The diffusion of sustainable practices within the Australian Housing Industry:

Implications for Future Change Management

A dissertation submitted in fulfilment of the requirements for award of the degree:

Doctor of Philosophy in Sustainable Futures

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Declarations

This thesis contains no material which has been accepted for the award of any other degree or diploma in any university, and, to the best of my knowledge and belief, neither does it contain material previously published or written by another person, except where due acknowledgement is made in the text.

Signature of candidate:

Christopher Charles Reardon

Thursday, 04 June 2009

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Table of contents

List of case study boxes

List of illustrations and tables

List of abbreviations and acronyms

ABCB	Australian Building Codes Board
ABEC	Australian Building Energy Council
ABS	Australian Bureau of Statistics
ABSA	Association of Building Sustainability Assessors
ACT	Australian Capital Territory
AGO	Australian Greenhouse Office (Commonwealth)
AHI	Australian Housing Industry
AIBD	Australian Institute of Building Designers
AIBS	Australian Institute of Building Surveyors
ALGA	Australian Local Government Association
ANT	Actor Network Theory
ANTA	Australian National Training Authority
ANZSES	Australia & New Zealand Solar Energy Society
AQF	Australian Qualifications Framework
AR	Action Research
ASBEC	Australian Sustainable Built Environment Council
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers
BASIX	Building and Sustainability Index
BaU	Business as Usual
BCA	Building Code of Australia
BDA	Building Designers Association (state branch e.g. NSW)
BDAA	Building Designers Association of Australia Ltd
BDP	Building Design Professionals
BERS	Building Energy Rating Scheme
BITS	Building Industry Training in Sustainability
BRANZ	Building Research Association of New Zealand
BREAM	British Research Establishment Assessment Method
BSS	Building Sustainability Seminars
CA	Change Agency (e.g. SEDA)
CC	Construction Certificate
CEO	Chief Executive Officer
CFL	Compact Fluorescent Lamp
CIE	Centre for International Economics (Canberra & Sydney)
CO_2	Carbon Dioxide
CO2-e	Carbon dioxide – equivalent
CoAG	Council of Australian Governments
CPD	Continuing Professional Development

CPRS	Carbon Pollution Reduction Scheme
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DEC	Department of Environment and Climate Change (NSW)
DEST	Department of Education, Science and Training
DEUS	Department of Energy, Utilities and Services (NSW)
DEWHA	Department of Environment, Water, Heritage and the Arts
DIPNR	Department of Infrastructure, Planning and Natural Resources (NSW)
DIY	Do It Yourself
DoI	Diffusion of Innovations
DoP	Department of Planning (NSW)
DTS	Deemed To Satisfy
DTC	Deemed To Comply
EA	Environment Australia (now DEWHA)
EE	Energy Efficiency
EEC	Energy Efficiency Certificate
EEI	Energy Efficiency Improvement
ESD	Ecologically Sustainable Development
ESH	Energy Smart Homes
GBC	Green Building Council
GBCA	Green Building Council of Australia
GGE	Greenhouse Gas Emission
GHG	Greenhouse Gas
GJ	gigajoule
GL	gigalitre
GREX	Green Build and Renewable Energy Exhibition and Conference
HDAA	Housing Design and Architecture (e-group)
HERS	House Energy Rating Software
HIA	Housing Industry Association
HMB	HERS Management Body
HPE	Health Promotions and Education
HWS	Hot Water Service
IC	Interpersonal Communications
IE Aust.	Institute of Engineers, Australia
IPCC	Intergovernmental Panel on Climate Change
ISF	Institute for Sustainable Futures, UTS
ISR	(Department of) Industry, Science and Resources
ITAB	Industry Training Advisory
LA21	Local Agenda 21
LCA	Life Cycle Assessment
LCC	Life Cycle Costing
LCP	Least Cost Planning
LED	Light Emitting Diode
LEED	Leadership in Energy and Environmental Design
MBA	Master Builders Association
MD	Mandatory disclosure (of sustainable performance)
MEPS	Minimum Energy Performance Standards (appliances)
MRET	Mandatory Renewable Energy Target
Mt	Mega tonne
MV	Mandatory valuation (of sustainable performance)
MWh	Megawatt hour
NABERS	National Australian Built Environment Rating System
NAFI	National Association of Forest Industries
NatHERS	National House Energy Rating Software

NFEE	National Framework for Energy Efficiency
NGO	Non Government Organisation
NHERS	National House Energy Rating Scheme
NSW	New South Wales
NT	Northern Territory
OL	Opinion Leader
PATHE	Partnerships Advancing the Housing Environment (HIA GreenSmart)
PC	Private Certifier
PV	Photovoltaic (panel)
QA	Quality Assurance
QLD	Queensland
R&D	Research and Development
RAIA	Royal Australian Institute of Architects
RAPS	Remote Area Power Supply
RICS	Royal Institute of Chartered Surveyors
RIS	Regulatory Impact Statement
ROC	Region of Councils
RP	Reflective Practice
RPL	Recognition of Prior Learning
RPS	Recognition of Prior Skill
RTO	Registered Training Outlet
SA	South Australia
SAPS	Stand Alone Power Supply
SC	Sustainability Consultant
SEAV	Sustainable Energy Authority of Victoria
SEDA	Sustainable Energy Development Authority (NSW)
SEDO	Sustainable Energy Development Office (WA)
SME	Small to Medium Enterprise
SP	Sustainable Practices and Technologies
SV	Sustainability Victoria
TAFE	Tertiary AND Further Education
TAS	Tasmania
TD	Transdisciplinary
TEC	Total Environment Centre
TM	Thermal Mass
UDIA	Urban Design Institute of Australia
UNFCCC	United Nations Framework Convention on Climate Change
UTS	University of Technology, Sydney
VEET	Victorian Energy Efficiency Target
VET	Vocational Education Training
VIC	Victoria
WA	Western Australia
WMO	World Meteorological Association
YH	Your Home

Abstract

A substantial barrier to sustainable change arises from reliance on positivist, disciplinary science and neo-classical economic theory to create the new knowledge that underpins policies intended to deliver such change. This barrier is particularly evident within the core focus of this research, change strategies to reduce or eliminate adverse net lifecycle environmental emissions and depletions by the cost sensitive, risk averse built environment sector. While recognising the role and importance of traditional disciplinary knowledge in this field, this thesis suggests that such knowledge creation processes are self-defeating in terms of creating sustainable futures because the only truly positivist proof of a threat to sustainable futures is the irreversible failure of biospheric life support systems.

Accordingly, an alternative, transdisciplinary (TD) approach to knowledge creation is adopted. An Action Research (AR) methodology applied within a social constructivist epistemological stance is used to generate 'temporary knowledge' to inform the change agendas of AR partners in their attempts to apply the 'precautionary principle'. This temporary knowledge is created through AR monitoring and explanation of sustainable change strategies being implemented in the Australian Housing Industry (AHI) and is framed within Diffusion of Innovations theory (DoI). The knowledge is temporary in that it provides useful insights and understandings that are valid or relevant at specific stages of an evolving change process. In successive cycles of AR and reflective practice, multiple case studies and examples drawn from a variety of change agendas are used to test and refine hypotheses and develop arguments that explain successes and failures.

AR observations and temporary knowledge are 'retrospectively' analysed through an innovative combination of DoI and Actor Network Theory (ANT) to develop deeper or more 'permanent' understandings of effective processes of sustainable change in the AHI. These explanations are presented as a series of generalisations to inform the subsequent 'prospective' analysis that underpins concluding recommendations for future management of sustainable change within the AHI. The generalisations also form the basis of theoretical contributions with potential for adaptive application in other sustainable change agendas.

This thesis makes contributions to knowledge at several levels. Key industry recommendations address the need for: fresh approaches to regulation, skill and information provision drawn from DoI and ANT; a shift in focus from new to existing housing stock; strategies to engage the finance and marketing sectors; greater emphasis on the role of networks in change planning and management and a shift in regulatory focus to encourage innovation and technology transfer between the custom and volume housing sectors. Additionally, the research contributed to the significant, practical, sustainable change outcomes that occurred during its currency. Finally, theoretical contributions are embodied in the evolution of ANT and DoI through their application as complementary analytical frameworks.

Key words: Change creation, Action Research; sustainable change; Diffusion of Innovations; Actor Network Theory; epistemological pluralism; transdisciplinary; Australian Housing Industry.

Introduction

Overview of this thesis

This research was commenced in late 1998 at a time when the implications of built environment related biospheric impacts had been recognised at a global level (UN 1992 -a, 1997; WCED 1987) and processes of reform by both government and non-government organisation(NGO) change agencies in Australia were in early stages of development and implementation. The thesis focuses on observing and evaluating the methods applied to create sustainable change in the Australian Housing Industry (AHI) during the next ten years through Action Research (AR) predominantly in the new housing sector.

Reflective analysis of AR observations within the theoretical frameworks of Diffusion of Innovations (DoI) and Actor Network Theory (ANT) identifies both opportunities to accelerate change and barriers to more widespread adoption of sustainable practices and technologies (SP) by AHI practitioners and consumers. In the concluding chapters, insights developed through reflective AR analysis are applied prospectively to current and proposed change creation strategies. Outcomes from this analysis are presented as a set of recommendations to inform future change management by AR partner change agencies (CAs) operating within the AHI.

The urgency of many problems (particularly climate change) had not been fully recognised at the outset of the research but became apparent during the nine-year research period as 100-year periods for change were reduced to 50-years and less. My AR methodology facilitated a flexible approach that allowed the research to address new challenges that arose from increasingly dire scientific warnings (IPCC 1995, 2001, 2007a; OECD 2003). While the specific research focus is the Australian Housing Industry (AHI), broader built environmental implications and examples are discussed where relevant.

Within the AR methodology, I adopt a participatory 'observing player' role through which I observe and influence current change agendas that are initiated and managed by others. This methodology limits the scope of solutions investigated to those that fit within the neo-classical economic paradigm (capitalism) that currently prevails within the Australian Housing sector. In Chapter 2 a literature review recognises that a much broader range of philosophical approaches to change are required to ensure inter and intra-generational equity. However, it also highlights the need for immediate reductions in greenhouse gas emissions (GGE) to avert critical climate change

and identifies the arguably unique potential of the built environment sector (particularly new housing) to deliver immediate, cost effective GGE reductions.

Structure

Chapter 1 describes, explains and argues the validity of the intellectual framework in which the thesis is structured. A social constructivist epistemological stance (Crotty 1998; Fuller 2002) is adopted to frame and position my transdisciplinary (TD) approach (Kline 1995; Gibbons et al. 1994; Machlup 1980) in a relevant body of knowledge (Lyotard 1984). The research was conducted in three often concurrent, interdependent phases (conception, investigation and analysis). Each phase employed complementary research methodologies, to combine qualitative AR observations with quantitative questionnaire data to produce cohesive results. This pluralistic methodological research approach was adopted to facilitate AR participation in, and observation of, rapidly developing AHI sustainable change agendas. For example, several pre-2002 agendas explored during the investigative phase assumed a greater 'luxury of time' than that which now confronts us.

Some of my AR contributions to those agendas I classify as temporary knowledge (Gibbons et al. 1994) because they provided useful insights into specific stages of the change process and became less relevant after that change had occurred. Retrospective analysis was applied to these insights and their AR outcomes, to draw useful base level understandings of sustainable change creation in the AHI. This knowledge was applied through subsequent cycles of AR to new agendas that evolved in response to research findings and associated shifts in socio-political awareness and priorities.

Chapter 2 describes and scopes the Action Research components of the thesis. It commences with a brief literature review to position the research in the body of knowledge relating to sustainable built environment. Reflective practice analysis of my previous AHI practitioners roles and 'action learning' in the initial AR cycle is then used to identify gaps, opportunities and barriers in early change agendas. This exercise generates preliminary research questions through which remedial strategies, intended to capitalise on opportunities, fill gaps and overcome barriers, are explored during subsequent AR cycles. In Chapters 3 and 4, these strategies are tested and refined through retrospective analysis of successive cycles of AR in the theoretical framework of Diffusion of Innovations (DoI) (Rogers 1983). This iterative analysis develops increasingly refined or convergent understandings of how, what, why (or why not), sustainable change is being adopted in the AHI. In Chapter 5, Actor Network Theory (ANT) (Callon 1986; Latour 1999; Law 1986) is applied as an additional analytical method in DoI to develop further insights into the role of socio-political interaction in creating sustainable change.

Chapter 6 presents a prospective analysis comprising strategic recommendations to AR change agency partners in the AHI based on the research findings presented in Chapters 3, 4 and 5. Chapter 7 summarises the theoretical outcomes and contributions of the thesis.

The structure described above evolved in response to rapid change that occurred in the research field during my nine-year research journey. Initially, the research focussed on ways to create sustainable change in the AHI at a time when the AHI was unaware of or, at best, poorly informed about its environmental impacts and the urgent need to adopt sustainable practices and technologies (SP) to reduce them. Throughout the AR research phases, AHI awareness grew rapidly in response to rising global awareness and change agendas initiated by change agencies (CAs) and implemented in the AHI through industry partnerships.

