the summary forum

report. CSIRO (the Flagship) led and controlled the techno-economic modelling and report writing.

At the first meeting forum participants worked in self-selected small groups in which each group further scoped future scenarios based on selected assumptions about: 1) international oil supply (each group either adopted the 'ASPO perspective' on future international oil supply or the 'ABARE/EIA perspective'); and 2) future carbon constraints (high or low), along with other assumptions about social responses to transport fuel issues and technology options, e.g. the availability, cost and effectiveness of alternative fuel and engine technologies (CSIRO, 2007, *Meeting of the Future Fuels Forum*, 22-23 November). Participants specified public policies that should also be incorporated into each scenario. The final core scenario set retained this structure: the two core 'drivers' are future emissions trading schemes and whether, and the degree to which, international oil supply is constrained. The peak oil-focussed scenarios also considered alternative fuel and vehicle availability rates i.e. technology options (CSIRO 2008a; Graham, Reedman & Poldy 2008). Other assumptions around social preferences, technology and additional government policies were termed 'default', i.e. were the same in all core scenarios (Graham, Reedman & Poldy 2008).

Specific interests of forum participants were also further explored in 'sensitivity cases', i.e. additional modelling with related assumptions. For example, a "picking winners" scenario was developed to explore the potential benefits of greater government support for algae-derived biofuels (CSIRO, 2008, *Meeting of the Future Fuels Forum*, 13 March).¹³⁰

In conducting the above research process an effort was made to minimise politics and facilitate a shorter process with less conflict than the first forum, the Energy Futures Forum (J. Wright, 2014, personal communication, 9 June). The Flagship viewed the "politics and process [as] under control ... compared to EFF [Energy Futures Forum]" (CSIRO 2008b).

External communication was also a major component of the forum. Two reports were developed: a 'strategic challenges' report – termed *Fuel for Thought* – prepared by the Flagship (led by project leader) based on the forum and feedback provided by forum delegates; and a more technical report on the modelling. The following spokespeople were selected to lead external communications:

- Dr John Wright: CSIRO/Energy Transformed Flagship;
- Paul Graham: CSIRO/Energy Transformed Flagship;
- Mark Reuss: Chairman and General Manager, GM Holden;
- Bruce Harrison: CEO, Biofuels Association of Australia (BAA);
- Monica Richter: Sustainable Australian program manager, ACF; and
- Phil Hart: Australian Association for the Study of Peak Oil (ASPO-Australia).

¹³⁰ This scenario is related to both the interest the Flagship had in algal biofuels research and the biofuels players that were present. This scenario was developed despite concerns raised by participants. The meeting record for the 13 March 2008 meeting reads: "all uncomfortable with policy advocacy. We should not be picking winners but [should be] presenting range of options to inform their decisions."

The forum report was launched on 11th July at GM Holden's headquarters in Melbourne. Longer speeches were made by Dr John Wright, who asserted that "Australia's vulnerability to the critical drivers of the cost of oil and the need to decrease our greenhouse emissions" demanded a large cross-sectoral response, and by GM Holden's Mark Reuss, who pointed to the alignment between the report findings and GM Holden's belief that there is "no one solution" or "silver bullet" in moving away from petroleum-based fuels. Reuss also emphasised the need for collective action, due to the potential for a "chicken and egg scenario" to hamper change and for related problematic situations where there is "equipment on the car or truck before the infrastructure and supply was in place" (Reuss 2008).

Reuss further outlined his views on the "key elements to create alternative fuel options". These options were argued to require a set of interconnected actions to:

Introduce the infrastructure to deliver these to consumers; to build vehicles that support these alternative fuels and finally; establish policy that will encourage consumers to move away from petroleum. And our thoughts are certainly reflected and addressed in this report (Reuss 2008).

These speeches were followed by shorter remarks from other spokespeople and a Q&A session. The CEO of the BAA, Bruce Harrison, drew on the forum modelling to emphasise the risks of oil dependency and warned that alternative fuels may not reach the necessary scale in the required timeframe without further government intervention. ASPO-Australia's Phil Hart argued that "the peak oil scenarios in this report provide a far more useful insight into our future" and that behavioural and cultural change will be as important as technology choices. ACF's Monica Richter argued that the report "puts policy-makers on notice" and advocated for associated investment and policies, such as in public transport, automotive industry assistance, and inclusion of transport in an emissions trading scheme.

Following the process CSIRO Energy Transformed Flagship representatives gave a series of briefings to government departments and agencies, including to the following Government Departments: Department of Climate Change; Department of the Treasury (Treasury); Department of Resources, Energy and Tourism; Department of Transport and Regional Services; Department of Environment Water and Heritage; Department of Innovation, Industry, Science and Research; and the Department of Defence.

Following the process, the project leader (Paul Graham) also gave a number of public presentations in which the forum's analysis was also communicated and discussed, including at relevant conferences (e.g. Australian Engineering Week 2008 Biofuels Forum, Australian Logistics Council Energy & Environment Summit, Future City Transport summit) and other invited presentations (e.g. Australian Institute of Energy).

Forum outputs

The summary report, *Fuel for Thought – The future of transport fuels: challenges and opportunities (a report of the Future Fuels Forum)*, is described by CSIRO as a "strategic challenges" report. The report draws on the discussions that were held at the forum and the

techno-economic modelling to specify risks and opportunities, rather than presenting a highly technical analysis.

The media coverage of this report largely focussed on the worst case scenario for which modelling projected a fuel price of \$8/Ltr in 2018 if “international oil supplies abruptly decline and fuel and vehicle manufacturers are unable to quickly ramp up alternative supplies and technologies” (CSIRO 2008a, p. 11).¹³¹ In contrast, in the interviews done by the project leader Paul Graham, Graham emphasised uncertainty, noting the contrasting views on future oil supply constraints discussed in the *Fuel for Thought* report and stating that “[i]t's frustrating. We don't know who's right, so we just have to acknowledge that the outlook is very uncertain” (as quoted in: Cawood 2008).

A more technical modelling report was also released. This report presents a high-level explanation of the way the future projections presented in *Fuel for Thought* were developed, describing the modelling framework (but not describing in detail the model equations and structure), modelling limitations, underpinning assumptions, and model results associated with each scenario.¹³² This report also contains ‘sensitivity cases’ (see *Table 30*) that either weren’t discussed in detail in *Fuel for Thought* (e.g. where carbon capture and storage is not available) or weren’t discussed at all in *Fuel for Thought* (e.g. nuclear power as an energy option).¹³³

Table 30: Overview of Future Fuels Forum scenario modelling

Scenario	Conceptualisation and modelling details
Core ‘scenario set’	<ul style="list-style-type: none"> • Two core drivers are varied in the core set: 1) emissions trading and related constraints (60% or 95% reduction by 2050); and 2) international oil supply: EIA projections (reference case and ‘high price’ case) assume that oil supply remains unconstrained; alternative supply projections are based on the ASPO perspective (where physical limits are reached and supply declines within five years) • The core ‘scenario set’ is alternative assumptions about these two drivers, with all other major drivers held constant (which in the report are termed “default assumptions”) such as the use of the CSIRO technology outlook for all the core scenarios. These core assumptions are used as techno-economic modelling inputs • The peak oil-focussed scenarios also explicitly considered oil supply decline rates (either fast or slow) and alternative fuel and vehicle availability rates (either slow, moderate, or fast).

¹³¹ For example see McManus (2008), Coorey (2008), Morton (2008), and Anon. (2008b).

¹³² CSIRO’s Energy Sector Model (ESM) was used which had been co-developed by Flagship staff. It is a ‘partial equilibrium model’ of the Australian energy sector (including transport sector representation) that was co-developed by CSIRO and ABARE. For “given time paths of the exogenous (or input) variables that define the economic environment, ESM determines the time paths of the endogenous (output) variables” e.g. fuel price, greenhouse gas emission, demand for transport, and fuel, engine and electricity generation technology uptake (Graham, Reedman & Poldy 2008, p. 15).

¹³³ Some participants requested that this case be removed from the main strategic challenges report, i.e. ‘Fuel for Thought’.

<p>'Sensitivity case' scenarios</p> <p>(four themes of additional modelling that was conducted)</p>	<p><i>Theme 1: Social and cultural preferences for transport</i></p> <ul style="list-style-type: none"> • Social preferences remain unchanged from present. As a result demand for private passenger road transport is higher and demand for mass transport lower (than in the core scenario set) <p><i>Theme 2: technology and technological uncertainty</i></p> <ul style="list-style-type: none"> • Algae-based biofuel becomes available at low cost • Hydrogen road vehicles are available at competitive cost • Nuclear power is available as an option • CO2 capture and storage is not available and electricity end-use efficiency is higher <p><i>Theme 3: additional government policies that may be implemented to complement an emission trading scheme or to achieve other goals.</i></p> <ul style="list-style-type: none"> • Accelerated scrapping of older road vehicles • Higher fuel excise • Subsidies for low emission road vehicles • Mandatory fuel efficiency improvements for road vehicles <p><i>Theme 4: alternative peak oil scenarios</i></p> <ul style="list-style-type: none"> • Slow decline in oil product supplies, slow infrastructure response • Slow decline in oil product supplies, moderate infrastructure response
--	--

The technical report also discusses the core forum scenarios and what were selected as 'sensitivity cases' for further analysis and reporting. For example, the core scenarios that explored a near-term decline in oil supply are discussed. The core scenarios (included in the core 'set' and featured in the main public report) examine "what might be called the two extremes" where either the rate of oil supply decline is fast and the technology response is slow (leading to \$8/litre fuel prices) or, alternatively, the rate of decline is slow and the technology response is fast (Graham, Reedman & Poldy 2008, p. 78). The sensitivity cases "fill in the possibilities in between" (Graham, Reedman & Poldy 2008, p. 78).

Overall, the Flagship described the forum reports and associated research as providing "a road map of options for reducing greenhouse gas emissions from transport that will also benefit Australia in increasing its fuel supply security" that "was developed directly with the transport industry" (CSIRO n.d.).

2.3 Forum outcomes

The main identified outcomes patterns are summarised below under the following sub-headings:

- General process outcomes (e.g. impact on strategic choices and decision-making);
- Other process outcomes related to collaboration/collective action;
- Influence on policy-making processes;
- Shorter-term Energy Flagship outcomes (e.g. influence on R&D activities);
- Other Energy Flagship outcomes: relationship-building and further modelling work; and
- Other important outcomes

General process outcomes (e.g. impact on strategic choices and decision-making)

Many participants reported that the process and reports reinforced their pre-existing views and/or strategic choices regarding the future of transportation fuel issues and alternative fuel options.¹³⁴ For example, prior to the forum General Motors (GM) adopted a new energy diversity strategy and GM Holden staff interpreted the forum as supporting this approach.¹³⁵ The forum's assessment and modelling was reviewed in-detail internally and considered at board level and was judged to have added credibility to their energy diversification strategy and policy positions, internally and externally (R. Marshal, 2014, personal communication, 23 October). In December 2008 GM Holden announced that it would release an E85 Commodore as part of GM's plan to take a "leadership position" on ethanol fuels (Pettendy 2010). Additionally, the firm announced new plans to collaborate with US biofuels firm Coskata to establish a major cellulosic ethanol facility in Australia (however it was never built).

The forum reports and process were used as part of discussions around whether to trial new fuels, such as LNG, in Woolworths' truck fleet and contributed to an internal consensus on these trials (A. Booth, 2014, personal communication, 29 September). These trials were also consistent with plans announced in 2007 to increase the use of alternative fuels as part of its efforts to reduce the company's greenhouse gas emissions (Woolworths 2007). The forum analysis, thus, reinforced Woolworths emerging adoption of alternative fuels.

Prior to the forum Caltex also had a developing focus on biofuels, which was partly driven by the Howard Government's Biofuels Action Plan. In early 2008 (mid-forum) Caltex was "the leading biofuels marketer in Australia amongst the majors" (King 2008). This direction continued post-forum with the company's: development of the largest biofuel network in Australia (Caltex 2009); advocacy of new "proactive" policy frameworks to support the growth of biofuels (e.g. *The Star* Issue 50, Dec 09-Jan10); and development of new fuels such as the

¹³⁴ All surveyed forum participants neither agreed nor disagreed with the statement '*I made different strategic decisions and/or created different policies because of the Future Fuels Forum*', which indicates limited or no shift in strategic thinking and choices. Similarly, few surveyed participants agreed with statement that '*The Future Fuels Forum challenged my beliefs and assumptions about transport fuel issues and the options for managing these issues*'. Of the 12 respondents, 7 neither agreed nor disagreed, and 1 disagreed. 4 participants agreed, most of whom previously had limited knowledge of alternative fuels and associated issues: Monica Richter (Australian Conservation Foundation), Clive Mottram (Engineers Australia), Hugh Thomas (Victorian Government Policy Officer), and another Victorian government participant (who is non-identifiable). Similar results were gained from CSIRO's survey of forum participants: regarding the statement '*my perception of future fuel needs of Australia to 2050 is different from those at the beginning of the project*', about 50% (47%) of respondents were neutral (n=8), 35% disagreed (n=6), and 18% of respondents agreed with the statement (n=3).

¹³⁵ The (then) Director of Innovation at GM Holden, Richard Marshall, contended that "one of the key things was that it provided independent third-party data and endorsement for a particular strategy. I'm not saying it was going to predetermine what the outcome was, but whatever the outcome was of the future fuels forum would add data to help guide that overall direction" (R. Marshal, 2014, personal communication, 23 October).

E85 ethanol blend fuel.¹³⁶ The company's biofuels advocacy shifted to also emphasise energy security. The Oct-Nov 2008 edition of the company magazine *The Star* emphasised the firm's strong "belief in biofuels",¹³⁷ stating that:

The fact is, these fuels have an important role to play in Australia's energy supply security and in helping to reduce greenhouse emissions into the future. If properly developed, biofuels need not adversely impact food supplies and will have undeniable environmental benefits (Anon. 2008a).

Although energy security was increasingly emphasised by the company (e.g. Topham 2009), including the expectation that "oil demand will outstrip conventional oil supply in the foreseeable future" (Topham 2009, p. 5), there is no evidence that Caltex took the forum's near-term oil peak scenarios seriously. Senior management publicly presented and drew on selected outputs from the forum modelling, specifically those based on EIA-projections of largely unconstrained oil supply (and not the ASPO perspective which predicted near-term oil supply constraints).¹³⁸ The firm's energy security advocacy emphasised what it argued to be the importance of maintaining an oil refining industry in Australia and a "strategic framework" for advancing the development of biofuels in Australia (Topham 2009).¹³⁹

The Convenor of the Australian branch of the Association for the Study of Peak Oil and Gas (ASPO-Australia) Bruce Robinson interpreted the forum's analysis as accepting "a lot of my assumptions and beliefs" and argued that it "challenges everyone else's, but not mine" (B. Robinson, 2014, personal communication, 23 October). Following the forum Robinson also remained highly skeptical of the potential for alternative fuels to mitigate oil supply risks. Robinson (and ASPO-Australia) emphasised the near-term decline scenarios in *Fuel for Thought* in public presentations and largely ignored the other scenarios: "the fast decline peak oil scenario coupled with a slow uptake of alternatives, that's the sort of scenario that I think is quite probable" (B. Robinson, 2014, personal communication, 23 October). Thus, Robinson's pre-existing views and beliefs were reinforced by the forum.¹⁴⁰

¹³⁶ The new Managing Director of Caltex Australia Julian Segal (appointed in July 2009) put it this way: Caltex "actively seeks new business opportunities [in biofuels]. We are already Australia's leading supplier of biofuels blends to retail and commercial customers, and see potential commercial upside in them in future". Segal added: "we are proposing that Australian governments, in conjunction with industry and other interested parties, adopt a proactive policy framework".

¹³⁷ Available online at: <http://microsites.caltex.com.au/thestar/issues/45-Oct-Nov-08/default.asp>, last viewed on 30/06/2017.

¹³⁸ Also see Topham (2009): "While conventional fossil fuels including refined products will remain dominant over the next few decades, alternatives will make a relatively small but significant contribution and energy policy should support this diversification of energy supply". This is consistent with the company's focus on "diversifying its fuels portfolio".

¹³⁹ A strategic framework for alternative fuels was created in 2010-11 (Australian Government 2011b) and this framework was an input in to the Energy White Paper that was released by the Gillard Labor Commonwealth Government in 2012.

¹⁴⁰ Similar to this effect on participants' beliefs, some other participants who were skeptical about peak oil and its implications became more skeptical (e.g. reduced concern about peak oil, development of stronger beliefs that there are available alternatives to oil should we need them, etc.).

For NRMA the forum process and outputs were seen as complementing NRMA's ongoing advocacy work (such as through the Jamison Group) and it also informed their advocacy activities. Previously in 2006 NRMA had initiated an Alternative Fuels Summit (with the theme "It's time to address Australia's fuel crisis"). NRMA used the forum outputs as part of its continuing advocacy of a national alternative fuel plan. In contrast to Caltex, NRMA emphasised the worst case scenarios modelled by the forum in which petrol prices rose as high as \$8/litre, further asserting that "there is no doubt that the price will rise as oil becomes scarcer" (NRMA Motoring & Services 2010).

For other participants, such as those with less pre-existing knowledge, the forum did generate new thinking and strongly shape their strategies and activities. Post-forum the Australian Conservation Foundation (ACF) focussed more on sustainable cities and sustainable transport. Then manager of the ACF's Sustainable Australia program, Monica Richter, secured resources to hire a sustainable transport campaigner which boosted ACF's capacity "in the policy space around transport" (M. Richter, 2014, personal communication, 13 October).

An additional group of participants – including Sasol Chevron, and the Biofuels Association of Australia – principally attended the forum as part of their ongoing efforts to advance particular alternative fuels, such as gas-to-liquids fuels (Sasol Chevron) and biofuels (BAA), and/or to advocate a particular viewpoint on transport fuels (e.g. ASPO-Australia). As such, for these participants, the forum wasn't a learning exercise/opportunity so much as an *advocacy* opportunity. The associated perceived benefit for Sasol Chevron was that forum provided the company with a new "platform" to enable communication of the potential benefits of gas-to-liquids fuels as a product and future energy pathway (E. van der Wateren, 2014, personal communication, 20 October). Sasol Chevron reported that no tangible outcomes resulted from their participation and, soon after the forum, the joint venture was disbanded in large part due to the shifting economic outlook for natural gas and crude oil and associated commercial considerations (E. van der Wateren, 2014, personal communication, 20 October).

Other process outcomes related to collaboration/collective action

Following the forum collaborations developed, including coordinated action by forum participants:

- Joint advocacy activities in Federal and State parliament by the Australian Conservation Foundation (ACF), ASPO-Australia and the Biofuels Association of Australia.
- The Australian Conservation Foundation (ACF) and NRMA collaborated, including joint participation in advocacy (e.g. associated with NRMA's 'Jamison Group') and development of ACF's Alternative Technologies and Fuels Coalition (which included NRMA, the Australian Automobile Association, NSW Farmers Federation, and Environment Business Australia).
- Post-forum ACF also conceived of the Rapid, Active and Affordable Transport Alliance (RAATA), which – according to then Sustainable Australia program manager Monica Richter (a forum participant) – "was seeded through our increased engagement on the issues and comfort in working with some of the FFF [Future Fuels Forum] members"

(M. Richter, 2014, personal communication, 13 October).¹⁴¹ RAATA advocated for investment in “public and active transport infrastructure and ensure our urban centres and suburbs are redesigned to support Transit Oriented Development”.

Caltex and GM Holden formed a biofuels partnership following the forum, but this was unrelated to their participation in the FFF (R. Marshall, 2014, personal communication, 23 October). (This partnership led to the development of an E85 fuel, an ethanol-based fuel designed for use in Holden's VE Series II Commodore flex-fuel vehicles which was subsequently released in 2010. Caltex and Holden were part of a consortium that investigated the potential for turning household and building waste products into ethanol fuel¹⁴²).

ACF also focussed more on these issues, led by Monica Richter (a forum participant), including employing a full-time sustainable transport campaigner. This included coalition-building and related policy advocacy and related sustainable cities research and advocacy work.

Influence on policy-making processes

Forum participants reported that the forum had a little direct influence on policies of the participating State governments (Victoria and South Australia). Interviewees involved with the development of the Victorian Transport Plan (released in December 2008, i.e. five months after the report was released) reported limited use of the forum learnings and outputs (K. Handberg, 2014, personal communication, 28 November).¹⁴³ A participant involved in the development of the Victorian Governments climate change ‘green paper’ (released in July 2009) and ‘white paper’ (released in July 2010) reported some, but limited, use of forum reports to support policy recommendations, with evidence “cherry picked out of the report” (H. Thomas, 2014, personal communication, 1 December).

The Victorian Transport Plan (VTP) asserted that “we need to take action now to position the Victorian transport sector to reduce emissions over the short, medium and longer term”, and included a small project entitled ‘Increasing the Use of Low Emission Vehicles’ (Victorian Government 2008, p. 112).¹⁴⁴ This project included a set of planned actions to: set mandatory carbon emissions targets for State Government fleets (which were not introduced); enable

¹⁴¹ Alliance members included: ACF, the Australian Association for the Study of Peak Oil and Gas (ASPO-Australia), Australian Council of Trade Unions, Bicycle NSW, Bus Industry Confederation, City of Sydney, Conservation Council of South Australia Inc, Conservation Council of Western Australia, Diabetes Australia, Environment Victoria, GetUp, National Heart Foundation, Nature Conservation Council of NSW, Public Transport Users Association, Queensland Conservation Council, Rail Tram and Bus Union, and UITP (International Association of Public Transport).

¹⁴² Source: <http://www.caltex.com.au/LatestNews/Pages/NewsItem.aspx?ID=13178>

¹⁴³ Another Victorian government participant stated that “the outputs were difficult to directly use as they were consensus based rather than demonstrably supported by rigorous evidence” (government informant [off-the-record], 2014, personal communication, 22 August).

¹⁴⁴ Related to this, one Victorian government participant remarked (in reference to the electric vehicle trial) that “\$5 million out of \$38 billion was for some work around low emission vehicles”. Whilst other initiatives also had some funds committed to them, overall the vast majority of funds were committed to investments in infrastructure i.e. roads and public transport (K. Handberg, 2014, personal communication, 28 November).

new partnerships between fuel and vehicle industries and commercial fleets; and support for small-scale trials of emerging technologies, such as the Victorian electric vehicles trial that ran from 2010-2013 (K. Handberg, 2014, personal communication, 28 November).¹⁴⁵

Initiatives such as the electric vehicles trials were undertaken for many reasons:

“You could construe that to be an outcome from the Future Fuels Forum which indicated that yes there should be some work done to reduce the barriers to adoption of such technologies [i.e. electric vehicles]. And that is sort-of true. But the real reason that was invested in was because it was viewed as a sweet spot – we have a local automotive industry, there is a global trend towards this particular technology, we have to green our transport package, so we will kick \$5 million into it” (K. Handberg, 2014, personal communication, 28 November).

The VTP also included a continued commitment to trialling hybrid busses. From 2009-2011 hybrid-electric bus technologies were trialled in the Victorian bus fleet. Two studies were also completed on the availability and suitability of alternative fuels and vehicle technologies for buses.

Transport was also one of the sectors targeted by the Victorian Brumby Government’s climate change policy which aimed to complement the (then planned) ‘Carbon Pollution Reduction Scheme’ (CPRS). The initial ‘green paper’ (Victorian Government 2009) noted that a carbon price alone is not expected to lead to significant reductions in emissions in the transport sector in the short- to medium-term – consistent with forum analysis – but didn’t cite the forum’s analysis. (It cited research by the National Transport Commission). The white paper outlined actions to improve the fuel efficiency of cars and trucks (e.g. early support for the electric vehicle market, use of lower-emissions vehicles in the government fleet, and advocacy for a national fuel efficiency target) but no initiatives for developing alternative fuels.

There is no evidence that participation of the South Australian government in the Future Fuels Forum informed or influenced government policy and programs. Major planning documents, e.g. the ‘30 Year plan for Greater Adelaide’ released in 2010, cited other research such as by the Garnaut Climate Change Review and US Energy Information Administration. Related initiatives such as the Algal Biofuels Consortium were separate activities with no overlap with the forum (T. Beer, 2014, personal communication, 2 December).

In addition, at the national level, the forum outputs were drawn on by biofuels advocates which may have influenced Federal policies. Advocates utilised the forum’s analysis (along with other analysis) when lobbying for an extension to the existing fuel excise regime in 2009-10,

¹⁴⁵ Participation in the forum also had an influence on the design of the electric vehicle trial. Handberg – who manage this trial – stated that “I was strongly influenced by the sense that there is a very solid policy argument in favour of taking steps to allow for an easy transition or an easier transition”. The trial was designed to enable advance learning, i.e. about possible futures (e.g. a future when it is cost effective to drive electric vehicles), such as learning about policies and programs that could help to smooth the roll-out and adoption of electric vehicles when they are cost effective.

for which a bipartisan commitment was reached on in 2011 to extend this regime to 2021 (but it was subsequently adjusted in 2014).

GM Holden also used the forum analysis in national policy debates, in particular the debate about mandatory vehicle requirements (e.g. new fuel efficiency targets or CO₂ emissions standards).¹⁴⁶ The forum reinforced GM Holden's view that demand-side approaches are needed and supply-side mandatory measures would be "quite unworkable" (R. Marshall, 2014, personal communication, 23 October), pointing to "issues relating to consumer willingness and ability to pay for the various technologies which will be required to achieve the target" and negative impacts on "vehicles produced in Australia" (GM Holden 2008).

Shorter-term Energy Flagship outcomes

The Flagship Director was able to use the forum analysis and reports to advocate internally for the Flagship's proposed alternative fuel research projects to secure access to internal 'appropriation' funding (which had been allocated, but not provided, to the Flagship) and related resources. Overall, the forum "confirmed the direction that we thought the transport fuels situation should go" and the forum outputs were used when justifying proposed research programs (e.g. to CSIRO management) and accessing resources (J. Wright, 2014, personal communication, 25 August).¹⁴⁷ Convening the forum also contributed ideas such as for new technologies for trucking, which was stimulated via dialogue with Woolworths.

In this process, the perceived backing of transport industry stakeholders was important:

"There were some programs and projects which I thought were inherently a good thing to do... [but] if you didn't have anything to back that up and justify that this is the way to go, for example presenting evidence that this is the way that industry would like us to go, then your chance of getting that program approved was very low" (J. Wright, 2014, personal communication, 25 August).

The forum also reinforced the Director's concerns about fuel security risks:

"I always did have a concern that whenever government talked about Australia and

¹⁴⁶ For example, in its submission to the Fuel Efficiency Working Group GM Holden cited the modelling completed for the Future Fuels Forum when arguing that: "introduction of any additional measures to reduce emissions from vehicles [i.e. supplementary to an emissions trading scheme] will not represent an efficient policy outcome"; introduction of mandatory fuel standards may "leads to an immediate increase in CO₂ emissions"; and that "the introduction of a mandatory fuel efficiency standard does not achieve long-term additional reduction in CO₂ emissions and as such, is an inefficient policy option" (GM Holden 2008).

¹⁴⁷ The then Stream Leader for transport biofuels also stated that: "we were already doing it [algal biodiesel-focussed research] before the forum and the forum sort of narrowed us down. My recollection is that we essentially started out trying to narrow down what our research should be with a thing called the alternative fuels calculator. It never reached the light of day for lots of good reasons but it turned out to be a useful exercise in which we tried to rank various alternatives on different criteria. Perhaps a core role of the Future Fuels Forum was in helping to make the case that this existing research agenda – focussed on biodiesel production, especially from algae – should be more of a priority" (Dr T. Beer, 2014, personal communication, 14 September).

transport fuels they were not giving it the weight that I thought it should have... because if something major did happen [to disrupt international liquid fuel supplies] we know from our own studies that in a very short period of time, particularly with respect to liquid transport fuels, that basically the whole country shuts down. To me that's a big issue and if we're not preparing for that we're in trouble... What happened with the Future Fuels Forum is that it made me realise, and I think other participants too, just how fragile we are" (J. Wright, 2014, personal communication, 25 August).

The leader of the transport biofuels 'Stream' became "absolutely convinced of this future diesel problem" (Dr T. Beer, 2014, personal communication, 14 September). This CSIRO staff member asserted that forum modelling was perceived to reinforce "Deborah O'Connell's work [which] gave the hard figures showing that diesel is harder to substitute" and he used the outputs in presentations given on the Flagship's biofuels research to justify their focus on algal biodiesel (Dr T. Beer, 2014, personal communication, 14 September).

Participation in the forum by some Flagship staff also significantly increased their commitment to biofuels research. Forum participation resulted in the leader of the 'Sustainable Biomass Production' project, Deborah O'Connell, focussing on biofuels for a number of subsequent years and becoming committed to aiding the creation of domestic bio-based energy industries (Dr D. O'Connell, 2014, personal communication, 4 September).

The net result of the above included:

- Increased internal ('appropriation') spending on biofuels research, through to 2012-13, to assess whether advanced generation biofuels (i.e. second-generation biofuels, third-generation biofuels, etc) are a credible option for domestic fuel supply.¹⁴⁸ An involved scientist from the Flagship asserted that "I think CSIRO was more willing to fund further research even without industry and government co-investment on the basis of a better understanding the potential contribution to fuel security, the potential price competitiveness and the potential emissions reduction benefits" (D. O'Connell, 2014, personal communication, 4 September);
- Additional research projects on algal biofuels (conducted from 2008-09 onwards) – including on biodiesel from algae (e.g. algal speciation research) and thin film algae ponds – and other potential advanced generation biofuels (e.g. lignocellulosic to bio-crude); and
- Greater collaboration between the Flagship and related research Divisions at CSIRO such as Marine and Atmospheric Research (also see the Australian National Algae Culture Collection).¹⁴⁹

¹⁴⁸ Internal financial records were reviewed to confirm this increase in funding.

¹⁴⁹ Dr John Wright argued that the forums assisted the Flagship with accessing internal resources: "the Future Fuels Forum helped me to get more people and resources out of different Divisions in CSIRO, particularly in the biofuels area. As Flagship Director my role was to get the chiefs of Divisions to agree to work with the Flagship and the Division chiefs wanted to know that their people are working on something that's wanted both internally and externally" (J Wright, 2014, personal communication, 15 August). He used approvals from CSIRO management to convince various Divisions to provide the people and resources he needed (Dr J. Wright, 2014, personal communication, 25 August).

The forum process also generated additional related learnings about transport and potential fuels. For example, the forum stimulating greater consideration of electricity as a transport 'fuel', consideration of the role of transport in emission reduction, detailed consideration of hydrogen and of LNG in freight, and an understanding of the potential implications of peak oil (CSIRO 2008b).

However, some Flagship staff were disappointed with some of the forum outcomes. The Stream Leader for transport biofuels research (at the Flagship) lamented that "the forum didn't unzip the wallets and purses of industry, which is what I would have hoped it had done" (T. Beer, 2014, personal communication, 14 September). Similarly, the then low-emission transport Theme Leader emphasised the barriers faced when the Flagship tried "to get some traction in alternative fuels, because there was the tiniest foetus of an industry there. There was very little capital..." When "you ask or talk about what money is going to be spent furthering the objectives of the report the answer is zilch. So it becomes a political exercise" (D. Lamb, 2014, personal communication, 18 August).

The focus on potential shorter-term or medium-term rises in petrol fuel prices (i.e. the scenarios in which the price rises to as much as \$8/litre by 2018) also disappointed the Stream Leader for transport biofuels research, who stated: "possibly herein lies a problem. To me that was one of the most unlikely, outlandish scenarios and furthermore to me petrol wasn't the problem. So what I go out of it [the Future Fuels Forum] obviously wasn't a shared vision. I was absolutely convinced of this future diesel problem and that got very little of the attention and publicity" (T. Beer, 2014, personal communication, 14 September).

Other Energy Flagship outcomes: relationship-building and further modelling work

The forum led to new and strengthened relationships between the Flagship and some of the participating organisations and process observers. Relationships with some government bodies and agencies developed including closer ties with the Federal Bureau of Infrastructure Transport and Regional Economics (BITRE), who participated in the forum as an observer. The Flagship was also requested to contribute to public policy processes (P. Graham, 2014, personal communication, 21 November).¹⁵⁰ The Department of Resources, Energy and Tourism (also an observer) sought further updates on the viability of synthetic fuels and advice on the transport sections of its Energy White paper. The industry relationship that was most enhanced by the forum was with the biofuels sector, including with the Biofuels Association of Australia (J. Wright, 2014, personal communication, 9 June).

The forum contributed to a new relationship with Queensland Transport (QT). QT contracted CSIRO to examine how vehicle registration and stamp duty could be aligned with emissions

¹⁵⁰ Specifically, Graham noted that "the government requested CSIRO provide their modelling capability to the Garnaut Review and their modelling of the Carbon Pollution Reduction scheme in partnership with CSIRO was also able to provide more value to the BTRE (who also participated as observers). In their internal analysis of the impact of tightening oil prices they requested CSIRO conduct further exploration of this issue for them. BITRE are Australia's premier transport demand modeller but do not have the capability to model fuel uptake. CSIRO's capability therefore neatly complements their own" (P. Graham, 2014, personal communication, 21 November).

reduction. The Queensland Government subsequently changed stamp duties, pricing hybrid and electric vehicles in the lowest vehicle stamp duty price category in Queensland (Office of Climate Change 2010).

Finally, for the Flagship itself, including the project leader (Paul Graham), the FFF also helped to establish its techno-economic modelling activities and led to improved relations with relevant government agencies such as BITRE. This led to additional modelling work for the Garnaut Climate Change Review (in partnership with BITRE) and the National Transport Commission. CSIRO, via the Energy Flagship, became a regular, trusted advisor to government in regard to the future of transportation and transport fuels and associated policy issues (e.g. future greenhouse gas emissions and emissions reduction).¹⁵¹

Other important outcomes

For the Flagship, the clearest longer-term impacts are related to greater internal funding for biofuels research through to 2012-13. The forum contributed to this area of research being seen as *legitimate* area for CSIRO to provide strategic pre-commercial funding to, in order to assess whether biofuels provide a credible fuel option, despite the lack of industry and/or government co-investment (D. O'Connell, 2014, personal communication, 4 September; J. Wright, 2014, personal communication, 15 August). This enabled Flagship staff to become leading experts on biofuels and to produce additional research that assisted the development of investment cases and, in some cases also helped to secure further investment in biofuels operations such as by CSR Ethanol (G. Hughes, 2014, personal communication, 7 October). The forum itself contributed to Qantas approaching the Flagship to run an aviation fuel forum (D. O'Connell, 2014, personal communication, 4 September).

One State government approached for Flagship to conduct additional research. The Victorian Government, led by Regional Development Victoria (RDV), sought to better understand the State's biomass resources and their development potential, including a review conducted by the Flagship (Taylor et al. 2011). The research funded by RDV has underpinned programs that seek to increase investment in biofuels and related bioenergy industries (see the former *Fuelled for Growth* program).

For the Flagship, the forum also helped to further establish its techno-economic modelling activities and improved its relations with relevant government agencies as a strategic advisor (see details provided above), which informed related government policies (e.g. the Carbon Pollution Reduction Scheme proposed by the Rudd Government).