The final outcome recognises that, while significant change towards adopting SP is now occurring in the AHI, the emphasis of those initial change agendas has shifted from broad or holistic approaches to reducing the environmental impact of housing to an urgent focus on averting or mitigating the imminent threat of catastrophic or irreversible climate change (IPCC 2007b). To achieve this effectively, deeper understandings of the complex nature of the recent and rapidly evolving transdisciplinary field of sustainability are required. Such understandings guide and inform short, medium and long-term planning of change agendas in the AHI to ensure its potential contribution to truly sustainable futures is fully realised.

Contributions

This thesis makes significant contributions to both practice and theory. In broad terms, the research has contributed and continues to contribute to the creation of sustainable change in the AHI through AR outcomes and to the body of industry knowledge about sustainable practices and change management through analytical findings.

Contributions to the body of theoretical knowledge about adaptation and application of the relevant theories, methodologies and methods used in this thesis are presented in Chapter 1. These include an innovative application of DoI and ANT as theoretical frameworks in a change-focussed AR methodology to create socially constructed knowledge through a transdisciplinary approach.

The AR methodology described in Chapter 2 facilitates contributions to various change agendas as an *observing player* drawing on previous skill and expertise. Subsequent retrospective analysis of AR observations and findings within DoI and ANT in Chapters 3, 4 and 5 generates detailed, theoretically informed recommendations for change agencies and other industry actors. Similarly, further recommendations that focus on future strategies through prospective analysis are presented in Chapter 6.

In Chapter 7, this breadth of contributions is further elaborated and is framed within Mitchell and Willetts' *three outcome spaces associated with TD research* which include the problem space, peer reviewed knowledge and mutual learning (Mitchell & Willetts 2008 in preparation).

Chapter 1   Intellectual framework

1.1   Overview

In this chapter, I explain and justify the intellectual framework through which this thesis and its contributions are argued and positioned. Crotty (1998) describes this process as justifying my choice of methods and methodologies by examining and declaring the 'assumptions about reality' that I bring to the research and positioning those assumptions in a theoretical perspective that explains how my research outcomes should be regarded by the reader. These epistemological considerations reach...*into the understanding you and I have of what human knowledge is, what it entails, and what status can be ascribed to it* (Crotty 1998, p. 2). He identifies four important questions that should be answered through an intellectual framework:

- What methods are used?
- What methodology governs the choice and use of those methods?
- What theoretical perspective lies behind the methodology in question?
- What epistemology informs this theoretical perspective?

Below, I address each of these four elements in the order that they inform and influence each other. Section 1.2 introduces and argues the epistemological stance adopted for this thesis and explains why contributions to knowledge in the relatively recent transdisciplinary research field of sustainable futures require explanation of epistemological positioning. Section 1.3 introduces transdisciplinarity and explains its influence in selecting epistemological stance, theoretical perspective and methodology. It also argues the necessity of such an approach in this research context, identifies implications arising from it and declares how those implications are addressed.

In Section 1.4, I argue for adopting the theory of Diffusion of Innovations (DoI) as an appropriate theoretical framework in which to position my research and introduce the theory through a review of the extensive literature of DoI. In Section 1.5, I argue for my selection of Action Research (AR) as the primary methodology and define my atypical application of this methodology. Section 1.6 discusses the range of methods applied in my AR methodology to generate and analyse both qualitative and quantitative data.

The complexity of this research demands a robust intellectual framework. This is presented in graphic form in Figure 1. As described in the introduction, there are three broad, overlapping research phases. Phase 1 (Section 2.1) is conceptual. It identifies and scopes the research focus using Action Research (AR), Reflective Practice (RP) and Literature Reviews. Phase 2 (Section 2.2) is investigative. Research questions are explored and refined through AR and RP.

Phase 3 (Chapters 3, 4 and 5) is analytical. The problems identified in Phase 1 and investigated in Phase 2 are analysed in DoI and other theories to support concluding arguments in Chapters 6 and 7, where they are presented as both recommendations to industry stakeholder partners and theoretical contributions to the body of knowledge.
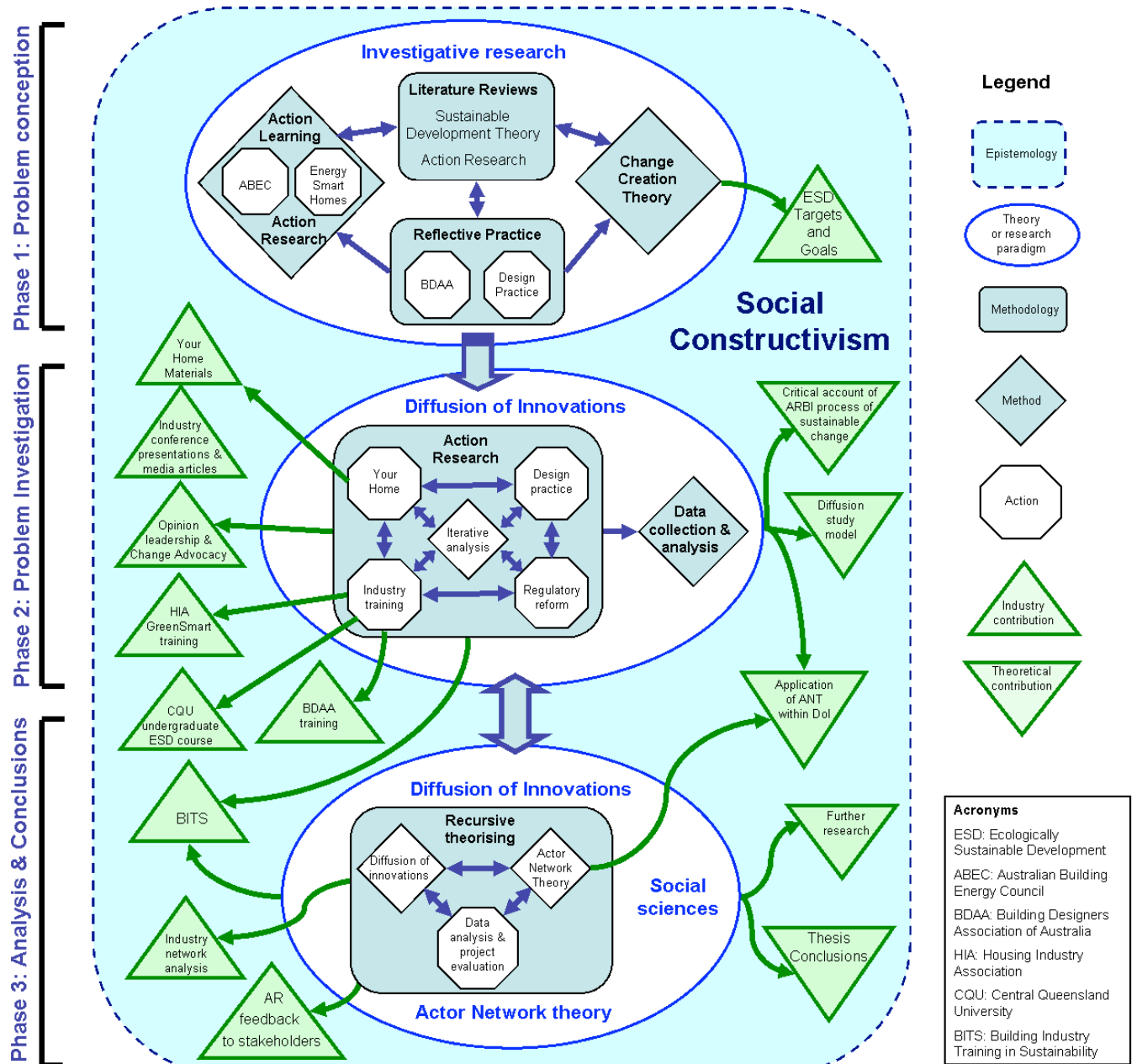
Figure 1: Intellectual framework

1.2   Epistemological positioning of this transdisciplinary thesis

The purpose of this section is to position the research in an appropriate body of knowledge to establish how the reader should regard its outcomes and the theoretical frameworks in which they are argued to be valid.

Epistemology is concerned with providing a philosophical grounding for deciding what kinds of knowledge are possible and how we can ensure that they are both adequate and legitimate (Maynard 1994 cited in Crotty 1998, p. 8).

This positioning is necessary because the transdisciplinary nature of this research (see definition in 1.3 below) means that it cannot draw upon knowledge assumptions inherent in established disciplines (e.g. the physical sciences). As a relatively recent or emerging research field, the body of knowledge and research paradigms upon which research into sustainable futures can be based are evolving. This often requires that philosophical perspectives and methods of enquiry be drawn from a number of disciplines to deliver useful and meaningful outcomes (Willetts & Mitchell 2006).

I begin by describing and arguing the philosophical knowledge assumptions or epistemological stance that underpins the contributions this thesis generates by its intellectual framework.

1.2.1   Epistemological stance and its role in transdisciplinary research

The purpose of this section is to explain the meaning of key epistemological stances, examine their implications in the context of this research and argue for adopting a pluralistic stance based predominantly in constructivism.

Carew (2004) describes an *epistemological continuum at the centre of which sits constructivism*. She places objectivism at one end of this continuum and subjectivism at the other and summarises the meaning of each in Figure 2. Healy (2003a) refers to *the big [epistemological] divide*, positioning objectivism on one side and constructivism on the other (Healy 2003a). While scholars debate the relative positioning of various stances, few question how a stance determines the type of knowledge produced, the methods and methodologies used to produce it, the validity of conclusions drawn from it and, the way(s) the audience should regard it. Epistemology deals with...*the nature of knowledge, its possibility, scope and general basis* (Hamlyn 1995 cited in Crotty 1998, p. 8).

In Healy's words; *[Epistemology] becomes a problem only when: a) researchers don't understand the epistemological and theoretical foundations of their research and b) exceed claims that can [validly] be made or c) communicate with an audience that does not share their stance (Healy 2003aworkshop)*. What are the key stances and what do they mean?
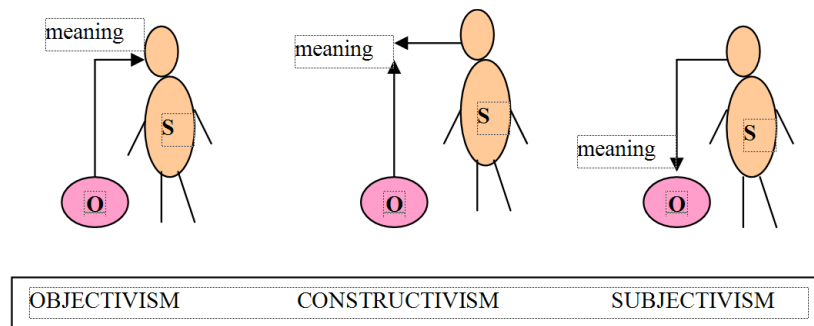
Figure 2: A simplified continuum of epistemologies from objectivism to subjectivism and the relationship each construes between object (O) and subject (S). Source: Carew 2004 p.40.

In an objectivist epistemological stance, meaning is drawn from the object being studied by the subject or researcher. Only properties of the object able to be observed or measured by the subject contribute to meaning. In a subjectivist epistemological stance, meaning is drawn from the subject's perception or interpretation of the object in a defined circumstance or context. The object itself does not contribute to meaning – only the subject's interpretation of it. In a constructivist epistemological stance, both the object and the subject contribute to producing meaning in some way (Carew 2004; Crotty 1998; Healy 2003b).

From a constructivist epistemological position, material things exist but can only be understood by the use of meaning systems applied by the researcher or the research context. In other words, an object is investigated and understood via the researcher's efforts and interpretations. Because of this, it is argued that *meaning is not discovered, it is constructed* (Healy 2003a). Objectivism is the predominant epistemological stance adopted in the science-based research (Chalmers 1999; Denzin & Lincoln 2005) that typifies much research and development conducted in the building industry. In contrast, humanities and social science-based research is framed in a constructivist or subjectivist epistemology (Foucault 1972; Fuller 2002; Machlup 1980).

The literature reviewed in Section 2.1.1 demonstrates that the body of knowledge on adverse implications for sustainable futures arising from current anthropogenic actions, is predominantly based in the natural sciences and its objectivist epistemological stance. However, effective solutions to anthropogenic problems identified by objectivist research are commonly developed in the constructivist and subjectivist epistemological stances typically adopted in the social sciences and humanities. Sustainability is a social, economic and environmental (science) research problem. The abundant literature relating to Triple Bottom Line accounting (Elkington 1997), the Russian Doll (Levett 1992), Three Pillars and other models (Pope, Annandale & Morrison-Saunders 2004), which analyse the interdependent relationship of the three elements of sustainability is briefly reviewed in Section 2.1.1. In the context of this chapter, I argue that this interdependence demonstrates the need for an epistemologically pluralistic, transdisciplinary approach to my research because not only

does it involve research in three traditional disciplinary boundaries, it also seeks to engage each discipline in a process of change at both theory and practice level.

Indeed, I argue that the knowledge assumptions in a purely objectivist epistemological approach to researching sustainable futures are potentially contradictory and self defeating, because the concept of sustainable futures is not simply concerned with investigation, it also involves creating change. In defining objectivist epistemology, Crotty writes: *[it] holds that meaning, and therefore meaningful reality, exists as such apart from the operation of any consciousness* (Crotty 1998, p. 8) and yet, the field of sustainable futures is characterised by a need to research phenomena that do not yet exist or have no reality. For example, many of the innovations required to produce cost-effective sustainable housing are yet to be invented and, while this research does not set out to create those innovations, it does seek to establish an innovation-supportive environment to encourage others to create them. In other words, these phenomena exist only in the consciousness of futurists whose research task it is to identify future problems or needs and construct reality around them so that they develop meaning in objectivist terms. At an ESD conference in 1996, futurist Peter Ellyard generalised: *80% of the solutions required to create a sustainable future are yet to be invented* (Ellyard 1996). While significant progress has been made since 1996, the challenges have increased exponentially, creating a greater and urgent need for innovation.

I argue that objectivist arguments denying the existence of phenomena likely to contribute to unsustainable futures (e.g. GGE and climate change) are a barrier to the development and implementation of sustainable change strategies in the built environment sector. In a strictly objectivist interpretation, these arguments can be claimed by some to be valid. I claim that the current policies of some nations, which argue that their short-term economic interests might be compromised by adopting sustainable practices), are based on a selective and predominantly objectivist interpretation of precautionary arguments, as argued on neo-classical economic theory by (Diesendorf & Hamilton 1997) and contextualised in current economic scenarios by (Stern 2006) and (Garnaut 2008a).

However, when the implications of doing nothing are considered in alternative constructivist or subjectivist epistemological stances, such arguments become less defensible. Constructivist epistemology rejects objectivist views of human knowledge and holds that:

…there is no objective truth waiting for us to discover it but that truth or meaning comes into existence in and out of our engagement with the realities of the world. There is no meaning without a mind. Meaning is not discovered but constructed...In this view of things, subject and object emerge as partners in the generation of meaning (Crotty 1998, p. 8).

The 'precautionary principle' (Diesendorf & Hamilton 1997) is an important example of knowledge that arguably is fundamental to the creation and maintenance of sustainable futures. While based on objectivist research findings, the precautionary principle can be challenged in an objectivist stance but is defensible in a constructivist stance. For example, as argued by (McRight & Dunlap 2003) in their analysis of the conservative movement's impact on US climate change policy, climate change sceptics challenge the positivist arguments of climate change science regardless of the positivist research confirming its existence (IPCC 2007b). On this basis, I argue my constructivist stance to be appropriate and valid.

1.2.2 Appropriate modes of knowledge

Here, I examine modes of knowledge production (Gibbons et al. 1994) and types of scholarship (Boyer 1997) to define the type of knowledge created through my Action Research analysis and position it in the constructivist epistemological stance argued above.

Gibbons et al.(1994) explore new modes of knowledge production that reflect what they refer to as *the social transformation of knowledge production*. They argue that a new mode of knowledge production (Mode 2) is emerging alongside the old or traditional mode (Mode 1) and that a primary characteristic of Mode 2 knowledge production is that it *operates in a different context of application in that problems are not set in a disciplinary framework*. In other words, it is predominantly transdisciplinary. The new form of knowledge produced in Mode 2 differs from knowledge produced in traditional disciplinary structures or paradigms (Mode 1) by using new legitimating mechanisms, being generated in new contexts, being structured differently and utilising new or different reward or recognition mechanisms (Gibbons et al. 1994).

Specifically, Gibbons defines the qualities of Mode 2 knowledge as being produced in the context of application, being transdisciplinary (i.e. neither mono nor multi-disciplinary), embodying heterogeneity and organisational diversity, and being socially accountable and reflexive. According to Gibbons, *quality in Mode 1 [knowledge] is determined essentially through peer review judgement about the contributions made by individuals*. He argues that, in this system, *quality and control mutually reinforce one another*. In contrast, Mode 2 achieves quality assurance through a range of social accountability criteria that reflect a broadened social composition in the review system consistent with the heterogeneous, collaborative processes of Mode 2 knowledge production. Mode 2 validation criteria include economic viability and social acceptability and, in a sustainable futures research context, ecological sustainability.

Gibbons further differentiates between modes as follows. *Mode 1 problems are set and solved in a context governed by the largely academic interests of a specific [scholarly] community* , are primarily focussed on a *search for fundamental principles* and are *homogeneous* in nature. *Mode 2 knowledge is carried out in a context of*

application, [where] …modes of enquiry [are] oriented towards contextualised results (Gibbons et al. 1994 p.43) and the outcomes are heterogeneous in nature. Mode 2 includes a *wider, more temporary and heterogeneous set of practitioners, collaborating on a problem defined in a specific and localised context* (ibid).

I argue that Gibbons' Mode 2 is a useful and appropriate knowledge production framework for my research application. The Mode 2 characteristic of *discovery in the context of application* is ideally suited to this research application, where the research objectives are to discover ways to accelerate the adoption of sustainable practices in the Australian Housing Industry (AHI) and implement them through transdisciplinary action research in collaboration with a heterogeneous set of industry partners and stakeholders. While the knowledge produced is more temporary in nature than traditional, disciplinary research (Mode 1), Mode 2 applied research outcomes are valid owing to their application and usefulness in the rapidly evolving sustainable change agendas of the AHI.

When AR is applied in a change creation context, the timeframe for application and delivery of useful research outcomes is often beyond the control of the researcher, because it is defined by opportunities and needs generated by the heterogeneous industry partners and stakeholders. Gibbons' (1994) arguments for validity of *temporary* knowledge are useful and relevant in my research context. Adoption of the change advocated through Action Research validates the knowledge that created it and in doing so, renders much of the detail obsolete. This is consistent with Gibbons' (1994) observations about the temporary nature of Mode 2 knowledge.

Some knowledge created in the AR sections of this research is indeed temporary in nature. Data drawn from surveys and questionnaires was used to inform change agendas and then discarded as those agendas were implemented, modified or discontinued as a result of my AR recommendations. Whilst such data is valid in the temporary context of Mode 2, the same data might not be considered valid in Mode 1 terms, because it was collected for a temporary, application-specific purpose to inform a dynamic change process at a given point in time. Checkland and Holwell (1997) observe that while the research process of natural science (Mode 1) might have the *strongest truth claim,…its application…to phenomena beyond those for which it was developed…is problematical* (Checkland & Holwell 1997, p. 9). Whilst the data became less relevant once that change had occurred, the analytical processes used to draw strategic recommendations from it remain highly relevant. I argue that my mode 2 questionnaire data was validated by change outcomes attributable to the implementation of strategic AR recommendations drawn from it. As Checkland and Holwell (1997) observe, *the only certain object of [action] research becomes the change process itself.*

Refined analysis of that change process through subsequent AR observations (Chapters 3, 4 and 5) is then used to *socially construct* the knowledge underpinning my concluding recommendations in Chapter 6. This aligns with Checkland and Holwell's (1997) concluding recommendation that

…researchers investigating social phenomena via AR must…achieve a situation in which their research process is recoverable by interested outsiders. In order to do this, it is essential to state the epistemology…by means of which they will make sense of their research (Checkland and Holwell 1997, p. 11).

In this way, socially constructed Mode 2 knowledge can emulate the *replicability* expected of Mode 1 knowledge.

Gibbons argues that appropriate applications for Mode 2 knowledge are especially relevant in contexts where the research outcomes need to be cost effective and socially equitable. In the context of the AHI, both these outcomes are desirable, if not essential. This is the case in sustainable futures research when addressing ecological sustainability and its implications for inter-generational and intra-generational equity (Diesendorf & Hamilton 1997). Gibbons describes one application of Mode 2 knowledge as *taking science to the market* (Gibbons et al. 1994*)*. One of my AR case studies *Your Home* (Reardon et al. 2001a) involves translating technical descriptions of sustainable practices from Mode 1 knowledge into practical 'how to' language in a format accessible to building practitioners and their clients. The research problem in that case study was one of *interpretation, application and acceptance* and *shaping intellectual values in the social context in which they are developed* (Gibbons 1994 p90).

In relating the historical role and function of academia to contemporary needs, Ernest Boyer (1997 pp. 15–25) identified and argued the need for *a vital new vision of scholarship*. He argued that, if higher learning institutions are effectively to...*meet today's urgent academic and social mandates, their missions must be carefully re-defined and the meaning of scholarship creatively reconsidered* (Boyer 1997). He challenges the current paradigm of scholarly reward and recognition through publication as being narrow. Alternatively, Boyer recommends recognising four *separate, yet overlapping functions* of scholarly action, which he describes as the scholarships of discovery, integration, application and teaching, and for which publication in scholarly journals should not be the only path to reward and recognition. He concludes that society urgently needs a *more inclusive view of what it means to be a scholar – a recognition that knowledge is acquired through research, through synthesis, through practice, and through teaching* (Boyer 1997, p. 16).

Because my transdisciplinary research focuses on creating socio-technological change among AHI practitioners by encouraging them to adopt a range of innovative new practices and technologies through strategies developed in the theoretical frameworks of DoI and ANT, I argue that it falls predominantly within Boyer's scholarship of integration. He defines this as: *[research that deals with] making connections across the disciplines, placing the specialties in larger context, illuminating data in a revealing way, often educating non-specialists*…Further, that this includes...*serious, disciplined work that seeks to interpret, draw together, and bring new insight to bear on original research.* For Boyer, the scholarship of integration requires discovery type research *at the boundaries where fields converge* and, this type of research is increasingly necessary, as traditional disciplinary research parameters confine the

understandings drawn from new knowledge. Most importantly, in the context of this research, Boyer describes the scholarship of integration as...*interpretation, fitting one's own research (or the research of others) into larger intellectual patterns* (Boyer, 1997 p. 15). I use reflective practice to draw from my experiences as a practitioner to identify opportunities and barriers to change, which I then test through AR and position in a change creation template framed in the theories of DoI and ANT.

Carew (2004) describes the scholarship of integration as *the synthesis of new ideas from existing original research* and cites Boyer's second form of scholarship, which *describes the act of synthesising new theory, understandings or insights by making connections between disconnected knowledge, theory or facts in and between disciplines.* She notes the potential for this form of scholarship to *break down barriers between disciplines and reduce the fragmentation in disciplines* and to *assist non-specialists to make sense of isolated facts by providing different perspectives or frameworks to assist the sense-making process (Carew 2004 p46).* My AR change creation roles as an author, educator and OL called for the transformation of knowledge created in several fragmented, specialist disciplines (e.g. architecture, building physics and property marketing) into the non-specialist language of those whose role in applying it is fundamental to the sustainable change process.

Boyer's arguments for alternative pathways to scholarly reward and recognition are relevant to my arguments about contributions from my research context because each of his four functions of scholarly action is present (albeit at varying levels) in my change-focused AR process. The very nature of this process meant that opportunities to publish findings as discreet, traditional scholarly contributions were limited and of questionable value. On the other hand, opportunities to identify new technologies, practices and motivations (largely *discovered* by others), to contribute to their *integration* in new change creation frameworks developed by AR partners and to participate in and monitor the effectiveness of their *application* through practice-based AR were abundant and relevant. Further, while essential to reporting research outcomes (this thesis), I assert that scholarly publication is an ineffective format through which to advocate urgent change to my principal AR audience groups: designers, builders and their consumers. In contrast, publication and in a range of purpose designed industry media (the *Your Home* suite of materials), consumer and industry magazines and *teaching,* though AR participation in continuing professional development (CPD) courses, industry conference presentations and community awareness events, proved very effective and provided ideal AR opportunities. In summary, I draw on Boyer's work to argue that scholarly contributions from this research arise from the analytical integration of reflective practice and AR discovery through application and teaching in subsequent AR cycles.

Lawrence and Després' arguments on the need to develop (or apply) innovative thinking and research methods to resolve conflicts between ecological and anthropogenic needs provide additional support for the research approaches I argue for in this section. They attribute our current

incapacity to resolve these issues to: the complexity of the problems; the *compartmentalisation of scientific and professional knowledge* and *a lack of effective collaboration between scientists, professionals and policy decision-makers.* They identify an *applicability gap* in the knowledge and understandings produced by *traditional scientific research and professional practice*, in order to deal with these problems and attribute this (in part) to epistemological stances that *value rational, utilitarian approaches to interpret the layout, use and management of human and natural ecosystems* and *specialisation, segmentation and bureaucratisation of knowledge and expertise* (Lawrence & Després 2004, pp. 398-399).

While I re-visit this critique of *orthodox disciplinary knowledges* (Horlick-Jones & Sime 2004, p. 441) in my argument for a transdisciplinary research approach (Section 1.3) it is raised here to illustrate the interdependence of epistemological stance and disciplinarity and to support my arguments for an unorthodox approach to this research. I argue that social constructivism provides an appropriate epistemological stance in which to position research into the socio-political changes required to support and accelerate adopting a recent and rapidly developing multi-disciplinary field (sustainable built environment practices) in a complex, conservative, positivist and risk averse industry.