Members of the biofuels industry lobbied for an extension to existing taxation arrangements (in particular for locally produced ethanol to be exempt from fuel excise), including the Biofuels Association, and some actors used the forum modelling during this advocacy. A ten-

¹⁵¹ The Flagship has contributed to various climate policy analyses conducted for the Federal Government (Garnaut, Carbon Pollution Reduction Scheme, the Clean Energy Future package) and some of the various Federal Government Energy White Paper processes (e.g. during 2011-12) and is a regular provider of transport emission projection updates.

year moratorium was subsequently agreed by the Gillard government. The *Taxation of Alternative Fuels Legislation Amendment Bill 2011* legislated: 1) a 10 year moratorium on changes to the taxation and grant arrangements for ethanol, biodiesel, renewable diesel and methanol; and 2) introduced new taxes on LPG, LNG and CNG phased in from 2011-2015 (at a 50% discount rate to regular petrol).

However, large-scale commercial investment in biofuels hasn't occurred. The biofuels industry remains small, with only three ethanol plants, and established industries have not made significant investments (D. O'Connell, 2014, personal communication, 4 September).¹⁵² GM Holden is the only firm that sells flexible-fuel vehicles in Australia (Commodore and Saab vehicles). Consistent with this assessment in 2011 the Australian Automotive Association described the status of alternative fuels in Australia as "fledgling" (Australian Automobile Association 2011), and little change in status has occurred since.

There is some evidence that over the 2007-2011 period liquid fuel security and the development of alternative transport fuels became more salient policy issues, but it is unclear to what extent the forum, associated advocacy (e.g. by forum participants), or the additional external communications by Flagship staff, contributed to these events. In 2008 the Federal Department of Resources, Energy and Tourism began commissioning regular Liquid Fuel Vulnerability Assessments (ACIL Tasman 2008, 2011), and in December 2011 the Gillard Government released a new 'Strategic Framework for Alternative Transport Fuels' (Australian Government 2011b) which was an input in the Energy White Paper. This new framework argued against government intervention and for "market driven diversification".

2.4 Summary

The Future Fuels Forum advanced the Flagships alternative fuels research program *internally* (e.g. via program approvals, greater access to resources and people in CSIRO Divisions) and *externally* didn't stimulate, or lead to, the investments that are needed to further develop and to commercialise at-scale alternative fuel options. The available evidence also suggests that participation in the forum, for most participants, tended to reinforce preexisting views and directions – e.g. providing an 'endorsement' (real or perceived) for an existing/proposed strategy (e.g. GM Holden), reinforcing existing thinking on adopting particular fuels (e.g. Woolworths Limited's adoption of LPG in its trucking fleet), and reinforcing pre-existing

¹⁵² The former Theme Leader for low-emissions transport research at the Flagship, David Lamb, similarly lamented that "*the opportunity in Australia was so limited, it was so difficult to be ambitious or to be hopeful of success*" (D. Lamb, 2014, personal communication, 18 August). Little funding was ultimately also provided to increase the electrification of road transport and develop such vehicles in Australia. The Victorian Government provided some funding to Toyota build a local hybrid Camry vehicle but that decision was criticised by Lamb who noted that "*Toyota got \$30 million dollars from the government to build a hybrid vehicle in Australia; of course, what we wanted was the Prius, but that would have taken a massive investment. So, what did they do? They convinced the government to produce a bastardised Camry which was a Camry with a few trick pieces in it in order to call it a hybrid. But a Camry is an 8 litres per 100 kilometres car; a long way away from the Prius which is a 4 litres per 100 kilometres car. So Australia never really had a hybrid car and to tell you the truth never actually stood any prospect of producing one*" (D. Lamb, 2014, personal communication, 18 August).

positions on peak oil (e.g. those who were alarmed become more so) and its implications (e.g. related beliefs about alternative fuel options and government policy priorities) – and also indicates that the forum had limited influence on public policy. Additionally, the forum stimulated new collaborations between advocacy organisations.

There is little evidence that the broader objectives of the exercise were achieved; that is, there is little evidence that the forum itself, nor the subsequent communications activities, “facilitate[d] wide adoption of the views developed by the Future Fuels Forum so they achieve the necessary momentum required to support the investment and policy decision making” (CSIRO 2007b). In a limited number of cases the forum’s analysis was considered in investment and policy decision-making, such as the Victorian electric vehicle trial and the expansion of ethanol production by CSR Ethanol. The available evidence suggests that the process didn’t contribute to a significant increase in investment in alternative fuels (such as greater external investment in the Flagship’s research or greater commercialisation activity), nor was there wide adoption in policy decision-making.

Some non-participants referred to the report during discussions around alternative fuels and climate change strategy, such as use of the forum report by Qantas staff and by some local councils during local debates about transport infrastructure. The Flagship’s associated process convening experience and credibility also contributed to subsequent futures forums (e.g. the Sustainable Aviation Fuel Road Map Forum).

Core forum delegates (Future Fuels Forum)

(as listed in the public forum report)

Total core delegates: 62

Sectoral breakdown

- Government department/agency representative: 28 (45%) – Federal/State split: 11/17 (Victoria most strongly represented)
- Industry: 19 (31%)
- NGO representative: 10 (16%)
- Research/CSIRO: 5 (8%)

Full details

Name	Organisation	Title	Sector
Maria Askildsen	Queensland Rail	Mechanical Engineer	Government
Tom Beer	CSIRO Energy Transformed Flagship	Research stream leader – transport biofuels	Research
Alan Booth	Woolworths	Senior Logistics Analyst	Corporate
Andrew Brewer	Caltex Australia Ltd	Acting Group Manager – Strategy & Planning	Corporate
Mark Byrne	Public Interest Advocacy Centre	Senior Policy Officer	NGO / Issue advocate
Fiona Calvert	Victorian Department of Transport	Director Sustainable & Active Transport Policy	Government
Andrew Ceber	Commonwealth Treasury	Policy Analyst, Climate Change Modelling Unit	Government
Roy Chamberlain	CSIRO Energy Transformed Flagship	Deputy Director	Research
Mark Dess	Victorian Government – Department of Business & Industry	Senior Policy Advisor	Government
Dragan Djakovic	Sasol Chevron	Market Development Manager – Gas to Liquids	Corporate
Gary Dolman	Bureau of Infrastructure, Transport and Regional Economics (BITRE)	Head of Bureau	Government Agency
Glenn Drover	Victorian Government – Department of Business & Industry	Manager – Economic Infrastructure	Government
Ian Dunlop	ASPO Australia and Australia21	Deputy Convenor	Advisor Issue advocate
Craig Eyes	Regional Development Victoria	Program Manager, Regional Infrastructure Development	Government

David Gargett	Bureau of Infrastructure, Transport and Regional Economics (BITRE)	Research Leader	Government Agency
Garry Glazebrook	University of Technology Sydney (UTS)	ASPO-Sydney member A/Professor	Research / Issue Advocate
Andrew Gurney	Australian Bureau of Agricultural and Resource Economics (ABARE)	Senior research officer	Government Agency
Jack Haley	NRMA Motoring and Services	Senior Policy Advisor	Industry / Interest Group
Stewart Hames	Queensland Rail	Mechanical Engineer	Government
Kristian Handberg	Victorian Department of Sustainability and Environment	Project Manager	Government
Bruce Harrison	Biofuels Association of Australia	Chief Executive Officer	Industry association
Phil Hart	Association for the Study of Peak Oil and Gas (ASPO)	Convenor – Oil and Gas Industry	NGO / Issue advocate
Murray Heck	Rocky Point Distillery	Executive Director – Ethanol	Corporate
Edwin Higginson	Woolworths	National Fleet Manager National Supply Chain	Corporate
Mark Hull	Victorian Department of Primary Industries	Manager, Sustainable Technology Development	Government
Elliot Fishman	Association for the Study of Peak Oil (ASPO)	Convenor – Melbourne Branch	NGO / Issue advocate
Marwa Khalaf	Victorian Department of Primary Industries	Senior Policy Analyst	Government
Andrew Klos	South Australian Department for Transport, Energy and Infrastructure	Principal Policy Advisor, Environment Policy	Government
David Lamb	CSIRO Energy Transformed Flagship	Theme Leader – Low-emissions transport	Research
James Le Cornu	Engineers Australia	Voluntary committee member	NGO / Issue advocate
Richard Marshall	GM Holden	Director – Innovation	Corporate
Jack McAuley	Bureau of Infrastructure, Transport and Regional Economics (BITRE)	Research officer	Government
Donald McKinnon	Caltex Refineries (NSW) Pty Ltd	UNKNOWN	Corporate
Jane Melanie	Australian Bureau of Agricultural and Resource Economics	General Manager	Government
John Metcalfe	Australian Automobile Association	Director – Research and Policy	Interest Group
David Middleton	Queensland Rail	Rollingstock Engineering	Government
Deirdre Moor	Public Interest Advocacy Centre	Manager Policy and Programs	NGO / Issue advocate
Helen Morrow	Victorian Department of Primary Industries	Policy Officer	Government
Clive Mottram	VicRoads (Attended as a representative of Engineers Australia from the	Manager, Planning Investigations	Government

	National Committee on Transport Engineering)		
Dugald Murray	Victorian Department of Primary Industries	Senior Policy Advisor	NGO / Issue advocate
Henry O'Clery	Future Climate Australia	Executive Director	NGO / Issue advocate
Deborah O'Connell	CSIRO Energy Transformed Flagship	Project leader – alternative fuels	Research
Jim Patel	CSIRO	Research Team Leader	Research
Monica Richter	Australian Conservation Foundation	Sustainability Programs Manager	NGO / Issue advocate
Bruce Robinson	Association for the Study of Peak Oil and Gas (ASPO) –Australia	Convenor	NGO / Issue advocate
Ken Robson	Sasol Chevron	Business Manager	Corporate
Wal Setkiewicz	NRMA Motoring and Services	Senior Economic Advisor	Interest group
Mike Shackleton	ARRB Group Ltd	Manager - Research Operations & Strategy	Consultancy / advisors
John Sligar	Sligar and Associates	Director	Consultancy / advisors
Neville Smith	Queensland Rail	Station Master	Government
Donna Soo	National Transport Commission	Senior Policy Analyst – Safety & Environment	Government
Laurie Sparke	EDay Life Ltd	Technical Director	Corporate / business
Kelvyn Steer	Environment Protection Agency South Australia	Branch Manager Air and Noise	Government
Robert Stewart	Bureau of Infrastructure Transport and Regional Economics (BITRE)	General Manager, Infrastructure and Transport Research	Government agency
Nicholas Stoney	Commonwealth Treasury	Senior Adviser	Government
Norm Taylor	Sasol Chevron	External Affairs Manager	Corporate
Hugh Thomas	Victorian Government	Policy Officer	Government
Thorolf Thoresen	ARRB Group	Principal Economist, Asset Management	Consultancy / advisors
Eric van der Wateren	Sasol Chevron	General Manager – Global Marketing	Corporate
Crispin Walker	Federal Department of Resources, Energy and Tourism	Manager – Petroleum Refining and Retail Section	Government
Neil Wong	National Transport Commission	Senior Manager – Environment	Government
Allyson Woodford	Caltex Australia – Lytton Refinery	Process Engineering Superintendent	Corporate

List of interviewees and surveyed forum delegates (Future Fuels Forum)

List of interviews (n=18)

Name	Role(s) at time of the Future Fuels Forum	Date of interview(s)
<i>Interviews with project staff and/or partner(s) – 3</i>		
Dr John Wright	Director, Energy Transformed Flagship, CSIRO	15 August 2014 25 August 2014
Oleg Morozow	Future Fuels Forum Chairman	14 August 2014
<i>Other interviews (forum delegates, informants) – 15</i>		
Dr Tom Beer	Transport biofuels Stream Leader, Energy Transformed Flagship, CSIRO	14 September 2014
Jack Haley	Senior Policy Advisor, NRMA Motoring and Services	3 October 2014
Kristian Handberg	Senior Policy Officer, Department of Sustainability and Environment	28 November 2014
Phil Hart	Convenor – Oil and Gas Industry working group, Australian Association for the Study of Peak Oil & Gas (ASPO-Australia)	10 October 2014
Gavin Hughes	Director, Biofuels Association of Australia; General Manager, <i>CSR Ethanol</i> (Current role was CEO of the Biofuels Association of Australia)	7 October 2014
David Lamb	Low emission transport Theme Leader, Energy Transformed Flagship, CSIRO	18 August 2014
Richard Marshall	Director of Innovation, GM Holden	23 October 2014
Clive Mottram	Engineers Australia representative (also employed by VicRoads)	10 October 2014
Deborah O’Connell	Project Leader – Sustainable biomass production project, Energy Transformed Flagship, CSIRO	4 September 2014
Monica Richter	Sustainable Australia Program Manager, Australian Conservation Foundation	13 October 2014
Bruce Robinson	Convenor, Australian Association for the Study of Peak Oil & Gas (ASPO-Australia)	23 October 2014
Hugh Thomas	Policy Officer, Victorian Department of Sustainability and Environment; shifted to Department of Premier and Cabinet in February 2008	1 December, 2014
Eric van der Wateren	GM Global Marketing, Sasol Chevron	30 October 2014
Nicole Williamson	Group Manager, Climate Change Strategy and Programs, Qantas	6 November 2014
N/A	Employed by government department (requested to not be identified)	17 October 2014
N/A	Commonwealth Government department public servant (requested not to be identified)	2 December 2014

Surveyed participants (n=12)

Name	Role(s) at time of the Future Fuels Forum	Date completed
Alan Booth	Senior Logistics Analyst, Woolworths Ltd	29 September 2014
Mark Byrne	Senior Policy Officer, Public INterest Advocacy Centre	22 August 2014
N/A	Employed by government department (requested to not be identified)	22 August 2014
Glenn Drover	Manager Economic Infrastructure, Victorian Government	6 August 2014
Jack Haley	Senior Policy Advisor, NRMA Motoring and Services	19 August 2014
Jim Le Cornu	Engineers Australia representative	6 August 2014
Richard Marshall	Director of Innovation, GM Holden	14 August 2014
Clive Mottram	Engineers Australia representative (also worked for VicRoads)	28 August 2014
Monica Richter	Sustainable Australia Program Manager, Australian Conservation Foundation	7 August 2014
Bruce Robinson	Convenor, Australian Association for the Study of Peak Oil & Gas (ASPO-Australia)	10 August 2014
Hugh Thomas	Policy Officer, Victorian Department of Sustainability and Environment; shifted to Department of Premier and Cabinet in February 2008	19 August 2014
Eric van der Wateren	GM Global Marketing, Sasol Chevron	25 August 2014

Interviewee matrix for the Future Fuels Forum (sector and interviewee category breakdown)

SECTORAL CATEGORY	INTERVIEWEE	OUTCOMES CATEGORY		
		'Worked' n=8	'Mixed' outcomes n=6	'Didn't work' n=3
Research	John Wright (CSIRO)	X		
	Tom Beer (CSIRO)		X	
	David Lamb (CSIRO)		X	
	Deborah O'Connell (CSIRO)	X		
	Paul Graham (CSIRO)	X		
Industry	Richard Marshall (GM Holden)	X		
	Gavin Hughes (Biofuels Association of Australia)	X		
	Eric van der Wateren (Sasol Chevron)			X
	Nicole Williamson (Qantas)	N/A	N/A	N/A
Government	N/A (non-attributable)		X	
	N/A (non-attributable)			X
	Kristian Handberg (Victorian Government – Department of Sustainability & Environment)		X	
	Clive Mottram (but mainly represented Engineers Australia at the forum)	X		
	Hugh Thomas (Victorian Government – Department of Premier & Cabinet)		X	
NGO / Interest group	Monica Richter (Australian Conservation Foundation)	X		
	Jack Haley (NRMA)	X		
	Phil Hart (Association for the Study of Peak Oil and Gas)		X	
	Bruce Robinson (Association for the Study of Peal Oil and Gas)			X

Appendix 2: Overview of the Sustainable Aviation Fuel Road Map (SAFRM) Forum and research undertaken on this forum

Forum description (SAFRM Forum)

1. Introduction

In 2010 the Australasian branch of Sustainable Aviation Fuel Users Group (SAFUG) and CSIRO convened the Sustainable Aviation Fuel Road Map (SAFRM) forum. Delegates met in a series of seven meetings held during 2010 (some of which were held over multiple days, such as a two-day workshop) from 23rd March to 13th October. In May 2011 the CSIRO Energy Flagship released the report *Flight Path to Sustainable Aviation: Towards establishing a sustainable aviation fuels industry in Australia and New Zealand* and an accompanying modelling report.

The study was the initiative of the Australasian branch of SAFUG, in particular Qantas, Virgin Blue/Australia, Air New Zealand, and Boeing. Qantas approached the Energy Flagship regarding their possible involvement in such a study and Flagship staff saw an opportunity to use its energy forum process. The process was also supported other firms (e.g. General Electric Australia, Caltex Australia, Airbus, Rolls Royce Australia) and government organisations (e.g. Defence Science and Technology Organisation [DSTO], NSW Government [Office of Trade, Business and Industry], and Queensland Department of Employment, Economic Development and Innovation [DEEDI]). One environmental group participated throughout the forum (The Climate Group); additionally, WWF participated in part of the forum but dropped out of the process due to conflicting views on climate change action priorities.¹⁵³

1.1 Forum objectives

The invitation sent to potential participants stated the overarching objective of the project was to “bring a diverse set of stakeholders together to build a high level road map building on international knowledge but focussed on the unique challenges of implementing a sustainable aviation fuels industry in the region” (Sustainable Aviation Fuel Users Group, CSIRO & Defence Science and Technology Organisation 2010). Additionally, the project aimed to:

- “Identify alternative paths and required actions that could be pursued by different stakeholders;
- Identify the level of environmental sustainability and other impacts that may be expected to be achieved over different timeframes;
- Identify the barriers; and
- Produce a fact based outcome to assist stakeholders in providing input to business and policy decision making” (Sustainable Aviation Fuel Users Group, CSIRO & Defence Science and Technology Organisation 2010).

¹⁵³ The project leader stated that the international arm of WWF had released a report which argued that the priority should be reducing airline travel, which resulted in the Australian WWF team dropping out of the process: “they said it was a good report but that they couldn’t be seen saying two different things in two reports” (P. Graham, 2015, personal communication, 23 November).

The project leader, CSIRO's Paul Graham, interpreted SAFUG's initiating of this process as seeking "a tool for getting people to move quicker and signalling to other stakeholders that they wanted to move quicker" (P. Graham, 2015, personal communication, 26 March). One of the forum Chairs, Roy Chamberlain from CSIRO, believed that the aviation's sectors main goal was to secure government support for transitioning to alternative fuels:

"I think that is really what the aviation industry wanted to do [lobby for government support]. They wanted to say here's a report from CSIRO, Australia's leading research organisation, which says what needs to be done and to then go and plonk that down on various government departments' desks and then receive funding for those activities" (R. Chamberlain, 2015, personal communication, 9 April).

Key participants from the aviation sector and related industries also conveyed a broader set of drivers and challenges, such as strategic intelligence and coordination challenges:

"We wanted to do something because we were hearing a lot about it [alternative bioderived fuels] and we were getting companies approaching us about being able to sell us renewable fuels and making all sorts of promises [i.e. about their availability, cost, volume potential, etc]. We'd been hearing about the work that was happening overseas, and of course Virgin Atlantic did the first test flight, we knew it was growing and wanted to get on with it" (D. White, 2015, personal communication, 1 June).

"What I saw happening was little efforts that were disconnected – the airlines, defence and others doing bits and pieces, or not much, and it was disconnected.... It was really trying to stimulate a new industry. What we need is a multi-billion dollar biofuels industry and we're trying to build that from the ground up. That isn't an easy task and it certainly couldn't be done if everyone is going in their own little direction" (B. Waters, 2015, personal communication, 18 June).

"It was an important step in bringing all interested parties together to develop and pull together a single view on where the industry [aviation] was going" (N. Williamson, 2015, personal communication, 26 May).

Some participants had related interests in the continuing growth of the aviation sector and wanted to help to facilitate this. The major airframe manufacturers, Boeing and Airbus, had in the years prior to SAFRM forum determined that they needed to play new "facilitative" style roles in the development in new alternative fuel supply chains and markets, due to perceived market failures (W. Lyons, 2015, personal communication, 16 June).¹⁵⁴ At the time of the forum General Electric's (GE) R&D units were working on aviation fuels and local staff were liaising with local airlines. They saw the SAFRM forum as part of this relationship-building and a key (then) GE staff member, Ben Waters, noted that "my interest was that we want aviation to be a growth industry" (B. Waters, 2015, personal communication, 18 June).

¹⁵⁴ Also see related comments by Paul Nash from Airbus (Head of New Energies), who was their forum delegate: <https://www.youtube.com/watch?v=-YQ15lcvYfU>, last viewed 30/06/2017

2. Description of the forum and its outcomes

2.1 Context

Pawson and Tilley's (1997b) "4 I's" context framework can be used to structure consideration of the process context: individuals; interpersonal relations; institutional settings; and the wider 'infrastructure' (e.g. the broader socio-technical context). Following this, the post-forum context is outlined.

Individuals

43 core delegates participated in the SAFRM forum with approximately 2/3 of the core forum delegates being from industry and 1/3 from government. One core delegate was from an environmental NGO (The Climate Group). The forum delegates from the participating airlines were mostly from environmental, engineering and/or operational departments (i.e. did not have a corporate strategy role and were not members of the airlines' C-Suite).

Interpersonal relations

A core group of delegates from the main convening organisations (i.e. Qantas, Boeing, Virgin, CSIRO) had many discussions prior to SAFRM forum including about other possible projects. Nonetheless, one of the forum Chairs, Roy Chamberlain, observed tense participant relations:

"Discussions during the forum were quite emotional and there was a lot of tension, because we obviously had competitors in the room and each one wanted to keep some things confidential but this whole forum approach relied on them being fairly open and it took time to break down a lot of those barriers" (R. Chamberlain, 2015. Personal communication, 9 April)

As per such interpersonal relations, early on the following body language was observed: "arms crossed, quite tense, with major competitors sitting at opposite ends of the table" (R. Chamberlain, 2015. Personal communication, 9 April).

There were also commercial dimensions to many relationships. For example, at the time of the forum General Electric was seeking to secure new engine sales with the local airlines who participated (B. Waters, 2015, personal communication, 18 June). Additionally, Qantas and Virgin Australia are some of Caltex Australia's biggest fuel customers.

Institutional settings

In terms of represented industries, the main delegates were from the following industries:

- Over half of the main forum delegates (n=24/43) were from a participating airline or the broader aviation sector such as an airframe manufacturer or an aircraft engine manufacturer or representative organisations such as the Royal Aeronautical Society;
- Four main forum delegates (n=4/43) were from a fuel producer or supplier (e.g. Caltex Australia) or fuel technology developer. (NOTE: Boeing's R&D division also does some research on alternative fuels such as on "green diesel"); and
- One main forum delegate was from the finance sector (n=1/43).

As was noted earlier, prior to the forum a view had developed in the aviation sector that key industry organisations – such as main airframe manufacturers such as Boeing and Airbus – needed to play “facilitation” roles to help enable the development of new supply chains for alternative fuels, sometimes referred to as helping to setup new value chains such as by leveraging their reputations to raise the profile of activities or by connecting players. This is reflected in the participation of broader aviation sector organisations.

Table 31 below outlines which organisations from these industries were represented at the forum.

Table 31: Industries and organisations represented at the SAFRM Forum

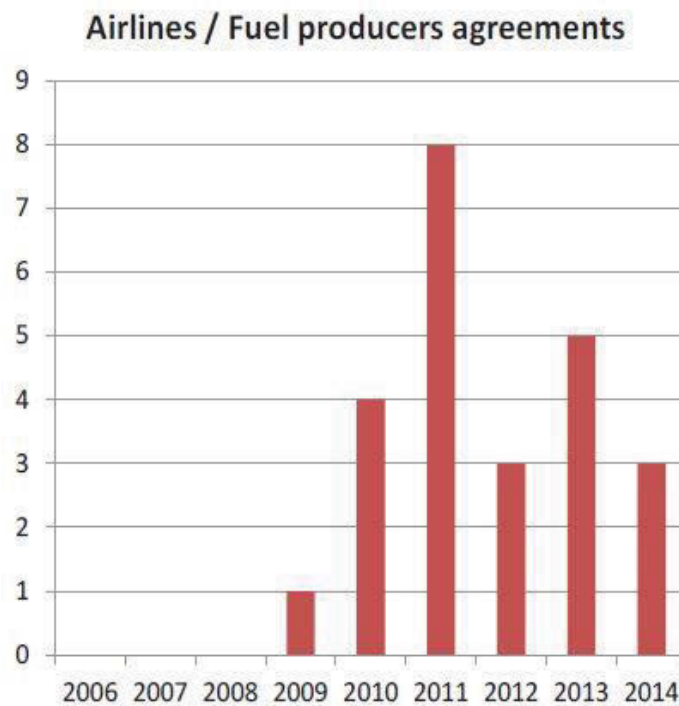
Industry	Organisation
Airline industry (Australia, New Zealand)	Air New Zealand Qantas Virgin Australia
Aviation and aerospace sector	Airbus Boeing Commercial Airplanes Boeing Research & Technology (R&D unit) Brisbane Airport Corporation General Electric (aviation division) Macdonald Technologies International Pratt & Whitney Rolls Royce Australasia Royal Aeronautical Society
Fuel sector / fuel supplier or technology developer	Biofuels Association of Australia Caltex Australia IOR UOP (a Honeywell company)
Finance	Macquarie Capital
Other: public sector / government organisations	<i>Federal Australian Government Departments/Agencies:</i> -Department of Innovation, Industry, Science and Research -Department of Climate Change and Energy Efficiency -Department of Defence (Federal Department) -Defence Science and Technology Organisation <i>State Australian Government Departments:</i> -Department of Premier and Cabinet, South Australia -NSW Trade & Investment -Office of Biofuels, NSW Government -Regional Development Victoria <i>New Zealand Government Departments:</i> Ministry of Research, Science and Technology (MoRST)
Other: NGO	The Climate Group Worldwide Wildlife Fund (WWF Australia) – NOTE: WWF dropped out of the forum process towards the end and, consequently, didn’t include its logo in the report

During the forum requests were made by participants to hear from feedstock developers and experts on feedstock-to-jet fuel production pathways, perhaps seeking to address the above

imbalances. Presentations were made by the representatives from Algal Fuels Consortium, Aquaflow, CleanStar Ventures, and Renewable Oil Corporation (Colin Stucley).

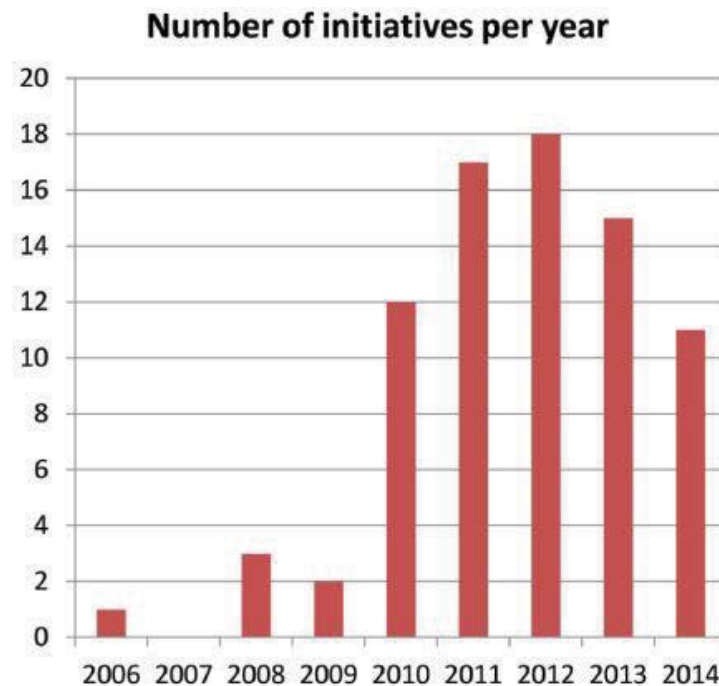
In terms of the wider institutional context, at the time of the forum there was strong growth in collaboration between airlines and fuel producers (see *Figure 9* below), along with a large increase in both multi-stakeholder initiatives on alternative fuels (see *Figure 10* below) and general growing enthusiasm for biofuels in the aviation sector. In the 2009-2010 period the International Air Transport Association (IATA) declared biofuels to be essential for achieving major industry-wide reductions in greenhouse gas emissions (International Air Transport Association 2009, 2010).¹⁵⁵ In late 2009 senior aviation industry staff judged alternative fuels to be “an imminent part of the aviation industry’s future” (International Air Transport Association 2009, p. 1).

Figure 9: Agreements between airlines and fuel producers (IATA 2014, p. 11)



¹⁵⁵ The Sustainable Aviation Fuel Users Group (SAFUG) was formed in September 2008.

Figure 10: Multi-stakeholder initiatives on alternative aviation fuels (IATA 2014, p. 13)



Wider 'infrastructure' (socio-technical, infrastructural, political and economic contexts)

The price gap with conventional jet fuel was a major hurdle at the time of the forum and this remains the case (IATA 2014). In 2014 the cost of alternative aviation fuels remained “a significant barrier to large-scale commercial production of aviation biofuels” (IATA 2014, p. 1). The general expectation – articulated in 2014 – is that “although fuel costs should decrease with the scale-up of production, in the short term, sustainable alternative fuels are not expected to arrive at par with fossil Jet-A1” and, secondly, “airlines are not in the position to deal with the associated premium” (IATA 2014, p. 12). One related policy focus advocated by IATA is assisting with “the challenge of crossing the ‘valley of death’” which can constrain the commercialisation of new and emerging technologies.

Relevant policy processes occurred concurrently to the SAFRM forum. During the 2010-12 period the Federal Government developed a new *Energy White Paper*. As part of this process, the Federal Department of Resources, Energy and Tourism (DRET) developed a *Strategic Framework for Alternative Transport Fuels* (Australian Government 2011b). The taxation arrangements for ethanol and biodiesel also became the focus of heated policy debate. The Gillard Labor Federal Government announced on May 20th, 2010 the phasing-in of fuel excise for biofuels, which was contested by the biofuels sector (and subsequently in June 2011 was agreed to be postponed until 2021).

During the SAFRM forum a Federal election was held on August 21st (between meetings 6 and 7), which resulted in a minority Labor government being elected prior-to the final SAFRM meeting. The associated agreement between the Australian Greens and the Australian Labor Party included a commitment to legislating a carbon price. Two months following the public release of the SAFRM report, the Federal Government released bills for its Clean Energy

Legislative Package which became law in December 2011. Under this legislation domestic airlines were required to pay a carbon price through an increase in fuel excise and were not provided with transitional assistance.

In the process of forming minority government an independent MP, Tony Windsor, also negotiated \$20 million of funding for the establishment of the Australian Biofuels Research Institute (ABRI). The Gillard Government stated that the main goal of ABRI was “to drive down the costs of next generation biofuel technologies” (Australian Government 2011a).

Post-forum context

The domestic and international climate policy context was dynamic post-forum. As noted above, from July 2012 domestic airlines were exposed to the starting carbon price (\$23 per tonne) through an increase in aviation fuel excise until its repeal in July 2014. Qantas did not pass on this cost to customers, argued that a carbon price is a punitive measure, and called for a shift towards alternative climate policy measures that it argued would better drive investment and innovation. The legislation for the European emissions trading scheme (ETS) was also amended so that only emissions from flights within the European Economic Area fall under the ETS. This followed a commitment by the International Civil Aviation Organization (ICAO) assembly in 2013 to develop a global market-based mechanism for international aviation emissions and to implement this by 2020.¹⁵⁶

In December 2011 the Gillard Labor Government released the *Strategic Framework for Alternative Transport Fuels* (Australian Government 2011b). This framework focussed on change (towards alternative fuel use) being driven by market forces rather than via direct government intervention. Centrally, it also proposed that measures aiming to “support the market development and deployment of alternative transport fuels” should “be feedstock and technology-neutral”. The framework and subsequent *Energy White Paper* were only partly implemented prior to a change of Federal government in 2013.

During the 2012-2014 period the “capacity war” between Qantas and Virgin Australia intensified. Virgin Australia’s chief executive John Borghetti stated on August 30, 2014 that “the last 12 months have been the most challenging in the history of Australian aviation” (Freed 2014). Major Australian airlines recorded large financial losses for the 2013/14 financial year. Key players in local sustainable aviation fuel development also made reference to “turmoil in the aviation sector” during this period (Dr S. Pond, 2015, personal communication, 23 June). A forum delegate from Boeing observed that the capacity war meant that the major Australian airlines “didn’t have the focus that they also need to have on this”, and further contended that “you had two major stakeholder groups who were just not able to participate in any meaningful way” (W. Lyons, 2015, personal communication, 16 June). Susan Pond, Chair of the Australian Initiative for Sustainable Aviation Fuels (which operated from August 2012 to July 2014), further described this context as follows:

“We were talking about going to Canberra and meeting with various departments and

¹⁵⁶ http://ec.europa.eu/clima/policies/transport/aviation/index_en.htm

Ministers but it proved difficult to develop a clear message. The airlines always wanted to be in the room but found it difficult to coordinate internally. The airline public policy folks had so many other issues on the boil that the last thing they wanted was to raise another one with government. We were put into a holding pattern by the turbulence in the [Australian] aviation sector” (Dr S. Pond, 2015, personal communication, 23 June).

The funding and capital markets context is also an important factor in the development of capital-intensive new industries and technologies. One bioenergy industry expert lamented that “Australia’s VC [venture capital] industry is too small to really do anything with biofuels” and argued that there has been a “funding vacuum” for biofuel projects and a related “funding learning curve” (industry informant, 2015, personal communication, 19 June). The Australian Government (2011b) also recognised that access to capital was a major challenge for renewable energy projects, acknowledging that “the gap in early-stage capital is a particular market failure and has been clearly demonstrated, including in Australia”.

2.2 Overview of the forum process and its outputs

Introductory overview

Broadly a three stage process was used. An initial two day process was conducted with Sustainable Aviation Fuel Users Group (SAFUG) members. This process was, in essence, a mini forum process. Subsequently, CSIRO invited others to attend a larger forum process (the main futures forum) seeking to leverage the clout of the core group (SAFUG members) to gain the participation of other relevant stakeholders. Third, this larger forum process was run by the CSIRO Energy Flagship following existing procedures.

Initially the Flagship intended to run a fairly standard forum process but a decision was made mid-forum to modify the process. This new process was a “more of a feasibility study with a backcasting component”, with the associated analysis focussed on “sensitivities around the central proposition which was that the industry would move towards using biofuel” (P. Graham, 2015, personal communication, 26 March).¹⁵⁷ However, several interviewees reported tension during the middle period of the forum. A new forum Chair was appointed, shifting from an independent Chair to a CSIRO staff member (Roy Chamberlain from the Flagship). Additionally, a mid-project review was held by CSIRO and SAFUG which led to a decision to hold teleconferences between each meeting attended by SAFUG and CSIRO.

The roadmap component of the final report – a set of recommended actions, timeline and goals for the next decade, and associated statements about the key challenges for establishing a bio-jetfuel industry – was led by CSIRO and informed by group dialogue and techno-economic modelling. This aspect of the process deviated from normal roadmapping practices, which typically involve lengthy participatory exercises to *collectively* draft and refine a

¹⁵⁷ Consistent with this shift, the forum report states that the “study aimed to determine the feasibility of the Australia and New Zealand aviation sector taking up bio-derived aviation fuels, the benefits of doing so and the challenges that need to be overcome to make it a reality” (CSIRO 2011, p. 5).

roadmap. In the SAFRM study CSIRO was the lead author of a draft roadmap which was refined at later meetings and during report writing.

Outline of forum meetings

Seven main meetings were held during 2010, some of which were conducted over multiple days (e.g. a two day workshop) from 23-24 March to 13 October. Most time was spent on information gathering and knowledge sharing (e.g. invited presentations, presentations given by participants, etc.) and reviewing/progressing the modelling. The latter involved discussing key modelling parameters and assumptions and providing feedback on preliminary modelling results presented by CSIRO. The modelling projected uptake of alternative fuels and technologies out to 2050 in Australia and New Zealand and related outcomes (e.g. economic outcomes, greenhouse gas emissions, social outcomes) in the aviation, energy, and transport sectors. CSIRO led the report development and writing process, i.e. CSIRO staff wrote the initial drafts. The second-half of the process focussed on refining, elaborating and agreeing the forum report. Less time was spent on developing next steps or agreeing shorter-term actions: a brief discussion occurred in meeting four; and in meeting six there was more detailed discussion of the need to “strengthen” the next steps and roadmap.

Meeting one involved knowledge sharing principally through formal presentations made by some forum participants, further exploring emerging themes (noted below), and synthesis/prioritisation of discussion points into what the group saw as the “most uncertain” and “most impactful” issues. The intention was to focus the scenario modelling on “high impact” and “highly uncertain” issues.

Presentations were made by staff from participating airlines (Qantas, Virgin Blue/Australia, and Air New Zealand), Boeing, CSIRO (in particular transport biofuel experts), government departments, fuel producer/technology developers (UOP) and environmental groups (WWF, The Climate Group).

Seven main themes were identified and further explored: 1) fuels market; 2) sustainability standards; 3) global and national carbon policy; 4) aviation logistics and supply chains; 5) the role of government and other stakeholders; 6) feedstocks for Australia; and 7) megatrends.

The second day involved small group work where “groups were randomly assigned to seven tables to work on their prioritisation of the most uncertain and impactful changes affecting the future of aviation fuels”. Four types were identified (low impact-low uncertainty, low impact-high certainty, high impact-low uncertainty, high impact-high uncertainty) but due to time constraints effort was concentrated on high impact events of high and low uncertainty. A shorter list was then produced through facilitated discussion and a voting process, as presented in *Table 32* below.

Table 32: Issue ranking data (from SAFRM Forum meeting notes)

Ranking	Theme (# overall votes)	Issues (# votes)
1	Feedstocks (53)	<ul style="list-style-type: none"> ▪ Feedstock type (residual or solo), location, area, yield, fit (22) ▪ Price/ cost curve (8) ▪ Model's for sustainable, commercial production (7) ▪ Rural development (6) ▪ Conversion methods and competition (4) ▪ Co-products (2) ▪ Competitive use (2) ▪ Yield, temporal flow (1) ▪ Inputs, nutrients (1) ▪ Bio-security - regulatory risk (0)
2	Role of government (38)	<ul style="list-style-type: none"> ▪ Start-up support (risk capital) or regulation/mandates (15) ▪ clarity and stability of policy and roles (7) <ul style="list-style-type: none"> ○ (carbon policy) (5) ○ (energy security) (3) ▪ Fuel tax policy - land transport (5) ▪ Public education (2) ▪ Rural development (1) ▪ Complementary state initiatives in national aviation framework (0)
3	Sustainability (33)	<ul style="list-style-type: none"> ▪ Criteria e.g. Roundtable on Sustainable Biofuels (17) ▪ Landscape scale and change (8) ▪ International patchwork (4) ▪ Public confidence/ licence to operate (4)
4	Business Models (29)	<ul style="list-style-type: none"> ▪ Vertical Integration (12) ▪ Business Cases (12) ▪ Targets (4) ▪ Urgency (1)
5	Global and National Carbon policies (23)	<ul style="list-style-type: none"> ▪ Level of carbon price projections (trajectories) (11) ▪ Global commitment and policy (8) ▪ National commitment (2) ▪ How aviation is treated post-Kyoto (2) ▪ Transaction (compliance) costs (0) ▪ Patchwork v coherent? (0) ▪ Offsets, availability (0)
6	Oil price and volatility (11)	<ul style="list-style-type: none"> ▪ Volatility drivers (china, politics) (9) ▪ Security drivers (3) ▪ Travel demand (0) ▪ Long term prices - International Energy Agency forecasts (0) ▪ Impacts (tipping point) (0) ▪ Heavy crude risk (0) ▪ Exchange rate (0)

The remainder of the meeting considered in more detail possible commercial scale pilot plants – as outlined by Steve Lupton from UOP LLC – and scoped the preliminary scenario modelling. The CSIRO team proposed to focus on the top three issues: 1) Feedstock type, location, area, yield and fit (22 votes); 2) Sustainability criteria (17 votes); and 3) Government start-up support, regulations and mandates (15 votes). The following structure was proposed for the initial modelling:

- *“Reference case: no carbon price, IEA reference oil price, existing feedstock*

- availability, trend aviation demand, trend aircraft efficiency
- *Feedstock scenarios:*
 - Plant oil: Existing feedstocks; existing plus new systems (pongamia, algae)
 - Lignocellulose: existing feedstocks; existing plus new systems
- *Sensitivity cases*
 - Volatile oil price around IEA reference oil price trend
 - Carbon price ranges: CPRS-5 to CPRS-25 [the global and national carbon price regimes published by Australian department of Treasury]
 - A government start-up scheme”

The group provided feedback including comments and questions such as “the modelling needs to address infrastructure”; “it may be useful to address the issue of stable clear policy by varying the length of time over which government support is provided”; and “can we define economic benefits to farmers, opportunity costs?”. The group also requested additional presentations throughout the forum, such as from a State government panel on their respective policies and perspectives, an Australian petroleum peak body, oil refiner, investor perspectives and a pongamia expert.

Meeting two involved two main components: additional knowledge sharing via a State government panel session (involving representatives from Queensland, NSW, South Australia and Victoria) and prearranged presentations (APAC Biofuel Consultants, Caltex, PricewaterhouseCoopers, Macquarie Capital, and CSIRO staff); and secondly, consideration of preliminary scenario modelling.

Following the first component (panel session and presentations) participants were asked to reflect on the information that was shared. Five aspects noted in earlier analysis were reinforced:

- Examining the case and options for government intervention;
- Considering the business case for refinery upgrades needed to support sustainable biofuel production;
- Examining the feasibility of scaling up biofuel production;
- Alternative financing models; and
- Implementation of RSB principles (Roundtable on Sustainable Biofuels) in the context of understanding what is a sustainable fuel.

Six key issues were identified as needing to be better addressed in the modelling outputs:

- “Fuel price, showing break-even point
- Lead times for large scale commercially viable plant
- Key variables in general
- Support case for a particular action:
 - All new industries need assistance
 - Show what this industry needs by when for whom
 - Show the public good and political appeal (e.g. employment, regional development, greenhouse gas abatement)

- Australia's position in a global context
- A pathway with specifics" (CSIRO, 2010, *Meeting of the Sustainable Aviation Fuel Road Map Forum*, 5 May)

The final main discussion topic was "how to address the issue of competition for feedstocks". The following summary of discussion was recorded in the meeting notes:

"Long term contracting or vertical integration was dismissed because a favourable contract would only be reached on a one-off basis. Suppliers would re-negotiate a higher price for additional contracts and therefore this is unlikely to secure long term sustainable supplies at a cost below what other competitors would be willing to pay. There was a suggestion that once all fuel is saturated in the road transport market (nearly all vehicles on E85 and biodiesel hybrids) then this would make supplies available to other modes of transport. However, this was seen as a very long term outcome which also depended too much on their being a large biomass feedstock supply. A mandate was also discussed however there is little support amongst industry to be imposed with such a stringent means of attaining sustainable fuel supply. Finally the group agreed that since the transport fuel excise arrangements were largely responsible for the distortion that meant aviation could not compete for bio-derived fuels, then it was in this area where the feedstock competition issue is likely to be resolved.

CSIRO will explore the impact of removing the excise distortion in road transport on bio-derived jet fuel uptake in the aviation sector. This could be approached in a number of ways (e.g. rebates to aviation, harmonisation of taxes in road sector). CSIRO will use the manner which is most intuitive" (CSIRO, 2010, *Meeting of the Sustainable Aviation Fuel Road Map Forum*, 5 May).

Meeting three involved a feedstock developer presentation from the Algal Biofuels Consortium, discussion of the second round of modelling, and discussion of draft "straw man" key messages for the forum report developed by CSIRO (Paul Graham). Participants' comments indicated concerns about the modelling. Comments recorded in the meeting notes include the following: "scenarios are still too negative"; "the industry will move faster than that"; "a free market approach is the reason why the results are not as positive as expected. Should we change approaches and work back from some desired target?" (CSIRO, 2010, *Meeting of the Sustainable Aviation Fuel Road Map Forum*, 26 May).

The meeting notes (from the 26 May meeting) record an agreed shift "to a middle ground approach whereby we model both market forces and some industry targets (i.e. backcasting and forecasting). That is, we impose the regional aviation industry's target minimum share of biofuel by 2020 and allow market forces to prevail over the longer term". It was also noted that "the project can use this scenario to define the benefits of the sector shifting to more sustainable fuels (fuel import and carbon offset savings)". Related considerations such as "how the industry will best secure the biofuel (e.g. long term contracts, government subsidies or other interventions)" were viewed as "a challenge we can discuss qualitatively in the report and may not be solved as an outcome of this project".

Major changes were made between meetings three and four (noted above under the *'Introductory overview'* subheading), such as appointing a new forum Chair. Forum participants also provided feedback on a draft outline of the public forum report circulated by CSIRO.

Meeting four involved a feedstock developer panel session, discussion of the round III modelling developed by CSIRO, and the first main discussion about the report. The report discussion focussed on "overall report storyline", "possible roadmap actions" (who, what, by when), "social impacts and potential benefits", and "why Australia (and New Zealand)?" (CSIRO, 2010, *Meeting of the Sustainable Aviation Fuel Road Map Forum*, 15 June).

Between meetings four and five further modelling was conducted - first round macroeconomic modelling (CSIRO and contractor) – and feedback was provided on the draft forum report.

Meeting five focussed on communications planning for the forum report (e.g. agreeing the main target audience, identifying key decisions the group wants to influence, related evidence required, etc) and further progress made by CSIRO on developing the modelling results and related data. Presentations were made by the Roundtable on Sustainable Biofuels and Airbus.

Meeting six further developed the main report, seeking to reach agreement from the group on key changes to the document, along with a presentation from Rolls Royce on the firm's perspective and biofuel testing program. The two major categories of feedback were (i) "lack of data supporting the report" and (ii) the need for "stronger next steps to overcome barriers". This is reflected in participant comments such as "weak", "wish-washy", and "not aggressive enough" (CSIRO, 2010, *Meeting of the Sustainable Aviation Fuel Road Map Forum*, 17 August). A related key discussion topic during this meeting was 'Addressing strength of next steps'. The project leader (from CSIRO) "proposed that a clear pathway for overcoming competition with the road sector could be one way of strengthening the roadmap". The forum discussed this and other 'next steps' considerations/questions.

As noted above the meeting notes record pressure from some participants to define a 'stronger', more 'concrete' roadmap. The following key discussion points are also noted in the meeting notes (from the 17 August meeting) along with suggestions for other 'next steps' (an illustrative sample of these suggestions is included below):

- "The report should clearly state what governments and business should do";
- "Government to reduce regulatory and standards "barriers" to implementation";
- "Set up government accreditation/ recognition for sustainability certification";
- "Aim for a first commercial plant as a key step? Identify existing infrastructure and costing a demonstration scale plant. Develop a co-funding scheme between industry and government. Government might support a technical value chain feasibility study. This is the end point, the other steps are the means. What about a feedstock study? Oil-based or lignocellulosic? These are two different development pathways. Compare the CCS institute. Study L-C study in Victoria";
- "Business case analysis paid by a consortium of government and industry players";
- "The overall conclusion of this discussion [*about competition with the road sector*] is

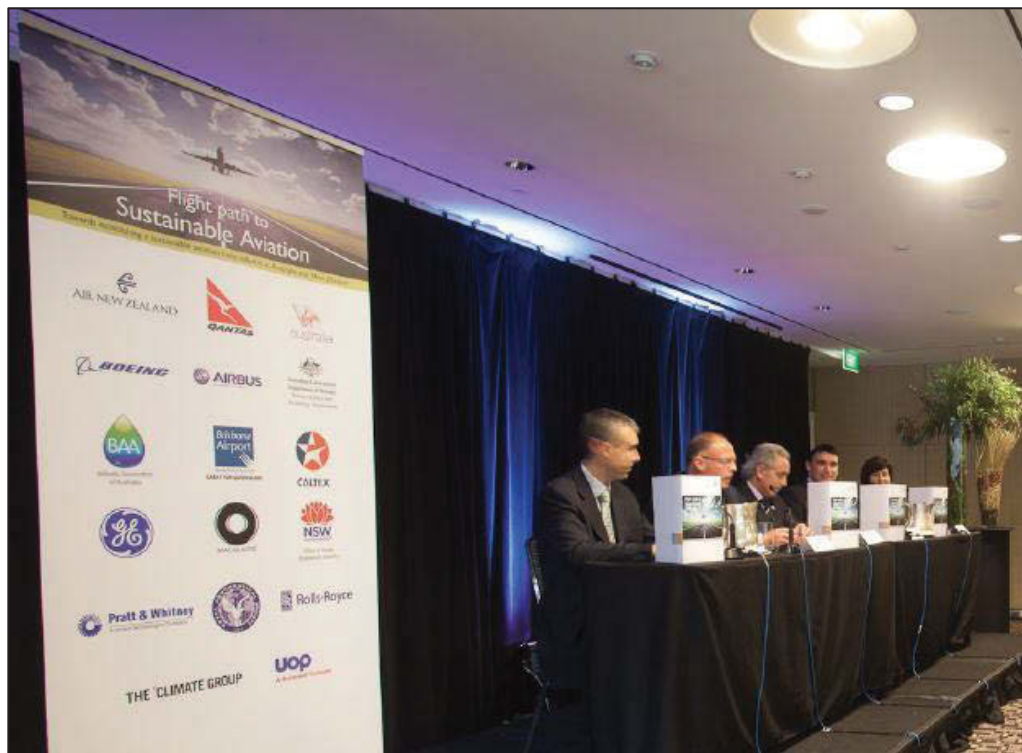
that we should call for a level playing field but not be prescriptive about how that is resolved as we have not analysed enough options at depth to recommend one”;

- “Should we discuss the ideal carbon framework? Depends on the election outcome. Need to be able to buy carbon permits. Globally consistent, open and transparent. no competitive distortions, complies with UN convention. Market mechanisms. Other sorts of offsets - direct investment”; and
- “Ask for co-ordination”.

Meeting seven was focussed on final major report changes, and report completion and launch planning. Further presentations were also made by a representative of Renewable Oil Corporation on alternative jet fuel pathways (Colin Stucley), and by James Kinder from Boeing.

A report launch event was held following finalisation of the main public report (*Figure 11*):

Figure 11: Sustainable Aviation Fuel Road Map report launch event



Forum dynamics

CSIRO reported some further differences between SAFRM and earlier processes. Many participants were observed to be more focussed on gathering information – such as via the invited presentations and panel sessions – and perceived to be less willing to do “work” during forum meetings, preferring to more passively collect information and build networks. Related tensions needed to be addressed (P. Graham, 2015, personal communication, 26 March). Consistent with this Virgin Australia (VA) staff viewed the airline as a sponsor of the SAFRM report rather than a major contributor to a study (R. Boyd, 2015, personal communication, 25 June). Similarly, David White (former Virgin Airways Australia climate change manager) stated

that “we’re in no way the experts in the area, it’s a completely new concept, it’s a different industry” (D. White, 2015, personal communication, 1 June).

The meeting notes indicate some tension towards the end of the forum, in particular regarding the two aspects of the public report: the suggested/agreed next steps outlined in the roadmap and the empirical basis of the report. The adequacy of the identified next steps was questioned (see participant comments like “not aggressive enough”, “wishy-washy”, etc, and related feedback on the draft report that it needed “stronger next steps to overcome barriers”). CSIRO felt that this could, in part, be addressed by identify a “clear pathway for overcoming competition with the road sector”, but no such pathway was identified. Instead the potential for such competition was noted along with the need to manage related issues.

Some participants and bioenergy experts also voiced concerns about process governance. Related issues include whether it was appropriate for a scientific organisation like CSIRO to manage the process and lead the roadmap/report development; role definition, such as tensions related to client-service provider relations; and the possible influence of organisational biases. Whether all the necessary people were in the room was also questioned by the forum Chair (R. Chamberlain, 2015, personal communication, 9 April) and bioenergy industry experts (industry informant 2015, personal communication, 22 May).

Forum outputs:

Two reports were released: the main public report, *Flight Path to Sustainable Aviation: Towards Establishing a Sustainable Aviation Fuels Industry in Australia and New Zealand* (CSIRO 2011), and an accompanying modelling and data report (Graham et al. 2011). The public report details risks and challenges that need to be faced along with recommended actions “to ensure a bio-derived jet fuel industry is established” and “to ensure the [airline] industry commences uptake of sustainable fuels by 2015 and realises the substantial social and economic benefits for the region” (p.7). The report also discusses a “road map scenario” which “assumes the construction and operation of two commercial scale refineries by 2020, the first in 2015” (p. 40). The modelling discussed in the report seeks to quantify the benefits of developing a local sustainable aviation fuels industry.

Four categories of recommendations were identified:

- **“Market structure”**, including development of a “national strategy and action plan for alternative fuels incorporating sustainable aviation fuels” and establishing “appropriate mechanisms” so that supply chain members could access industry support;
- **“Biomass supply”**, including actions to secure both existing and new sources of biomass;
- **“Refining”**, including assessment of potential locations for “sustainable fuel refining capacity” and establishing access to fuel distribution infrastructure; and
- **“Certification”**, including establishing “a harmonised system for sustainability certification of fuel”.

In addition to 14 recommendations a timeline of key milestones over the next decade was outlined. The immediate priority identified in the timeline is to “establish government support mechanisms”. The report also discussed the role of government. The report stated that “the bio-derived jet fuel industry is expected to be commercially independent over the long term” but also asserted that “a review of government support mechanisms to assist the transition of the industry from its fledgling stage will need to be conducted in order to determine what role government could play” (p. 44).

2.3 Outcomes

This section summarises identified forum outcomes in the following five categories:

- General process outcomes (e.g. forum participant learning);
- Influence on policy-making related to sustainable aviation fuels;
- Overall contribution to industry development;
- Energy Flagship outcomes (e.g. influence on R&D activities); and
- Other important outcomes.

General process outcomes

This outcome category includes changes in participants’ understandings or views and related impacts on strategic choices/decision-making. Some participants reported that the forum confirmed their preexisting views, such as regarding commercialisation opportunities, as per these survey responses:

- “To some extent the report confirmed Caltex’s internal position that material changes towards sustainable aviation fuel were still some way off” (M. Ridley-Smith, 2015, personal communication, 7 May);
- “I already had a belief in biofuels for the aviation industry but the study reinforced those beliefs” (R. Stanier, 2015, personal communication, 11 April). This participant also stated that “I believe the study results are credible and this [the perceived credibility] gives me confidence to promote them”; and
- “It did not change my views, however, as I was already in favour of diversifying Australia’s energy mix and reducing our carbon footprint” (D. Perera, 2015, personal communication, 28 April).

Many participants reported that the process challenged their assumptions, such as regarding the near-term prospects of commercialising bio-jetfuels and the volume potential of some alternative fuels (e.g. through new and innovative feedstocks such as algae-derived biofuels). For example, one policy officer stated that “I attended with a strong belief that bioderived aviation fuels were a possibility and the results of the forum deeply challenged that perception” (A. Verdier, 2015, personal communication, 10 April). Participating scientists also challenged existing beliefs about novel feedstocks such as algae, finding that volume limitations and cost issues would limit their usage (see Graham et al. 2011).

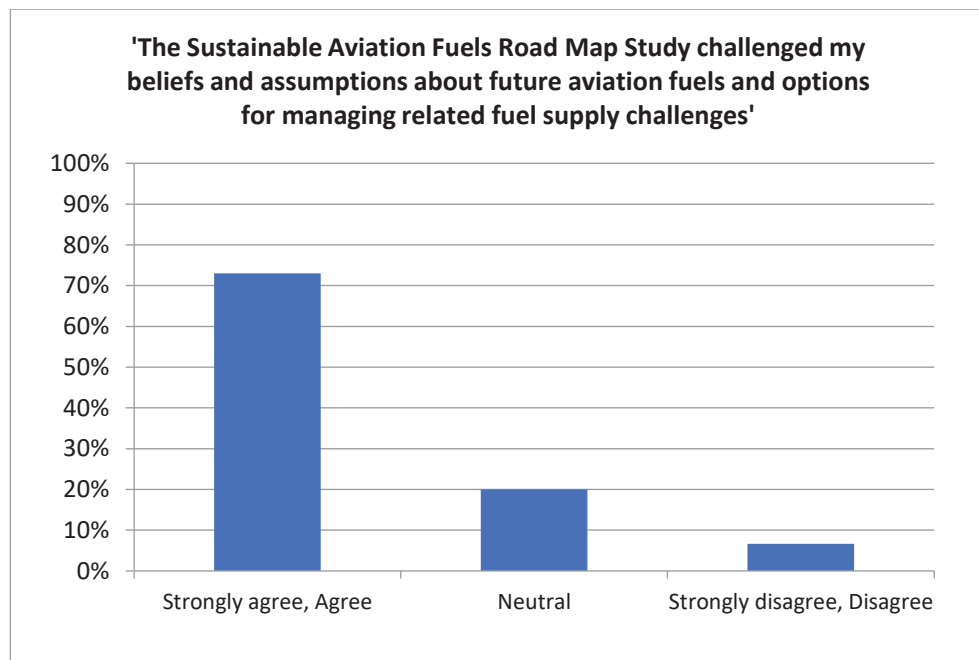
At the forum staff from the airlines also challenged the assumptions of some participants who previously believed that airlines could or would make investments in biofuel production. As a

participant from Virgin Australia (VA) put it, “at the end of the day the airlines have made it clear that they just want to buy the stuff” (D. White, 2015, personal communication, 1 June). The participating airlines sought to convey that they viewed their core roles as being an end customer and providing clear signals of market demand.

A related discussion topic was fuel costs and potential changes to fuel procurement. A forum chair, Roy Chamberlain from CSIRO, observed that it “became abundantly clear during the process ... that they [airlines] weren’t prepared to pay a premium” for bio-derived jetfuel (R. Chamberlain, 2015, personal communication, 9 April). For some participants (e.g. Michael Ridley-Smith from Caltex) this confirmed their preexisting understanding.

A majority of surveyed participants (n=11/15) stated that the process challenged their beliefs and assumptions about future aviation fuels and related options (see *Figure 12*):

Figure 12: Impact of the SAFRM Forum on beliefs and assumptions (self-report)



Airlines: Post-forum the participating Australian airlines made stronger public commitments to using biofuels. Both VA and Qantas committed to sourcing 5% of their fuel from sustainable sources by 2020 (i.e. from alternative bioderived liquid fuels). Two participating airlines – VA and Air New Zealand – signed a memorandum of understanding with Licella in December 2011, an Australian company seeking to commercialise technologies which can produce a ‘bio-crude oil’ from any form of lignocellulosic material such as from agricultural or forestry waste products. This decision was consistent with the forum findings on the potential of lignocellulosic biomass as a biofuel feedstock.

The forum’s analysis strongly informed VA’s renewable jet fuel program. In particular, the airline’s (then) climate change manager, David White, stated that “I chose the thermochemical conversion route with lignocellulosic feedstock based largely on the work done for the

roadmap, the modelling etc, which I think has been pretty well vindicated” (D. White, 2015, personal communication, 1 June). Specific actions included the MoU with Licella and involvement with a CRC for Future Farm Industries project which explored growing mallee biomass in south-western Australia and converting that into jetfuel.

Qantas Airways further recognised the potential for alternative fuels to reduce carbon emissions from commercial aviation. In addition to the focus on fuel optimisation and efficiency, the Qantas Group committed to achieving “carbon neutral growth by 2020 and to see a 50 per cent reduction in carbon emissions by 2050, relative to 2005 levels” and stated that it “believes this goal is achievable by embracing technological innovation in efficiency and by securing commercially viable alternative fuel sources that are genuinely sustainable” (Qantas Airways 2012). Qantas conducted a subsequent feasibility study in collaboration with Shell (also supported by funding from ARENA), focussed on fuel production ‘pathways’ from biologically-derived oils – such as animal fats and plant-derived oils – via the HEFA process (Hydro-processed Esters and Fatty Acids process) and also commissioned Solena Fuels to consider the alternative Fischer Tropsch (FT) production pathway.

At the forum the participating airlines also restated their view that an acceptable alternative fuel must provide a ‘drop-in’ replacement for existing fuels, be competitively priced, be available in significant quantities (i.e. at scale), and these fuels must meet sustainability criteria.

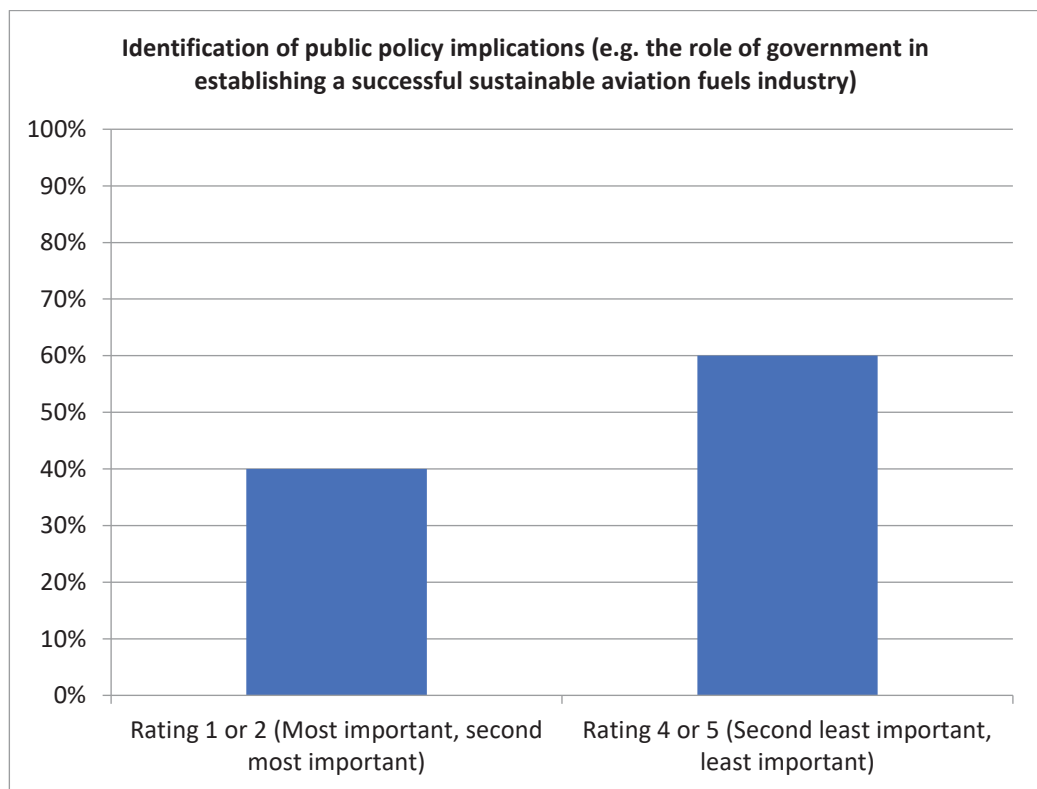
Fuel producer/supplier, retailer, or technology developer: the forum enabled Caltex to “provide relevant details on the practical challenges of changing the supply chain and distribution system and be honest about the degree to which incumbency of the current system created barriers” and the company was, therefore, “more comfortable that public policy could be debated and created with the appropriate fact base” (M. Ridley-Smith, 2015, personal communication, 7 May). Their delegate further stated that the forum didn’t prompt Caltex to invest in alternative aviation fuel production; rather “the outputs confirmed our position of devoting scarce resources to this challenging problem”. The forum helped to establish that UOP is seeking to commercialise a technology to produce aviation biofuel from biologically-derived oils, but also “did point out that the availability of cost effective vegetable or animal lipid oils would be limiting in Australia” (S. Lupton, 2015, personal communication, 10 April). [NOTE: the forum report also pointed to significant cost advantages from converting biologically-derived oils into road biodiesel fuel, and asserted that “if the feedstock is lignocellulose rather than biologically derived oil the cost of producing road and jet fuels are much closer” (CSIRO 2011, p. 36)]

Perceptions of commercialisation imperatives and processes: The process surfaced a wide range of commercialisation issues and related views on the priorities for developing a local sustainable fuels industry. For example, the main participant from General Electric (GE) stated that the process was “most importantly a call to arms for the industry” and further argued that “I think it was more about that the industry could have a go at this itself rather than wait for government” (B. Waters, 2015, personal communication, 18 June). He further asserted that “I

don't think aiming for a government subsidy is the be-all and end-all, it's something much bigger than that". In contrast, the lead biofuels industry participant argued that discussions during the forum "inevitably came back to 'we need subsidies, we need subsidies...' It was like this mantra in the room" (H. Bone [Brodie], 2015, personal communication, 29 May). Consistent with this a participant from the Royal Aeronautical Society (Australian Division) asserted that "the most critical issue is to get the Government to act and develop supporting policies" (R. Stanier, 2015 personal communication, 11 April). Consequently, this participant argued that the most important priority is to convince government "of the benefits of going to biofuels" and saw the 'assessment of potential environmental, social and economic benefits that would result from a bio-derived jet fuel production industry (e.g. reduction of greenhouse gas emissions)' as the most important part of the forum report.¹⁵⁸

Consistent with such differences of opinion, ratings of the importance of 'identification of public policy implications' in the forum report differed: 40% of respondents viewed this as a crucial report element, 60% rated it as having lower importance (see Figure 13).

Figure 13: SAFRM Forum report content ranking (public policy implications)



¹⁵⁸ See the related sections of the roadmap. The first major section – entitled “A new future can be created” – aimed to highlight aviation is an “essential service” (pp. 10-12), as well as the greenhouse gas emission challenge and the aviation industry’s options, and potential energy security benefits. The final major section – entitled “Seizing the opportunity” – also sought to quantify expected benefits to the community.

Views/expectations regarding the role of specific organisations: the potential roles of airlines were debated in the forum, such as by offering ‘off-take agreements’ (i.e. reaching long-term agreements with biomass/fuel producers) and related risk sharing, or through investments in fuel companies or co-financing fuel production plants. Some participants reported shifts in their understanding of the roles that airlines would play. For example, Roy Chamberlain from CSIRO stated that “I initially thought the airlines would or should make investments but that probably was a false assumption” (R. Chamberlain, 2015, personal communication, 9 April).

Decision-making: The majority of surveyed participants (60%) stated that the process enabled them to make more confident decisions about sustainable aviation fuels (see *Figure 14*). For example, forum participants mentioned the following decision support:

- Decision-making that was better informed by the forum’s analysis of potential feedstocks (e.g. the process informed VA’s decision to focus its renewable fuel program on lignocellulosic biomass feedstocks);
- Forming the basis of related Qantas policy documents;
- Relationship building between parties and enabling related joint ventures (JVs) and/or joint actions;¹⁵⁹
- A decision to further explore the feasibility of a local “bio-port” at Brisbane Airport;
- Decisions regarding which R&D opportunities should be prioritised;
- Reinforcing existing thinking – held by General Electric (GE) Australia’s (then) Commercial Director, Ben Waters – about the need for local action and “a local approach”, because “there will essentially be local industries and you need hubs around airports” (B. Waters, 2015, personal communication, 18 June).¹⁶⁰ Subsequently, GE Australia “made it a real subject for our local team” and Waters stated that “we were a leading region which pushed for progress from the global team”;
- More confident promotion of aviation biofuels as an alternative to conventional jet fuel and greater capacity to do this. For example, David White (former VA Climate Change Manager) stated that “it [the roadmap/report] basically says that it is possible and that was a big boost, obviously, and something our senior managers took note of” (D. White, 2015, personal communication, 1 June); and
- Contrastingly, some participants stated that the process gave them more confidence to *not* promote a focus on bio-derived jetfuel. The process was interpreted as confirming Caltex’s internal position of aviation biofuels (see earlier discussion of this). A policy officer from the Queensland Government also stated that the process enabled a more confident decision to *not* promote aviation biofuel industry development due to his heightened awareness of uncertainties and decreased expectation of policy success (A. Verdier, 2015, personal communication 16 April).

¹⁵⁹ A very recent example of joint action over the 2016-17 period by two participating airlines, Virgin Australia and Air New Zealand, is their attempt to jointly promote local industry development efforts by signalling demand for locally-produced biofuels via a Request for Information (RFI) process.

¹⁶⁰ Most recently the Queensland Government announced a new biofuel trial in collaboration with Virgin Australia and exploration of the potential to use sugar as a biofuel feedstock and alcohol-to-jetfuel technologies for local fuel production in Queensland to be used at local airports (in contrast to the forum’s emphasis on lignocellulosic feedstocks and related fuel production methods).