Finally, I argue that research investigating sustainable futures requires the researcher to consider more than one epistemological stance. Such pluralistic epistemological stances are uncommon in conventional or orthodox disciplinary approaches but are often a distinguishing characteristic of transdisciplinary research. Indeed, Healy (2003a) suggests that while epistemological stance is often assumed to be implicit in orthodox research approaches, it must be explicit in TD approaches (Healy 2003a). I suggest that, inherent in the recently emerging research field of sustainable futures is a requirement for researchers to examine objectively what exists and subjectively or constructively, to interpret that knowledge in order to create new understandings about what can or might be. To this end, useful tensions exist between objectivist exploration and constructivist explanation that I apply to my research problem in a structured, compare and contrast analytical context to generate these broader or deeper insights and understandings (See 1.2.2). Horlick-Jones and Sime (2004, p. 253) describe the role of transdisciplinarity in capitalising on these tensions through their observation that: …*in epistemological terms, it [transdisciplinarity] seems to make progress in finding a way of capturing the tension between possibility and constraint.* Here, the theoretical structures of Diffusion of Innovations theory and Actor Network Theory frame the analysis. (See Section 1.4 for supportive theoretical arguments and Chapters 3, 4 and 5 for application).

Chapter 2 establishes and scopes my research focus through a review of scholarly literature describing technologies, practices and policies intended to reduce the environmental impact of the built environment. These technologies, practices and policies are referred to throughout this thesis as Sustainable Practices (SP). From that review, I argue that the volume of 'discovery' research in the field is disproportionate to the volume of 'integration' research and that this imbalance

contributes significantly to non-adoption or application of SP by the practitioners and consumers in the societies intended to benefit from it. Action research observation of the barriers encountered in early AHI sustainable change agendas confirms these arguments (See Chapter 3). Accordingly, I have chosen to align my research contributions predominantly in Boyer's 'scholarship of integration' by integrating my own (action) research and the disciplinary research of others (technologies and practices) in a transdisciplinary intellectual framework of change creation in order to deliver their potential benefits to current and future generations.

1.2.3 Summary

In the sections above, I examined the role of epistemological stance in defining the type of knowledge generated through this research. I discussed the importance of epistemologically positioning that knowledge so that the context in which to regard it is clear, because it is produced in the recent, transdisciplinary research field of sustainable futures. I argued that this new and evolving research field draws on knowledge produced in a number of established disciplines and that while a defined research paradigm and assumed epistemological stance exists for each of these disciplines, research traditions are yet to be established for sustainable futures.

I reconciled my research (field, philosophical approach and intended outcomes) in Boyer's four functions of scholarship (Boyer 1997) and argued that this thesis produces knowledge drawn predominantly from the scholarship of integration and that this knowledge is communicated and validated through the scholarships of application and teaching. My research is less aligned with (but nonetheless reliant on) the 'scholarship of discovery', which Boyer argues is valued more by the academy, and validated primarily through scholarly publication.

Additionally, I argued that while knowledge outcomes from the thesis include both input to AR change agendas and transferable theoretical insights to guide future change, the AR contributions align most with Gibbons' (1994) 'Mode 2' definition of knowledge and less with the disciplinary 'Mode 1'. Accordingly, publication and application in AR change agendas and industry forums validate my AR knowledge outcomes rather than scholarly publication. Because my AR stakeholder audience often comes from objectivist, disciplinary backgrounds, I use objectivist language where possible to present my socially constructed AR outcomes and strategies for change creation to these audiences.

On the other hand, my theoretical research contributions are generated through either iterative or retrospective theoretical analysis of AR, to explain why the change occurred as well as prospective analysis to identify future improved change management strategies and to explore notions of transferability to other applications. Accordingly, the knowledge produced through that analysis is presented within a social constructivist stance.

In other words, while the research is framed within a predominantly social constructivist epistemological stance, an objectivist stance was adopted where appropriate during the Action Research (AR) phases. I therefore describe my stance as epistemological pluralism (Healy, 2003) within an overarching social constructivist stance. This has important implications for the methodology and methods applied and deemed valid by my varied audience groups. In the sections below, I introduce and discuss my selection of compatible analytical frameworks and methods.

1.3   Transdisciplinarity

1.3.1   Overview

In 1.2, I discussed transdisciplinarity in terms of its relationship to an epistemological stance, the kind of knowledge created and how a reader should interpret that knowledge. In this section, I explore the meaning of transdisciplinary (TD) research and justify adopting a TD approach. The approach brings certain implications and assumptions to the research that influence the selection of both a theoretical framework within which to structure the research and, what methods and methodologies are appropriate or useful.

1.3.2   What is transdisciplinarity and why use it?

Scholars agree that transdisciplinary research involves the production of knowledge that draws from a number of disciplines to solve problems that cannot be understood or explained in the research paradigms of those individual disciplines (Braxton, Luckey & Helland 2002; Foucault 1989; Gibbons et al. 1994; Glassick, Huber & Maeroff 1997; Kline 1995; Lyotard 1984; Machlup 1980).

Transdisciplinary research should not be confused with multi- or inter-disciplinary research. Wickson et al. (2006) explored theoretical variations in the distinguishing characteristics of transdisciplinarity which they synthesised into a *coherent means for distinguishing transdisciplinarity from multi- and interdisciplinary approaches* (Wickson, Carew & Russell 2006, p. 5). Their review of the abundant recent literature addressing TD identified *three key characteristics that have been used by authors in this field to describe what constitutes a transdisciplinary approach to research... problem focus, evolving methodology and collaboration (ibid)*. Thomson-Klein observed that *forms of multi-, pluri-, and interdisciplinarity do not call into question disciplinary thinking [whereas] transdisciplinarity does, through the principle of articulation between different forms of knowledge* (Thompson-Klein 2004, p. 524).

Transdisciplinary scholars warn that knowledge produced in this way is unable to draw on disciplinary assumptions about validity and positioning in the body of knowledge (Horlick-Jones & Sime 2004; Willetts & Mitchell 2006). In other words, while the absence of a defined, disciplinary research structure imparts freedom to choose the most appropriate and useful intellectual framework through which to investigate and create knowledge about a problem, it also imposes a

responsibility to explain and argue those choices so that the type of knowledge and the intellectual framework in which it is created and claimed to be valid are understood (Bruce et al. 2004; Lawrence & Després 2004; Wickson, Carew & Russell 2006). The advantages and disadvantages of each approach (disciplinary and transdisciplinary) are described by Gibbons through his knowledge production Modes 1 and 2 (Gibbons et al. 1994).

As a recent or emerging research field, sustainable futures is yet to develop the type of agreed scholarly framework that defines traditionally recognised disciplines. In their community of practice approach to a TD framework at ISF (UTS), Willetts and Mitchell (2006) observe that *sustainability throws up the challenges of solving complex real-life problems that transcend traditional disciplinary boundaries and knowledge systems…to create change towards sustainable futures* (Willetts & Mitchell 2006, p. 398). As explained in the sections below, my research typifies that summarised by this observation, because it involves the production of knowledge drawn from a number of disciplines in order to solve change related, socio-technological problems that cannot be understood or explained in the research paradigms of individual disciplines. In short, it aligns closely with the above research definitions, thereby supporting adopting a TD approach.

In the sections below, I describe and define that approach in terms of appropriate language (Section 1.3.3), theoretical framework (Sections 1.4, 1.5 and 1.6), methodology (Section 1.7) and data collection or creation methods (Section 1.8).

1.3.3 Language

In Section 1.2.2, I discussed the languages of knowledge and argued that the language style and communication parameters inherent within traditional disciplinary research paradigms should not be assumed to be relevant in a transdisciplinary research context and that transdisciplinary researchers should consider audiences and adopt the most appropriate language style. Here, I examine language, communication and information, citing differences between my academic research audience and my action research audience and arguing for my decision to write specific sections of this thesis in a language and style appropriate to each intended audience.

Transdisciplinary action research requires continuing communication with diverse stakeholder groups. Because this project sets out to create change in a wide range of stakeholder groups through AR, I argue that communication of the research arguments, outcomes and recommendations to each intended audience group in appropriate language contributes to its effectiveness. This argument is common to many change creation theories, including Social Marketing (McKenzie-Mohr & Smith 1999; Robinson 1999); Diffusion of Innovations (Moore 1999; Rogers 2003); Environmental Education (Day & Monroe 2000) and other models for understanding and creating environmentally significant transitions (Klupfel, Pfeiffer & Filson 2003).

While the knowledge, experience and participation of each stakeholder group is essential to successful change creation, each has a distinctly different background and preferred language set or communication style.

The distinction between my AR *change agency partner* research audience and my AR *change creation audience* is critical in the arguments in Section 1.2.2 that position this research in Boyer's (1997) scholarship of integration. An examination of the implications of this for publishing or presenting AR in language styles and formats that each audience group is most familiar with and responsive to requires that differences between the groups be understood and addressed.

The first group comprises the innovators (who are most likely to access this research) whose advice to policy makers often determines the scope and focus of the change agendas at the core of this research. This group is often criticised for assuming that its audiences shares its understanding, knowledge and passion for the subject being communicated. This assumption is often untested and frequently leads to a communication 'gap' between innovators and their intended audience (Moore 1999). Because expertise and influence tends to position innovators as OLs and change agents within the AHI community (Rogers 2003), this lack of understanding was observed to be a barrier to effective communication during AR as demonstrated by AR case studies. (See Sections 3.3, 6.2, 6.4 and 6.5 for detailed analysis of the important role of audience appropriate language in change creation).

Because innovators draw information from a range of disciplinary sources, they readily accept information presented in diverse disciplinary languages. However, many innovators tend to attribute greater credibility to information presented in quantitative, positivist language and commonly communicate their findings in this language, leaving their audiences (who include practitioners, consumers and policy makers) to translate them into meaningful, acceptable socio-political contexts of application. Much can go wrong in this process of translation, as recognised by AtKisson (1999) in his language-based explanation of why the majority of people fail to respond to the dire warnings of environmentalists and discussed by Moore (1999) in his analysis of the role of communication 'chasms' between innovators and later adopters in explaining the failure of promising innovations to diffuse.

The second audience group comprises industry practitioners (designers and builders) and their clients. This group is not the audience for this thesis. Rather, it is the audience for the action research publications and activities analysed and reported in the thesis. I argue that Boyer's (1997) scholarship of integration is embodied in my AR communication with this audience in ways that create change or identify barriers to it.

Communications research for *Your Home* (Penman & Reardon 2000) indicated that all three members of this group shared a common language set. Both practitioners and consumers

commonly source information through the mass media and popular magazines. Practitioners accessed additional sources that included industry publications, conference presentations and CPD training seminars. Effective communication with these groups (in my AR role as an OL) was achieved through practical, positivist translation of technical and theoretical concepts into 'why to', 'what to' and 'how to' information and publication in the media they access. Practical, application-oriented knowledge produced through AR roles during the research is presented in this style. (See *Your Home*, BDAA and GreenSmart Case studies).

In summary, I use a variety of language styles throughout the thesis appropriate to the specific audience for each section. Social constructivist scholarly language is used in the theoretical sections (predominantly Chapters 1, 2 and 7), while positivist industry stakeholder language is used to report AR findings and make concluding recommendations to my AR change agency partners (Chapters 3, 4, 5 and 6). Finally, while not applied in the thesis itself, a motivational communication style suitable for industry training, publications and conference presentations was applied to AR publications and communications with my practitioner and consumer audiences.

1.4   Theoretical framework

1.4.1 Overview

Below, I briefly review literature describing theoretical frameworks, methodologies and methods with relevance for application in my research (Section 1.4.2). Through this review, I argue for adopting Diffusion of Innovations (DoI) theory as the principal theoretical framework in which I later describe, analyse and explain the phenomena being investigated in this transdisciplinary action research thesis. Section 1.4.3 briefly introduces DoI theory through a simple overview that positions my AR application of it in the intellectual framework of the thesis. Chapters 3 and 4 draw on the extensive literature of DoI application to describe and argue for applying the theory in both retrospective and prospective analytical contexts.

1.4.2 Selecting the theoretical framework

As discussed in Sections 1.2 and 1.3 above, the focus of this research is to contribute actively to creating the socio-technological change required to reduce and mitigate adverse biospheric impacts from the housing sector while developing deeper understandings of the elements and processes of that change, to inform the future management of this and other sustainable change agendas. This involves: discovery in the context of application (Gibbons 1994); integration (Boyer 1997) of knowledge (technologies, theories and practices) developed through a range of disciplinary approaches (by myself and others) and communication of the findings to change agencies, policy makers, practitioners and consumers in ways that encourages adoption and implementation of change. Accordingly, I developed the following

criteria with which to examine a range of change creation theories and methodologies to inform my selection of an appropriate theoretical framework for this research application. The most relevant framework would be:

- adaptable and flexible in a clearly defined and recognisable structure;
- capable of structuring dynamic, transdisciplinary research in a rapidly evolving research field;
- able to integrate and inform top down and bottom up change strategies;
- capable of analysing complex socio-technological change outcomes in both a technologically and sociologically deterministic focus;
- applicable in both a retrospective (evaluative and analytical) and prospective (predictive) context;
- capable of informing, modelling, monitoring and assessing complex, urgent and change at multiple levels in a diverse audience group;
- inclusive of multiple communication channels including interpersonal, multimedia, technical expert and regulatory;
- suitable for application in an action research context; and
- able to integrate interpersonal, organisational and governmental change agendas.