Figure 14: Impact of the SAFRM Forum on decision-making confidence (self-report)

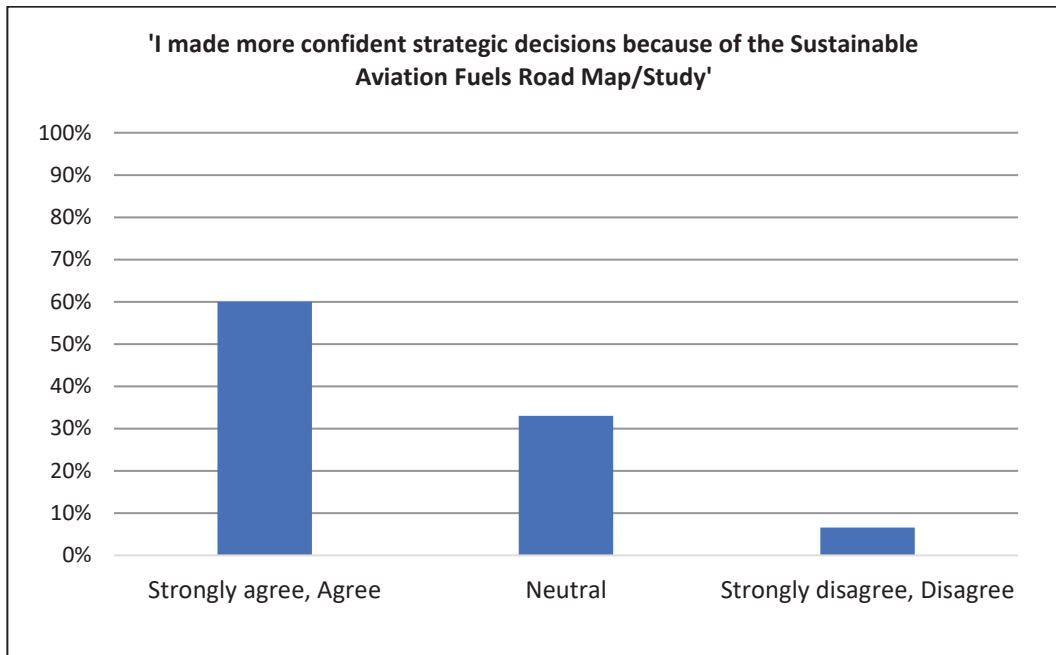
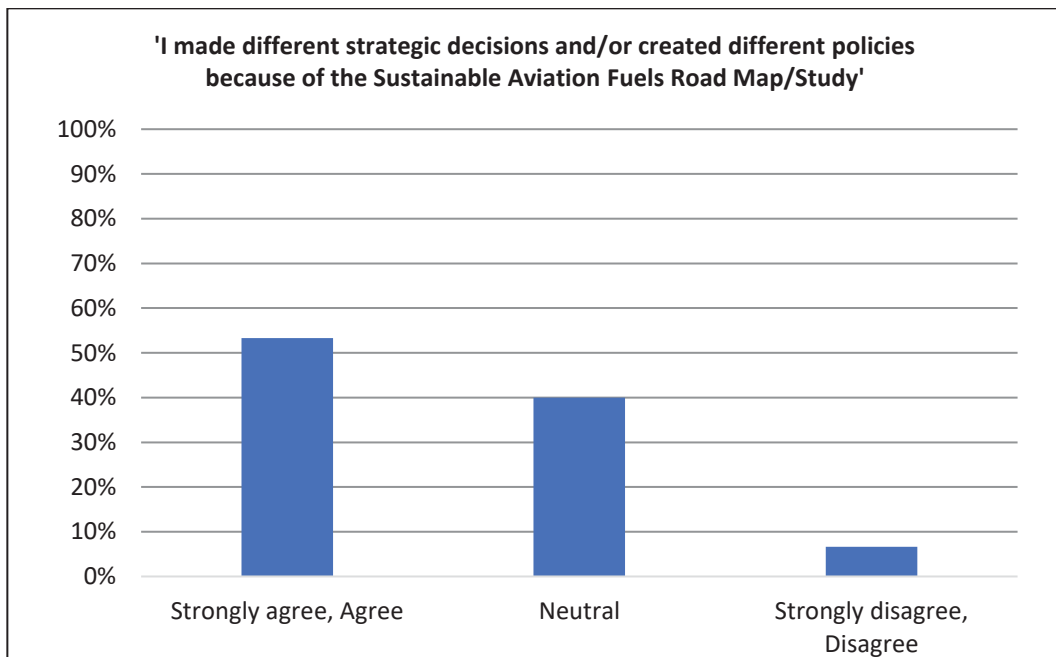


Figure 15: Impact of the SAFRM Forum on policy-making/decision-making (self-report)



Influence on policy-making related to sustainable aviation fuels

Some participants argued that greater government recognition of the importance of biofuels was a significant outcome from the process and related advocacy activities. For example, the 2012 *Energy White Paper* discussed the future roles of alternative transport fuels. The White Paper noted that biofuels may increasingly be used in aviation and included modelling done by

the CSIRO Energy Flagship which projected – over the period to 2050 – that “the aviation sector will have a greater focus on the development of bio-derived jet fuels to contribute a growing share of aviation fuel consumption as supply chains mature” (Australian Government 2012, p. 127). The government also committed \$15 million to the Advanced Biofuels Investment Readiness program “to build the investment case for significant and scalable pre-commercial demonstration projects for the production of advanced high-energy, ‘drop-in’ biofuels in Australia” (Australian Government 2012, p. 128). The alternative transport fuels ‘strategic framework’ noted that “advanced biofuels are considered to have [the] potential to provide an alternative jet fuel on a commercial scale” and outlined the key findings of the roadmap study, including the view that “sustainable aviation biofuels are the only alternative transport fuels that can meet all of the environmental, economic and technical challenges for the aviation sector” (Australian Government 2011b, pp. 35-6).

A participant in the above policy processes stated that the SAFRM study “dovetailed neatly into what we were doing”; “we were aware of it, we read it” and also viewed it as “consistent with what we were doing” (Government informant, 2015, personal communication, 12 June). Of particular note was “the strong support those things gained from industry”. Linked with this the Federal government’s view (as conveyed by this informant) was that “that work [the roadmap process] meant that the aviation side of things, and the support from some of the major carriers such as Virgin, already had some runs on the board in a market that had fewer players and where they could see longer-term benefits compared to the complexity of some of the other [transport fuel] markets”. Consistent with these statements no aviation-sector specific recommendations were made in the strategic framework for alternative transport fuels. The framework aimed to lay the “foundation” for the “market-led diversification” of Australia’s “transport fuel mix” (Australian Government 2011b).

As noted above in the overview of the post-forum context, the aviation sector did not receive transitional assistance under the Clean Energy Futures legislation, nor did firms such as Qantas win related policy arguments. (Qantas argued that a carbon price is a punitive measure and advocated a contrasting policy focus on “investment and innovation in sustainable energy and low emissions technologies and infrastructure”.¹⁶¹) These developments also indicate that the process provided limited support to domestic Australian airlines in prosecuting related policy arguments.

The energy security arguments made in the roadmap were not seen as justifying government involvement. The general government view at the time was that “there’s no energy security issue” largely because “we’ve got multiple points of import” and alternative fuels will come into the market if required e.g. if conventional fuels become significantly more expensive (Government informant, 2015 personal communication, 12 June).

¹⁶¹ Paul Graham (CSIRO) noted that “when the carbon price came on the airlines argued that what they needed, instead of the carbon price, was money to help pay for the development of new technological solutions not a new tax” (P. Graham, 2015, personal communication, 26 March).

A number of forum participants expressed disappointment about the unwillingness of government to provide greater support. For example, a senior participant from Boeing (Boeing Research & Technology) remarked that “the real disappointment ... is how little interest the Australian Government has shown in developing an industry when aviation is so fundamental to national prosperity” (W. Lyons, 2015, personal communication, 20 April). This assessment contributed to Boeing’s decision to conduct related R&D in other regions (S Pond, 2015, personal communication, 23 June). Another forum participant from VA similarly viewed Australian government policy related to alternative aviation fuels as “a bit wanting ... to say the least” (D. White, 2015, personal communication, 1 June).

Overall contribution to industry development

A core goal of the process was to help accelerate the development of renewable jet fuel industries in Australia and New Zealand.¹⁶² Overall, there is little evidence that this was achieved. Key goals sets for 2015 have not been met to-date, such as the commercial uptake of sustainable fuels (i.e. beyond small-scale biofuel trials and test flights) and the associated construction of a commercial-scale “refining facility” (CSIRO 2011, p. 9). A well-informed bioenergy industry expert judged such industry development to still be “a long way off” (industry informant, 2015, personal communication, 22 May).

Some potentially supportive actions did follow the forum, with increased collaboration in Queensland (e.g. the Queensland “bio-port” initiative) and Western Australia (e.g. the Mallee jetfuel initiative). New connections between related organisations were directly enabled or indirectly assisted, such as the collaborations around the Mallee jetfuel initiative (see *Figure 16* below) and other cooperation (e.g. between GE, Virgin Australia Airlines, Renewable Oil Corporation, Licella, Dynamotive Energy Systems, etc). Further engagement and policy advocacy was also enabled through the subsequent formation of the Australian Initiative for Sustainable Aviation Fuels. However, these initiatives have mostly been neither sustained nor practically impactful in terms of enabling investment or policy changes.

¹⁶² For example, Virgin Australia’s website states: “We have continued to lead industry efforts towards establishing a renewable jet fuel industry in Australia through our role as a founding partner of the Australian chapter of the Sustainable Aviation Fuel Users Group (ASAFUG). In 2010 ASAFUG commissioned the CSIRO to lead a “Roadmap” study to help accelerate the commercialisation of a renewable jet fuel industry in Australia and New Zealand” (Source <http://www.virginaustralia.com/au/en/about-us/sustainability/sustainable-aviation-biofuel/>, last viewed September 19, 2015).

Figure 16: Aviation representatives Delia Dimitriu (Airbus), David White (Virgin Australia), Future Farm Industries' Peter Zurzolo and GE's Ben Waters inspect a Great Southern mallee plantation (Nyman 2012)



The life-cycle and sustainability analysis component of the Mallee jetfuel initiative was financially supported by Airbus, with in-kind and 'facilitative' contributions from Virgin Australia and General Electric. Virgin's interest helped to bring Airbus to the initiative, however no major financial investments were made by other industry participants. As emphasised by an interviewed bioenergy industry expert "Virgin and Qantas stated from the outset that they didn't have the money to do these sorts of things, aside from maybe the odd feasibility study" (industry informant, 2015, personal communication, 22 May).

Some participants were also *less* likely to promote bio-jetfuels as a result of participating in the forum (see survey and interview findings reported above). For example, participants from Caltex Australia interpreted the results of the forum as confirming their internal position on biofuels. This meant Caltex focussed its capital expenditure and strategy on other opportunities.

The process may have hampered industry development efforts in other ways (bioenergy industry informant, 2015, personal communication, 22 May). In particular, the emphasis on fuel “refining” in the roadmap was seen as misinformed and highly problematic along with the strong emphasis on research and development priorities which won’t assist near-term commercialisation efforts (e.g. research on novel feedstocks).

Energy Flagship outcomes (e.g. influence on R&D activities)

Participants from Boeing pointed to the establishing of R&D gaps that it and CSIRO subsequently sought to fill. Michael Lakeman argued that the process usefully “steered us in value-added R&D directions”, such as the subsequent value chain scoping/design work focused on central Queensland (M. Lakeman, 2015, personal communication, 9 July). CSIRO conducted – with support from Boeing – a preliminary feasibility study of a potential biofuels industry based on the use of woody biomass in the Fitzroy Basin region in central Queensland (see Booth et al. 2014; Hayward et al. 2013). These more detailed studies further explored the potential of lignocellulosic feedstocks.¹⁶³ A related forum outcome was that the Flagship deemphasised research on algae-derived biofuels, an option it had previously championed and investigated (D. O’Connell, 2015, personal communication, 25 June).

The CSIRO Energy Flagship staff also sought support from industry (principally Boeing) and government to conduct further research in central Queensland to help de-risk investment cases for biofuel supply chain establishment. When Boeing pulled out CSIRO also withdrew its support (D. O’Connell, 2015, personal communication, 25 June).

The Energy Flagship also strengthened its relationships with some key industry players – such as Boeing and GE – and with government. These outcomes and reputational benefits were valued by CSIRO staff such as one senior Flagship staff member who asserted (in an interview) that “I would do it again just for those reasons” (Flagship staff member [non-attributable], 2015, personal communication, 7 May).

Other important outcomes

Further engagement and policy advocacy activities was enabled post-forum by the creation of the Australian Initiative for Sustainable Aviation Fuels (AISAF) in August 2012. Whilst AISAF cannot be seen as the direct result of the SAFRM forum – it was principally created to support implementation of the Memorandum of Understanding signed between Australia and the United States on ‘Sustainable Aviation Alternative Fuels Development’ which was signed in September 2011 – its creation by Dr Susan Pond from the United States Studies Centre at the University of Sydney was assisted by the forum (Dr S. Pond, 2015, personal communication, 23 June). AISAF “intended to use the information out of the roadmap to implement the MoU” but was wound-up in 2014 due to insufficient financial support and collaboration barriers (Dr S. Pond, 2015, personal communication, 23 June).

¹⁶³ This R&D work is consistent with recommendation 7: “Assess the most promising locations for sustainable fuel refining capacity”. The roadmap discussed the need for detailed value chain design such as identifying optimal feedstocks, conversion technologies and optimal locations for plantations and refineries.

The idea of facilitating multi-stakeholder collaboration on national or regional roadmaps was also adopted by Boeing and the firm subsequently conducted roadmap projects in many other regions. Boeing subsequently led or co-convened similar strategic engagement and planning exercises in Brazil, the Pacific Northwest and Mid-West of the United States, Scandinavia, and most recently in Japan (W. Lyons, 2015, personal communication, 16 June).¹⁶⁴

CSIRO researchers involved with the forum were enabled to advance their personal research programs. The strong emphasis on demonstrating biofuel sustainability enabled CSIRO bioenergy expert Deborah O’Connell to advance her research on sustainability assessment and measurement and to contribute to sustainability standards for biofuels. The forum also enabled the Energy Flagship to further advance its transport modelling capabilities. This contributed to future modelling work conducted for a range of Federal government departments, including techno-economic modelling for the strategic framework on alternative transport fuels and carbon policy-related modelling work for Treasury.

AISAF Chair Dr Pond was also co-author of a report by the Australian Academy of Technological Sciences and Engineering (ATSE) entitled *Green Growth – Energy: Industry Opportunities for Australia* (Godfrey, Sargent & Pond 2013). This report argued that sustainable liquid aviation fuel production is a “tangible and major Green Growth opportunity for Australia” (p. i), and identified the aviation sector as a demanding customer with greenhouse gas emission reduction needs and a potential leader of a new sustainable liquid fuels industry. The ATSE report cited the CSIRO-led roadmap report and subsequent actions taken by the aviation sector and it is indicative of increasing interest stimulated by the roadmap exercise. However, consistent with the above outline of policy-making related to sustainable aviation fuels, the policy recommendations made in the report have not been implemented.

2.4 Summary

Participation in this futures forum informed and, in many cases, altered key players understandings, such as their understanding of fuel supply options and challenges. Some participants’ core beliefs about bioderived aviation fuels were challenged by the forum, such as regarding near-term commercialisation opportunities and issues. Other participants reported that the forum reinforced their existing views.

The domestic Australian airline industry made stronger commitments to using bioderived jetfuel post-forum and supported further feasibility-style studies into possible replacements for fossil fuel-based jetfuel. Environmental staff in the airlines were able to draw upon the study and modelling results, such as when seeking internal support for VA’s renewable jet fuel strategy or developing policies. Additionally, the core group of actors that initiated the forum were able to continue this advocacy and engagement through the subsequent Australian

¹⁶⁴ Dr Michael Lakeman from Boeing stated that these multi-stakeholder exercises have “become a global franchise for us” (M. Lakeman, 2015, personal communication, 9 July).

Initiative for Sustainable Aviation Fuels; however, this initiative was largely wound-up in August 2014 due to a lack of funding and other support. Overall, some additional momentum towards alternative aviation fuels was evident during the 2011-2012 post-forum period; however, this momentum was not subsequently maintained.

Overall, there is little evidence that the SAFRM process or its outputs helped to accelerate the development of renewable jet fuel industries in Australia and New Zealand, at least not until this point in time, though recent (and future) initiatives – such as those in Queensland – may in-time partially alter this picture. The overall judgement of credible bioenergy industry experts is that establishment of these industries remains a long way off at present. More speculatively, the remarks of some experts and actors also indicates that the process may have hampered industry development in addition to other key issues such as political instability, industry tensions (e.g. the capacity war) and limited government support.

The Energy Flagship improved its relationship with some important stakeholders in industry and government but didn't significantly advance its transport fuels research program. It is now far less active in the area of alternative fuel development. The Flagship's major post-forum research and development activities were comprised of two main areas of research: value chain scoping studies in central Queensland co-financed by Boeing; and further transport sector modelling such as those conducted for the Federal Department of Resources, Energy and Tourism. In mid-2014 CSIRO management decided to cease funding biofuels research due, in large part, to an inability to secure sufficient co-investment from industry.

Core forum delegates (SAFRM Forum)

(as listed in the public forum report)

Total core delegates: 43

Sectoral breakdown

- Government department/agency representative: 11 (25%)
- Industry: 29 (67%), broken down further by sector
 - Airlines and aviation: 24/29 (83% of industry participants)
 - Fuel producer/supplier and technology developer: 4/39 (14%)
 - Finance: 1/29 (3%)
- NGO representative: 3 (7%)

Full details

Name	Organisation	Title	Sector
Matthew Andrew	Queensland Department of Employment, Economic Development and Innovation	Director, Regional Economic Strategies	Government
Peter Birt	Boeing Australia	Business Manager	Corporate
Heather Brodie	Biofuels Association of Australia	Chief Executive Officer	Industry Association
Peter Broschofsky	Qantas Airways	Head of Environment and Fuel Conservation	Corporate
Grant Crenfeldt	Air New Zealand	Head of Engineering	Corporate
Andrew Drysdale	Royal Aeronautical Society, Australian Division		NGO
Andrew Dudgeon	Rolls-Royce Australasia	Chief Executive Officer	Corporate
Alan Epstein	Pratt & Whitney	Vice president, Technology and Environment	Corporate
Mark Garbin	GE Aviation	Sales Director – Aviation	Corporate
Andrew Gillespie	Australian Department of Defence	Director Strategic Fuel, Strategic Logistics Branch	Government
Ian Guss	Regional Development Victoria	Biomass Industry Development	Government
Kylie Hargreaves	NSW Trade & Investment	Executive Director - International Markets and Trade	Government
Jon Hart	Rolls-Royce	Environment Strategy Manager – Civil Aerospace	Corporate
Michael Homer	Airbus	Sales Director Australia	Corporate
Chris Hulston	Defence Science and Technology Organisation	Head Fuels and Lubricants	Government
Michael Lakeman	Boeing Commercial Airplanes	Director, Biofuel Technology Strategy	Corporate
Stephen Lupton	UOP	Senior Research Associate, R&D - Renewable Energy & Fuels	Corporate

William Lyons	Boeing Research & Technology	Director – Global R&D Strategy	Corporate
Ross Mackenzie	IOR	Director and General Manager	Corporate
Greg McDowall	Office of Biofuels, Division of Resources and Energy, NSW Government	Director	Government
Elizabeth Mitchell	Pratt & Whitney	Manager, Technology & Environment Special Initiatives	Corporate
Marc Muller	Airbus	Marketing Director	Corporate
Paul Nash	Airbus	Head of New Energies	Corporate
Robert Nuttall	Rolls Royce	VP Marketing	Corporate
Maurice Oldham	Department of Climate Change and Energy Efficiency, Australian Government	Senior Policy Officer	Government
Rupert Posner	The Climate Group	Australia Director	NGO
Mabelle Reyes	Caltex Australia	Biofuels Marketing Manager	Corporate
Michael Ridley-Smith	Caltex Australia	National Manager – Marketing Services	Corporate
Tony Robinson	Ministry of Research, Science and Technology (NZ MoRST)		Government
John Rooney	Department of Innovation, Industry, Science and Research (DIISR)	Manager – Industry, Energy and Environmental Policy Section; Industry and Small Business Policy Division	Government
Nyla Sarwar	Department of Premier and Cabinet, South Australian Government	Senior Researcher – Fuels	Government
Robin Stanier	Royal Aeronautical Society	Honorary Secretary	NGO
Simon Thorpe	Virgin Australia Airways / Virgin Blue (at beginning of the forum)	General Manager – Safety Systems; General Manager – Air New Zealand Alliance Program (February 2011 onwards)	Corporate
Maaïke van der Windt	Brisbane Airport Corporation	Manager, Business Performance	Corporate
Richard Venning	Air New Zealand Ltd	Engineering Support Manager	Corporate
Alain Verdier	Queensland Department of Employment, Economic Development and Innovation	Policy Officer	Government
Peter von Bertouch	Macdonald Technologies International	Marketing Manager	Corporate
Ben Waters	General Electric Australia	Commercial Director	Corporate
Brad Wheatley	Boeing Australia	Research Leader – Environment	Corporate
Virginia Whewy	Boeing Australia	Director, Environment, Health and Safety	Corporate

David White	Virgin Australia / Virgin Blue (at the beginning of the forum)	Environmental Advisor, Virgin Blue; later held position of Manager, Sustainability and Climate Change, Virgin Australia	Corporate
Nicole Williamson	Qantas Airways	Group Manager, Climate Change Strategy and Programs	Corporate
Oliver Yates	Macquarie Capital	Executive Director	Corporate

List of interviewees and surveyed forum delegates (SAFRM Forum)

List of interviews (n=19)

Name	Role(s) at time of the SAFRM Forum	Date of interview(s)
Interviews with project leader(s) and partner(s) – 5		
Roy Chamberlain	Forum Chair; CSIRO, Stream Leader – Energy Transformed Flagship (Low-emissions transport), CSIRO	9 April 2015
Paul Graham	Chief Economist, Energy Transformed Flagship, CSIRO	26 March 2015 1 December 2015
David White	Environmental Advisor, Virgin Blue; later held position of Manager, Sustainability and Climate Change, Virgin Australia Airways	1 June 2015
N/A	Flagship staff member (non-attributable)	7 May 2015
Other interviews (forum participant, additional informants) – 14		
Heather Bone (Brodie)	CEO, Biofuels Association of Australia	29 May 2015
Robert Boyd	Principal Economic Analyst, Virgin Australia	25 June 2015
Michael Lakeman	Director, Biofuel Technology Strategy, Boeing Commercial Airplanes	9 July 2015
William Lyons	Director – Global R&D Strategy, Boeing Research & Technology	16 June 2015
Dr Deborah O’Connell	Project Leader – Sustainable biomass production project, Energy Transformed Flagship, CSIRO	25 June 2015
Dr Susan Pond	Leader, Alternative Transport Fuels Initiative, at United States Study Centre at the University of Sydney; Adjunct Professor in Sustainability	26 May 2015 23 June 2015
Rupert Posner	Australian Director, The Climate Group	11 June 2015
Michael Ridley-Smith	National Manager – Marketing Services, Caltex Australia Limited	20 July 2015
Alain Verdier	Policy Officer, Queensland Department of Employment, Economic Development and Innovation (DEEDI)	16 April 2015
Ben Waters	Commercial Director, General Electric Australia	18 June 2015
N/A (non-attributable)	Australian bioenergy industry expert	22 May 2015 19 June 2015

N/A (non-attributable)	Government informant (policy-maker)	12 June 2015
------------------------	-------------------------------------	--------------

Notes

- I approached current Air New Zealand staff members and others who represented the company at the forum but none were willing to participate in the research. Tony Steer from Air New Zealand commented by email that: *“all I can add is that the outcome of the study in terms of the flight path report is extremely Australia focussed and makes recommendations for ‘federal’ and ‘state’ action, i.e. Australian government etc. The report’s recommendations are very much aspirational and you will have to look at the evidence, - are there biojet fuel refining facilities operational, are airlines using biofuels in Australasia as Air New Zealand currently does not use biojet fuels”*

Surveyed participants (n=15)

Name	Role(s) at time of the SAFRM Forum	Date completed
Heather Bone (Brodie)	CEO, Biofuels Association of Australia	10 April 2015
Kieran Donovan	Victorian Government - Manager, Aviation Services	24 April 2015
Chris Hulston	Head Fuels and Lubricants, Defence Science and Technology Organisation	27 April 2015
Nyla Khan (Sarwar)	Senior Researcher – Fuels, Department of Premier and Cabinet, South Australian Government	24 April 2015
Steve Lupton	Senior Research Associate, R&D - Renewable Energy & Fuels, UOP LLC	10 April 2015
William Lyons	Director – Global R&D Strategy, Boeing Research & Technology	20 April 2015
Donna Perera	Department of Infrastructure, Regional Development and Local Government	28 April 2015
Rupert Posner	Australian Director, The Climate Group	13 April 2015
Michael Ridley-Smith	National Manager – Marketing Services, Caltex Australia Limited	7 May 2015
Robin Stanier	Honorary Secretary, Royal Aeronautical Society – Australian Division	11 April 2015
Maaiké van der Windt	Strategic Planning Manager, Brisbane Airport Corporation	10 April 2015
Alain Verdier	Policy Officer, Queensland Department of Employment, Economic Development and Innovation (DEEDI)	10 April 2015
Ben Waters	Commercial Director, General Electric Australia	29 April 2015
Nicole Williamson	Qantas/Group Manager Carbon & Renewables	26 May 2015
David White	Environmental Advisor, Virgin Blue; later held position of Manager, Sustainability and Climate Change, Virgin Australia Airlines	17 April 2015

Interviewee matrix for the SAFRM Forum (sector and interviewee category breakdown)

SECTORAL CATEORY	INTERVIEWEE	OUTCOMES CATEGORY		
		'Worked' n=8	'Mixed' outcomes n=5	'Didn't work' n=3
CSIRO (research)	Roy Chamberlain	X		
	Paul Graham		X	
	Dr Deborah O'Connell	X		
	Flagship staff member (non-attributable)		X	
Industry (airline sector)	Robert Boyd (Virgin)	X		
	David White (Virgin)	X		
	William Lyons (Boeing)		X	
	Michael Lakeman (Boeing)		X	
	Nicole Williamson (Qantas)	X		
Industry (other)	Ben Waters (GE)	X		
	Heather Bone (Brodie) (BAA)			X
	Michael Ridley-Smith (Caltex)	X		
	Bioenergy industry informant (non- attributable)			X
Government	Alain Verdier (QLD DEEDI)		X	
	Government informant (non-attributable)	X		
NGO	Rupert Posner (Climate Group)			X

Appendix 3: Overview of the Future Grid Forum and research undertaken on this forum

Forum Description (Future Grid Forum)

1. Introduction

The Future Grid Forum was a scenario development and analysis process which was focussed on the future of Australia's electricity grid. The exercise was initially planned and scoped by CSIRO and General Electric (GE) Australia who subsequently sought other "partners to join the Forum and contribute to the future of Australia's electricity grid" (CSIRO 2012, p. 3).¹⁶⁵ Of the forums run to-date, this forum had the largest number of delegates: 102 core delegates from 49 organisations. Forum participants contributed different amounts to the project funding: "platinum" (\$200K), "gold" (\$100K) and "bronze" (\$20K) forum partners, as well as free participation for NGO representatives. The two platinum sponsors were GE and CSIRO, and there were two gold sponsors, Grid Australia and Ausgrid (CSIRO 2013a).¹⁶⁶ This was by far the largest forum held to-date: \$750,000 was raised and the forum cost \$1.1million (CSIRO invested more than the other platinum sponsor due the extra meetings that were required and longer than expected project time, both of which are outlined in this forum description). The process began in August 2012 and the reports were released in December 2013.

A cross-sectoral mix of organisations was represented. The breakdown, from most strongly to least strongly represented, can be summarised as follows (also see the delegate list):

- Electricity sector organisations such as network businesses, peak bodies, electricity generators, and energy retailers (22 organisations);
- Government organisations (12 organisations);
- Organisations from other industries such as telecommunications (6 organisations);
- Research sector organisations (5 organisation); and
- Community sector organisations / NGOs (4 organisations).

1.1 Forum objectives

The project prospectus document, entitled *Australia's Future Grid: Evaluating whole-of-system options for Australia's future electricity system* (CSIRO 2012), outlined a number high-level objectives and planned outcomes. The following objectives were emphasised:

- *To shift the energy debate to a "whole-of-system evaluation" of potential options:* the

¹⁶⁵ In an interview, Ben Waters (a GE Australia staff member heavily involved with the forum) reported that the genesis of the forum was a meeting at CSIRO attended by himself, other senior GE staff from their smart grid and renewables businesses, and Flagship staff. A major discussion topic was the supply focus of the electricity sector, i.e. rather than a strong customer or demand focus. As Waters put it in this interview, the "customer was thought of as a "load" which would, presumably, keep getting bigger". Initially a joint GE-CSIRO exercise was considered but it was agreed that it would be "much stronger if the industry was in there" (B. Waters, 2016, personal communication, 29 January).

¹⁶⁶ The major sponsors were part of the Project Review Committee. Grid Australia was a peak body which represented the owners of Australia's electricity transmission networks in both the National Electricity Market (NEM) and Western Australia. In 2016, Energy Networks Australia took over this role.

prospectus argued that “this work will provide the first analytical framework capable of assessing the full system costs in a fact-based and robust way” and “thus provide the analytic foundation for evidence-based policy making and investment decisions”;

- *To objectively evaluate alternative options through modelling and scenario analysis:* the forum aimed to identify and model scenarios that address key options, challenges and uncertainties in the electricity sector. Through the analysis of the identified options the process aimed to “highlight key barriers to their implementation and potential mechanisms to overcome them”; and
- *To shape the debate about new regulatory models:* the forum aimed to explore “how different regulatory and operating models of the transmission and distribution systems may lead to different system cost outcomes” and associated regulatory issues.

The following six planned outcomes were also stated in the prospectus, some of which refer to process outputs (e.g. scenarios) and others refer to outcomes (e.g. coalition formation):

1. Creation of a respected coalition of experts;
2. Creation of a set of whole of electricity system future scenarios;
3. Development of an “integrated assessment framework” which is “capable of estimating the impacts across the value chain for the future scenarios”;
4. Identification of “quantified opportunities”: this was to be achieved by “using the newly integrated analytical framework” (see planned outcome 3 above) to “quantify the delivered price of electricity, CO₂-e emissions, technologies adopted and landscape changes associated with each option”;
5. Development of “consensus solutions”: specifically, the prospectus stated that “CSIRO’s extensive energy futures forum expertise will be applied to systematically work through the complex trans-sectoral issues and forge consensus solutions”; and
6. Published and promoted findings: specifically, the prospectus stated that the forum will “publish a highly-credible, transformative road map for the Australian electricity system that presents the quantitative outputs and a shared view of the opportunities and challenges, accompanied by a transparent, evidence-based technical report”.

The two organisations that initiated the forum – CSIRO and GE Australia – had other strategic objectives. The project leader, Paul Graham from CSIRO, stated that a major motivation was taking advantage of a perceived opportunity to “reinsert ourselves into a leadership role in the [electricity] sector” and to “claim the space” related to trends towards smarter, more efficient electricity grids and onsite electricity generation (P. Graham, 2015, personal communication, 23 November). Prior to the forum the Flagship was judged to have a marginalised position in the electricity modelling and strategic analysis. Graham put this as follows: “I think that was really our main motivation – to take the opportunity to claim a space that we sort of felt that we owned because we were ahead”. The Flagship also “saw an opening” which Graham described as being created by disconnects between the dominant foci of electricity sector/modelling consultancies and emerging trends in the electricity sector (P. Graham, 2015, personal communication, 23 November). Additionally, existing ways of thinking about the electricity grid and energy technologies were seen as barriers to developing new research partnerships. Existing expectations and related ways of thinking were emphasised:

“[I]t starts to impact on us if we’re working on new technologies which people are saying won’t exist in the future. That can become a problem for us. If we reach a certain point where we’re confident that this should be considered as part of the electricity future and the main market operator and all the major consultants just don’t include it at all in their modelling or analysis more broadly then that becomes a problem for us because we’re out there talking to clients about working with them on smart grid related projects and if it’s not there in the official forecasts from anyone then there’s this disconnect which can be a problem” (P. Graham, 2015, personal communication, 23 November).

In particular, Graham argued that partnership building is hampered by such “disconnects” because “partnerships are about confidence that this is something worth investing in” (P. Graham, 2015, personal communication, 23 November).

The forum Chair from CSIRO emphasised related underlying objectives:

“One of the subtexts of the whole process, if you like, has been developing more in-depth relationships between CSIRO, as the national science agency, and what is the critical industry for the nation [i.e. the electricity sector in Australia] and – given the “I” in CSIRO stands for industry – that in itself was a worthy goal for us internally... I guess we’ve seen value in being the trusted friend that an industry like that can benefit from and actually saying, ‘let’s think about these hard things, they might not be pretty or pleasant but let’s “hold hands” and go and look at them together’... I guess for us it was about: how do we demonstrate to these people that somebody in the world can be trusted as a trusted advisor that can help them through some of the potentially catastrophic forces that they are facing?” (M. Paterson, 2014, personal communication, 17 June).

Related to this the Energy Flagship was seeking to grow one of its research programs – the ‘Grids and Energy Efficient Systems’ program: “We’ve always had this section of the Flagship which has had different names over the years like local energy systems, and distributed energy systems, and at the moment it’s currently called grids and energy efficient systems... it has always been in the space of demand management, onsite generation, that whole space” (P. Graham, 2015, personal communication, 27 November). Consequently, if this research program is advanced by running a forum then the forum would be judged to have contributed to achieving the Flagship’s goal of enabling a lower emissions energy future.¹⁶⁷

Finally, linked with the above objectives, the project leader from CSIRO emphasised the potential benefits of showcasing the capabilities of the Flagship:

“Before we went into the Future Grid Forum we knew we had some stuff that was relevant. We’d been working ahead of where the industry was. So we certainly wanted our team’s capability showcased and to show how relevant it is ... [to people who] might not have known that we have something to add in terms of strategic thinking

¹⁶⁷ Also see the Flagship’s current “impact strategy” which is presented at: <http://www.csiro.au/en/Research/EF/Areas/Our-impact-strategy> (last viewed 30/06/16)

about how the sector is changing. If our team shows that we've got something relevant then it impacts the wider CSIRO organisation and the conversations we get to join in on" (P. Graham, 2015, personal communication, 27 November).

GE Australia's involvement as a founding project partner was initiated by Ben Waters who was, at the time, Commercial Director – Australia/New Zealand and also the local Australian lead for GE's "Ecomagination" initiative. Waters stated that GE's involvement was primarily driven by reputational and brand goals:

"It was more about reputation and brand than any sales-driven exercise. At the time, since late 2010, GE had been rebranding in Australia as a technology company and not a money company. GE was known more for financial services in Australia than it was for industrial and it wasn't known for aircraft engines, energy, healthcare, locomotives, or all the other things it does. There was a big brand-building exercises going on and it fit neatly into that" (B. Waters, 2016, personal communication, 29 January).

Waters also noted that GE had a research alliance with CSIRO which was formed in 2010: "a five year \$20m joint research commitment across all areas but including Ecomagination and low-carbon technologies" including 'smart grid' solutions. He added that:

"CSIRO and GE had also been in discussion for years about smart grids, had worked together on smart grid, smart cities projects, had seen the decentralisation trend and yet were also seeing the business-as-usual approach by the industry to putting in what turned out to be \$45 billion into pretty much standard network infrastructure for which it is doubtful whether that much of it was required and which doubled the price of electricity. So it was also a chance for the industry to get together to think about what its future might look like and consider all parts of that disaggregated and uncoordinated system and get them thinking, perhaps for the first time, about their customers rather than about themselves. Those were the motivations" (B. Waters, 2016, personal communication, 29 January).

The above quote also indicates broader objectives, as Waters noted: "Ultimately GE wants to sell more kit to industry customers [some of whom attended the Future Grid Forum] but also not to be surprised by industry transitions".

2. Description of the forum and its outcomes

2.1 Context

Individuals

102 core delegates participated in the Future Grid Forum, with 63% of delegates from industry (including government-owned electricity network businesses), 20% from government (e.g. from government departments and agencies), 14% from the research sector, and 4% from the community/NGO sector. A detailed sectoral breakdown is shown in *Table 33*.

Table 33: Sectoral breakdown of delegates (Future Grid Forum)

Sector	Organisations represented
Industry (65 forum delegates)	<ul style="list-style-type: none"> ▪ Electricity sector participants (53 forum delegates): <ul style="list-style-type: none"> ○ Network business representatives: 17 delegates ○ Electricity generator/retailer representatives: 12 delegates ○ Peak body representative: 12 delegates ○ Other company representatives: 12 delegates ▪ Other industry participants (11 forum delegates) ▪ Smart Grid Australia
Government (20 delegates)	<ul style="list-style-type: none"> ▪ Federal Department and Agency representatives (14 forum delegates): <ul style="list-style-type: none"> ○ AEMC, AEMO, AER, ARENA, BREE, CEFC, DCCE, DRET ▪ State Department and Agency representatives (6 forum delegates): <ul style="list-style-type: none"> ○ Queensland DEWS, Vic DPI, South Australian Department of State Development, SA Government
Research sector (14 delegates)	<ul style="list-style-type: none"> ▪ ClimateWorks Australia ▪ CSIRO/Energy Flagship ▪ Grattan Institute ▪ Monash Sustainability Institute ▪ University of Sydney
Community sector/NGO (3 delegates)	<ul style="list-style-type: none"> ▪ ACOSS ▪ The Climate Institute ▪ Total Environment Centre

Interpersonal relations

Some interviewees pointed to conflictual stakeholder relations in the electricity sector, and others suggested that tensions were exacerbated by other contextual factors:

“There’s no love lost between energy retailers and the distribution network. There’s a lot of animosity instead of working together to create something” (Industry informant [non-attributable], 2016, personal communication, 24 March).

“The process was conducted during a period of incredible political danger around carbon pricing and the views in the room on this were by no means unified. For a lot of the groups represented there they were also very aware of other interests in things like maintaining a good relationship with the current government or with the incoming government” (O. Kember, 2016, personal communication, 24 March)

Issues related to stakeholder relations (e.g. between network businesses and the regulator) and conflicting interests (e.g. between incumbent electricity generators and the renewables sector in the context of oversupply) were part of the forum context (P. Graham, 2015, personal communication, 23 November). There were also tensions around emerging issues such as the possibility of asset value write-downs, which some participants stated that “you couldn’t talk about” at the forum (B. Waters, 2016, personal communication, 29 January).

The forum Chair pointed to cultural factors within the sector:

“I knew that this glacial pace of change and risk aversion and so on would also make engaging people difficult, getting them to pay for it difficult, and keeping them engaged for the long haul challenging. And just the fact it’s such a complex area, it’s so interconnected, there are so many vexed points, even ideological points that are also mixed up in all that” (M. Paterson, 2014, personal communication, 17 June).

Although the participants were diverse, issues related to group dynamics such as groupthink were raised. A state government representative argued that “there was a bit of groupthink when you got there [to the forum]. It was all going to be off-grid, it was all going to be solar. There was perhaps a preoccupation with climate change to some extent” (Government informant [non-attributable], 2016, personal communication, 18 March).

Institutional settings

Some aspects of the institutional settings of participants are indicated by *Table 33* above. Different interest groups in the electricity sector were strongly represented such as via the strong participation of peak bodies (as well as industry participants) including the Energy Retailers Association of Australia, Energy Supply Association of Australia, Smart Grid Australia, Grid Australia, Clean Energy Council, and Energy Efficiency Council. Approximately 20% of forum delegates also had current roles focussed on, or related to, smart grid solutions/options including delegates from these organisations:

- Smart Grid Australia;
- Landis+Gyr;
- Ericsson;
- Telstra;
- GE Digital Energy;
- Network business such as SA Power Networks, Ergon Energy, Western Power and Energex;
- Clean Energy Council; and
- Researchers from CSIRO, University of Sydney.

Another important aspect of the context was the increasing examination of electricity market rules and regulatory frameworks. Some major inquiries were prompted by electricity price increases. The following is a summary of some of the important reports and reviews:

- Australian Energy Market Commission (AEMC) released a report entitled ‘Power of Choice’ which emphasised “giving consumers options in the way they use electricity”. (The more technical term for this is ‘demand-side participation’). The report was presented to the ministers of the Council of Australian Government (COAG) Energy Council in November 2012. The report resulted in rule change requests from the COAG Energy Council and other parties;¹⁶⁸
- The COAG Standing Committee on Energy and Resources (2012) examined market reforms designed to “put downward pressure on rising electricity costs while ensuring Australians continue to enjoy expected levels of reliable supply”;

¹⁶⁸ See: <http://www.aemc.gov.au/Major-Pages/Power-of-choice> (last viewed 30/06/20176)

- A Federal Senate inquiry into electricity prices (August–November 2012);
- The Productivity Commission inquiry into Electricity Network Regulation. This major inquiry began before the Future Grid Forum and the final report was released in June 2013. The Commission argued that “a fundamental nationally and consumer-focused package of reforms” is required “that removes the interlinked regulatory barriers to the efficiency of electricity networks”;¹⁶⁹
- A review of the national Renewable Energy Target was conducted by the Climate Change Authority which released the final report in December 2012; and
- The AEMC also reviewed the market arrangements for electric and natural gas vehicles with a focus on supporting “economically efficient uptake of electric and natural gas vehicles”.

Forum meetings often began with a review of such inquiries and reports, many of which were concluded or released during the forum. This process was called the “group bulletin”.

Wider ‘infrastructure’ (socio-technical, political, and economic contexts)

Electricity consumption continued to slightly decrease in 2012-2013 (over the forum period) which led the Australian Energy Market Operator (AEMO) to make downward revisions to its electricity demand forecasts (Parkinson 2013). Such developments led to increasing analysis of why consumption decreased over the previous four years (e.g. Saddler 2013). Analysis by Saddler (2013) identified three factors: energy efficiency programs driven new regulations, structural economic change away from electricity intensive industries, and consumer responses to higher prices. These factors emphasise important aspects of the social context which were discussed during the Future Grid Forum.

The forum Chair also pointed to a context of accelerating change in the sector:

“Really in the last five years, last 10 years certainly but particularly the last three-to-five years, the pace and scale of change has significantly shifted. Now you’ve the growing story of the “death spiral” for utilities, which takes the Kodak scenario and applies it to electricity. Electricity is facing a world of potential product substitution and that’s unheard of really in the last century” (M. Paterson, 2014, personal communication, 17 June).

The carbon pricing scheme became effective two months prior to the forum. This meant the effects of carbon pricing were closely monitored and debated during the forum period, including during the Federal election campaign during August/September 2013. During the 2011-2013 period strong investment in renewable energy also occurred, at least \$5billion annually, including \$5.2 billion in 2013 despite a \$480 million drop in solar investment caused by reduced state-based support (Clean Energy Council 2014).

Finally, a new Federal Government – the Abbott Liberal Government – was elected in Australia two months prior to the release of the forum reports. This new Government immediately

¹⁶⁹ See: <http://www.pc.gov.au/inquiries/completed/electricity/report> (last viewed 30/06/2017)

sought to repeal the carbon tax/pricing (the repeal of these laws formally came into effect on July 1 2014, about seven months after the forum reports were published).

Post-forum context

Climate change policy was a major focus in the 2014-2015 post-forum period and was fiercely debated in the Federal Parliament. The Abbott Government shifted climate policy toward a new “direct action” policy (along with repealing the carbon price). A further review of the Renewable Energy Target was undertaken and in May 2015 the government reached an agreement with the Labor party to reduce the target to 33,000 gigawatt hours of renewable energy by 2020. The government’s efforts to repeal the Australian Renewable Energy Agency (ARENA), Clean Energy Finance Corporation and the Climate Change Authority were blocked in the Senate. Related to these developments uncertainty in the renewable energy sector contributed to a large drop in investment in new projects (Hannam 2015).

Investment in new large-scale renewable energy projects reduced by 88 per cent in 2014 compared with 2013 (Clean Energy Council 2015). Additionally, the further winding back of state-based support schemes for small-scale solar energy contributed a reduced number of new installations, although the average system size grew resulting in a larger addition of new generating capacity.

More recently, other policy developments such as the Paris Climate Agreement and Australia’s associated 2030 emissions reduction goal (defined by the Federal Government), as well as emerging social movements (e.g. the fossil fuel divestment movement), are more closely aligned with the analysis conducted by the Future Grid Forum. These events represent more positive developments from a climate change action perspective.

Technological developments were also a strong feature of the post-forum context. In 2015 local energy storage technologies became a core focus. A number of major reports examining emerging storage technologies were released, including by AEMO (2015), CSIRO (Cavanagh K et al. 2015) and AECOM (Christiansen & Murray 2015). The AEMC asked the CSIRO to examine how these technologies may be used throughout the electricity supply chain. The organisation of more conferences and events on energy storage was part of this context.

2.2 Overview of the forum process and its outputs

Introductory overview

Like earlier forums the Future Grid Forum process had four main components:

- (i) A participatory scenario development process;
- (ii) Detailed techno-economic modelling (led by CSIRO, with some elements conducted by specialist consultants such as ROAM Consulting);
- (iii) Qualitative analysis of the implications of the scenario analysis and modelling results including potential opportunities, future challenges and options; and
- (iv) Report writing and other communications activities.

A major difference between this forum and the previous futures forums is that working groups and other small groups were formed at different stages of the forum in order to advance aspects of the analysis in-between meetings. One reason for this was the challenges faced making sufficient progress during the main meetings. Additional meetings were required (than planned) due principally to challenges that were faced during the scenario development phase which took additional meetings to resolve.

The initial two-day workshop (the first meeting) was focussed on developing a set of scenarios. The development and refinement of the scenarios required further discussion and debate over the subsequent five meetings (six in total). The project leader from CSIRO described this aspect of the process as follows:

“Well, there certainly were maybe four or five meetings where we were struggling through the scenario process... We had to work through it and consider what scenario style is going to be useful for this particular project. In some ways it was almost unhelpful for CSIRO to say ‘you need to choose the scenarios because we need to remain independent’. We actually let the debate go on for a fair while and for a fair bit of pain, but we kept telling them that the pain is good, it’s ok, these are valuable conversations” (P. Graham, 2015, personal communication, 23 November).

“We had this hands-off philosophy which we took to the extreme. There was a real financial cost to it also. We had about three meetings more than we had budgeted for” (P. Graham, 2015, personal communication, 27 November)

Additionally, working groups were established during the forum to examine key issues and help resolve process challenges. Five working groups were created on: 1) demand management; 2) scenario development/refinement (the ‘scenario champions’ working group); 3) social research; 4) electricity pricing; and 5) regulation. Participants self-nominated for working groups in response to invitations to participate.

Outline of forum meetings

The *inaugural meeting* was a two day workshop. Day one involved development of historical timelines, and presentations by participants covering the following perspectives and interest groups: (i) government (AEMC, AER, DRET); (ii) electricity networks businesses and industry (AusGrid, Grid Australia); electricity generators (Stanwell Corporation); (iii) retailers (ERAA); (iv) technology suppliers (General Electric); and (v) NGOs/advocates (Total Environment Centre). Project overview presentations were also given by CSIRO staff from the Flagship. The main activities on day two were reaching agreement on the “rules of engagement” (meeting protocol) and a scenario workshop which involved group activities that aimed to produce in half a day a group decision on what scenarios would be modelled.

The rules of engagement defined recommendations for the meeting design/processes and content that is produced by the forum. The content-focussed rules are reproduced below:

“Content:

- *Participants will try to see the whole system and contribute bigger than their own company/industry agenda*
- *Participants will look to maximise the things we can agree on (e.g. win-win, or at least not win-lose) wherever possible, while recognising that some issues there will be trade-offs*
- *Participants will flag issues where they think it will be difficult for their organisation to sign-off on*
- *The report has to say something about how we get there not just what we want (i.e. provide a high level action plan). Outcomes have to be able to be implemented. But the implementation plan would not be expected to be detailed from this group.*
- *A culture of willingness to ‘face the brutal facts’ where necessary”*
(CSIRO, 2012, Meeting of the Future Grid Forum, 29 August).

The scenario development workshop initially explored major perceived trends, the key factors or ‘drivers’ perceived to be most important, and potential high-level scenarios for each identified driver (e.g. energy demand). The CSIRO-led modelling team then attempted to translate these discussions into proposed set of initial ‘model runs’. Subsequent discussions centred on three topics: participant concerns (e.g. the meeting notes state that “the participants felt they were not well prepared for understanding how the modelling team arrived at this outcome and on what basis they should judge whether they represent good model runs”); the desire for more information on the intended use of the scenarios and the model inputs; and the style of scenarios that were proposed. Some participants voiced their preference for a scenario storyline approach (i.e. not only doing model runs based on defined assumptions/constraints). The following key actions were agreed:

“CSIRO commence the preliminary modelling of scenarios; CSIRO create a brief storyline for each scenario; CSIRO provide a more complete brief to participants on the available model inputs and outputs; CSIRO provide a more complete brief to the participants on how the project elements – the modelling and the qualitative material – are co-developed and relate to each other in the final report and communications”.
(CSIRO, 2012, Meeting of the Future Grid Forum, 29 August).

Meeting two began with an update, in which the project leader responded to earlier queries and concerns, and a participant presentation from ACOSS. CSIRO staff then outlined the initial modelling work and discussed how this could be extended to other scenarios. A working group on demand management was formed to review peak electricity demand reduction approaches and how this could be considered in the scenarios. Feedback was provided on the scenarios. A final session explored what topics should be discussed at upcoming meetings. The following question was examined: “What important aspects of the current Grid system are potentially unsustainable by 2050?” The facilitator led a discussion on how such topics should be approached at future meetings. Diverse suggestions were provided which ranged from breaking into discussion groups to working on a “roadmap to 2050”. “No clear approach emerged” (CSIRO, 2012, *Meeting of the Future Grid Forum*, 31 October).

Meeting three began with a review of activities and progress to-date in the initial meetings:

“In reflecting on progress the group discussed the following points:

- *There is concern that we are not capturing big step changes in some of the scenarios, how can we capture those (e.g. people producing own power at low cost).*
- *There is also concern whether the models can examine more fringe scenarios. The models seem to continue existing trends rather than more radical trajectories. We need a process where we can look at change potential separate from the modelling.*

Paul Graham indicated that he felt the dialogue process proposed later in the agenda would support these views – the current scenarios did need more stretching and there does need to be dialogue outside of the modelling”.

(CSIRO, 2012, Meeting of the Future Grid Forum, 4 December).

Three main activities were then conducted: a presentation of second round modelling; a group discussion around ‘designing for impact’ i.e. maximising the impact of the project¹⁷⁰; and, thirdly, initial exploration of a qualitative analysis tool focussed on key performance indicators and exploration of potential trade-offs. This tool was conceived by CSIRO staff and the independent facilitator as “a means of arriving at the integrated visions which are the key unique impact of this forum” (source: meeting notes). The tool visually represents projected future outcomes in “spider” charts. An initial discussion and voting process was run to select KPIs for “a ‘good’ electricity system”. Five KPIs were chosen:

- Greenhouse gas emissions;
- Reliability;
- Whole of system cost per user;
- Service and price customisation; and
- Resilience.

The remainder of the meeting focussed on exploration of different combinations of KPIs in small groups and associated potential trade-offs. Two KPIs were allocated to each group. Each group was asked to “develop stories for achieving the extreme points of two of the KPIs ... and their potential trade-offs or impacts on other KPIs”.

The project leader described how the initial scenario modelling could be aligned with the focus of the dialogue at the forum. The initial modelling was described as “building blocks” that could be used in the development of “integrated visions”. Participants were also invited to provide feedback on the KPI web tool process and meeting. Some participants expressed that they found the process useful and that the insights gained shouldn’t be lost. Others expressed concerns about the focus on trade-offs and lack of clarity on terminology.

¹⁷⁰ The meeting notes for meeting three state: “The challenge for the remaining dialogue sessions is to target our dialogue in a way that would deliver most impact for this project. To do this we need to be clear about our audience and our products and how they deliver impact”.

At the beginning of *meeting four* the forum Chair outlined feedback provided by participants:

“Mark [Paterson] said that the Forum project team had received a lot of useful feedback since the last meeting including:

- *Forum meetings have been “too polite” so far*
- *Too much focus in the forums on getting the scenarios 100% right. (“...trying to precisely predict the future”)*
- *Need to move to multi-dimensional scenarios*
- *A number of participants are still unclear on where the Forum is heading”*

(CSIRO, 2013, Meeting of the Future Grid Forum, 6 February)

The three main activities during meeting four were an update of modelling progress provided by CSIRO, a brainstorm of potential “megashifts” which the scenarios should consider, and a session on creating “integrated scenarios”. The scenario creation exercise involved forming small groups which were asked to come up with a proposed scenario informed by the forum’s analysis to-date (source: meeting notes). Difficulties were faced with agreeing a scenario development approach and agreeing scenarios. Most groups produced a high-level scenario set using the “axis” approach (2x2 quadrant model). Participants also had different methodological preferences.¹⁷¹ These issues weren’t resolved at this meeting. A decision was taken to call for “scenario champions” (see meeting notes text and overview of these in ‘BOX A3-1’) who were tasked with advancing this analysis between meetings:

“The forum decided to elect scenario champions that would develop scenarios after the workshop given we were out of time to fully resolve these issues within the workshop. The riding instructions for the scenario champions were to:

- *Review workshop scenarios*
- *Review previous Forum material*
- *Work with other team volunteers*
- *Write a narrative using a template provided by the forum team and based around a “quirky title” assigned during the meeting. The narrative is not a forecast – it is a story about the experience of being in 2050 in that scenario and how we got there.*

Actions: *Paul Graham and nominated scenario champions to develop scenarios and report back to the Forum within approximately two weeks. Modelling team to work with scenario champions to commence modelling the new scenarios for presentation at the next workshop session on ‘building integrated scenarios’.*

(CSIRO, 2013, Meeting of the Future Grid Forum, 6 February)

BOX A3-1: Scenario champions

- **“Smart consumers/prosumers” scenario** champion(s): Alan Coller (Origin Energy – Manager, Strategy Development), Marcy Faith (Telstra – Emerging Technology)

¹⁷¹ The meeting notes state that the group was “fairly evenly split between those who wanted to agree on the key axes ... and then reduce that down to a desired scenario set and those that thought scenario development should not be based on key drivers but should come from a narrative process”.

Specialist);

- **“Emerging energy independence” scenario** champion(s): Chris Baker ([Department of Climate Change and Energy Efficiency](#) – Director, Energy Markets);
- **“DIY” scenario** champion(s): Andrea Pape ([ACOSS](#) – Senior Policy Officer, Energy and Climate Change);
- **“Flexibility / choice / horses for courses” scenario** champion(s): Yochai Glick ([Ericsson Australia](#) – Principal Architect [Smart Grid]);
- **“Digital electrons” scenario** champion(s): Gwen Andrews ([Alstom](#) – VP – Environmental Policies and Global Advocacy – Asia & Oceania);
- **“Utility heroes” scenario** champion(s): Alan Coller ([Origin Energy](#) – Manager, Strategy Development), Bob Darwin ([Ergon Energy](#) – Manager, Emerging Opportunities);
- **“Black box/DIFM” scenario** champion(s): Kieran Donoghue ([Energy Supply Association of Australia](#) – General Manager, Policy); and
- **“Anti “let it rip”” scenario** champion(s): Dave Lee ([Energy Retailers Association of Australia](#) – Policy Manager)

Source: Future Grid Forum meeting notes provided by CSIRO

Between meetings four and five the scenario champions did further work focussed on constructing scenario narratives, refining the scenario set, and providing advice on planned modelling. The meeting records (for meeting 5) state that “the modelling team distilled the 9 scenarios into 4 and checked in with the Scenario Champions group during that process” (CSIRO, 2013, *Meeting of the Future Grid Forum*, 10 April).

The discussion at *meeting five* focussed on the scenarios and modelling. The project leader (Paul Graham from CSIRO) reviewed the process to-date and outlined the completed work on distilling the forum’s work to-date into four scenarios. Feedback was provided by participants, including an agreement to proceed with these scenarios. Group debate then focussed on brainstorming/identifying scenario implications (e.g. for different parts of the supply chain in each scenario) and potential actions that could be taken to ensure that the electricity system is “resilient given the range of futures described in the 4 scenarios”.

Meeting six began with a discussion led by the project leader, Paul Graham, focussed on a proposed graphical approach for presenting the scenarios and other ‘sensitivity cases’ along with more detailed scenario assumptions. This was followed by a modelling review. The final major task was an open discussion of possible key messages for the forum report. The project leader provided framing comments on these messages which emphasised the desirability of consensus messages, limitations around making recommendations (the meeting notes convey this as follows: “we must limit ourselves to “options””), and how messages could be informed by modelling (e.g. via “if X occurs... then outcome Y is likely” formulations). The project team agreed to incorporate the discussion themes into refined key messages.

Between meeting six and seven the CSIRO-led core project team continued work on the key messages and developed a draft version of the two forum reports (i.e. the summary public

report and the supporting techno-economic modelling report).

Meeting seven focussed on the forum report and communications plan. The project leader provided an overview of the proposed (draft) report structure, features and messages. The forum participants worked in supply chain/sectoral groups and provided feedback. An open space session was run in which topics were proposed and participants broke up into thematic subgroups (e.g. a 'smart meters and data intelligence/use' group, a 'cost-reflective pricing' group, etc.) and then considered ways to improve the report. The CSIRO Energy Flagship communications manager also outlined the draft communication plan. A post-meeting modelling review was held to discuss technical modelling issues, refine some of the analysis (e.g. the analysis of the future cost-effectiveness of energy storage and the implications of this) and address unresolved assumptions (e.g. the future take-up of electric vehicles).

The core theme of *meeting eight* was "impact and consensus".¹⁷² The main activities were a discussion of feedback on the draft report, a further modelling update from CSIRO, and an 'open forum' on proposed improvements to the report. Three main issues were discussed:

- "It was agreed the most important worklist for the day were the following three items:*
- 1. Discuss what modelling can/should be brought up into the main report*
 - 2. Response options – bottom line for some readers but we've not given it matching attention. Consider structural change suggestion. Response option 1 – delete, keep or modify? What existing processes do we endorse, what new options are we putting on the table?*
 - 3. Fine tuning of price statements - this is an area of disagreement"*

(CSIRO, 2013, Meeting of the Future Grid Forum, 31 July)

The group worked on a sectoral impact table which considered the degree of change likely to be faced by actors in each scenario and related implications. Overarching issues were noted by the group and recorded in the meeting notes, e.g. "the best scenario will depend on who you are in the system. No scenario is universally positive for all actors". Finally, a CSIRO researcher gave a presentation outlining social dimensions research which was "designed to support our messages around customer choice being a strong future driver of outcomes".

Meeting nine focussed on refining the main forum report. Key discussion topics included the level of modelling detail; what should be stated about the possibility of asset write-downs and related perceived risks such declining network utilisation; and report sign-off issues.

The final meeting, *meeting ten*, was held to discuss further modelling changes, report feedback and sign-off, and planned communications activities around the report launch. Attendance was significantly weaker than the first meeting (36 delegates attended this meeting compared with 56 attendees at meeting one). The discussion covered diverse topics ranging from

¹⁷² The meeting notes (for meeting 8) state – in the 'Welcome, introductions and agenda overview' section – that "we need to make sure we push the boundaries of our discussions to design the report for impact but achieve consensus at the same time"

modelling inputs / assumptions (e.g. the battery cost projections used in the scenario analysis which CSIRO described as a “conservative” projection) through to more micro issues such as possible report titles. Report sign-off – in particular inclusion of logos and gaining the necessary internal stakeholder feedback – was an issue for some. CSIRO offered assistance such as providing briefing sessions for these organisations.

Forum outputs

Three outputs were produced: the main forum report entitled *Change and Choice: The Future Grid Forum’s analysis of Australia’s potential electricity pathways to 2050* (CSIRO 2013a), a shorter eight page summary report (CSIRO 2013b), and a longer modelling report. The main report was launched at an event hosted by ABC journalist/presenter Tony Jones.

2.3 Outcomes

This section summarises identified forum outcomes in the following categories:

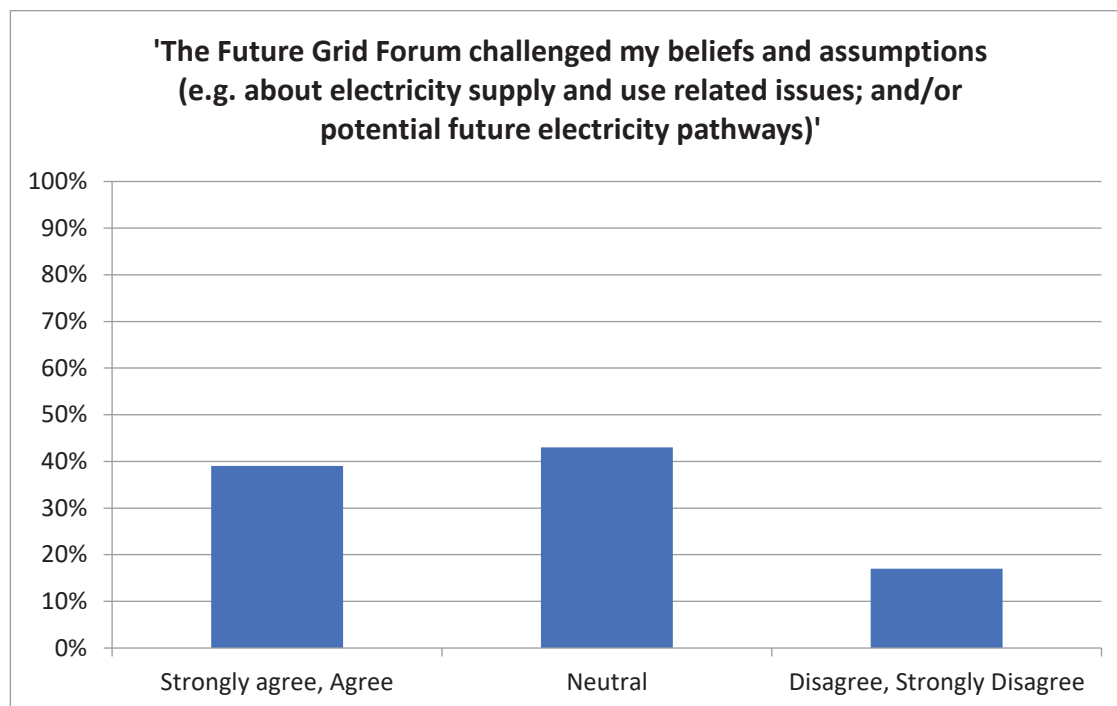
- General process outcomes (e.g. participant learning outcomes);
- Influence on policy-making processes;
- Industry impact and related outcomes (e.g. electricity sector outcomes); and
- Energy Flagship outcomes (e.g. influence on R&D activities)

General process outcomes

This outcome category includes changes in participants’ understandings or views, such as their assumptions and/or beliefs about electricity supply or potential future electricity pathways. 39% of surveyed delegates (n=23) stated that the Future Grid Forum challenged their assumptions and/or beliefs, as shown in *Figure 17* below. The following comments were made by the surveyed forum delegates (61% of total surveyed forum delegates) who either ‘disagreed’ or ‘neither agreed nor disagreed’ with the following statement ***‘The Future Grid Forum challenged my beliefs and assumptions (e.g. about electricity supply and use related issues; and/or potential future electricity pathways)’***:

- “The report primary pulled together existing thoughts and opinions and helped order those, which was the key benefit of the process (rather than inventing new content)” (A.J. van Vuuren, 2016, personal communication, 12 February)
- “It did more to confirm my beliefs rather than challenge them” (J. Jarvinen, 2016, personal communication, 10 February);
- “I think the forum outcomes and scenarios strengthened my beliefs and assumptions” (T. Barry, 2016, personal communication, 12 February);
- “The forum aligned to current industry discussions and thinking regarding what the future may hold for industry, policy makers and consumers” (T. Barry, 2016, personal communication, 12 February); and
- “At a high level, FGF findings with respect to distribution sector were generally aligned with prevailing strategic thinking in SA Power Networks, but forum and final report contributed significant depth of modelling and breadth of research, as well as bringing new insights from other sectors such as generation” (B. Williams, 2016, personal communication, 12 February).

Figure 17: Impact of the Future Grid Forum on beliefs and assumptions (self-report)



Two-thirds of surveyed forum delegates (65%) agreed with the statement ***'I made more confident strategic decisions because of the Future Grid Forum'*** (see Figure 18 below). A smaller percent – 48% – of surveyed forum delegates agreed with the statement ***'I made different strategic decisions and/or created different policies because of the Future Grid Forum'*** (as is shown in Figure 19). The following comments are example comments made by forum delegates who stated that they made more confident decisions:

- “I don't know that I made different decisions, but it helped me to be more confident of the decisions that I did make” (J. Jarvinen, 2016, personal communication, 10 February);
- “The report provided a consolidation of the data with an Australian focus. Similar themes can be found across the globe and have been highlighted in reports published in other countries” (P. Wilson, 2016, personal communication, 4 February); and
- “By understanding the potential impacts of the different scenarios I was more informed to support my decision making” (S. Bell, 2016, personal communication, 3 February).

The following comments are example comments that were made by forum delegates and other respondents who disagreed (with the statement ***'I made more confident strategic decisions because of the Future Grid Forum'***) or were neutral:

- “Unfortunately it was not given a priority view for strategic thinking at Telstra at the time of the final report's release” (M. Faith, 2016, personal communication, 14 February);
- “For my work, the real challenge is how to frame recommendations for today's policy

makers, and it probably was less relevant in that context” (T. Wood, 2016, personal communication, 12 February);

- “The report was ... not directly relevant to policy decision-making” (government agency informant, 2016, personal communication, 3 February); and
- “Really a matter of timing - not directly relevant to decisions being made at the time, then I retired” (A. Millis, 2016, personal communication, 17 February)

Figure 18: Impact of the Future Grid Forum on decision-making confidence (self-report)

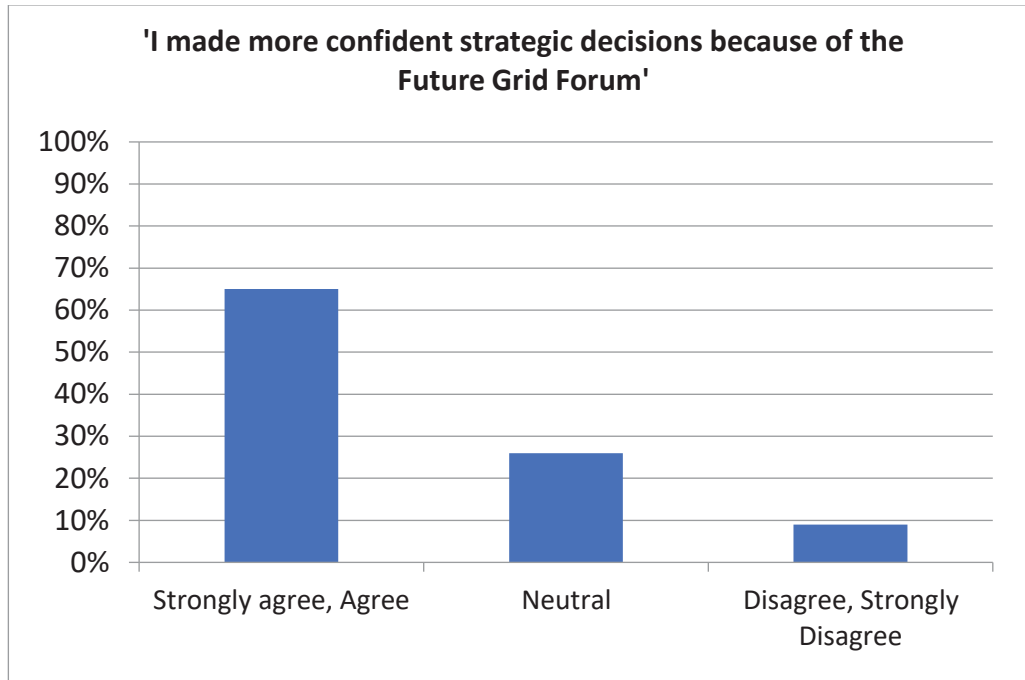
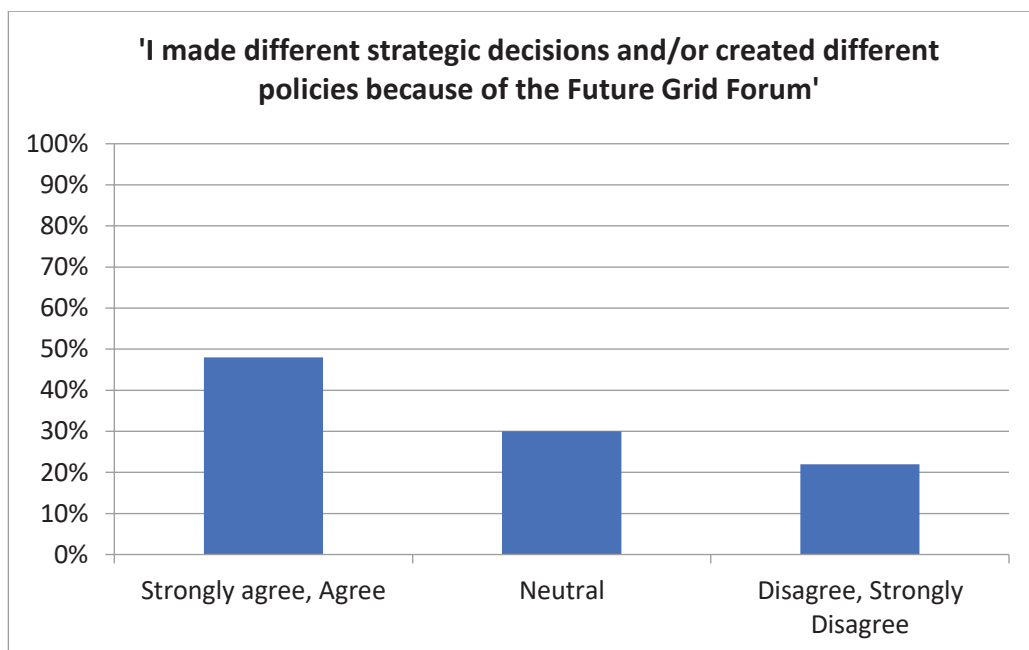
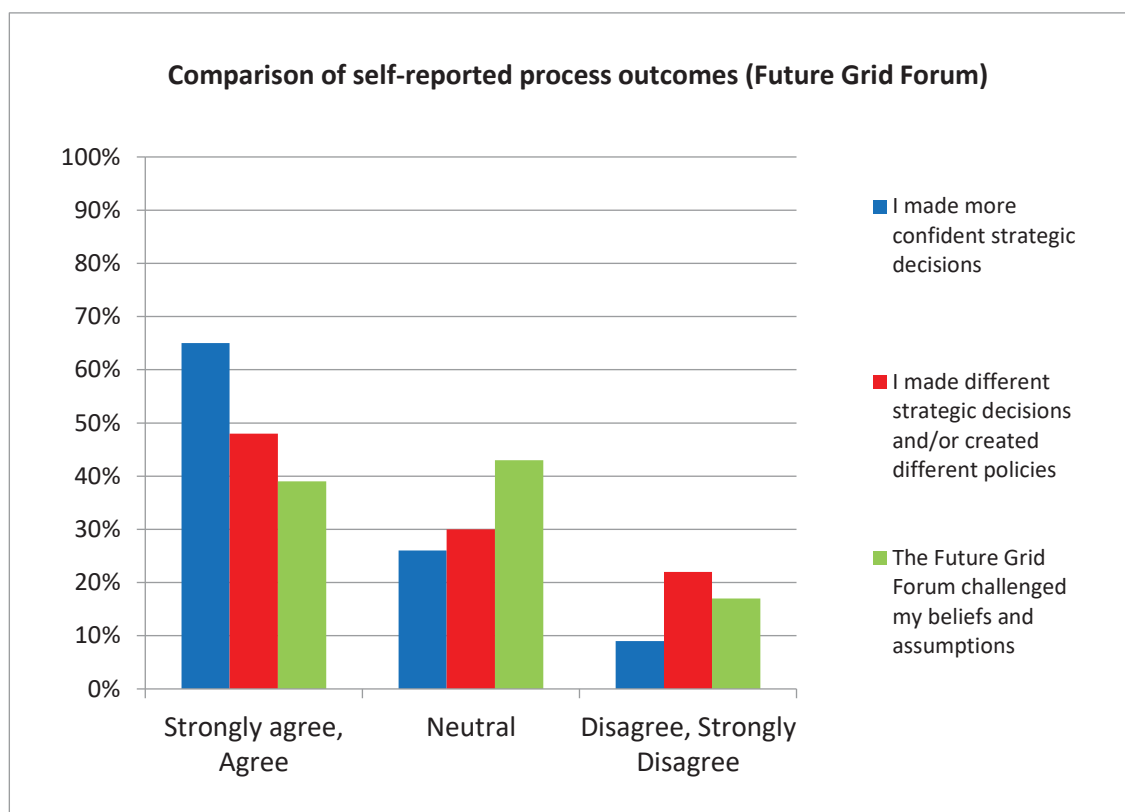


Figure 19: Impact of the Future Grid Forum on policy-making/decision-making (self-report)



These self-reported process outcomes (or effects) are compared in *Figure 20* below. The majority (65%) of surveyed forum delegates reported greater confidence; fewer reported making different decision or changing their views:

Figure 20: Comparison of process outcomes reported by Future Grid Forum participants



Remarks by surveyed delegates indicate that the outputs were used by most delegates from participating network businesses and related organisations, as summarised below:

Table 34: Use of the outputs of the Future Grid Forum by networks businesses/industry

Organisation	Relevant comment by surveyed forum delegate
Energy Networks Association (ENA)	“Yes we [Energy Networks Australia (ENA)] have used them to discuss broad energy futures, the diverse role of centralised and decentralised energy and to underpin the subsequent Network Transformation Roadmap project as a foundation input” (J. Bradley, 2016, personal communication, 16 February).
CitiPower & Powercor	“[We used the outputs at Citipower & Powercor] as one of the building blocks and reference documents used in our Network for the Future Strategy” (S. Hunt, 2016, personal communication, 15 February).