A brief literature search identified a range of potential frameworks for assessment in the above criteria and noted that in his review of theories, methodologies and strategies to create change in the development communication sector for the Rockefeller Foundation, Sylvio Waisbord (2001) developed a family tree of change strategies and theories. Development communication involves creating change in developing countries and by definition, this change needs to be sustainable. Additionally, such programs have important social, economic and environmental implications for both the developing (recipient) and developed (donor) countries. These characteristics indicate that sufficient commonality exists between the objectives of development communication and sustainable futures to make this review a useful starting point.

Waisbord identifies theories of health promotion and education, modernisation, opinion leadership, social marketing and diffusion of innovations as having been most effective and influential in creating change throughout the evolution of development communication. He concludes that a multiplicity of strategies is required to change behaviour, rather than promotion and adherence to specific theories and methodologies and observes that consensus is emerging that different techniques are appropriate and useful in different contexts (Waisbord 2001.).

While some of Waisbord's criticisms of singular theoretical approaches to change creation are attributable to the varying needs, cultures, motivations and geo-political contexts for change in the global audience of development communication, the similarities between this audience and that of

the broader, global, sustainable change agenda could have implications for the transferability of my research outcomes to other sustainable change agendas, although that level of transferability is not an objective of this research. These limitations are declared in Chapter 7, but these concerns are less significant in this research context because the audience is confined to the socio-economic and geo-political context of the Australian Housing Industry (AHI). A further literature search related to social change creation theories identified three theoretical frameworks with potential for application in this research: Community Based Social Marketing (CBSM) theory (McKenzie-Mohr & Smith 1999), Health Promotions and Education (HPE) theory (WHO 1986), and Diffusion of Innovations (DoI) theory (Rogers 1983).

While CBSM's application of conventional commercial marketing techniques (e.g. multi-media promotions) to promote socially responsible behaviour change via simple, achievable steps is relevant to the consumer change agendas, it was considered less useful in the practitioner focus preferred by AR partners whose agendas are the predominant focus of this research. Accordingly, I recommend applying CBSM strategies in Sections 6.5.1 and 6.5.2, where I apply prospective analysis to identify 'next steps' in extending change agendas beyond the AHI practitioner focus of the last 10 years to consumers.

HPE and DoI were relevant to change creation among practitioners, owing to their focus on the voluntary adoption of change through personal behaviour modification and the range of interventions (e.g. education and training, information provision, regulation, incentives and subsidies) able to be applied and monitored in each theory. Useful insights into the problems associated with sustainable change creation were gained through comparison of these two frameworks. These are briefly summarised below as part of my critical evaluation of DoI.

In philosophical terms, significant commonality exists between the objectives of health promotions summarised in the Ottawa Charter (WHO 1986), which is regarded as the seminal health promotion mission statement and the equivalent sustainable built environment mission statements, the Brundtland Report (WCED 1987) and the Bellagio Principles (IISD 1998). Both are essentially preventative in nature and have few immediate benefits (or consequences) for those who would adopt the change being advocated (e.g. beneficiaries of sustainability are future generations and most preventable health issues need to be addressed years in advance to be effective). Both approaches are based on the premise that individual behaviour is largely responsible for adverse outcomes and each includes a substantial focus on changing intimate personal behaviour (e.g. sexual practices in health promotion or shower duration in sustainability). A problem common in both fields is that would-be adopters of change can reject either set of behaviours on the grounds that the consequences will not (or might not) happen to them. For this reason, it is difficult for

change agencies to measure, monitor or regulate personal choices. Contrasts between the two theories are of particular interest here.

Because it is difficult to monitor personal behaviour change in health terms (adoption is virtually impossible to measure until disease symptoms manifest), HPE has developed an extensive literature of evaluation reporting strategies and methodologies (e.g. Hawe, Degeling & Hall 1994; Rootman et al. 2001) lacking in the DoI literature. While this lack can be explained partially by Rogers' (2005) observation that the vast majority of diffusion studies are retrospective (and therefore evaluative in nature), it identifies a limitation in DoI's suitability for application in the prospective or predictive context of Chapter 6. This suggests that adaptation of HPE evaluation strategies to the sustainability context (as suggested in prospective recommendations in Section 6.5.6) would be useful to evaluate the outcomes from change agendas to improve their effectiveness or alert policy makers to the need for new, effective strategies.

In contrast to health, adopting personal behaviours in sustainability can be regulated because measurement systems are available for the outcomes in the form of energy and water bills. While DoI has the capacity to frame and analyse the change contributions of regulation through its 'authority' category of adoption decisions, DoI literature is predominantly concerned with 'optional' adoption decisions (Rogers 2003). (This limitation is further addressed in Section 1.5.2 and overcome through modification of the theory in Section 4.1.2).

Non-adoption of most sustainable practices does not expose an individual to greater personal risk (sanitation and water supply being an obvious exception) whereas the non-adoption of health promotion initiatives does. Conversely, non-adoption of health innovations by an individual has fewer implications for society, whereas sustainable outcomes are reliant on adoption by a high percentage of its member. For this reason, HPE change agendas place less emphasis on total adopter numbers and more on total adoption by individuals with minimal rejection, whereas sustainable change agendas benefit from an emphasis on partial adoption by large numbers of a population and are less concerned with complete adoption or rejection by a few individuals. In this regard, DoI has distinct advantages over HPE through its capacity to frame detailed, structured analysis of information flows and adoption drivers at both individual and societal levels.

While ten per cent of all DoI studies have involved health promotion issues (Rogers 2003, pp. 65, 72, 192, 326 & 387), the majority of DoI applications deal with the innovations typically associated with sustainable change. While many of the innovations researched in DoI have more immediate benefits for the adopter (Rogers 2003, pp. 44-45) than sustainable innovations (e.g. mobile phones and fax machines) sufficient scope exists in DoI to address the diffusion of complex and less immediately beneficial innovations. Indeed, DoI's capacity to analyse the characteristics of an

innovation that leads to its adoption identifies significant barriers to adopting sustainable innovations (Chapter 3).

In summary, while sustainability and health have many similarities in terms of change creation, fundamental differences between them make adaptation of the HPE framework to this research context unviable. The innovation focus of DoI and its broad application in a diverse range of change applications make it preferable as a framework within which to research sustainable change creation. Nevertheless, DoI would benefit from adding aspects of the HPE monitoring and evaluation capacity to overcome limitations in its evaluative capacity identified through the brief comparative analysis above. DoI's adaptability is well suited to this type of modification.

Finally, DoI's well developed and recognised structure, its long history of application as a generic theory in disciplinary and transdisciplinary projects and its capacity for adaptation to individual research contexts, substantially met the criteria listed earlier. Accordingly, I have adopted DoI as the primary theoretical framework for my research.

Technologically vs. sociologically deterministic approaches

The action research methodology of this research required interaction and communication with an industry audience working predominantly in a positivist paradigm (e.g. engineers, building physicists, materials scientists). Positivist approaches to change creation focus on the technical aspects of the innovation and treat the social system in which that innovation needs to be diffused as 'context' or background. In their analysis of change creation information systems, Grint and Woolgar (1997) describe this as a technologically deterministic stance. Technological determinists assume that all outcomes of technological change are attributable to the technological aspects of the innovation rather than the sociological aspects of its diffusion.

An alternative stance is social determinism, where social context is used to explain technical change. The research focus then becomes the social interactions in which change occurs and the technological aspects of the innovation are relegated to a background position (Law & Callon 1988). Technological determinism is the dominant stance adopted by industry stakeholders in developing the technological aspects of sustainable innovations but is limited in its capacity to address the social dimensions of the equally important diffusion process in this research. A socially determinist approach is useful in examining these aspects, and clearly, a combined approach is required in this research.

While DoI takes into account the role of social interactions in the diffusion of an innovation, its primary focus is the innovation itself. This tends to position it in a technologically deterministic stance than a socially deterministic one. While this is a valid and useful stance in which to describe

the diffusion process to my stakeholder audience, DoI is less useful in its capacity to examine socially deterministic influences at a deeper level. Therefore, I use ANT as a useful extension of DoI to explore these relationships and influences (see Section 1.6).

Summary

As argued above, Diffusion of Innovations theory embodies most of the criteria nominated as desirable in a theoretical framework for this research. It is a broad, adaptable theoretical framework in which the ways that individuals, communities and societies adopt new ideas, systems and technologies can be analysed, explained and understood. As demonstrated in my investigation of the scholarly status of diffusion research below, DoI is a widely recognised research tradition with successive application in nine major disciplines (Rogers 2003 pp 93-94), several of which underpin the stance of the industry sectors involved in this research.

DoI theory is grounded sufficiently in the discourse of these disciplines that it defines a recognisable, interconnective framework for this transdisciplinary research (see Section 1.5 below). It is readily adaptable to a broad range of innovations, communication modes and social systems. Rogers observed that there is a *general framework to the diffusion of innovations* and that this framework holds true regardless of the application, cultural setting or discipline. *So that is the origin of the diffusion model.* (Rogers in McGrath & Zell 2001, p. 387). These characteristics align well with the transdisciplinary approaches typically applied in the relatively recent field of sustainable change creation.

1.5   DoI as a theoretical framework

1.5.1   DoI theory through a review of relevant literature

Overview

This literature review briefly introduces and describes the theory of Diffusion of Innovations (DoI) as the framework in which I later analyse my Action Research findings. It entails a selective review of literature relevant to this application and draws heavily on the seminal works of Everett Rogers. Rogers identifies four fundamental elements in the diffusion of innovations:

- innovation
- communication
- time
- a social system.

These four elements are at the core of this research. If we are to reinvent the way we build houses to reduce (and ultimately eliminate) their environmental impact, how might the diffusion of

innovative practices and associated technological components best be communicated in the social systems of the AHI to ensure its adoption in the shortest possible time frame?

Rogers defines innovation as *an idea perceived as new by an individual* and diffusion as *the process by which the innovation spreads* throughout a given social system. Diffusion of Innovations theory has an extensive history, ranging from modelling the diffusion of individual technological improvements, to creating and managing complex organisational and social change. It provides a flexible and convenient framework in which to analyse and understand the complex variables that cause an innovation to be adopted or rejected and informs the management and direction of the associated change process. Rogers describes the theory in its simplest form as:

The essence of the diffusion process is the human interaction in which one person communicates a new idea to another person. Thus, at the most elemental level of conceptualisation, the diffusion process consists of (1) a new idea, (2) individual A who knows about the innovation, and (3) individual B who does not yet know about the innovation. The social relationships of A and B have a great deal to say about the conditions under which A will tell B about the innovation, and the results of this telling (Rogers 1983).

Because social relationships are invariable complex, the theory and its application is complex. In the next section, I briefly outline the historical development of DoI.

DoI origins

The origins of diffusionism are attributed to Gabriel Tarde, a French lawyer and judge who developed hypotheses to explain why *given 100 innovations conceived at the same time (innovations in the form of words, mythological ideas, industrial processes etc.), 10 will spread abroad while 90 will be forgotten.* Tarde observed that *an innovation is first adopted by an individual who is socially closest to the source of the new idea and that it then spreads from higher status to lower status individuals within a society* (Tarde in Rogers 2003, p. 41). He identified that adoption or rejection of innovations is a crucial research question and published his theories in *The Laws of Imitation* (Tarde 1903).

Tarde's laws of imitation were based on recorded observations which are fundamental to the theory of diffusion of innovations as we know it today and include:
- rates of adoption or rejection of a new idea usually followed an s shaped curve;
- take off on the 's' curve of adoption began to occur when opinion leaders in a system began to adopt the idea;
- the more similar an idea was to those that have already been accepted, the more likely the innovation was to be adopted.

In the 1920s, similar viewpoints were reached independently of Tarde by two groups described by Rogers as 'early anthropologists'. Both described a view of anthropology that explained change in a

given society resulting from innovations from another society. These 'early diffusionists' argued that all innovations spread from one original source–denying the now agreed phenomenon of 'parallel invention' (Rogers 2003 pp 39-43). Rogers credits these groups with bringing the importance of diffusion to the attention of other sociologists. Their theory that all social change could be explained by diffusion alone was discarded by later writers, who posited that *social change is caused by both invention (the process by which a new idea is discovered or created) and diffusion, which usually occur sequentially (Rogers 1983).*
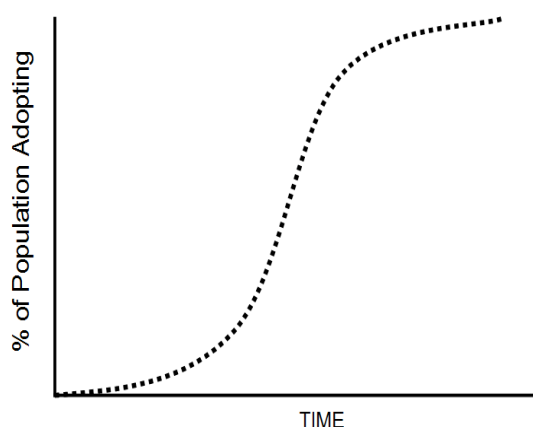
Figure 3a: A typical S shaped adoption curve.

In Rogers' view, the work of Ryan and Gross (1943) in their investigation of the diffusion of hybrid-seed corn in the Iowa farming community, influenced the methodology, theoretical framework and interpretations of other researchers more than any other study. Despite many apparent benefits for adopters, this innovation took approximately thirteen years to reach near 100% adoption rates among farmers. Ryan and Gross used a structured questionnaire to interview all the farmers who had adopted the hybrid seed variety. Their purpose was twofold: to learn why an innovation with obvious advantages took so long to diffuse, and to increase their understanding of how and why the diffusion eventually proved so successful. They concluded that, even though the farmers first heard about the hybrid corn from a commercial salesman, their neighbours and fellow farmers were the most influential actors in persuading them to adopt the innovation.

From this observation, they suggested that an individual passes through different stages in adopting a new idea and that different communication channels or agents play different roles at stages of that decision process. The long adoption time frame was explained by Ryan and Gross as differing innovativeness among farmers. Innovative farmers trialled the innovation soon after hearing about it while less innovative farmers deferred trials until they could observe the advantages derived by their neighbours (Ryan & Gross 1943). This explanation led to the eventual categorisation of adopters according to their innovativeness by Rogers in 1958 (Rogers 2003). The categories are innovators, early adopters, early majority, late majority and laggards.
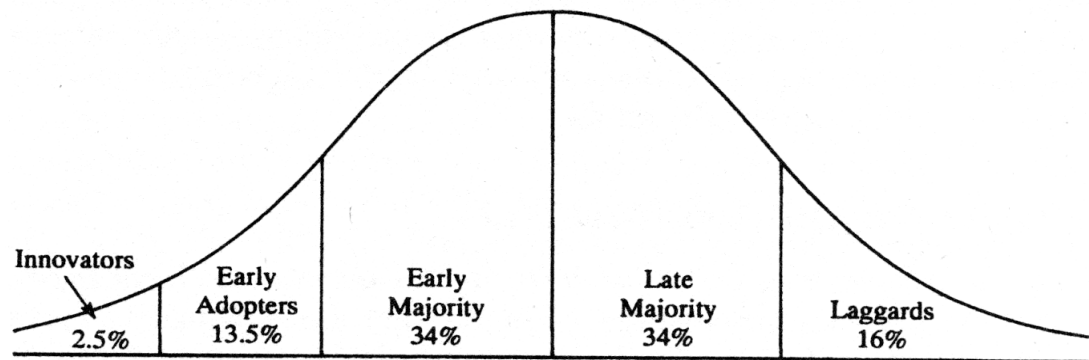
Figure 3b: Adopter categories based on innovativeness (Rogers 2003)

The categories recognise that individuals in a social system do not adopt an innovation at the same time. Rather, they adopt in a sequence as shown in Figure 3b and their position in that sequence is determined by their innovativeness or preparedness to adopt a new practice or product. In the 50 years since Rogers first published these categories, diffusion scholars have been developing and testing generalisations drawn from them. A set of 'ideal types', to explain and predict adopter behaviour is now widely agreed. This capacity of DoI is fundamental to my analysis in Chapters 3, 4 and 6.

The scholarly status of diffusion research

In his first text, Rogers noted that diffusion scholars had been *working where the ground was soft* and challenged future researchers to *expand the area of digging and to search for different objectives than those of the past* (Rogers, 1962, p. x). He repeats this statement in his fifth and latest edition (Rogers 2003), where he consolidates 41 years of diffusion research evolution into an intellectual paradigm that: *…enables [scholars] to pursue a coherent set of research directions [but warns that]…the paradigm also imposes a set of assumptions and conceptual biases that, once begun, are difficult to recognise and overcome. That is the challenge for the next generation of diffusion scholars* (Rogers 2003, p.101)

Rogers describes diffusion as an 'invisible college' and explains how this college formed through repeated application and criticism of DoI theory by thousands of scholars over five decades. He demonstrates how the rise and fall of diffusion publications over time aligns closely with Khun's stages of paradigm development (Rogers 2003 p 46). Khun defines a paradigm as a scientific approach to a given phenomenon that provides model problems and solutions to a community of scholars. He describes three normal stages in the growth of science or a new paradigm. Initially, the new approach is tested, challenged and advanced by successive research applications. Gradually, a scientific consensus about the field is reached and eventually, after several generations of use and debate report fewer new findings, the revolutionary paradigm is accepted as a valid scientific method or fact (Kuhn 1970). I assert that this alignment confirms Rogers' claims on the scholarly status of diffusion theory and supports applying it in this research.

In defining the intellectual paradigm of diffusion research, Rogers describes the rise of nine major diffusion research traditions in which the paradigm of DoI has been established. These are anthropology, early sociology, rural sociology, education, public health or medical sociology, communication, marketing, geography and general sociology. Additionally, he identifies and defines eight types of diffusion research according to the main dependent variable addressed (Rogers 2003 pp 94–101). These are:

- earliness of knowing about the innovation
- rate of adoption of different innovations in a social system
- innovativeness
- opinion leadership
- diffusion networks
- rate of adoption in different social systems
- communication channel usage
- consequences of innovation

Rogers argues that one or more of these typologies will apply to any research project framed in DoI. However, Rogers' own research demonstrates that 58% of all published diffusion studies fit in the innovativeness of adopter typology. Communication channel usage accounts for seven per cent, earliness of knowing, five per cent and opinion leadership, only three per cent (Rogers 2003 pp 96-98). Less than one per cent investigate the role of diffusion networks and two per cent rates of adoption in different social systems. This has led to reliance on simple assumptions about the social systems in which the innovations are diffused. The implications of this for my research are discussed in Section 1.6 where I argue for applying ANT as a supplementary analytical framework in DoI to deepen the sociological investigation aspects of this research.

While all eight diffusion variables used by Rogers to define the typologies are applied to some extent in my research, applying DoI in this thesis is atypical because it involves the investigative analysis of current diffusion, prospective analysis of likely or preferred diffusion scenarios and strategic analysis of ways to accelerate rates of diffusion in those scenarios.

1.5.2 DoI limitations

In this section, I briefly describe the type of diffusion research applied in each analytical context and discuss some limitations relating to applying DoI as an analytical framework. I then explain my use of Actor Network Theory as an additional analytical method within the analytical framework of DoI to overcome these limitations. Actor Network Theory and its application in this research are explained in Section 1.6.1 where I argue for the validity of its use in DoI by identifying philosophical differences between the knowledge and understanding generated through ANT and

DoI and arguing the need for both in my research. I now address several broad DoI limitations I encountered.

The first involves the inherent DoI assumption that an individual either adopts or rejects an innovation and that the point at which adoption occurs can be easily recognised. Sustainability is a journey, not a destination. As such, there is no beginning or end. While we are beginning to develop scientific understandings which identify goals likely to be important stepping stones or benchmarks on that journey, and tools that can measure our progress towards them, the only real indicator of success is that human societies continue to exist because the environment that sustains them is itself sustained to a greater rather than a lesser extent. This rather vague indicator does not fit well in the 'adopt or reject' criteria of DoI. Rogers acknowledges this limitation in his Fifth Edition by commenting that a methodological problem concerning recognition and tracing of adoption exists for researchers applying DoI to 'idea only' (Rogers 2003, p 13) or conceptual innovations. While the innovations associated with sustainability have a strong technological basis, the conceptual complexity surrounding their adoption often dominates the perceptions of would-be adopters. In other words, the innovations addressed by this diffusion study are a rapidly evolving set of technologies and practices that could arguably be addressed effectively through a focus on adopting a value system or 'idea'.

DoI recognises various important stages in the decision-making process of a potential adopter but it does not adequately address variations to the definition of adoption or recognise the 'degrees' of adoption required to usefully apply DoI theory in the evolving field of sustainability. It is difficult if not impossible to define the point at which sustainable practices might be deemed to be 'adopted' by an individual – much less an AHI practitioner whose 'level' of adoption will vary from project to project according to budget, risk and market preference. Does adoption occur when a decision is made to apply SP or, does it require the active application of SP by an adopter? Then the question arises as to what degree of application is deemed to constitute adoption? Further, what innovations or pathways to the outcome of adoption are deemed to be valid? Is it regulatory compliance or adopting voluntary best practice? What happens when these change, evolve or are modified by change agencies, researchers or adopters?

To overcome this problem, I have chosen to apply a flexible definition of adoption dependent on a range of variables related to decision drivers, innovations and application context. While somewhat problematic in my limited quantitative application of DoI (industry surveys to plot progress on an adoption curve), it resolved the problem in my predominantly qualitative application of DoI in terms of valuing the shifts in attitude, knowledge and skill among practitioners that lead to adopting a continuum of sustainable practice (SP) ranging from mandatory minimum standards through better practice and eventually (ideally), to best practice. The position of a given practitioner on this

continuum will vary from project to project dependent on the range of variables listed above. One objective of the research is to clarify the role of those variables, in order to inform strategies to lessen or eliminate their influence.

A second limitation of DoI in my research context relates to the phenomenon Rogers describes as reinvention (Rogers 2003 pp 17 and 180 –186). Investigative analysis of the diffusion of current SP innovations in the AHI identified a complex, growing and interdependent series of innovations (described as 'technology clusters', Rogers 2003, p. 14) undergoing constant modification and refinement. This process is often viewed by DoI researchers as a consequence of diffusion rather than an integral part of the diffusion process. My prospective analysis demonstrates that substantial continuing reinvention of current technologies and practices is required to deliver preferred outcomes for future generations.

Indeed, in Chapters 3, 4 and 6, I argue that re-inventing SP innovations is a more important diffusion variable than individual innovation attributes. For example, the commercialisation of advanced glazing solutions facilitated greater thermal efficiency and led to benchmark creep and sophisticated modelling tools. This required practitioners to acquire new skills to design and build to these higher standards, which in turn led to innovative practices involving the reinvention of approaches to thermal performance that involved a range or cluster of new technologies in addition to advanced glazing.

The contribution of reinvention to the diffusion process extends beyond the creation, refinement and commercialisation of cost effective innovations, to include the diffusion of AHI understandings and acceptance of the moral and ethical underpinnings of sustainable change. Network analysis of the links created and strengthened through the reinvention process and strategic analysis of the engagement of individuals through participation in reinvention are explained at a theoretical level in Section 1.5.3. Chapters 3, 4 and 5 demonstrate how the reinvention process itself is fundamental to the AHI adoption decision process. Indeed, in Chapter 7, I argue that reinvention should become an important, additional diffusion typology in prospective diffusion studies.

A third DoI limitation relates to its capacity to address the role of regulation. While DoI theory addresses regulatory influence on decision-making under authority decision types, I have found it limited in its capacity to adequately frame my analysis of the influence of a complex and constantly changing regulatory framework on adoption decision making. Investigative analysis reveals that mandated adoption of minimum SP practices, combined with AHI competition, is effective in diffusing minimum and best practice SP throughout the AHI when combined with effective communication strategies. While only a small percentage of innovation decisions are mandated at

present, regulation is driving adoption decisions for a much broader range of non-mandated innovations (see Section 4.2). The challenge is to explain why this occurs and to project that understanding, through prospective analysis, into future scenarios to ensure that the potential of each adoption driver is utilised (see Sections 6.3 and 6.4).

Fourthly, the DoI assumption that innovations can be defined clearly, is over simplistic in my research context. As will be argued in Chapter 2, sustainability is anything but a clearly defined concept or innovation. Rather, I argue that it is a relatively new and evolving science and a process of social change. Both the scientific and social change aspects of sustainable practice are constantly evolving. Defining SP innovations is a complex problem because it depends on the level of focus being applied. At its broadest definition, the innovation is sustainable practices. At its most specific, it might be an energy-efficient lighting system. This diverse range of valid innovations and outcomes becomes complex and meaningless within a typical quantitative DoI focus and, while DoI yields useful insights when applied as an analytical framework, ANT punctualisation (see Section 1.6) provides a reductionist framework in which each level of innovation can be usefully described, analysed and incorporated into the framework of sustainable change.

Finally, DoI theory attributes adoption rate variations between sectors to the position of an individual or company in a network, exposure to opinion leadership or change agency or the innovativeness of the adopters. I argue that the network has a much greater diffusion role in the AHI context than can be modelled in DoI's diffusion network framework. My investigation calls for detailed analysis of the role of multiple, independent change agencies (at best un-coordinated and often in direct competition with each other) in driving the diffusion of multiple, constantly changing innovations (practices and technologies) in the complex, multi-layered AHI social system. Again, the reductionist capacity of ANT (explained in Section 1.6) provides a framework in which this complexity can be analytically framed in what I describe as a 'three dimensional' framework that facilitates a non-exclusive focus on any individual actant and its network linkages.

1.5.3 Scope of DoI application

Overview

As argued above, DoI is a broad, adaptable theoretical framework (albeit with some limitations) in which the ways that individuals, communities and societies adopt new ideas and systems and technologies can be analysed, explained and understood. In this section, I critically review relevant diffusion studies by other researchers to inform and support using DoI to analyse sustainable change that occurred in the AHI during my AR (Section 1.5 below). The purpose of this analysis is to inform and facilitate the design, delivery and management of effective future change strategies. Firstly, I reconcile DoI in the theoretical context of my research. Secondly, I review the many and

varied applications of DoI found in the literature and identify those most relevant to my work. This review exposes some further DoI limitations specific to the context of this research and facilitates the identification of strategies to overcome them. Finally, I develop and define a DoI framework specific to this research in which I frame my AR analysis (Section 1.5.3) to support my conclusions in Chapters 6 and 7.