SA Power Networks	<p>“In conjunction with the ENA we are now using this report as a basis for future network strategies” (A.J. van Vuuren, 2016, personal communication, 12 February).</p> <p>“The future scenarios modelled by the FGF have informed our thinking [at SA Power Networks] on the possible future of the distribution network in South Australia” (B. Williams, 2016, personal communication, 12 February).</p>
Ergon Energy	<p>“[We have used the outputs at Ergon Energy] at a very high level to set context” (P. Wilson, 2016, personal communication, 4 February).</p>
Powerlink	<p>“Yes – [the outputs were] used [at Powerlink Queensland] to challenge future scenarios which were then used as input to strategic forecasting and decision making” (S. Bell, 2016, personal communication, 3 February).</p>

General strategic and policy-related use of the outputs was reported by some other forum participants such as the following comments made in online survey responses:

- “[We used to process/outputs at Ericsson] to articulate and understand our [utility] customer's strategic directions” (Y. Glick, 2016, personal communication, 3 February). Glick also stated that the Future Grid Forum analysis was used in the specific context of regulatory consultative committees (AEMC, AEMO) and that participation was cited by Ericsson as an example of thought leadership;
- “[We used the outputs] as context for various internal conversations [at AGL Energy]” (J. Jarvinen, 2016, personal communication, 10 February);
- “Used in an ongoing way to inform project decisions”; also “helped to support our [Stockland’s] positions in developing customer opportunities and options” (M. Napper, 2016, personal communication, 12 February); and
- “We have made references to certain Change and Choice findings in Climate Institute submissions and reports” (O. Kember, 2016, personal communication, 12 February).

Contrasting statements by other forum delegates and/or key informants indicating limited use or non-use of the forum outputs are summarised in *Table 35* below:

Table 35: Limited use and non-use of the outputs of the Future Grid Forum

Organisation	Relevant comment by forum delegate(s) or key informant(s)
Grattan Institute	<p>“For my work [at the Grattan Institute], the real challenge is how to frame recommendations for today's policy makers, and it probably was less relevant in that context” (T. Wood, 2016, personal communication, 12 February).</p>
Australian Energy Regulator	<p>“The outputs were noted. They provided a point of reference for discussion... [but are] “not directly relevant to policy-makers” (government informant, 2016, personal communication, 3 February).</p> <p>“Overall, I have not used much of that work. It has been useful background context, among other reports and work, but I have not seen a need to quote that work in any way in anything I have been doing” (Informant from the Australian Energy Regular, 2016, personal</p>

	communication, 20 April). “The forum outputs have informed internal policy processes in some relevant decisions on new technologies pat the Australian Energy Regulator”; “added to our information base” (P. Dunn, 2016, personal communication, 3 February).
Telstra	“It was not given a priority view for strategic thinking at Telstra at the time of the final report's release ... but the output was definitely used for PR” (M. Faith, 2016, personal communication, 14 February).
ClimateWorks Australia	“[Outputs used at ClimateWorks Australia] to develop energy/emissions scenarios, or to inform modelling assumptions”; [but the outputs are] sometimes difficult to include as no classic "BAU" scenario (but that was the purpose of the exercise!) or because all scenarios are perceived to be very ambitious in terms of climate action” (A. Dennis, 2016, personal communication, 3 February).

Influence on, and contribution to, policy-making related to the national electricity grid

The project leader and forum Chair from CSIRO cited post-forum examination of regulatory frameworks for electricity networks via the COAG Energy Council and stronger relationships with government agencies and bodies such as ARENA and the Australian Energy Market Operator (AEMO) as key examples of policy-related impact. As part of the COAG Energy Council’s review of regulatory framework an adapted version of the Future Grid Forum scenarios were used as part of the “stress-testing” of regulatory frameworks.¹⁷³ The Forum Chair, Mark Paterson, stated that the forum found that “we needed to give attention to whether these frameworks are suitable for these divergent futures” and asserted that “I think there’s almost a dotted line from that recommendation to the decision by COAG to undertake that analysis” (M. Paterson, 2015, personal communication, 21 December). Post-forum some Flagship staff involved with the Future Grid Forum (such as Alex Wonhas and Paul Graham) were also asked to provide advice to government bodies/agencies.¹⁷⁴

In contrast to the assessments made by CSIRO staff, interviewed key informants from policy-making and governmental contexts typically reported limited use of the outputs from the process and questioned the assumed policy-making utility. For example:

- One key informant who works in a regulatory policy-making role argued that the scenarios “are meaningless from a policy perspective”, such as with respect to contributing to an improved understanding of whether there “are the flaws in the policy settings in the regulatory framework” (government informant [non-attributable], 2016, personal communication, 4 March); and

¹⁷³ Paul Graham from CSIRO further noted that Flagship staff attended meetings with the COAG Energy Council to inform this process and noted that the forum’s scenarios were explicitly referred to.

¹⁷⁴ Graham gave the examples of providing strategic advice to AEMO and invited major presentations given by Flagship staff such as to the Council of Australian Governments (COAG), i.e. to the peak intergovernmental forum in Australia. For example, the Flagship Director, Alex Wonhas, was asked to give a short presentation at a COAG meeting to outline (amongst other information) updated Future Grid Forum scenarios. This presentation was “the first time Alex has been asked to speak in a private session at a COAG meeting” (P. Graham, 2015, personal communication, 27 November).

- Another informant working in a regulatory policy-making capacity stated that he had monitored the Future Grid Forum process and outputs but hadn't tangibly used the analysis in this policy work nor judged it to be relevant for this (government informant, 2016, personal communication, 20 March). The main impact noticed by this policy-maker was that the report provided some "background context" and were "somewhat informative in terms of ... the urgency of considering certain policy questions". These questions include "questions around the boundaries between regulated and unregulated service provision. What is the role for monopoly networks with respect to the provision or coordination of new and emerging technologies and services" (government informant, 2016, personal communication, 20 March)?

The main delegate from the Australian Energy Regulator, Paul Dunn (a Director of AER), provided a some more 'positive' assessments of the forum and its outputs:

- "The forum outputs have informed internal policy processes in some relevant decisions on new technologies". The process "added to our information base" and highlighted that "network investment decisions must factor in new technology trends" (P. Dunn, 2016, personal communication, 3 February); and
- "Enhancing my personal network" via participation in the Future Grid Forum was argued to have led to better-informed decision processes: specifically, his enhanced network "resulted in side exchanges of ideas and new learnings with other professionals I might otherwise have had little contact. This resulted in a capacity to include additional insights in AER [Australian Energy Regulator] decision processes" (P. Dunn, 2016, personal communication, 3 February).

Some energy sector experts questioned the extent to which the AER is welcoming change, which may raise questions about the extent to which its decision processes have been influenced. Regarding electricity pricing and other reform, one informant argued that a "number of networks have clearly wanted to do more in this space than the AER has been prepared to allow them to do" (Research sector informant [non-attributable], 2016, personal communication, 7 April). Related issues were raised regarding potential incentives for demand management. This informant argued that "it's not so much the network culture that's holding us back, it's more the regulator culture" (Research sector informant, 2016, 7 April).

The impact of the forum on State Government policies and programs: these impacts are, overall, unclear but appear to be limited. A state government informant from Queensland (who participated in the forum) stated that the outputs weren't "directly applicable to the everyday work of the policy groups" during the Newman State Government, with the forum having "a longer-term focus than what was relevant to policy decisions or, let's say, the implementation decisions that we were working on at the time" (Government informant [non-attributable], 2016, personal communication, 18 March). The State government "had its own specific focus and wasn't really being distracted from that". The relevance of the scenarios for key policy questions was also questioned by this participant: "For a lot of the short-term policy questions I think the answer is the same regardless of which future we move towards".

Broader commentary on the value/utility for policy-making processes: The value of long-term modelling exercises was unclear to another policymaker who argued such analysis is “nonsense from a policy perspective” (Government informant [non-attributable], 2016, personal communication, 4 March). Whether it was appropriate or useful to use the Future Grid Forum scenarios to ‘stress-test’ the current regulatory framework was also queried. A related question was posed by this policymaker: “CSIRO made no attempt to model all possible scenarios and yet who is to say that some other scenarios, such as low probability scenarios, aren’t more important [than those modelled for the forum] from a policy perspective?” (Government informant, 2016, personal communication, 4 March).

Other views regarding policy relevance and influence which were expressed by delegates from the research sector and NGOs also point to limitations. The limited consideration and discussion of the *implications* of the forum’s analysis for current policy was emphasised by delegates from Grattan Institute and The Climate Institute. Tony Wood from Grattan Institute raised the challenge of “how to frame recommendations for today’s policy makers” and argued that the forum report “probably was less relevant in that context” (T. Wood, 2016, personal communication, 12 February). Finally, Amandine Denis, Head of Research at ClimateWorks Australia, asserted that “I think there are too many barriers still existing for the report to have made a real impact” (A. Denis, 2016, personal communication, 3 February), and pointed to contextual factors which – in her view – militated against stronger outcomes.

Industry impacts and related outcomes

The Future Grid Forum had a more obvious and significant follow-on project than previous forums, with the Network Transformation Roadmap (NTR) project being conducted in collaboration with the Energy Networks Association (ENA).¹⁷⁵ This project was scoped and negotiated by the Chair of the Future Grid Forum, Mark Paterson. The NTR project has a much shorter time horizon (focussed on the 2015-2025 period). Related to this one delegate from a network business, SA Power Networks, observed that “the ENA has used this document [the Future Grid Forum reports] to start a debate amongst network businesses on future strategic direction” (A.J. van Vuuren, 2016, personal communication, 12 February).

The follow-up work (NTR) being done by ENA and CSIRO was viewed by some participants as the main tangible example of action that wouldn’t have occurred if the Future Grid Forum hadn’t been convened. Use of the findings by peak industry bodies like ENA was emphasised.

Some industry participants also felt that the forum contributed to more shared understanding:

“It was amazing that over the months people came to a more common view and had respect for each other’s viewpoints. No one was then arguing that the changes aren’t going to happen, we were talking about how to handle it best. I thought that was a great evolution” (B. Waters, 2016, personal communication, 29 January).

¹⁷⁵ See <http://www.energynetworks.com.au/electricity-network-transformation-roadmap> (last viewed 30/06/2017).

Electricity sector impact/changes

During the post-forum period there is evidence of an increased in strategic engagement with the issues and possibilities raised by the Future Grid Forum but, overall, there is little evidence of tangible resulting changes. One industry informant, who represented the peak body Grid Australia at the forum, put this as follows:

“I think the benefits are somewhat intangible and that’s a difficult thing if you’re doing a cost/benefit analysis... There’s no tangible change that I could point to that has directly come out of the process that’s got a real dollar value. There are people thinking about the future, but the future is evolving anyway, and change is happening in the industry, but you can’t necessarily attribute any of that to a process like this. You probably can’t do that until it results in a change in a framework, or incentives, or something that’s probably going to be a policy change that unlocks value but that hasn’t happened yet” (C. Popple, 2016, personal communication, 22 April).

Similarly, a senior executive from a network business in Queensland asserted that “the business is not changing direction to the extent it needs to. They are still playing very reserved” (P. Wilson, 2016, personal communication, 4 February). Other informants also pointed to such constraints on change related to limited impacts.

Industry participants pointed (in survey responses and interviews) to various impacts (see Table 36), though mostly of an incremental variety:

Table 36: Electricity sector outcomes reported by forum delegates

Reported outcomes	Details/examples
Better informed strategic thinking in network businesses	<ul style="list-style-type: none">• One informant from a Queensland network business stated that the forum contributed to a shift in expectations regarding likely electricity demand over the medium-term and related network management/investment decisions. The forum’s analysis and findings was used internally as part of planning and forecasting activities; and• Many participants stated that the process reinforced current strategic thinking, e.g. at SA Power Networks: “At a high level, FGF findings with respect to distribution sector were generally aligned with prevailing strategic thinking in SA Power Networks, but forum and final report contributed significant depth of modelling and breadth of research, as well as bringing new insights from other sectors such as generation” (B. Williams, 2016, personal communication, 12 February).

<p>General use of reports and/or learnings in planning</p>	<ul style="list-style-type: none"> • Respondents cited ‘high-level’ usage such as use to help set the context in strategic planning processes; • Other uses included use of forum to assist efforts “to better position for an uncertain future” (J. Jarvinen, 2016, personal communication, 10 February); and • Use as “one of the building blocks and reference documents” drawn on for CitiPower & Powercor’s ‘Network for the Future Strategy’ (S. Hunt, 2016, personal communication, 15 February).
<p>Informing subsequent strategic analysis conducted for/by electricity network businesses</p>	<ul style="list-style-type: none"> • Some industry actors stated that they have sought to build on the forum’s analysis and used the analytical frameworks it produced, including critically reviewing some of the conclusions that were reached and related future projections (e.g. the forecasts of potential electricity grid disconnections over the medium-term or longer-term future); reviewing related assumptions being made in strategic planning; and • The forum’s analysis and findings was also described as providing “a platform for further [analytical] work” conducted within the sector (C. Popple, 2016, personal communication, 22 April).
<p>Prompting change in strategic planning approaches</p>	<ul style="list-style-type: none"> • One respondent stated that scenario modelling methods are used more as a result of the forum (in addition to existing forecasting methods such as regression analysis).
<p>Enhanced alignment and coordination</p>	<ul style="list-style-type: none"> • One respondent claimed that the forum “created a united and informed industry voice at a pivotal time in energy policy-making” (J. Jarvinen, 2016, personal communication, 10 February); • Another highlighted the opportunity provided by the forum to “inform various stakeholders on the challenges likely to be experienced by the electricity value chain over coming years” (S. Bell, 2016, personal communication, 3 February); and • Similarly, a participant stated at SA Power Networks that the “forum deepened my understanding of the perspectives of other industry participants” (B. Williams, 2016, personal communication, 12 February).

Telecommunication sector impacts and other industry outcomes

Forum delegates from Telstra and Ericsson who participated in the process emphasised their interest in regulatory changes/processes. Limited other strategic outcomes were specified:

- *Improved consideration of the possible strategic implications of regulatory changes:* Telstra “was interested in energy regulatory policy during the FGF [Future Grid Forum]” and the process was used “to gain a deeper understanding of the nuances of the ‘Power of Choice’ review and the implications for Telstra for future opportunities” (M. Faith, 2016, personal communication, 14 February);

- *Informing participation in regulatory processes:* Ericsson’s delegate, Yochai Glick, stated that the process “helped me in regulatory consultative committees (AEMC, AEMO) by bringing to the fore results of certain scenarios”, such as by clarifying the possible “ICT reference architecture for the future grid” that may be required under future scenarios (Y. Glick, 2016, personal communication, 3 February); and
- *Other strategic outcomes:* Ericsson staff used the process and its outputs “to articulate and understand our [utility] customer’s strategic directions” and cited its participation as an example of “thought leadership” (Y. Glick, 2016, personal communication, 3 February). However, Telstra’s main delegate stated that the report “was not given a priority view for strategic thinking” at the time and was “used for PR” purposes (M. Faith, 2016, personal communication, 14 February).

Stockland’s sustainability manager, Matthew Napper, reported that the Future Grid Forum “helped to support our positions in developing customer opportunities and options”. The outputs were used in an “ongoing way to inform project decisions” (M. Napper, 2016, personal communication, 12 February). Examples were not given; however, Stockland has invested in large solar energy arrays at properties it develops (e.g. shopping centres).¹⁷⁶

CSIRO Energy Flagship outcomes such as influence on R&D activities

One outcome is the development of new research partnerships such as with ENA. The Network Transformation Roadmap (NTR) project is a multi-million dollar research project. Related to this and the ‘Grids and Energy Efficient Systems’ research program, Paul Graham asserted that “I think it [the forum] helped in the sense that we’ve got no shortage of work on in the space in which we wanted to be working”, i.e. growing the ‘grids and energy efficient systems’ program (P. Graham, 2015, personal communication, 23 November).

The Forum Chair, Mark Paterson, argued that some additional subsequent projects are a “straight” and “unbroken line” between the Future Grid Forum and subsequent projects and “then there are others where the relationship is somewhat ephemeral but it’s clearly there, it’s part of the narrative” (M. Paterson, 2015, personal communication, 21 December). He further argued that the “work [we] did for the AEMC around energy storage which is directly related to and actually builds on the modelling that was done for the Future Grid Forum” is an example of the former, and cited behavioural economics research as an example of the latter:

“Behavioural economics work ... was done around human responses to cost-reflective electricity pricing. The fact that the Future Grid Forum has a heavy emphasis on the need to be moving in that direction and evolving the way we value and price electricity that body of work kindof added to the wave of the focus on that topic” (M. Paterson, 2015, personal communication, 21 December).

Other subsequent research includes the following:

- Additional modelling completed for network businesses who participated in the forum;

¹⁷⁶ For more information see: <http://onestepoffthegrid.com.au/stockland-to-add-big-solar-arrays-to-three-more-shopping-centres/> last viewed 30/06/2017.

- \$6million of funding (via the National Energy Productivity Plan) to develop an ‘Energy Use Data Model’ for improved planning in collaboration with the Commonwealth Government. This model has a direct relationship with the Future Grid Forum modelling; and
- Contributing to the Deep Decarbonisation Pathways project, a global project for which the local component was led by ClimateWorks Australia.

The forum Chair (who is also leading the Network Transformation Roadmap work) cited other benefits. He argued the forum and its outputs “provided the broad strategic metanarrative as to why CSIRO is playing in this space”, which assists with making “the individual project proposals and discussions much more coherent and much more sensible” (M. Paterson, 2015, personal communication, 21 December). Additionally, he argued that “in the past we might have to go cap in hand almost begging for opportunities. There’s much less necessity now to bend our shoulder totally out of shape to prove that we can do something. It’s really strengthened the credibility of the organisation” (M. Paterson, 2015, personal communication, 21 December). Related to this, the project has been “a door opener generally to the most senior decision-makers across the energy ecosystem”.

Finally, reputational and positioning benefits are attributed to the Future Grid Forum:

“In terms of getting CSIRO back into a leadership position in the electricity sector as someone to look to in order to understand the future of the sector we completely hit a home run there. To underscore how far we’ve come I used to run into people who didn’t think we did any electricity modelling. So [previously] we were right down at zero in a way” (P. Graham, 2015, personal communication, 23 November).

2.4 Summary

Energy Flagship staff judged the Future Grid Forum as highly effective in terms of strategically positioning the Flagship in “a space that we sort of felt that we owned because we were ahead” (P. Graham, 2015, personal communication, 23 November). This “space” is related to the Flagship’s ‘Grids and Energy Efficient Systems’ research program. The forum also increased awareness of the Flagship’s electricity sector modelling and analysis capabilities, advanced their toolkit for such work, and led to related research opportunities.

The forum’s analysis was also interpreted by some Energy Flagship staff as providing a stronger justification for the Grids and Energy Efficient Systems research program. This justification was also described as being a “broad strategic metanarrative as to why CSIRO is playing in this space” (M. Paterson, 2015, personal communication, 21 December).

Related to the above outcomes, there is good evidence that the forum helped the Flagship to achieve the goal of developing a stronger relationship between CSIRO and the electricity industry. This goal was emphasised by the forum Chair, Mark Paterson. Notably, ENA’s late engagement (ENA attended the last three meetings) contributed to ongoing collaboration. Compared to other futures forums this one had the most tangible follow-up project (i.e. the

Network Transformation Roadmap project that was launched in mid-2015).

The other core forum partner, GE Australia, was reported by its main delegate, Ben Waters, to have received intangible benefits from participating (e.g. reputational and branding benefits).

The other available evidence reviewed above indicates that the external impact has to-date been limited. Some electricity sector businesses have engaged at a strategic level with the issues, scenarios and options identified by the forum, and some participants drew on the analysis in planning and decision-making processes, however tangible actions have to-date been limited. There is no evidence of public policy impact *if* this is judged in terms of tangible changes to policy directly related to the forum's findings and forum process. The relevance of the outputs to policy-making at the Federal and State levels was questioned.

With regards to the stated objectives – such as shifting shift the energy debate to a whole-of-system evaluation of potential options and influencing debates about regulatory models – there is some, but limited, evidence that these were achieved. For example, the Future Grid Forum scenarios and analysis has been considered in assessments of regulatory frameworks and subsequent work led by the Flagship (such as the network transformation roadmap initiative) has continued to look at whole-of-system issues and options.

Other forum information:

Sectoral breakdown of Future Grid Forum participants

Electricity sector organisations (22)	<ul style="list-style-type: none"> ▪ <i>Network businesses:</i> Ergon Energy (QLD), Powerlink (QLD), Energex, CitiPower and Powercor (VIC), SP AusNet, SA Power Networks (SA), Western Power (WA), Ausgrid (NSW) ▪ <i>Electricity generators/retailers:</i> AGL, Origin Energy, Hydro Tasmania, Aurora Energy, Stanwell Corporation ▪ <i>Other companies:</i> GE Australia (plus related GE businesses such as GE Digital Energy), Siemens, Alstom, Ampcontrol ▪ <i>Peak bodies:</i> Energy Networks Association, Energy Supply Association of Australia, Energy Retailers Association of Australia Limited, Clean Energy Council, Energy Efficiency Council
Government organisations (12)	<ul style="list-style-type: none"> ▪ Australian Energy Market Commission (AEMC) ▪ Australian Energy Market Operator (AEMO) ▪ Australian Energy Regulator ▪ Australian Renewable Energy Agency ▪ Bureau of Resources and Energy Economics ▪ Clean Energy Finance Corporation ▪ Department of Climate Change and Energy Efficiency (DCCEE) ▪ Department of Resources, Energy and Tourism ▪ Queensland Department of Energy and Water Supply ▪ Victorian Department of Primary Industries (DPI) ▪ South Australian Department of State Development ▪ SA Government
Organisations from other industries (6)	<ul style="list-style-type: none"> ▪ AMIRA International ▪ Ericsson Australia ▪ Ernst & Young ▪ Landis+Gyr ▪ Stockland ▪ Telstra
Research sector (5)	<ul style="list-style-type: none"> ▪ ClimateWorks Australia ▪ CSIRO/Energy Flagship ▪ Grattan Institute ▪ Monash Sustainability Institute ▪ University of Sydney
Community sector/NGO (4)	<ul style="list-style-type: none"> ▪ ACOSS ▪ The Climate Institute ▪ Smart Grid Australia ▪ Total Environment Centre

Core forum delegates (Future Grid Forum)

(as listed in the public forum report)

Total core delegates: 102

Sectoral breakdown

- Government department/agency/authority representative: 20 (22%)
- Industry: 64 (62%) (NOTE: this includes government-owned business in the Australian electricity sector, such as some network businesses)
- NGO representative: 4 (4%)
- Research organisation: 14 (14%)

Full details

Name	Organisation	Title	Sector
Scott Agnew	Queensland DEWS	Director - Energy Sector Reform	Public sector
Gwen Andrews	Alstom	VP - Environmental Policies & Global Advocacy – Asia & Oceania	Industry
Brad Archer	Department of Climate Change and Energy Efficiency (Federal)	Acting First Assistant Secretary	Public sector
Louise Avon-Smith	Western Power	Branch Manager – Sustainability	Industry
Paul Backscheider	GE Digital Energy	Technical Solutions Director - Digital Energy	Industry
Chris Baker	Department of Climate Change and Energy Efficiency (Federal)	Director Energy Markets	Public sector
Alberto Balbo	General Electric	Market Development Manager	Industry
Tom Barry	Department of Resources Energy and Tourism	Manager Smart Grid Initiative	Public sector
Stephanie Bashir	AGL	Manager Metering Developments	Industry
Stewart Bell	Powerlink	Manager Asset Strategies	Industry
Darryl Biggar	ACCC	Special Economic Adviser (Regulatory)	Public sector
David Bowker	Hydro Tasmania	Manager Regulatory Affairs	Industry
John Bradley	Energy Networks Australia	Chief Executive	Industry (peak body)
Miguel Brandao	GE Energy	Smart Grid - Technical Solutions Director APAC	Industry
Jillian Broadbent	Clean Energy Finance Corporation	Board member	Public sector
Paul Budde	Smart Grid Australia	Executive Director	Community organisation

Tom Butler	Clean Energy Council	Network Specialist	Industry (peak body)
Mark Byrne	Total Environment Centre	Energy Market Advocate	Community organisation
Simon Camroux	AGL	Manager Regulation and Market Development	Industry
Lucy Carter	Grattan Institute	Energy Fellow	Research
James Clements	GE Energy	Manager, Low Carbon Solutions ANZ	Industry
Alan Coller	Origin Energy	Manager, Strategy Development	Industry
Peter Coppin	CSIRO	Research Consulting CMAR	Research
Catherine Cussen	QLD Department of Energy and Water Supply		Public sector
Matthew Dalziel	AMIRA International	Program Manager	Industry
Bob Darwin	Ergon Energy	Manager Emerging Opportunities	Industry
Amandine Denis	ClimateWorks Australia	Head of Research	Research
Kieran Donoghue	Energy Supply Association of Australia	General Manager, Policy	Industry (peak body)
Paul Dunn	Australian Energy Regulator	Director - Network Operations & Development	Public sector
Marcy Faith	Telstra	Emerging Technologies Specialist	Industry
Trevor Gleeson	Stanwell Corporation	Principal Engineer – Technology Analysis	Industry
Yochai Glick	Ericsson Australia	Principal Architect (Smart Grid)	Industry
Marty Grant	Landis+Gyr	Solution Architect	Industry
David Green	Clean Energy Council	Chief Executive	Industry (peak body)
James Hetherington	Australian Renewable Energy Agency (ARENA)	Acting Manager, Business Development	Public sector
David Hill	University of Sydney	Professor – Centre for Future Energy Network	Research
Jennifer Hocking	Energex	Group Manager Demand, Technology and Systems	Industry
Lyndall Hoitink	Department of Climate Change and Energy Efficiency (Federal)		Public sector
Paul Howarth	Ausgrid		Industry
Stephen Hunt	Powercor/Citipower	Team Leader Communications & Smart Networks	Industry
Amélie Hunter	Grattan Institute	Associate	Research
Rob Jackson	AEMO		Public sector
Ramana James	Stockland	National Sustainability Manager	Industry
Justine Jarvinen	AGL	Head of Emerging Technologies	Industry

Olivia Kember	The Climate Institute	National Policy and Research Manager	Community organisation
Ishaan Khanna	Western Power	Senior Engineer - Smart Grid Development	Industry
Anne-Marie Kirkman	Origin Energy	Public Policy Manager	Industry
Rebecca Knights	SA Department of State Development	Director, Energy Markets	Public sector
Jack Kotlyar	Siemens	Head of Strategy – Energy	Industry
Dave Lee	Energy Retailers Association of Australia	Policy Manager	Industry (peak body)
Chris Leverington	SA Government		Public sector
Madeleine Lyons	Origin Energy	Manager, Carbon & Emerging Markets Policy	Industry
Gerald Marion	Ernst & Young	Director – Advisory	Industry
Peter Milbourne	Aurora Energy	Smart Network Constraint Management Engineer	Industry
Alan Millis	Queensland Department of Energy and Water Supply	General Manager – Energy Networks and Regulation	Public sector
Frank Montiel	AEMO	Manager National Planning	Public sector
Rob Murray-Leach	Energy Efficiency Council	CEO	Industry (peak body)
Tim Nelson	AGL	Head, Economic Policy & Sustainability	Industry
Peter Newland	ENERGEX	Strategic Initiatives Manager	Industry
Bernard Norton	CSIRO	Business Development Director	Research
James O’Flaherty	Aurora Energy	Network Innovation Manager	Industry
Cameron O’Reilly	Energy Retailers Association of Australia	CEO	Industry (peak body)
Gill Owen	Monash Sustainability Institute	Research Program Leader	Research
Ray Pannam	ENERGEX		Industry
Andrea Pape	ACOSS	Senior Policy Officer, Energy and Climate Change	Community organisation
Charles Pelz	Siemens	Manager High Voltage Substations	Industry
Pam Pham	Bureau of Resources and Energy Economics	Economist	Public sector
Glenn Platt	CSIRO	Research Group Leader CET	Research
Charles Pople	SP AusNet	Executive Advisor	Industry
Nadesan Pushparaj	AEMO	National Transmission Network Development Plan	Public sector
Matt Rennie	Ernst & Young	Oceania Power & Utilities Leader	Industry

Lee Richardson	Ampcontrol	National Business Development Manager	Industry
Domenic Rotili	Alstom	Head of Alstom Grid – Australia	Industry
Anna Skarbek	ClimateWorks Australia	CEO	Research
Ramy Soussou	Energy Retailers Association of Australia	Deputy Chief Executive Officer	Industry (peak body)
Brian Spalding	Australian Energy Market Commission	Commissioner	Public sector
Michael Stoyanoff	Victoria DPI	Senior Policy Officer	Public sector
Susan Streeter	Energy Networks Association	Strategic Program Coordinator	Industry (peak body)
Michelle Taylor	Ergon Energy	Manager - Technology Development	Industry
Kane Thornton	Clean Energy Council	Director of Strategy	Industry (peak body)
John Thwaites	Monash Sustainability Institute	Chair	Research
Hao Tian	Ampcontrol Group	Engineering Manager	Industry
Keith Torpy	Landis+Gyr	Chief Technology Officer (Asia Pacific)	Industry
Alida Jansen van Vuuren	SA Power Networks	Smart Grid Strategy Manager	Industry
Tony Vassallo	University of Sydney	Delta Electricity Chair in Sustainable Energy Development	Research
Gregor Verbic	University of Sydney	Senior Lecturer in the Centre for Future Energy Networks	Research
Milan Vrkic	Landis+Gyr	GM Marketing & Prod Management	Industry
Colin Wain	Hydro Tasmania	Senior Strategy and Policy Analyst	Industry
Glenn Walden	Ergon Energy	GM Emerging Opportunities and Technology Development	Industry
Chris Ward	AMIRA International	Program Director – Extractive Metallurgy	Industry
Matthew Warren	Energy Supply Association of Australia	CEO	Industry (peak body)
Ben Waters	General Electric Australia	Commercial Director AUS/NZ	Industry
Neil Watt	CitiPower/Powercor	Manager Network Strategy	Industry
Alistair Wells	Alstom	Regional Managing Director - East Asia Pacific	Industry
Bryn Williams	SA Power Networks	Telecommunications Strategy Consultant	Industry
Peter Wilson	Ergon Energy	Manager Emerging Opportunities	Industry

David Wise	ENERGEX	Future Technologies Development Manager	Industry
Alex Wonhas	CSIRO Energy Flagship	Flagship Director	Research
Tony Wood	Grattan Institute	Program Director – Energy	Research
Ben Woodside	AEMC	Senior economist	Public sector
Hudson Worsley	Stockland	National Sustainability Manager, Residential Communities	Industry
Anna Zebrowski	Energy Retailers Association of Australia		Industry (peak body)

List of interviewees and surveyed forum delegates (Future Grid Forum)

List of interviews (n=17)

Name	Role(s) at time of the Future Grid Forum	Date of interview(s)
<i>Interviews with project leader(s) and partner(s) – 5</i>		
Paul Graham	Chief Economist, Energy Transformed Flagship, CSIRO	23 November 2015 17 November 2015
Mark Patterson	Forum Chair; Manager – Smart Grid Partnerships, Energy Transformed Flagship, CSIRO	21 December 2015
Ben Waters	Commercial Director AUS/NZ, General Electric Australia	29 January 2016
N/A	Flagship staff member (non-attributable)	13 June 2014
<i>Other interviews (forum participant, key informants) – 12</i>		
Amandine Denis	Head of Research, ClimateWorks Australia	15 March 2016
David Bowker	Regulatory Manager, Hydro Tasmania	31 March 2016
Mark Byrne	Energy Markets Advocate, Total Environment Centre	8 April 2016
Olivia Kember	National Policy and Research Manager, The Climate Institute	24 March 2016
N/A (non-attributable)	Informant who worked for a participating NGO	30 March 2016
Charles Popple	Grid Australia representative	22 April 2016
Peter Wilson	Manager Emerging Opportunities, Ergon Energy	24 March 2016
N/A (non-attributable)	Industry informant from a network business	24 March 2016
N/A (non-attributable)	University-based researcher	7 April 2016
N/A (non-attributable)	Informant who worked for state government department	18 March 2016
N/A (non-attributable)	Informant who worked for a federal government agency (Australian Energy Regulator staff member)	20 April 2016
N/A (non-attributable)	Informant who worked for a federal government agency	4 March 2016

*Note: some interviews were conducted via email (when requested by those interviewees)

Surveyed participants/delegates (n=23)

Name	Role(s) at time of the Future Grid Forum	Date completed
Tom Barry	Manager – Smart Grid Initiative, Federal Department Resources Energy and Tourism	12 February 2016
Stewart Bell	Manager Asset Strategies, Powerlink (also represented Grid Australia)	3 February 2016
David Bowker	Regulatory manager, Hydro Tasmania	18 February 2016
John Bradley	Chief Executive Officer, Energy Networks Association	16 February 2016
Lucy Carter	Energy Fellow, Grattan Institute	9 February 2016

Amandine Denis	Head of Research, ClimateWorks Australia	3 February 2016
Paul Dunn	Director, Australian Energy Regulator	3 February 2016
Marcy Faith	Emerging Technologies Specialist, Telstra	14 February 2016
Yochai Glick	Principal Architect (Smart Grids), Ericsson	3 February 2016
Professor David Hill	University of Sydney	31 March 2016
Stephen Hunt	Team Leader Communications & Smart Networks, CitiPower & Powercor	15 February 2016
Justine Jarvinen	Head of Emerging Technologies, AGL Energy	10 February 2016
Olivia Kember	National Policy and Research Manager, The Climate Institute	12 February 2016
Alan Millis	General Manager – Energy Networks and Regulation, Queensland Department of Energy and Water Supply	17 February 2016
Matthew Napper	Sustainability Manger, Stockland	12 February 2016
Charles Popple	Grid Australia; Executive Advisor, Industry Development, SP AusNet	20 April 2016
Dr Ian Rose	Executive Chairman, ROAM Consulting	15 February 2014
Arif Syed	Director – Energy Futures, Department of Industry (Federal)	16 February 2014
Alida Jansen van Vuuren	Smart Grid Strategy Manager, SA Power Networks	12 February 2014
Bryn Williams	Telecommunications Strategy Consultant, SA Power Networks	12 February 2014
Peter Wilson	Emerging Opportunities Manager, Ergon Energy	4 February 2014
Tony Wood	Program Director – Energy, Grattan Institute	12 February 2016
Unnamed government informant (requested not to be named)	N/A	3 February 2016

Interviewee matrix for Future Grid Forum (sector and interviewee category breakdown)

SECTORAL CATEGORY	INTERVIEWEE	OUTCOMES CATEGORY		
		'Worked' n=7	'Mixed' outcomes n=7	'Didn't work' n=2
Research	Paul Graham (CSIRO)	X		
	Mark Paterson (CSIRO)	X		
	Flagship staff member (non-attributable)	X		
	Amandine Denis (ClimateWorks Australia)		X	
	Unnamed informant (university-based researcher)		X	
Industry	Charles Popple (Grid Australia)	X		
	Peter Wilson (Ergon Energy)	X		
	David Bowker (Hydro Tasmania)		X	
	Ben Waters (General Electric)	X		
	Network business employee (non-attributable)	X		
Government	N/A (non-attributable – federal government authority)			X
	N/A (non-attributable – state government department)		X	
	N/A (non-attributable – federal government authority)			X
NGO	Olivia Kember (The Climate Institute)		X	
	NGO delegate informant (non-attributable)		X	
	Mark Byrne (The Total Environment Centre)		X	

Appendix 4: Example online survey instrument (used for research on the Sustainable Aviation Fuel Road Map Forum)

CSIRO 'Future Forums' online survey

Section 1: Informed consent and survey respondent information

This online survey is being conducted to gather feedback from delegates who participated in the development of the **Sustainable Aviation Fuels Road Map** and additional interested parties (e.g. those who requested a copy of the related report "Flight path to sustainable aviation: Towards establishing a sustainable aviation fuels industry in Australia and New Zealand"). Participation involves responding to a small number of questions about the study, the roadmap and the value / impacts of the study. Completion of the survey should take no more than 10 minutes.