My DoI application is an analytical and adopter-focused diffusion analysis rather than a quantitative or innovation-focused one. While I illustrate my qualitative analysis with quantitative data drawn from AR, this data contributes indicative support only. In other words, I do not claim that the diffusion study is mathematically or quantitatively rigorous. Rather, it is a socially constructed, qualitative analysis of recorded AR case studies that yields important new understandings and insights into how and why sustainable change is occurring in the AHI. My conclusions rely substantially on the strength of arguments developed through theoretical analysis and grounding of AR observations and outcomes in the bodies of knowledge associated with DoI and Actor Network Theory.
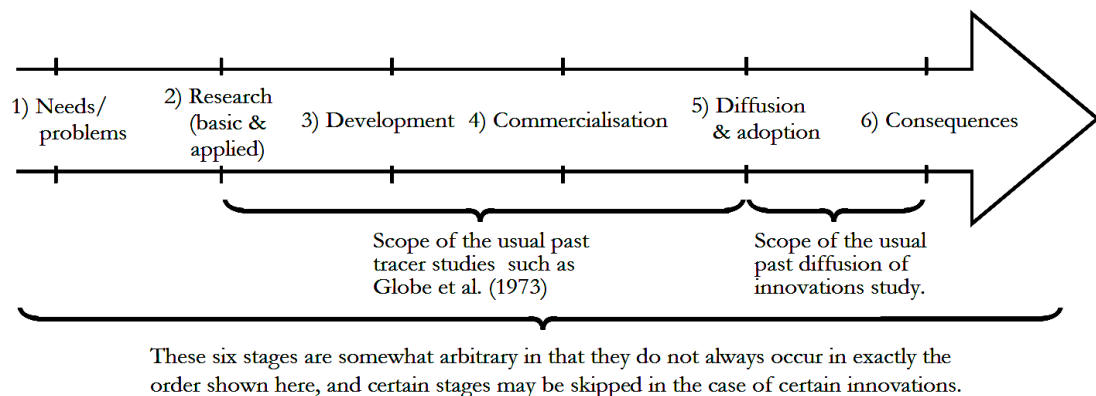
Figure 4: Six main stages in the Innovation Development Process, showing the limited scope of past tracer studies and of past diffusion studies (Rogers 2003, p. 138)

The scope of my application relative to other diffusion studies includes each of the stages summarised in Figure 4 and includes a seventh stage, reinvention (See Figure 6). Figure 4 depicts Rogers' six main stages in the innovation-decision process and summarises his assessment of the scope of coverage of each stage in past studies. Rogers makes a distinction between tracer studies (retrospective tracing of selected phases of diffusion) and diffusion studies (Rogers 2003, pp. 161-165). He observes the predominance of retrospective analysis to be a weakness in diffusion research and comments that *much could also be learned from conducting prospective studies of the innovation development process* (Rogers 2003, p. 163). In this research application, DoI theory is applied both retrospectively and prospectively. Retrospective analysis of the early stages of diffusion is used to inform predictive analysis of future stages. Recommendations for increasing both rates and levels of adoption of SP are drawn from this predictive analysis and fed back into the diffusion process through AR. In this way, the research is an interactive DoI application.

As mentioned in the discussion of DoI's limitations, the stages do not address the phenomenon of re-inventing innovations. While many of the innovations associated with SP in the AHI are at varying stages of development and commercialisation, the combined influence of market demand and regulation is increasing adoption rates exponentially (See Chapter 4 for detailed arguments). Many of the innovations already adopted by industry require further development and refinement through an process of innovation evolution where only the fittest (for purpose) survive in the marketplace. Reinvention is an essential and critical component of that process as suggested by Rogers through a series of generalisations:

i) reinvention occurs at the implementation stage for many innovations and many adopters; ii) a high degree of reinvention leads to a faster rate of adoption of an innovation and iii) a higher degree of reinvention leads to a higher degree of sustainability [of adoption] of an innovation (Rogers 2003, p. 182-183).

In recognition of the importance of reinvention in my DoI analysis of SP diffusion in the AHI, I argue that its omission from fundamental DoI analysis tools such as the innovation decision stages limits the usefulness of DoI in my prospective application. Accordingly, I argue for the addition of a seventh Reinvention stage to Rogers' innovation decision process, because it represents the type of *learning from a prospective application of DoI* contribution predicted by Rogers.

Additionally, Figure 4 implies that the innovation decision process is linear. While this assumption might hold true in a retrospective application, it is limiting in a prospective context. The evolution of SP innovations through reinvention engages adopters in a cyclical decision process requiring constant re-assessment of new or improved innovations. The interaction required between the adopter groups involved at each of the (now) seven stages of adoption decision further complicates this process.

Figure 5 below depicts the complex cyclical innovation decision process observed in this research context and provides a graphic summary of the innovation decision process for the diffusion of SP in the AHI. It also demonstrates the complex, interdependent relationships between change agencies, researchers, suppliers and manufacturers and each of the practitioner major adopter groups during the stages of the innovation development and reinvention cycle. A slightly modified version is in Section 4.2.2 where its role in this research is explained.
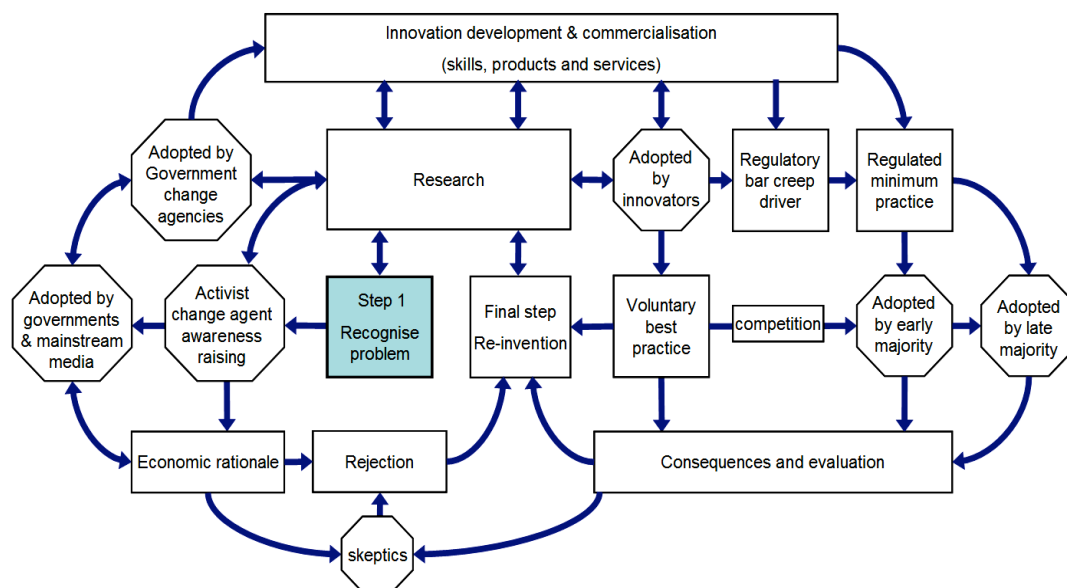
Figure 5: A cyclical innovation-decision process model for application in prospective diffusion analysis of evolving innovations in a complex social system.

Qualitative or quantitative application?

Whilst DoI theory has valid application as a mathematical or empirical tool in which complex statistical analysis of diffusion processes can be framed and validated (Abrahamson 1997; Mahajan c1985) its application in this research is primarily analytical. Arguments supporting the modelled, predictive adoption scenarios are drawn from theoretical analysis supported by indicative analysis of empirical data collected during the action research phases. This proved useful in providing feedback to AR stakeholders during action research cycles and assisted in refining and validating hypotheses by evaluating its application in stakeholder change agendas. (See *Your Home* and BITS case studies).

Because the diffusion of sustainable innovations is in its early stages, in this research context I argue that complex mathematical analysis is of limited value. Conversely, conceptual analysis of AHI sustainable change agendas in DoI, throughout the AR phases of the research has informed, structured and focused selected change agency agendas. Recommendations drawn from reflective analysis of AR in Chapter 3 and 4 inform my concluding analysis in terms of practice (Chapter 6) and theory (Chapter 7) to both my research case study agendas and the sustainable change agenda. Knoke's (1982) observation that the context of research application should determine appropriate emphasis and his subsequent description of valid contexts for both qualitative and quantitative application of DoI supports this argument.

Rogers notes that the majority of documented diffusion studies focus on retrospective analysis of successful diffusion and suggests that this has led to a *pro-innovation bias* (Rogers 2003 pp 106–116). He identifies a need for *a different kind of diffusion study to those of the past* and suggests, *Alternative*

research approaches to post-hoc data gathering about how an innovation has diffused should be explored (Rogers 2003 p 112). This diffusion study takes such an approach. Indeed, I argue that an innovation bias is of limited value in this research context and that the diffusion process itself is the primary adoption driver for the complex and evolving set of innovations described as change towards sustainable practices.

Innovation or adopter focus?

A distinction between an innovation focus and an adopter focus in diffusion models has been identified and described by several authors (Mahajan c1985; Midgley 1986; Waisbord 2001; Wejnert 2002). Research focus in diffusion studies is usually determined by the unique characteristics of each innovation or the adopter group and the researcher's epistemological stance. In the following sections, I identify the unique characteristics of the innovations and adopter groups in this research application, in order to argue for an appropriate focus for this research.

The bulk of published diffusion studies concern a single idea, such as: adopting IT in education (Geoghegan 1994); technological innovations such as the fax (Rogers 2003 pp 235), laptop computer (Rogers 2003 pp 144) and the internet (Rogers 2003 pp 346) or concepts such as innovative agricultural techniques (Ryan & Gross 1943). Indeed one of Rogers' original diffusion studies concerned the diffusion of diffusion theory among research and scholarly communities. Rogers has monitored this diffusion over almost 50 years (Rogers, 1962, 1971, 1983, 1995 & 2003).

Fewer studies deal with complex diffusion issues that might address a range of technological or conceptual diffusions in an agenda of social change. Health education and promotion is an example of one field where DoI has been applied to a broad agenda. (See 1.4.2 for a comparative analysis of the diffusion of health promotion and sustainable innovations). Moreover, many recent diffusion studies occurred in a commercial context where companies are creating, diffusing and improving technologies for profit (Moore 1999). While yielding insights for diffusion of sustainable innovations, that type of DoI application is distinctly different to the one applied in this research.

In closing this section, I argue that DoI research has focused on the role of innovations and their adopters in the diffusion process. This has led to a gap in the DoI literature on analysis of the role of complex social interactions. While DoI theory addresses diffusion networks (Rogers 2003 pp. 316-326), I find that it is limited in its capacity to address diffusion studies (such as this one) where the network is arguably the principal driver of diffusion. This highlights the complexity of the AHI as a DoI societal system and identifies a need for an adopter focus, which includes detailed analysis of the interaction between individual adopters and adopter organisations in the AHI network. In combination, these unique characteristics demonstrate the need for a more innovative approach to this diffusion study than has been previously taken and underpins my decision to introduce ANT.

This critique identified limitations in the capacity of DoI theory to address unknown qualities arising from the complex and evolving nature of sustainable innovations. I argued that this complexity limits the depth of my analysis of innovation alone as a driver of adoption in this research and justifies additional emphasis on the role of adopters.

1.6   ANT as an additional theoretical framework (within DoI)

1.6.1   Overview

Actor Network Theory is applied as a framework for analysis of how the complex, multiple layers of individual actants in the AHI societal system interact in response to sustainable change agendas by adopting the technological innovations implicit in them. In other words, I have chosen ANT over other network analysis tools because of its capacity to explain and give meaning to the human-centred processes of socio-technical change being applied through my AR. To the best of my knowledge, this is the first application of ANT in DoI and as such, constitutes a significant contribution. This aspect is addressed further in Chapter 7.

Bryce describes ANT as...*a process of idea-to-action that embodies experience legitimised by literature* (Bryce & Yasukawa 2004, p. 2). In my research process, action research and reflective practice parallel Bryce's experience element. Data collected during AR includes observations of relationships and interactions, shifts in interest, alliances and goals by participants, the role of mediators in these change-generating interactions and, changes in attitude, knowledge and skills related to sustainable practices (SP) among practitioners. Quantitative data drawn from key stakeholder groups through questionnaires supports this predominantly qualitative data. It does so by confirming socially constructed research outcomes that were valid indicators of change at a given point in time in the constantly evolving diffusion process. However, because the change process has progressed, statistical analysis of the data is of limited use (and might well be misleading) in my constructivist research stance.

Rather, ideas and concepts in the form of strategies with potential to increase rates of change were seen as outcomes, validly drawn from the research actions. Analysing the ANT and DoI literature legitimated these ideas and they were presented to industry peak bodies and government funding agencies as arguments to support creating and delivering new and improved change creation tools. Adopting and applying the change strategies validated AR partners' (knowledge) contribution and allows further validation by observing their effectiveness in creating change.