The survey includes general feedback questions (e.g. open-ended questions for comments and suggestions), and rating scale and ranking questions. For the rating and ranking questions, it is very important to explain the rating / ranking that you provide, so that CSIRO and the researchers can understand why you provided this rating / ranking. As such, following those questions we have provided a comment box for written feedback in which you can provide an explanation.

Individuals who complete the survey may be contacted at a later date to seek their participation in interview research. These interviews will be used to seek further clarity or information regarding survey responses and receive additional participant feedback. In the survey you will be asked to provide your contact details for this purpose.

If you agree to be part of the research you need to be aware that the research data may be published in a form that identifies you. Participants will be given an opportunity to check their comments (e.g. made in subsequent interviews) prior to their use in the research. At this point in time, the researchers will provide you with the options of confirming consent or of withdrawing consent for attribution (e.g. you may request the data be anonymised or the data may be withdrawn from the publication). You can change your mind at any time without consequence.

By agreeing to complete this survey (see below) you are providing informed consent.

1/ I have read and understood the above information, the participant information sheet and content form? (NOTE: Selecting 'YES' provides informed consent)

- Yes
- No

2/ Survey respondent information

- Name
- Employer(s) and position(s) at the time of the **Sustainable Aviation Fuels Road Map study** (March 2010 – May 2011)

- Current employer and position (if different to position at the time of the roadmap study):
- Email
- Phone

Section 2: Your interest in the Sustainable Aviation Fuels Road Map study

3/ Which of the following best expresses your interest in the Sustainable Aviation Fuels Road map study? (Please tick at least one box)

- It provided a source of information that was relevant to strategic decision-making processes
- It provided a source of information that was relevant to public policy development
- It provided a way to understand and cope with the uncertainties facing my organisation
- It provided an opportunity to influence public policy debates and/or influence corporate decision-making
- It provided a way to grow and strengthen my professional network
- Participation provided strategic benefits to my employer e.g. reputational benefits
- Other (please specify)

4/ With respect to the above areas of interest (each box you ticked), could you describe the extent to which the Sustainable Aviation Fuels Road Map study met your needs. *For example, if you wanted to improve your network did participation in the Sustainable Aviation Fuels Road Map study help to grow your professional network? Or if you sought to support strategic decision-making processes did the study support strategic decision-making?*

Please provide details on these outcomes – for example describing how your network changed as a result of your participation or the specific decisions that the forum and its outputs assisted with

Section 3: Use of outputs of the Sustainable Aviation Fuels Road Map study and general feedback on the sustainable aviation fuels roadmap

5/ Have you or your organisation(s) used the outputs of the Sustainable Aviation Fuels Road Map study? *For example, the sustainable aviation fuels roadmap may have been referred to in decision-making processes or draws on for other purposes (e.g. as part of supply chain development)*

- If yes, how were the outputs used?
- If no, why haven't you used the outputs? *(For example, the report may not have included specific data or insights that you were seeking)*

6/ Please select the option below that best represents your views on the Sustainable Aviation Fuels Road Map study for each of the following statements: (Strongly disagree ↔ Strongly agree -THESE POSSIBLE RATINGS/ASSESSMENTS ARE PRESENTED IN THE ONLINE VERSION)

- 6A: The **Sustainable Aviation Fuels Road Map study** credibly assessed the feasibility of the Australian and New Zealand aviation sector taking up bio-derived aviation fuels
- 6B: The study provided information that can support policy-making and strategic decision-making related to the development and take-up of bio-derived aviation fuels
- 6C: The **Sustainable Aviation Fuels Road Map** effectively communicated a future pathway to the commercial take-up of bio-derived aviation fuels and related sustainable aviation fuel options (e.g. via the report “Flight Path to Sustainable Aviation”)
- 6D: The **Sustainable Aviation Fuels Road Map Study** challenged my beliefs and assumptions about future aviation fuels and options for managing related fuel supply challenges
- 6E: I made more confident strategic decisions because of the **Sustainable Aviation Fuels Road Map/Study**
- 6F: I made different strategic decisions and/or created different policies because of the **Sustainable Aviation Fuels Road Map/Study**

7/ For each of the above ratings could you please briefly explain why you provided this assessment or judgement (e.g. for question 6A what influenced your judgement of whether the study credibly assessed the feasibility of the aviation sector taking up bio-derived aviation fuels?)

8/ Would you like to provide any additional feedback? (e.g. regarding the benefits or value of the Sustainable Aviation Fuels Road Map/Study)

Section 4: Rankings of most/least important aspects of the “Flight path to sustainable aviation” report

9/ Please rank the following aspects of the “Flight path to sustainable aviation” report from the most important to the least important (where 1 = most important; and 5 = least

important) **THESE POSSIBLE RATINGS/ASSESSMENTS ARE PRESENTED IN THE ONLINE VERSION):**

- Recommended actions and timeline for establishing a bio-derived jet fuel industry
- Assessment of potential sustainable biomass resources and production in the region
- Identification of key challenges involved in the development of a sustainable aviation fuel supply industry in the Australia and New Zealand regions
- Assessment of the potential environmental, social and economic benefits that would result from a bio-derived jet fuel production industry (e.g. reduction of greenhouse gas emissions)
- Identification of public policy implications (e.g. the role of government in establishing a successful sustainable aviation fuels industry)

10/ Could you please briefly explain the above ranking (e.g. why was one aspect of the report is judged to be the most important; and another was judged to be least important?)

Section 5: Suggestions for future roadmap studies and this research

11/ Would you like to provide any suggestions for how to improve studies of this type that CSIRO may run in the future (E.g. methodology suggestions, reporting suggestions, suggestions for enhancing impact, etc)?

12/ In order to assess the impacts of the Sustainable Aviation Fuels Road Map study it is necessary to understand how and if the roadmap has contributed to commercial deployment of sustainable aviation fuels and/or new supply chains. Can you suggest any key individuals who the researchers should speak to in order to assess the impact of the study? Other suggestions?

Thank you for your time and contribution to this research - please click on the finish button to finalise your response

References list

- ACIL Tasman 2008, *An Assessment of Australia's Liquid Fuel Vulnerability (Prepared for Department of Resources, Energy and Tourism)*.
- ACIL Tasman 2011, *Liquid fuels vulnerability assessment: A review of liquid fuels vulnerability (Report prepared for Department of Resources Energy and Tourism)*.
- AEMO 2013, *100 PER CENT RENEWABLES STUDY – MODELLING OUTCOMES*, Australian Energy Market Operator.
- AEMO 2015, *Emerging Technologies Information Paper: National Electricity Forecasting Report*, Australian Energy Market Operator.
- Allenby, B.R. & Sarewitz, D. 2011, *The Techno-Human Condition*, MIT Press.
- Allison, G. & Zelikow, P. 1999, *Essence of Decision: Explaining the Cuban Missile Crisis (Second Edition)*, Longman, New York.
- Anon. 2008a, 'Biofuels: Why Caltex is a supporter', *The Star*, October-November.
- Anon. 2008b, 'Petrol tipped to hit \$8 a litre by 2018', <http://www.abc.net.au>, July 11.
- Astbury, B. & Leeuw, F.L. 2010, 'Unpacking Black Boxes: Mechanisms and Theory Building in Evaluation', *American Journal of Evaluation*, vol. 31, no. 3, pp. 363-81.
- Australian Automobile Association 2011, 'Response to the Proposed Fuel Quality Standard - Ethanol (E85) Automotive Fuel Position Paper', Australian Automobile Association.
- Australian Conservation Foundation 2008, 'Submission in response to discussion paper 'Vehicle Fuel Efficiency – Potential measures to encourage the uptake of more fuel efficient, low carbon emission vehicles''.
- Australian Energy Market Commission 2012, *Power of Choice review - Giving consumers options in the way they use electricity*, Australian Energy Market Commission, Sydney South NSW.
- Australian Fleet Managers Association 2006, 'National Alternative Fuels Summit (event summary)', [https://ssecbp.ssc.nsw.gov.au/ebp/webpapr.nsf/0/a48fbd15a759a7a4ca2571d3000d9042/\\$FILE/Appendix%20A%20-%20National%20Alternative%20Fuels%20Summit.pdf](https://ssecbp.ssc.nsw.gov.au/ebp/webpapr.nsf/0/a48fbd15a759a7a4ca2571d3000d9042/$FILE/Appendix%20A%20-%20National%20Alternative%20Fuels%20Summit.pdf).
- Australian Government 2011a, 'Budget: Australian Biofuels Research Institute (10 May 2011)'.
- Australian Government 2011b, *Strategic Framework for Alternative Transport Fuels*, Commonwealth of Australia, Department of Resources, Energy and Tourism.
- Australian Government 2012, *Energy White Paper 2012: Australia's Energy Transformation*, Department of Resources, Energy and Tourism.
- Avelino, F., Grin, J., Pel, B. & Jhagroe, S. 2016, 'The politics of sustainability transitions', *Journal of Environmental Policy & Planning*, vol. 18, no. 5, pp. 557-67.
- Bacharach, S.B. 2016, *The Agenda Mover: When Your Good Idea Is Not Enough*, BLG Books (in association with Cornell University Press).
- Baumeister, R.F., Vohs, K.D. & Oettingen, G. 2016, 'Pragmatic Prospection: How and Why People Think About the Future', *Review of General Psychology*, vol. 20, no. 1, pp. 3-16.
- Bazeley, P. 2013, *Qualitative Data Analysis: Practical Strategies*, SAGE Publications Ltd.
- Beckert, J. 2013a, 'Capitalism as a System of Expectations: Toward a Sociological Microfoundation of Political Economy', *Politics & Society*, vol. 41, no. 3, pp. 323-50.
- Beckert, J. 2013b, 'Imagined futures: fictional expectations in the economy', *Theory and Society*, vol. 42, no. 3, pp. 219-40.
- Beckert, J. 2014, *Capitalist Dynamics: Fictional Expectations and the Openness of the Future (MPIfG Discussion Paper 14/7)*, Max Planck Institute for the Study of Societies, Cologne.

- Beckert, J. 2016, *Imagined Futures: Fictional Expectations and Capitalist Dynamics*, Harvard University Press.
- Beckert, J. & Dequech, D. 2005, 'Risk and Uncertainty', in J. Beckert & M. Zafirovski (eds), *International Encyclopedia of Economic Sociology*, Routledge, pp. 582-7.
- Berkhout, F., Hertin, J. & Jordan, A. 2002, 'Socio-economic futures in climate change impact assessment: using scenarios as 'learning machines'', *Global Environmental Change*, vol. 12, no. 2, pp. 83-95.
- Berkhout, F., Smith, A. & Stirling, A. 2004, 'Socio-technological regimes and transition contexts', in B. Elzen, F.K. Geels & K. Green (eds), *System Innovation and the Transition to Sustainability: Theory, Evidence and Policy*, Edward Elgar Publishing, Cheltenham, England.
- Blackburn, J. 2013, *Australia's Liquid Fuel Security: A Report for NRMA Motoring and Services*, John Blackburn Consulting Pty Ltd.
- Blackburn, J. 2014, *Australia's Liquid Fuel Security (Part 2): A report for NRMA Motoring & Services*, John Blackburn Consulting Pty Ltd.
- Blakers, A. & Fulton, R. 2014, 'How pushing water uphill can solve our renewable energy issues', *Water: Journal of the Australian Water Association*, vol. 41, no. 5, pp. 30-1.
- Bond, M. 2015, *The Power of Others: Peer Pressure, Groupthink, and How the People Around Us Shape Everything We Do*, Oneworld Publications, London.
- Booth, T.H., Raison, R.J., Crawford, D.F., Jovanovic, T., O'Connor, M.H., Raisbeck-Brown, N., O'Connell, D.A., Hogg, B.W. & Leec, D.J. 2014, 'Biomass for aviation fuel production in the Fitzroy Basin, Queensland: a preliminary assessment of native and plantation forest potential', *Australian Forestry*, vol. 77, no. 1, pp. 1-8.
- Borch, K., Dingli, S.M. & Jorgensen, M.S. (eds) 2013, *Participation and Interaction in Foresight: Dialogue, Dissemination and Visions*, Edward Elgar, Cheltenham, UK.
- Borup, M., Brown, N., Konrad, K. & van Lente, H. 2006, 'The Sociology of Expectations in Science and Technology', *Technology Analysis & Strategic Management*, vol. 18, no. 3, pp. 285-98.
- Bracks, S. 2008, *Review of the Australia's Automotive Industry*, Commonwealth of Australia.
- Bradfield, R.M. 2008, 'Cognitive Barriers in the Scenario Development Process', *Advances in Developing Human Resources*, vol. 10, no. 2, pp. 198-215.
- Brown, M.B. 2015, 'Politicizing science: Conceptions of politics in science and technology studies', *Social Studies of Science*, vol. 45, no. 1, pp. 3-30.
- Brulle, R.J. & Dunlap, R.E. 2015, 'Sociology and Global Climate Change: Introduction', in R.E. Dunlap & R.J. Brulle (eds), *Climate Change and Society: Sociological Perspectives*, Oxford University Press, New York, NY.
- Cairney, P. 2015a, 'The Advocacy Coalition Framework', in S.J. Balla, M. Lodge & E.C. Page (eds), *Oxford Handbook of the Classics of Public Policy and Administration*, Oxford University Press.
- Cairney, P. 2015b, 'An Advocacy Coalition Framework of Policy Change and the Role of Policy-Oriented Learning Therein', in S.J. Balla, M. Lodge & E.C. Page (eds), *The Oxford Handbook of Classics in Public Policy and Administration*, Oxford University Press.
- Cairney, P. 2016, *The Politics of Evidence-Based Policy Making*, Palgrave Macmillan, London, UK.
- Cairns, G., Ahmed, I., Mullett, J. & Wright, G. 2013, 'Scenario method and stakeholder engagement: Critical reflections on a climate change scenarios case study', *Technological Forecasting and Social Change*, vol. 80, no. 1, pp. 1-10.
- Cairns, G., Wright, G., Van der Heijden, K., Bradfield, R. & Burt, G. 2006, 'Enhancing foresight between multiple agencies: Issues in the use of scenario thinking to overcome fragmentation', *Futures*, vol. 38, no. 8, pp. 1010-25.
- Caltex 2009, *2009 Annual Review - "An Australian Story"*, Caltex Australia Limited.

- Caltex Australia Limited 2014, 'Relationship with Chevron', <http://www.caltex.com.au/AboutUs/Documents/PoliciesProcesses/Relationship%20with%20Chevron.pdf>.
- Camic, C., Gross, N. & Lamont, M. (eds) 2011a, *Social Knowledge in the Making*, University of Chicago Press, Chicago and London.
- Camic, C., Gross, N. & Lamont, M. 2011b, 'The Study of Social Knowledge Making', in C. Camic, N. Gross & L. Michele (eds), *Social Knowledge in the Making*, University of Chicago Press, Chicago and London.
- Camilleri, J.A. & Falk, J. 2009, *Worlds in Transition: Evolving Governance Across a Stressed Planet*, Edward Elgar, Cheltenham, UK; Northampton, MA, USA.
- Carter, N. 2007, *The Politics of the Environment: Ideas, Activism, Policy (2nd Edition)*, Cambridge University Press, New York.
- Cavanagh K, Ward J K, Behrens S, Bhatt A I, Ratnam E L, Oliver E & Hayward J 2015, *Electrical Energy Storage: Technology Overview and Applications*, CSIRO, Australia.
- Cawood, M. 2008, 'The future of fuel is wide open', *Stock & Land*, 17 July.
- Cerulo, K.A. 2006, *Never Saw it Coming: Cultural Challenges to Envisioning the Worst*, University of Chicago Press, Chicago; London.
- Chakraborty, A. 2011, 'Enhancing the role of participatory scenario planning processes: Lessons from Reality Check exercises', *Futures*, vol. 43, no. 4, pp. 387-99.
- Chang, H.J. 2002, 'Breaking the mould: an institutionalist political economy alternative to the neo-liberal theory of the market and the state', *Cambridge Journal of Economics*, vol. 26, no. 5, pp. 539-59.
- Chermack, T.J. 2011, *Scenario Planning in Organizations: How to Create, Use and Assess Scenarios*, Berrett-Koehler Publishers, Inc, San Francisco.
- Chermack, T.J. & van der Merwe, L. 2003, 'The role of constructivist learning in scenario planning', *Futures*, vol. 35, no. 5, pp. 445-60.
- Christiansen, C. & Murray, B. 2015, *Energy Storage Study: A Storage Market Review and Recommendations for Funding and Knowledge Sharing Priorities*, AECOM.
- Chubb, P. 2014, *Power Failure: The inside story of climate politics under Rudd and Gillard*, Black Inc.
- Clark, W.C., Kerkhoff, L.v., Lebel, L. & Gallopin, G.C. 2016, 'Crafting usable knowledge for sustainable development', *Proceedings of the National Academy of Science of the United States of America (PNAS)*, vol. 113, no. 17, pp. 4570–8.
- Clean Energy Council 2014, *Clean Energy Australia Report 2013*, Clean Energy Council.
- Clean Energy Council 2015, *Clean Energy Australia Report 2014*, Clean Energy Council.
- Climate Change Authority 2016, *Towards a Climate Policy Toolkit: Special Review on Australia's Climate Goals and Policies*, Commonwealth of Australia.
- ClimateWorks Australia, ANU, CSIRO & CoPS 2015, *PATHWAYS TO DEEP DECARBONISATION IN 2050: How Australia can prosper in a low carbon world (TECHNICAL REPORT)*, ClimateWorks Australia.
- Commonwealth of Australia 2013, *Report on Australia's oil refinery industry*, House of Representatives Standing Committee on Economics.
- Cook, C.N., Inayatullah, S., Burgman, M.A., Sutherland, W.J. & Wintle, B.A. 2014, 'Strategic foresight: how planning for the unpredictable can improve environmental decision-making', *Trends in Ecology & Evolution*, vol. 29, no. 9, pp. 531-41.
- Coorey, P. 2008, 'Peak oil: petrol to reach \$8 a litre', *Sydney Morning Herald*, July 11.
- Cozzens, S.E. & Woodhouse, E.J. 1996, 'Science, Government and the Politics of Knowledge', in S. Jasanoff, G.E. Markle, J.C. Petersen & T. Pinch (eds), *Handbook of Science and Technology Studies*, SAGE, pp. 533-53.
- Crisp, R. 2015, *The Social Brain: How Diversity Made the Modern Mind*, Robinson, London, UK.

- CSIRO 2007a, *CSIRO Annual Report 2006–07*, Commonwealth Scientific and Industrial Research Organisation, Campbell, ACT.
- CSIRO 2007b, *Future Fuels Forum: project details*, CSIRO Energy Transformed Flagship.
- CSIRO 2008a, *Fuel for thought - The future of transport fuels: challenges and opportunities (report of the Future Fuels Forum)*, Commonwealth Scientific and Industrial Research Organisation.
- CSIRO 2008b, 'Future Fuels Forum Project Review - June 08', CSIRO Energy Transformed Flagship.
- CSIRO 2010, 'Invitation to Participate: Australian and New Zealand Sustainable Aviation Fuel Road Map Study', CSIRO Energy Transformed Flagship.
- CSIRO 2011, *Flight Path to Sustainable Aviation: Towards establishing a sustainable aviation fuels industry in Australia and New Zealand*, CSIRO Energy Transformed Flagship.
- CSIRO 2012, *Australia's Future Grid: Evaluating whole-of-system options for Australia's future electricity system*, Commonwealth Scientific and Industrial Research Organisation.
- CSIRO 2013a, *Change and Choice: The Future Grid Forum's analysis of Australia's potential electricity pathways to 2050*, Commonwealth Scientific and Industrial Research Organisation.
- CSIRO 2013b, *Future Grid Forum - Change and Choice: Summary*, Commonwealth Scientific and Industrial Research Organisation.
- CSIRO n.d., 'Eureka Award submission: Solutions to climate change - Future Fuels Forum', CSIRO Energy Transformed Flagship.
- Dargaville, R. 2016, 'Despite the hype, batteries aren't the cheapest way to store energy on the grid', *The Conversation*, December 2, <<https://theconversation.com/despite-the-hype-batteries-arent-the-cheapest-way-to-store-energy-on-the-grid-68417>>.
- Darzins, A., Pienkos, P. & Edye, L. 2010, *Current Status and Potential for Algal Biofuels Production (report to IEA Bioenergy Task 39)*, IEA Bioenergy Task 39.
- Davies, A.R., Doyle, R. & Pape, J. 2012, 'Future visioning for sustainable household practices: spaces for sustainability learning?', *Area*, vol. 44, no. 1, pp. 54-60.
- de Brabandere, L. & Iny, A. 2013, *Thinking in New Boxes: A New Paradigm for Business Creativity*, Random House, New York, New York.
- Denning, L. 2013, 'Lights Flicker for Utilities', *The Wall Street Journal*, December 22.
- Denniss, R. 2015, 'Spreadsheets of Power', *The Monthly*, vol. April, pp. 28-33.
- Denniss, R. 2016, *Econobabble: How to Decode Political Spin and Economic Nonsense*, Black Inc (Redback).
- Dequech, D. 2003, 'Uncertainty and Economic Sociology: A Preliminary Discussion', *The American Journal of Economics and Sociology*, vol. 62, no. 3, pp. 509-32.
- Dobbin, F. 2004, 'The Sociological View of the Economy', in F. Dobbin (ed.), *The New Economic Sociology: A Reader*, Princeton University Press, pp. 1-46.
- Dodson, J. & Sipe, N. 2005, 'Oil Vulnerability in the Australian City', *Urban Research Program - Research Paper 6*, Griffith University (Urban Research Program).
- Doron, G. & Sened, I. 2001, *Political Bargaining: Theory, Practice and Process*, SAGE, London.
- Dryzek, J.S. & Schlosberg, D. (eds) 2005, *Debating the Earth: The Environmental Politics Reader (Second Edition)*, Oxford University Press, Oxford.
- Dunlap, R.E. & Brulle, R.J. (eds) 2015, *Climate Change and Society: Sociological Perspectives*, Oxford University Press, New York, NY.
- Eames, M. & McDowall, W. 2010, 'Sustainability, foresight and contested futures: exploring visions and pathways in the transition to a hydrogen economy', *Technology Analysis & Strategic Management*, vol. 22, no. 6, pp. 671-92.
- Edye, L. 2015, 'Developments from IEA Bioenergy Task 39 – Commercialising Conventional and Advanced Liquid Biofuels from Biomass,' paper presented to the *Bioenergy Australia Conference 2015: Local Solutions - Global Benefits*, Launceston, Tasmania.

- Eisenhardt, K.M. & Bourgeois, L.J. 1988, 'Politics of Strategic Decision Making in High-Velocity Environments: Toward a Midrange Theory', *The Academy of Management Journal*, vol. 31, no. 4, pp. 737-70.
- Elliston, B., MacGill, I. & Diesendorf, M. 2014, 'Comparing least cost scenarios for 100% renewable electricity with low emission fossil fuel scenarios in the Australian National Electricity Market', *Renewable Energy*, vol. 66, no. June, pp. 196-204.
- Energy Networks Association & CSIRO 2015, 'Electricity Network Transformation Project Overview'.
- Erdmann, D., Sichel, B. & Yeung, L. 2015, 'Overcoming obstacles to effective scenario planning', June 2015, <<http://www.mckinsey.com/business-functions/strategy-and-corporate-finance/our-insights/overcoming-obstacles-to-effective-scenario-planning>>.
- Erickson, M. 2016, *Science, Culture and Society: Understanding Science in the 21st Century*, Second edn, Polity Press, Cambridge UK; Malden, USA.
- Falk, J. 2012, 'Forum on Joseph A. Camilleri's and Jim Falk's Worlds in Transition: A brief afterthought', *Global Change, Peace & Security*, vol. 24, no. 1, pp. 45-8.
- Farla, J., Markard, J., Raven, R. & Coenen, L. 2012, 'Sustainability transitions in the making: A closer look at actors, strategies and resources', *Technological Forecasting and Social Change* vol. 79, no. 6, pp. 991-8.
- Ferguson, M. 2011, *LAUNCH OF THE DRAFT ENERGY WHITE PAPER: 'Strengthening the foundations for Australia's energy future'*, Australian Government, Speech to the Committee for the Economic Development of Australia.
- Ferguson, M. 2012, *Energy White Paper Launch (Minister's Speech)*, Australian Government.
- Fligstein, N. 2001, 'Social Skill and the Theory of Fields', *Sociological Theory*, vol. 19, no. 2, pp. 105-25.
- Fligstein, N. 2008, 'Fields, Power, and Social Skill: A Critical Analysis of the New Institutionalism', *International Public Management Review*, vol. 9, no. 1, pp. 227-52.
- Fligstein, N. & McAdam, D. 2012, *A Theory of Fields*, Oxford University Press, New York, New York.
- Fligstein, N. & Vandebroek, D. 2014, 'The frenzy of fields: an interview with Neil Fligstein on field theory and social skill', *Irish Journal of Sociology*, vol. 22, no. 1, pp. 107-29.
- Floyd, J. 2016, 'Navigating the energy transition landscape: summary findings from a dynamic systems view', September 22, 2016, <<https://beyondthisbriefanomaly.org/2016/09/22/navigating-the-energy-transition-landscape-summary-findings-from-a-dynamic-systems-view/>>.
- Flyvbjerg, B. 2006, 'Five Misunderstandings About Case-Study Research', *Qualitative Inquiry*, vol. 12, no. 2, pp. 219-45.
- Forcey, T. & Dargaville, R. 2015, 'Let's turn Latrobe Valley coal pits into hydro storage for renewables', May 15, <<http://reneweconomy.com.au/lets-turn-latrobe-valley-coal-pits-into-hydro-storage-for-renewables-91630/>>.
- Freed, J. 2014, 'Airline capacity war over as clock ticks on cheap tickets', *Sydney Morning Herald*, August 30, 2014.
- Frickel, S. & Moore, K. (eds) 2006, *The New Political Sociology of Science: Institutions, Networks and Power*, The University of Wisconsin Press, Madison, Wisconsin.
- Gaede, J. & Meadowcroft, J. 2016, 'A Question of Authenticity: Status Quo Bias and the International Energy Agency's World Energy Outlook', *Journal of Environmental Policy & Planning*, vol. 8, no. 5, pp. 608-27.
- Garb, Y., Pulver, S. & Vandever, S.D. 2008, 'Scenarios in society, society in scenarios: toward a social scientific analysis of storyline-driven environmental modeling', *Environmental Research Letters*, vol. 3, no. 4.
- Geels, F.W. 2002, 'Technological transitions as evolutionary reconfiguration processes: a multi-level perspective and a case-study', *Research Policy*, vol. 31, no. 8-9, pp. 1257-74.

- Geels, F.W. 2005, 'Processes and patterns in transitions and system innovations: Refining the co-evolutionary multi-level perspective', *Technological Forecasting & Social Change*, vol. 72, pp. 681-96.
- Geels, F.W. 2010, 'Ontologies, socio-technical transitions (to sustainability), and the multi-level perspective', *Research Policy*, vol. 39, no. 4, pp. 495-510.
- Geels, F.W. 2011, 'The multi-level perspective on sustainability transitions: Responses to seven criticisms', *Environmental Innovation and Societal Transitions*, vol. 1, no. 1, pp. 24-40.
- Geels, F.W. 2014, 'Regime Resistance against Low-Carbon Transitions: Introducing Politics and Power into the Multi-Level Perspective', *Theory, Culture & Society*, vol. 31, no. 5, pp. 21-40.
- Geels, F.W., Elzen, B. & Green, K. 2004, 'General introduction: system innovation and transitions to sustainability', in B. Elzen, F.W. Geels & K. Green (eds), *System Innovation and the Transition to Sustainability: Theory, Evidence and Policy*, Edward Elgar Cheltenham, UK; Northampton, MA, USA, pp. 1-16.
- Geels, F.W., Kern, F., Fuchs, G., Hinderer, N., Kungl, G., Mylan, J., Neukirch, M. & Wassermann, S. 2016, 'The enactment of socio-technical transition pathways: A reformulated typology and a comparative multi-level analysis of the German and UK low-carbon electricity transition (1990–2014)', *Research Policy*, vol. 45, pp. 896-913.
- Gilbert, D.T. 2007, *Stumbling on Happiness*, Vintage Books, Random House, New York.
- Gilbert, D.T. & Wilson, T.D. 2007, 'Prospection: Experiencing the Future', *Science*, vol. 317, no. 7 September, pp. 1351-4.
- GM Holden 2008, 'GM Holden submission to the Public Discussion Paper on Vehicle Fuel Efficiency 'Potential measures to encourage the uptake of more fuel efficient, low carbon emission vehicles''.
- Godet, M. 2000, 'The Art of Scenarios and Strategic Planning: Tools and Pitfalls', *Technological Forecasting and Social Change*, vol. 65, no. 1, pp. 3-22.
- Godet, M. 2006, *Creating Futures: Scenario Planning as a Strategic Management Tool*, Economica Ltd, France.
- Godfrey-Smith, P. 2001, 'Pragmatism: Philosophical Aspects', in N.J. Smelser & P.B. Baltes (eds), *International Encyclopedia of the Social and Behavioral Sciences*, Elsevier.
- Godfrey, B., Sargent, M. & Pond, S. 2013, *Green Growth - Energy: Industry Opportunities for Australia*, Australian Academy of Technological Sciences and Engineering, Melbourne, Victoria.
- Graham, P., Brinsmead, T., Dunstall, S., Ward, J., Reedman, L., Elgindy, T., Gilmore, J., Cutler, N., James, G., Rai, A. & Hayward, J. 2013, *Modelling the Future Grid Forum scenarios*, CSIRO.
- Graham, P., Brinsmead, T., Reedman, L., Hayward, J. & Ferraro, S. 2015, *Future Grid Forum - 2015 Refresh: Technical report*, CSIRO report for the Energy Networks Association, Australia.
- Graham, P., Reedman, L. & Poldy, F. 2008, 'Modelling of the future of transport fuels in Australia: A report to the Future Fuels Forum', CSIRO Energy Transformed Flagship.
- Graham, P., Reedman, L., Rodriguez, L., Raison, J., Braid, A., Haritos, V., Brinsmead, T., Hayward, J., Taylor, J., O'Connell, D. & Adams, P. 2011, *Sustainable Aviation Fuels Road Map: Data Assumptions and Modelling*, CSIRO Energy Transformed Flagship.
- Greene, J. 2013, *Moral Tribes: Emotion, Reason and the Gap Between Us and Them*, Atlantic Books, London.
- Gross, N. 2009, 'A Pragmatist Theory of Social Mechanisms', *American Sociological Review*, vol. 74, no. 3, pp. 358-79.
- Gross, N. 2010, 'Charles Tilly and American Pragmatism', *The American Sociologist*, vol. 41, no. 4, pp. 337-57.

- Haidt, J. 2001, 'The emotional dog and its rational tail: A social intuitionist approach to moral judgment', *Psychological Review*, vol. 108, pp. 814-34.
- Haidt, J. 2013, *The Righteous Mind: Why Good People are Divided by Politics and Religion*, Penguin Books.
- Hannam, P. 2015, 'Australia's renewable energy investment grinds to a halt', *Sydney Morning Herald*, April 15.
- Harder, H. 2010, 'Explanatory Case Study', in A.J. Mills, G. Durepos & E. Wiebe (eds), *Encyclopedia of Case Study Research*, SAGE Publications, Inc., Thousand Oaks.
- Harries, C. 2003, 'Correspondence to what? Coherence to what? What is good scenario-based decision making?', *Technological Forecasting & Social Change*, vol. 70, no. 8, pp. 797-817.
- Harrison, B. 2008, 'Remarks at CSIRO Future Fuels Forum report launch', <<http://www.smc.org.au/2008/07/media-briefing-national-briefing-what-is-the-future-of-petrol-csiro-future-fuels-forum-report-launch/>>.
- Hartmann, B. & Sam, S. 2016, 'What Low Oil Prices Really Mean', *Harvard Business Review*, March 28, 2016.
- Haxeltine, A., Whitmarsh, L., Bergman, N., Rotmans, J., Schilperoord, M. & Kohler, J. 2008, 'A Conceptual Framework for transition modelling', *International Journal of Innovation and Sustainable Development*, vol. 3, no. 1/2, pp. 93-114.
- Hayward, J.A., O'Connell, D.A., Raison, R.J., Warden, A.C., O'Connor, M.H., Murphy, H.T., Booth, T.H., Braid, A.L., Crawford, D.F., Herr, A., Jovanovic, T., Poole, M.L., Prestwidge, D., Raisbeck-Brown, N. & Rye, L. 2013, 'The economics of producing sustainable aviation fuel: a regional case study in Queensland, Australia', *GCB Bioenergy*, vol. 7, no. 3, pp. 497-511.
- Hayward, P. & Morrow, R. 2009, 'An Integral Approach to Scenarios', *Journal of Futures Studies*, vol. 13, no. 3, pp. 115-8.
- Healey, M.P. & Hodgkinson, G.P. 2008, 'Troubling futures: scenarios and scenario planning for organisational decision making', in G.P. Hodgkinson & W.H. Starbuck (eds), *The Oxford Handbook of Organisational Decision Making*, Oxford University Press, Oxford.
- Hearps, P., Dargaville, R., McConnell, D., Sandiford, M., Forcey, T. & Seligman, P. 2014, *Opportunities for Pumped Hydro Energy Storage in Australia*, Melbourne Energy Institute, University of Melbourne.
- Heinberg, R. 2005, *The Party's Over: Oil, War and the Fate of Industrial Societies*, New Society Publishers.
- Heywood, A. 2013, *Politics (4th Edition)*, Palgrave Macmillan.
- Hines, A. 1995, 'A Checklist for Evaluating Forecasts', *The Futurist*, vol. November-December, pp. 20-4.
- Hines, A. & Bishop, P.C. 2013, 'Framework foresight: Exploring futures the Houston way', *Futures*, vol. 51, no. July, pp. 31-49.
- Holtz, G., Alkemade, F., Haan, F.d., Köhler, J., Trutnevyte, E., Luthe, T., Halbe, J., Papachristos, G., Chappina, E., Kwakkel, J. & Ruutu, S. 2015, 'Prospects of modelling societal transitions: Position paper of an emerging community', *Environmental Innovation and Societal Transitions*, vol. 17, no. December, pp. 41-58.
- Hookway, C. 2015, 'Pragmatism', *The Stanford Encyclopedia of Philosophy (Summer 2016 Edition)*, Edward N. Zalta (Ed.), <<https://plato.stanford.edu/archives/sum2016/entries/pragmatism/>>.
- Hulme, M. 2014, 'Science can't settle what should be done about climate change', *The Conversation*, February 4, <<https://theconversation.com/science-cant-settle-what-should-be-done-about-climate-change-22727>>.

- Hulme, M. & Dessai, S. 2008, 'Negotiating future climates: a critical review of the development of climate scenarios for the UK', *Environmental Science and Policy*, vol. 11, no. 1, pp. 54-70.
- IATA 2014, *IATA 2014 Report on Alternative Fuels (9th Edition)*, International Air Transport Association, Montreal—Geneva.
- Inayatullah, S. 2008, 'Six pillars: futures thinking for transforming', *Foresight*, vol. 10, no. 1, pp. 4-21.
- Inayatullah, S. 2015, *What Works: Case Studies in the Practice of Foresight*, Tamkang University Press, Tamsui, Taipei, Taiwan.
- International Air Transport Association 2008, *Report on Alternative Fuels (3rd Edition)*, International Air Transport Association, Montreal-Geneva.
- International Air Transport Association 2009, *IATA 2009 Report on Alternative Fuels (4th Edition)*, International Air Transport Association, Montreal—Geneva.
- International Air Transport Association 2010, *IATA 2010 Report on Alternative Fuels (5th Edition)*, International Air Transport Association, Montreal—Geneva.
- IPCC 2014, *Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, R.K. Pachauri and L.A. Meyer (eds.)]*.
- James, W. 1890, *Principles of Psychology*, Henry Holt and Company, New York.
- Jarzabkowski, P. & Kaplan, S. 2015, 'Strategy Tools-in-Use: A Framework for Understanding "Technologies of Rationality" in Practice', *Strategic Management Journal*, vol. 36, no. 4, pp. 537-58.
- Jasanoff, S. 2004, *States of Knowledge: The Co-production of Science and Social Order*, Routledge, New York.
- Jasanoff, S. & Kim, S.-H. 2009, 'Containing the Atom: Sociotechnical Imaginaries and Nuclear Power in the United States and South Korea', *Minerva*, vol. 47, no. 2, pp. 119-46.
- Jasanoff, S. & Kim, S.-H. 2013, 'Sociotechnical Imaginaries and National Energy Policies', *Science as Culture*, vol. 22, no. 3, pp. 189-96.
- Jenkins-Smith, H. & Sabatier, P. 1993, 'The Dynamics of Policy-Oriented Learning', in P. Sabatier & H. Jenkins-Smith (eds), *Policy Change and Learning: An Advocacy Coalition Approach*, Westview Press, Boulder.
- Joas, H. 2001, 'Pragmatist Social Thought, History of', in N.J. Smelser & P.B. Baltes (eds), *International Encyclopedia of the Social and Behavioral Sciences*, Elsevier, pp. 11958-61.
- Joas, H. & Beckert, J. 2001, 'Action Theory', in J.H. Turner (ed.), *Handbook of Sociological Theory*, Springer US, pp. 269-85.
- John, B., Keeler, L.W., Wiek, A. & Lang, D.J. 2015, 'How much sustainability substance is in urban visions? – An analysis of visioning projects in urban planning', *Cities*, vol. 48, pp. 86-98.
- Jotzo, F., Skarbek, A., Denis, A., Jones, A., Kelly, R., Ferraro, S., Kautto, N., Graham, P., Hatfield-Dodds, S. & Adams, P. 2014, *Pathways to Deep Decarbonisation - Australian Chapter*, Published by Sustainable Development Solutions Network (SDSN) and Institute for Sustainable Development and International Relations (IDDRI).
- Kahane, A. 2004, *Solving tough problems: An open way of talking, listening, and creating new realities*, Berrett-Koehler, San Francisco, USA.
- Kahane, A. 2012, *Transformative Scenario Planning: Working Together to Change the Future*, Berrett-Koehler Publishers, Inc, San Francisco, USA.
- Kaplan, S. & Orlikowski, W. 2014, 'Beyond Forecasting: Creating New Strategic Narratives', *MIT Sloan Management Review*, vol. 56, no. 1, pp. 23-8.
- Kaplan, S. & Orlikowski, W.J. 2013, 'Temporal Work in Strategy Making', *Organization Science*, vol. 24, no. 4, pp. 965-95.

- Kerr, C., Phaal, R. & Probert, D. 2012, 'Addressing the cognitive and social influence inhibitors during the ideation stages of technology roadmapping workshops', *International Journal of Innovation and Technology Management*, vol. 9, no. 6, pp. 1-20.
- Khan, M.S. 2009, *The 2008 Oil Price "Bubble"*, Peterson Institute for International Economics.
- King, D. 2008, 'Annual General Meeting - Managing Director & CEO's address', <http://www.caltex.com.au/InvestorCentre/Documents/2008/2008amg_Managing_Director_Speech.pdf>.
- Kleiner, A. 2003, 'The Man Who Saw the Future', *Strategy+Business*, vol. Spring, no. 30.
- Kreil, E. 2007, *Short-Term Energy Outlook Supplement: Why Are Oil Prices So High?*, U.S. Energy Information Administration.
- Krzywoszynska, A., Buckley, A., Birch, H., Watson, M., Chiles, P., Mawyin, J., Holmes, H. & Gregson, N. 2016, 'Co-producing energy futures: impacts of participatory modelling', *Building Research & Information*, vol. 44, no. 7, pp. 804-15.
- Kunda, Z. 1998, 'The Case for Motivated Reasoning', *Psychological Bulletin*, vol. 108, no. 3, pp. 480-98.
- Leeuw, F.L. 2003, 'Reconstructing Program Theories: Methods Available and Problems to be Solved', *American Journal of Evaluation*, vol. 24, no. 1, pp. 5-20.
- Lempert, R.J., Groves, D.G., Popper, S.W. & Bankes, S.C. 2006, 'A General, Analytic Method for Generating Robust Strategies and Narrative Scenarios', *Management Science*, vol. 52, no. 4, pp. 514-28.
- Lerner, J.S. & Tetlock, P.E. 2002, 'Bridging individual, interpersonal, and institutional approaches to judgment and choice: The impact of accountability on cognitive bias', in S.L. Schneider & J. Shanteau (eds), *Emerging Perspectives on Judgment and Decision Research*, Cambridge University Press, Cambridge.
- Little, D. 1991, *Varieties of Social Explanation: An Introduction to the Philosophy of Social Science*, Westview Press, Boulder.
- Little, D. 2011, 'Causal mechanisms in the social realm', in P.M. Illari, F. Russo & J. Williamson (eds), *Causality in the Sciences*, Oxford University Press.
- Little, D. 2014, 'Actor-Centered Sociology and the New Pragmatism', in J. Zahle & F. Collin (eds), *Rethinking the Individualism-Holism Debate (Synthese Library, vol. 372)*, Springer, pp. 55-75.
- Mallard, G. & Lakoff, A. 2011, 'How Claims to Know the Future Are Used to Understand the Present: Techniques of Prospection in the Field of National Security', in C. Camic, N. Gross & L. Michele (eds), *Social Knowledge in the Making*, University of Chicago Press, Chicago, pp. 339-77.
- Masum, H., Ranck, J. & Singer, P.A. 2010, 'Five promising methods for health foresight', *Foresight*, vol. 12, no. 1, pp. 54-66.
- Maxwell, J.A. 1992, 'Understanding and Validity in Qualitative Research', *Harvard Educational Review*, vol. 62, no. 3, pp. 279-300.
- Maxwell, J.A. 2012, *A Realist Approach to Qualitative Research*, SAGE Publications.
- Maxwell, J.A. 2013, *Qualitative Research Design: An Interactive Approach (3rd edition)*, SAGE Publications.
- May, G.H. 2007, 'The end is nich ... but are we there yet? Futures and the environment', in P. van der Duin (ed.), *Knowing Tommorrow? How Science Deals With The Future*, Eburon Academic Publishers, Delft, The Netherlands.
- Mazzucato, M. 2014, *The Entrepreneurial State: Debunking Public vs. Private Sector Myths*, Anthem Press, London.
- Mazzucato, M. 2015, 'The Green Entrepreneurial State', *SWPS 2015-28*, SPRU Working Paper Series.
- Mazzucato, M. 2016, 'From market fixing to market-creating: a new framework for innovation policy', *Industry and Innovation*, vol. 23, no. 2, pp. 140-56.

- McDermid, D. n.d., 'Pragmatism', *Internet Encyclopedia of Philosophy*, viewed 22/01/2017.
- McDowall, W. 2012, 'Technology roadmaps for transition management: The case of hydrogen energy', *Technological Forecasting & Social Change*, vol. 79, pp. 530-42.
- McDowall, W. & Geels, F.W. 2017, 'Ten challenges for computer models in transitions research: Commentary on Holtz et al.', *Environmental Innovation and Societal Transitions*, vol. 22, no. March, pp. 41-9.
- McGrail, S. 2014, 'Rethinking the roles of evaluation in learning how to solve 'wicked' problems: The case of anticipatory techniques used to support climate change mitigation and adaptation', *Evaluation Journal of Australasia*, vol. 14, no. 2, pp. 4-16.
- McGrail, S., Gaziulusoy, A.I. & Twomey, P. 2015, 'Framing Processes in the Envisioning of Low-Carbon, Resilient Cities: Results from Two Visioning Exercises', *Sustainability*, vol. 7, no. 7, pp. 8649-83.
- McGrail, S. & Riedy, C. 2015, 'Creating scenarios or creating and sustaining social worlds? Towards new sociological understandings of the use and impacts of scenario planning', *International Journal of Foresight and Innovation Policy*, vol. 10, no. 2/3/4, pp. 103-25.
- McManus, G. 2008, 'Get ready for \$8-a-litre petrol', www.news.com.au, July 11.
- Meadowcroft, J. 2009, 'What about the politics? Sustainable development, transition management, and long term energy transitions', *Policy Sciences*, vol. 42, no. 4, pp. 323-40.
- Meissner, P. & Wulf, T. 2013, 'Cognitive benefits of scenario planning: Its impact on biases and decision quality', *Technological Forecasting & Social Change*, vol. 80, no. 4, pp. 801-14.
- Mercier, H. 2012, 'Some Clarifications About the Argumentative Theory of Reasoning: A Reply to Santibáñez Yañez', *Informal Logic*, vol. 32, no. 2, pp. 259-68.
- Mercier, H. & Sperber, D. 2011, 'Why do humans reason? Arguments for an argumentative theory', *Behavioral and Brain Sciences*, vol. 34, no. 2, pp. 57-74.
- Mercier, H. & Sperber, D. 2017, *The Enigma of Reason*, Harvard University Press, Cambridge, Massachusetts.
- Mill, J.S. 1975, *On Liberty*, Norton, New York : Norton.
- Miller, R. 2011, 'Futures Literacy - Embracing Complexity and Using the Future', *ETHOS*, no. 10, pp. 23-8.
- Miller, R. 2015a, 'Learning, the Future, and Complexity. An Essay on the Emergence of Futures Literacy', *European Journal of Education*, Vol. 50, No. 4, 2015, vol. 50, no. 4, pp. 513-23.
- Miller, T.R. 2013, 'Constructing sustainability science: emerging perspectives and research trajectories', *Sustainability Science*, vol. 8, no. 2, pp. 279-93.
- Miller, T.R. 2015b, *Reconstructing Sustainability Science: Knowledge and Action for a Sustainable Future*, Earthscan.
- Miller, T.R., Wiek, A., Sarewitz, D., Robinson, J., Olsson, L., Kriebel, D. & Loorbach, D. 2014, 'The future of sustainability science: a solutions-oriented research agenda', *Sustainability Science*, vol. 9, no. 2, pp. 239-46.
- Misak, C. 2013, *The American Pragmatists*, Oxford University Press.
- Misak, C. 2016, *Cambridge Pragmatism: From Peirce and James to Ramsey and Wittgenstein*, Oxford University Press, Oxford, UK.
- Moore, A. 2010, 'Beyond participation: Opening up political theory in STS', *Social Studies of Science*, vol. 40, no. 5, pp. 793-9.
- Morton, A. 2008, '\$8 a litre tipped for 2018', *The Age*, July 11.
- Mulligan, M., Nadarajah, Y., Smith, J.-A. & Zalchender, Y. 2009, 'Community, Scenarios and Narratives of Action: Reflections on a case study in the Hamilton region of Victoria', in J. Martin, M. Rogers & C. Winter (eds), *Climate Change in Regional Australia: Social Learning and Adaptation*, VURRN Press Inc, Ballarat, Australia.

- Myers, D. & Kitsuse, A. 2000, 'Constructing the Future in Planning: A Survey of Theories and Tools', *Journal of Planning Education and Research*, vol. 19, no. 3, pp. 221-31.
- Myers, D.G. 2012, *Exploring Social Psychology (Sixth Edition)*, McGraw-Hill, New York, NY.
- Nickerson, R.S. 1998, 'Confirmation Bias: A Ubiquitous Phenomenon in Many Guises', *Review of General Psychology*, vol. 2, no. 2, pp. 175-220.
- NRMA Motoring & Services 2010, 'Roadmap for the Next Australian Government', NRMA Motoring & Services, <<http://www.mynrma.com.au/about/reports-and-submissions.htm>>.
- Nyman, J. 2012, 'Airbus joins new energy program', *The West Australian (Regional edition)*, April 23.
- Office of Climate Change 2010, *Toward Q2 Carbon Target: 2010-2011 Target Delivery Plan*, State of Queensland.
- Ogilvy, J.A. 1996, 'Futures studies and the human sciences: the case for normative scenarios', in R.A. Slaughter (ed.), *New Thinking for a New Millennium: The Knowledge Base of Futures Studies*, Routledge, London, pp. 26-83.
- Ogilvy, J.A. 2002, *Creating Better Futures: Scenario Planning as a Tool for a Better Tomorrow*, Oxford University Press, New York.
- Parandian, A. & Rip, A. 2013, 'Scenarios to explore the futures of the emerging technology of organic and large area electronics', *European Journal of Futures Research*, vol. 1, no. 9.
- Parkinson, G. 2013, *Demand forecasts slashed again as consumers turn to solar*, <<http://reneweconomy.com.au/demand-forecasts-slashed-again-as-consumers-turn-to-solar-78062/>>.
- Parkinson, G. 2016, 'Garnaut - time to write down value of power grids', 29 January, <<http://reneweconomy.com.au/garnaut-time-write-value-power-grids-13534/>>.
- Pawson, R. 2008, 'Invisible mechanisms', *Evaluation Journal of Australasia*, vol. 8, no. 2, pp. 3-13.
- Pawson, R. 2013, *The Science of Evaluation: A Realist Manifesto*, SAGE Publications Ltd.
- Pawson, R. & Tilley, N. 1997a, 'An Introduction to Scientific Realist Evaluation', in E. Chelimsky & W. Shadish (eds), *Evaluation for the 21st Century: A Handbook*, SAGE, Thousand Oaks.
- Pawson, R. & Tilley, N. 1997b, *Realistic Evaluation*, SAGE Publications, London.
- Pawson, R. & Tilley, N. 2004, 'Realist Evaluation', Paper prepared for the British Cabinet Office.
- Pawson, R. & Tilley, N. 2005, 'Realistic Evaluation', in S. Mathison (ed.), *Encyclopedia of Evaluation*.
- Pears, A. 2013, 'Four years of falling electricity demand: can this continue?', *The Conversation*, January 21, <<https://theconversation.com/four-years-of-falling-electricity-demand-can-this-continue-11465>>.
- Pesch, U. & Quist, J. 2010, 'Sustainable innovation backcasting and participatory decision-making: The road from intervention to innovation', paper presented to the *Knowledge Collaboration & Learning for Sustainable Innovation (ERSCP-EMSU conference)*, Delft, The Netherlands.
- Petersen, A. 2011, *The Politics of Bioethics*, Routledge.
- Pettendy, M. 2010, 'Victorian ethanol plant and expanded E85 network to power new flex-fuel Holdens', <http://www.goauto.com.au>, 23 March.
- Pielke, R. 2007, *The Honest Broker: Making Sense of Science in Policy and Politics*, Cambridge University Press, Cambridge, UK.
- Piirainen, K.A. & Gonzalez, R.A. 2015, 'Theory of and within foresight - "What does a theory of foresight even mean?"', *Technological Forecasting and Social Change*, vol. 96, no. July, pp. 191-201.
- Pinch, T.J. 1992, 'Opening Black Boxes: Science, Technology and Society', *Social Studies of Science*, vol. 22, no. 3, pp. 487-510.

- Princen, T. 2010, *Treading Softly: Paths to Ecological Order*, The MIT Press, Cambridge, Massachusetts; London, England.
- Qantas Airways 2012, *Qantas Sustainability Review 2012*, Qantas Airlines Limited.
- Quist, J. 2007, *Backcasting for a Sustainable Future: The Impact After 10 Years*, Eburon, Delft, NL.
- Quist, J., Thissen, W. & Vergragt, P.J. 2011, 'The impact and spin-off of participatory backcasting: From vision to niche', *Technological Forecasting & Social Change*, vol. 78, no. 5, pp. 883–97.
- Quist, J. & Vergragt, P. 2006, 'Past and future of backcasting: The shift to stakeholder participation and a proposal for a methodological framework', *Futures*, vol. 38, no. 9, pp. 1027–45.
- Ramirez, R., Selsky, J.W. & van der Heijden, K. 2009, 'Causal Texture Theories of Turbulence & the Growth and Role of Scenario Practices', paper presented to the *EURAM 2009*, Liverpool.
- Ramírez, R., Selsky, J.W. & van der Heijden, K. (eds) 2008, *Business Planning for Turbulent Times: New Methods for Applying Scenarios*, Earthscan, London, UK.
- Ramirez, R. & van Der Heijden, K. 2007, 'Scenarios to develop strategic options: A new interactive role for scenarios in strategy', in B. Sharpe & K. van der Heijden (eds), *Scenarios for success: turning insights into action*, Wiley, Chichester, England; Hoboken, NJ.
- Ramirez, R. & Wilkinson, A. 2016, *Strategic Reframing: The Oxford Scenario Planning Approach*, Oxford University Press, Oxford, United Kingdom.
- Raven, P.G. & Elahi, S. 2015, 'The New Narrative: Applying narratology to the shaping of futures outputs', *Futures*, vol. 74, no. November, pp. 49-61.
- Raven, R., Kern, F., Verhees, B. & Smith, A. 2016, 'Niche construction and empowerment through socio-political work. A meta-analysis of six low-carbon technology cases', *Environmental Innovation and Societal Transitions*, vol. 18, no. March, pp. 164-80.
- Reichmann, W. 2013, 'Epistemic participation: How to produce knowledge about the economic future', *Social Studies of Science*, vol. 43, no. 3, pp. 852-77.
- Rescher, N. 2013, 'Pragmatism', in B. Kaldis (ed.), *Encyclopedia of Philosophy and the Social Sciences*, SAGE Publications, Thousand Oaks.
- Reserve Bank of Australia 2010, 'The Global Financial Crisis and its Impacts on Australia', in Anon. (ed.), *Year Book Australia, 2009-10 (1301.0)*, Australian Bureau of Statistics.
- Reuss, M. 2008, 'Remarks at CSIRO Future Fuels Forum report launch'.
- Rickards, L., Wiseman, J., Edwards, T. & Biggs, C. 2014, 'The Problem of Fit: Scenario Planning and Climate Change Adaptation in the Public Sector', *Environment and Planning C: Government and Policy*, vol. 32, no. 4, pp. 641-62.
- Roberts, K. 2009, *Key Concepts in Sociology*, Palgrave Macmillan, New York, N.Y.
- Robinson, J. 1988, 'Unlearning and Backcasting: Rethinking Some of the Questions We Ask about the Future', *Technological Forecasting and Social Change*, vol. 33, pp. 325-38.
- Robinson, J. 2003, 'Future subjunctive: backcasting as social learning', *Futures*, vol. 35, no. 8, pp. 839-56.
- Robinson, J., Burch, S., Talwar, S., O'Shea, M. & Walsh, M. 2011, 'Envisioning sustainability: Recent progress in the use of participatory backcasting approaches for sustainability research', *Technological Forecasting and Social Change*, vol. 78, no. 5, pp. 756-68.
- Rumelt, R.P. 2011, *Good Strategy, Bad Strategy: The Difference and Why it Matters*, Crown Business, New York.
- Saddler, H. 2013, *Power Down: Why is electricity consumption decreasing?*, The Australia Institute.
- Sandiford, M. 2012, 'The problem in the grid', August 16.
- Sandland, R. & Thompson, G. 2012, *Icon in Crisis: The Reinvention of CSIRO*, UNSW Press.

- Sankowska, A. & Söderlund, J. 2015, 'Trust, reflexivity and knowledge integration: Toward a conceptual framework concerning mobile engineers', *Human Relations*, vol. 68, no. 6, pp. 973-1000.
- Sarewitz, D. 2004, 'How science makes environmental controversies worse', *Environmental Science & Policy*, vol. 7, no. 5, pp. 385-403.
- Schermer, M. 2011, *The Believing Brain*, St Martin's Press, New York, NY.
- Schoemaker, P.J.H. 1993, 'Multiple scenario development: Its conceptual and behavioral foundation', *Strategic Management Journal*, vol. 14, no. 3, pp. 193-213.
- Schoemaker, P.J.H. 1995, 'Scenario planning: a tool for strategic thinking', *Sloan Management Review*, vol. 36, no. 2, pp. 25-40.
- Scoones, I., Leach, M. & Newell, P. 2015, *The Politics of Green Transformations*, Routledge, New York, NY.
- Scoones, I., Newell, P. & Leach, M. 2015, 'The Politics of Green Transformations', in I. Scoones, M. Leach & P. Newell (eds), *The Politics of Green Transformations*, Routledge, New York, NY.
- Scott, S. 2002, *Fierce Conversations: Achieving success in work and life one conversation at a time*, Piatkus Books, London, UK.
- Scriven, M. 1994, 'The fine line between evaluation and explanation', *Evaluation Practice*, vol. 15, no. 1, pp. 75-7.
- Scriven, M. 2004, 'Ask the Expert: Michael Scriven on the Differences Between Evaluation and Social Science Research', *The Evaluation Exchange*, vol. 9, no. 4, p. 7.
- Scruton, R. 2007, *The Palgrave Macmillan dictionary of political thought*, Palgrave Macmillan, Basingstoke, England; New York.
- Segal, N. 2007, *Breaking the Mould: The Role of Scenarios in Shaping South Africa's Future*, SUN Press, Stellenbosch, South Africa.
- Select Committee on Electricity Prices 2012, *Final Report: Reducing energy bills and improving efficiency*, Commonwealth of Australia.
- Selin, C. 2006, 'Trust and the illusive force of scenarios', *Futures*, vol. 38, no. 1, pp. 1-14.
- Senate Standing Committee on Rural and Regional Affairs and Transport 2007, *Australian's future oil supply and alternative transport fuels, Final report*, Commonwealth of Australia.
- Slooman, S. & Fernbach, P. 2017, *The Knowledge Illusion: Why We Never Think Alone*, Riverhead Books, New York, NY.
- Sondeijker, S. 2009, 'Imagining Sustainability: Methodological building blocks for transition scenarios', PhD thesis, Erasmus University, Rotterdam.
- Sondeijker, S., Geurts, J., Rotmans, J. & Tukker, A. 2006, 'Imagining sustainability: the added value of transition scenarios in transition management', *Foresight*, vol. 8, no. 5, pp. 15-30.
- Sovacool, B.K., Brown, M.A. & Valentine, S.V. 2016, *Fact and Fiction in Global Energy Policy: 15 Contentious Questions*, Johns Hopkins University Press, Baltimore, MD.
- Stehr, N. & Grundmann, R. 2012, 'How does knowledge relate to political action', *Innovation: The European Journal of Social Science Research*, vol. 25, no. 1, pp. 29-44.
- Stirling, A. 2007, 'Deliberate futures: Precaution and progress in social choice of sustainable technology', *Sustainable Development*, vol. 15, no. 5, pp. 286-95.
- Stirling, A. 2014, 'Transforming power: Social science and the politics of energy choices', *Energy Research & Social Science* vol. 1, no. March, pp. 83-95.
- STRN 2010, 'A mission statement and research agenda for the Sustainability Transitions Research Network', Sustainability Transitions Research Network.
- Sunstein, C.R. 2009, *Going to Extremes: How Like Minds Unite and Divide*, Oxford University Press, Oxford ; New York.

- Sustainable Aviation Fuel Users Group, CSIRO & Defence Science and Technology Organisation 2010, 'Invitation to Participate in the Australian and New Zealand Sustainable Aviation Fuel Road Map Study', Australian branch of the Sustainable Aviation Fuel Users Group.
- Swart, R.J., Raskin, P. & Robinson, J. 2004, 'The problem of the future: sustainability science and scenario analysis', *Global Environmental Change*, vol. 14, no. 2, pp. 137-46.
- Symons, J. & Karlsson, R. 2015, 'Green political theory in a climate-changed world: between innovation and restraint', *Environmental Politics*, vol. 24, no. 2, pp. 173-92.
- Talwar, S., Wiek, A. & Robinson, J. 2011, 'User engagement in sustainability research', *Science and Public Policy*, vol. 38, no. 5, pp. 379-90.
- Taylor, J., Braid, A., Prestwidge, D., Heerr, A., Crawford, D., Jovanovic, T., Quayle, W., Raison, J., O'Connell, D. & O'Connor, M. 2011, *Regional estimates of Victorian biomass resources*, CSIRO.
- Teske, S., Dominish, E., Ison, N. & Maras, K. 2016, *100% Renewable Energy for Australia – Decarbonising Australia's Energy Sector within one Generation. Report prepared by ISF for GetUp! and Solar Citizens*, Institute for Sustainable Futures.
- Tetlock, P.E. 1985, 'Accountability: The neglected social context of judgment and choice', *Research in Organizational Behavior*, vol. 7, pp. 297-332.
- Tetlock, P.E. 1992, 'The impact of accountability on judgment and choice: Toward a social contingency model', *Advances in Experimental Social Psychology*, vol. 25, pp. 331-76.
- Tetlock, P.E. 2000, 'Cognitive Biases and Organizational Correctives: Do Both Disease and Cure Depend on the Politics of the Beholder?', *Administrative Science Quarterly*, vol. 45, no. 293-326.
- Tetlock, P.E. 2002, 'Social-functionalist metaphors for judgment and choice: The Intuitive politician, theologian, and prosecutor', *Psychological Review*, vol. 109, no. 451-471.
- Topham, F. 2009, *submission to the Senate Select Committee Inquiry on Fuel and Energy*, Caltex Australia Limited.
- TransGrid 2016, *TransGrid Network Vision 2056: Our Network Vision is to connect you to the future of Energy*, TransGrid, Sydney NSW.
- Truffer, B., Voß, J.-P. & Konrad, K. 2008, 'Mapping expectations for system transformations: Lessons from Sustainability Foresight in German utility sectors', *Technological Forecasting & Social Change*, vol. 75, no. 9, pp. 1360-72.
- Turnheim, B., Berkhout, F., Geels, F., Hof, A., McMeekin, A., Nykvist, B. & Vuuren, D.v. 2015, 'Evaluating sustainability transitions pathways: Bridging analytical approaches to address governance challenges', *Global Environmental Change*, vol. 35, no. November, pp. 239-53.
- Turnhout, E., Dewulf, A. & Hulme, M. 2016, 'What does policy-relevant global environmental knowledge do? The cases of climate and biodiversity', *Current Opinion in Environmental Sustainability*, vol. 18, no. February, pp. 65-72.
- van Asselt, M.B.A., van 't Klooster, S.A., van Notten, P.W.F. & Smits, L.A. 2010, *Foresight in Action: Developing Policy-Oriented Scenarios*, Earthscan, London, UK & Washington, USA.
- van den Bergha, J.C.J.M., Truffer, B. & Kallis, G. 2011, 'Environmental innovation and societal transitions: Introduction and overview', *Environmental Innovation and Societal Transitions*, vol. 1, no. 1, pp. 1-23.
- van der Heijden, K. 1996, *Scenarios: The Art of Strategic Conversation*, John Wiley & Sons, Chichester, England.
- van der Heijden, K. 2004, 'Can internally generated futures accelerate organizational learning?', *Futures*, vol. 36, no. 3, pp. 145-59.
- van der Heijden, K., Bradfield, R., Burt, G., Cairns, G. & Wright, G. 2002, *The Sixth Sense: Accelerating Organizational Learning with Scenarios*, Wiley, Chichester; New York.

- van der Steen, M. 2008, 'Ageing or silvering? Political debate about ageing in the Netherlands', *Science and Public Policy*, vol. 35, no. 8, pp. 575-83.
- van Lente, H. 2010, 'Supporting and evaluating emerging technologies: A review of approaches', *Technology, Policy and Management*, vol. 10, no. 1/2, pp. 104-15.
- van Lente, H. 2012, 'Navigating foresight in a sea of expectations: lessons from the sociology of expectations', *Technology Analysis & Strategic Management*, vol. 24, no. 8, pp. 769-82.
- van Lente, H. & Rip, A. 1998, 'Expectations in Technological Developments: An Example of Prospective Structures to be Filled in by Agency', in C. Disco & B. van der Meulen (eds), *Getting New Technologies Together: Studies in Making Sociotechnical Order*, Walter de Gruyter, Berlin, pp. 203-29.
- Varum, C.A. & Melo, C. 2010, 'Directions in scenario planning literature — a review of past decades', *Futures*, vol. 42, no. 4, pp. 355-69.
- Vecchiato, R. 2012, 'Strategic foresight and environmental uncertainty: a research agenda', *Foresight*, vol. 14, no. 5, pp. 387-400.
- Verbong, G.P.J. & Geels, F.W. 2010, 'Exploring sustainability transitions in the electricity sector with socio-technical pathways', *Technological Forecasting & Social Change*, vol. 77, no. 8, pp. 1214-21.
- Vergragt, P.J. & Quist, J. 2011, 'Backcasting for sustainability: Introduction to the special issue', *Technological Forecasting and Social Change*, vol. 78, no. 5, pp. 747-55.
- Vervoort, J.M. 2014, 'Challenges to scenario-guided adaptive action on food security under climate change', *Global Environmental Change*, vol. Forthcoming.
- Victorian Government 2008, *The Victorian Transport Plan*, State of Victoria.
- Victorian Government 2009, *Victorian Climate Change Green Paper*, Department of Premier and Cabinet, State of Victoria.
- von Stackelberg, P. & Jones, R.E. 2014, 'Tales of Our Tomorrows: Transmedia Storytelling and Communicating About the Future', *Journal of Futures Studies*, vol. 18, no. 3, pp. 57-76.
- Voros, J. 2007, 'On the philosophical foundations of futures research', in P. van der Duin (ed.), *Knowing Tomorrow? How science deals with the future*, Eburon Academic Publishers, Delft, The Netherlands.
- Vorrath, S. 2014, 'Network lobby says asset write-downs would cost consumers even more', 6 August, <<http://reneweconomy.com.au/network-lobby-says-asset-write-downs-would-cost-consumers-even-more-22052/>>.
- Weaver, P., Jansen, L., van Grootveld, G., van Spielgel, E. & vergragt, P.J. 2000, *Sustainable Technology Development*, Greenleaf Publishing Limited, Sheffield, UK.
- Weible, C.M., Heikkila, T., deLeon, P. & Sabatier, P.A. 2012, 'Understanding and influencing the policy process', *Policy Sciences*, vol. 45, no. 1, pp. 1-21.
- Weiss, C.H. 1979, 'The Many Meanings of Research Utilization', *Public Administration Review*, vol. September-October, pp. 426-31.
- West, M. 2012, 'Gold-plating the power grid', *The Sydney Morning Herald*, July 5.
- Western, M., Baxter, J., Pakulski, J., Tranter, B., Western, J., van Egmond, M., Chesters, J., Hosking, A., O'Flaherty, M. & van Gellecum, Y. 2007, 'Neoliberalism, Inequality and Politics: The Changing Face of Australia', *Australian Journal of Social Issues*, vol. 42, no. 3, pp. 401-18.
- Wiek, A., Binder, C. & Scholz, R.W. 2006, 'Functions of scenarios in transition processes', *Futures*, vol. 38, no. 7, pp. 740-66.
- Wiek, A. & Iwaniec, D. 2014, 'Quality criteria for visions and visioning in sustainability science', *Sustainability Science* vol. 9, no. 4, pp. 497-512.
- Wilkinson, A., Kupers, R. & Mangalagiu, D. 2013, 'How plausibility-based scenario practices are grappling with complexity to appreciate and address 21st century challenges', *Technological Forecasting & Social Change*, vol. 80, no. 4, pp. 699-710.

- Wilkinson, A. & Mangalagiu, D. 2012, 'Learning with futures to realise progress towards sustainability: The WBCSD Vision 2050 Initiative', *Futures*, vol. 44, no. 4, pp. 372–84.
- Williams, R. 2006, 'Compressed Foresight and Narrative Bias: Pitfalls in Assessing High Technology Futures', *Science as Culture*, vol. 15, no. 4, pp. 327-48.
- Wittmayer, J.M., Avelino, F., van Steenberg, F. & Loorbach, D. 2017, 'Actor roles in transition: Insights from sociological perspectives', *Environmental Innovation and Societal Transitions*, vol. 24, pp. 45-56.
- Wollenberg, E., Edmunds, D. & Buck, L. 2000, 'Using scenarios to make decisions about the future: anticipatory learning for the adaptive co-management of community forests', *Landscape and Urban Planning*, vol. 47, no. 1-2, pp. 65-77.
- Wong, G., Westhorp, G., Pawson, R. & Greenhalgh, T. 2012, *Realist Synthesis RAMESES Training Materials*.
- Wood, T. 2013a, 'Australia stares down an electricity 'death spiral'', *Business Spectator*, December 11.
- Wood, T. 2013b, 'Why Australians are getting a raw deal on electricity prices', April 22, <<https://theconversation.com/why-australians-are-getting-a-raw-deal-on-electricity-prices-13296>>.
- Wood, T., Blowers, D. & Moran, G. 2015, *Post Paris: Australia's climate policy options (Grattan Institute Working Paper)*, Grattan Institute.
- Wood, T. & Carter, L. 2013, *Shock to the system: Dealing with falling electricity demand*, Grattan Institute.
- Woolworths 2007, *Sustainability Strategy 2007–2015: "Doing the right thing"*, Woolworths Limited.
- Wright, G. & Cairns, G. 2011, *Scenario Thinking: Practical Approaches to the Future*, Palgrave Macmillan, New York, NY.
- Wright, G., Cairns, G. & Bradfield, R. 2013, 'Scenario methodology: New developments in theory and practice: Introduction to the Special Issue', *Technological Forecasting & Social Change*, vol. 80, no. 4, pp. 561–5.
- Wright, J. 2008, 'Remarks at CSIRO Future Fuels Forum report launch'.
- Yin, R.K. 2009, *Case Study Research: Design and Methods*, SAGE Publications, London, UK.
- Zerubavel, E. 1997, *Social Mindscapes: An Invitation to Cognitive Sociology*, Harvard University Press, Cambridge, Mass.