No change outcomes have yet been quantified through objective measurement and testing of housing products thought to have improved their environmental performance as an outcome of an AR change agenda. While quantification would confirm or deny the success of AR change agendas

and legitimise the reporting of same to industry in the positivist language it best understands, I argue that it is too early in the change process for evaluation to be conclusive. Indeed, limited attempts to date (Williamson 2005) have shown negative outcomes or, at best, been inconclusive. To be meaningful, measurement requires accurate measurement protocols and tools applied in a rigorous auditing framework (such as those likely to be developed as part of future carbon tax and trading schemes) in addition to a clear understanding of performance before the change. Quality baseline data for the specific cases cited by Williamson (2005) was unavailable (as is often the case) and his critique was based on national averages reported in the Baseline Study (AGO 1999).

In this context, outcomes are interpreted as early indications of progress towards the truly sustainable practices defined in Chapter 2. The more valuable outcomes for the aims of this dissertation are indications that the social constructivist strategies identified and tested through this research have succeeded in engaging many actors in the AHI on a journey towards sustainable futures. I acknowledge that arrival at the destination is beyond the scope of this research and indeed, my lifetime. This research focuses on the initial steps of a long journey with undetermined destinations, somewhere in an unforeseeable future. My contribution is best positioned at the hope stage in the following quote from Francis Hodgson Burnett:

At first people refuse to believe that a strange new thing can be done, then they begin to hope it can be done–then it is done–and all the world wonders why it was not done centuries ago (Chapter 27, *The Secret Garden).*

What is ANT?

 ANT is attributed primarily to Bruno Latour, Michael Callon and John Law, who created it as a framework for understanding the socio-technological processes involved in innovation, knowledge and technology creation. A simple, anonymous overview from Wikipedia describes it as...*a sociological theory in which network interactions between individuals, organisations and the policies or objects that influence them can be analysed.* A fundamental and distinguishing feature of ANT is the concept of a heterogeneous network consisting of many dissimilar elements called actors or actants. Callon emphasises the interdependence of actors and networks in ANT: *An actor network is simultaneously: an actor whose activity is networking heterogeneous elements and; a network that is able to redefine and transform what it is made of* (Callon, 1987 in Stalder 1997, p. 3).

Selman and Wragg (1999) describe ANT as a way of explaining how: …*particular technological and scientific models gain acceptance as 'normal' custom and practice, arguing that, as a result of successive agreements and decisions, actors become committed to a conventional wisdom or enduring mindset which others must accept if they wish to join mainstream practice* (Selman & Wragg 1999, p. 329)**.**

In other words, ANT facilitates the exploration of why technologies, scientific theories, or social endeavours succeed or fail as the direct result of changes in their network integrity. Stalder (1997) expands the above definition by examining ANT as a theoretical framework in which the communication networks that generate socio-technological change can be analysed and explained free of the sociological or technological biases often encountered in other theories (Section 1.5.2 discusses the technologically deterministic bias of DoI theory).

ANT overcomes these biases through the concept of a heterogeneous network of actants, each defined by their interactive function in the network. Latour (1992) defines actors as *entities that do things* and explains that in ANT, *distinctions between humans and non-humans, embodied or disembodied skills, impersonation or 'machination', are less interesting than the complete chain along which* [their individual] *competences and actions are distributed.* (Latour 1992, pp. 241-243). ANT's focus on the role of the network, (rather than the actors in it) in generating socio-technical change, removes analytical biases towards either sociological or technological determinism.

ANT networks are defined by Callon as a *group of unspecified relationships among entities of which the nature itself is undetermined* (Callon, 1993 in Stalder 1997, p. 2*).* Wasserman and Faust highlight the inclusiveness of this definition by contrasting it with a conventional sociological definition of networks where *a social network consists of a finite set or sets of actors and the relation or relations defined on them* (Wasserman & Faust 1994 in Stalder 1997, p. 20).

A network can be described as an entity that links people and 'things' in a heterogeneous context. Stalder refers to this as an alliance of two systems*: People: everyone who is involved in the invention, construction, distribution, and usage of an artifact* [and] *Things: all the pieces that were already on stage or had to be brought into place in order to connect the people.* [In this sense], *actor and network are mutually constitutive. An actor cannot act without a network and a network consists of actors. Actor and network constantly redefine each other, …one is dependent on the other (Stalder 1997, p. 2).*

This constant redefinition is effected through the exertion of influence or power by mediators on intermediary actants. In this regard, it is important to note the ANT distinction between mediator actants that exert power or influence and the 'intermediaries' that simply convey their will within the network. While both are equally important in network terms, the ANT concept of *punctualisation* facilitates a seemingly reductionist focus on any actant or set of actants during analysis or network configuration (Figure 6) while maintaining the core ANT tenet of actant heterogeneity. Stalder (1997) describes intermediaries as the language of the network and observes that through intermediaries, actors communicate with one another and that is the way actors translate their intentions into other actors. He cites Latour's definition of actors as any element which makes other elements dependent upon itself and translates their will into a language of its own (Callon and

Latour, 1981, p. 286) and argues that *the possibility to command intermediaries lies at the heart of action itself* (Stalder 1997, p. 3).

A core focus of this research is the analysis of change agency effectiveness in 'commanding' intermediaries in this way because it yields insights and understandings into how existing industry actants influence (and are influenced by) new actants by change agencies. These new actants include knowledge, skills, technological solutions, regulations and other incentives. The capacity of ANT to structure explanations of complex interactions between these actant variables was described by Boudorides (2001) as *a structuration plan to describe and explain the complex social processes underlying the construction, development and stabilisation of forms of the social, the technological and the natural world and their combinations "* (Boudourides 2001, p. 5).

Boudorides' definition is more relevant to technology diffusion because it implies that a threshold of stability occurs where a particular product (e.g. photovoltaic panels) will evolve to a point where it is functionally or technologically stable. Because SP undergo constant development and evolution, thresholds of stability are likely to be re-visited as new actants (e.g. technologies, practices or regulations) are introduced.

In Chapter 5, I investigate ways that CAs might limit this re-visiting to specialist actants, to maintain a stable threshold for the majority of intermediaries (See Box 5-14: BASIX' potential to 'black-box' SP development for the AHI mainstream while encouraging innovation and affordable benchmark creep.) An open-ended definition that aligns better with the deeper aspects of sustainable change, involving the evolution of a sustainable society that limits its impact on the biosphere, is embodied in Callon's description (1986) of ANT as *a mechanism by which the social and natural worlds progressively take form (Callon 1986, p. 24).*

In Chapter 5, I apply aspects of both these definitions by describing, analysing and explaining their interaction within the complex set of change processes being applied to progress the AHI towards meaningful contributions to sustainable futures.

Establishing synergies and fit between ANT and DoI

Both DoI and ANT offer useful frameworks in which a process of change can be observed and analysed. When combined with AR, observations and analyses can identify and develop interventions intended to initiate, inform or influence change toward the research goals of sustainable futures. This raises the question: why use both?

Rogers' stages of the 'Innovation–Decision Process' (Rogers 2003, pp. 168 - 216) are compared with Callon's four stages of 'configuring an actant network' (Callon 1986) in Figure 6 to highlight

similarities and contrasts between them. While each is valid and useful in its own right, analysing agreement and tension between them yields deeper insights and explanations to inform my conclusions and communicate them to both industry and academic audiences.
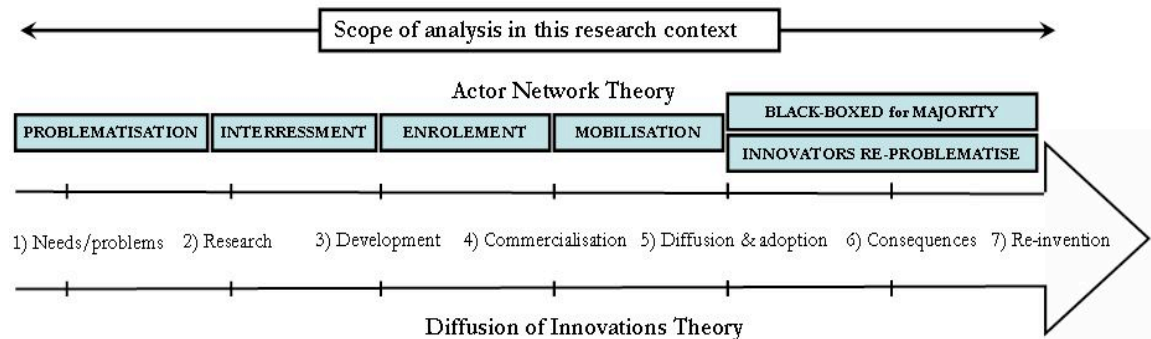
Figure 6: Seven main stages of the Innovation–Development Process (adapted from Rogers' six stages) aligned with Callon's four stages of configuring an actant network (Rogers 2003; Callon 1986).

Figure 6 demonstrates sequential synergies in the analytical approaches to change creation in each framework. Each theory has been customised to reflect the need for reinvention or re-problematisation as explained earlier. The figure also depicts an important contrast between the two theories. While the ANT stages are strongly related to sociological change, the DoI phases are technologically focussed. The contrasts that flow from this difference provide a rich source of insight and understanding of people, ideas and technologies in the AHI sustainable change process.

As argued in Section 1.5, DoI analysis tends to focus on the role of the innovations or technologies in motivating adopters, innovators and OLs throughout the diffusion process and less on the social context in which the diffusion occurs. In other words, DoI assumes that the characteristics of the innovation (which can be a technology, concept, practice or law) determine how it is perceived, accepted or rejected by individuals and entities in a social system. This approach is useful to explain why SP (technologies and practices) diffuse (or do not) in the AHI (a series of individuals and entities).

By contrast, an assumption inherent in ANT is that all actants (including innovations, innovators, adopters and OLs) are equal and that their importance is determined by the strength of their interaction with other actants in the network on the research focus. In other words, network interactions are the primary focus of ANT and technological actants are one component of the network. In that sense, ANT's focus is determined by sociological influences rather than technological ones. This characteristic of ANT is useful in my research context because the interconnection and interdependence of people, organisations, non-human resources, policies and regulatory instruments is in a constant state of flux. Each intervention affects one or more actants

beyond its intended focus. While this flow-on effect often delivers positive diffusion outcomes, ANT analysis demonstrates how and why this is not always the case and identifies strategies to overcome resultant barriers. The following case study (Box 1-1) demonstrates how tensions and agreements between DoI and ANT can yield richer or more complete insights into the same phenomena.

Box 1-1: A scenario to demonstrate useful analytical tensions between ANT and DoI.

Less than two per cent of hot water systems (HWS) in Australia are solar–yet solar systems are proven to deliver up to 96% of required hot water for free in a country with the world's highest solar incidence. Payback of the initial capital outlay occurs within three years. Why were solar systems not adopted by 100% of the population in the 1960s when they became available?

DoI explains the role of the innovation in this diffusion failure by examining the innovation's attributes: relative advantage (initial cost vs. operating cost), compatibility (visual intrusiveness, reliability, cost), complexity (electric and gas are well understood, how does solar work?), observability (neighbours, relatives, friends all have electric or gas HWS), trialability (family home or existing HWS) of electric or gas relative to the newness, and the relative rarity of solar HWS.

DoI analysis generates an adoption curve that flattens in the early 1970s as a measurable, quantitative, visual example of how diffusion of an innovation was derailed and provides a useful positivist framework in which to explain why other innovations (types of HWS) were perceived by adopters to have superior relative advantage or compatibility with their needs.

A simplistic DoI analysis of the network role might explain this diffusion failure as too much competition from conventional HWS, with which adopters were familiar in their own or friends' homes and exposed to much higher levels of opinion leadership from peers who were also familiar with them. The simple marketing task for competitors to maintain the status quo in their existing market, compared to solar's need to penetrate the market, meant that insufficient OLs adopted solar, leaving it struggling to achieve critical mass. While this innovation-focused explanation accounts for the diffusion failure, it generates insufficient detail to inform a change initiative to reverse that outcome.

ANT is better suited to this task. A simplistic ANT explanation might indicate that network connections to competitor products were stronger and more numerous (because most existing HWS are electric or gas storage, replacement costs are low, owing to simple fitting for plumbers and suppliers keeping them as stock items). Additionally, many negative network links to solar HWS exist (e.g. capital cost, plumber phobia, designer aversion, limited product development, low advertising budget, consumer ignorance etc.) which weaken the largely unknown (poorly promoted)

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positive connections to solar HWS (e.g. their role in GGE abatement, 3-year payback on additional outlay, low cost or free hot water for 20–30 years etc).

Thus, ANT analysis facilitates identifying all the actants linked to solar HWS and various sets of competing actants (according to role), regardless of strength or network position. Subsequent analysis or 'mapping' of their network influence paths can identify trends or 'hubs' of network influence based on number, nature and strength of links, to inform strategic planning of interventions by change agencies.

Conclusion: For simple, easily defined innovations (e.g. a HWS or a mobile phone), where the point of adoption can be defined simply as ownership, in a well researched social system (e.g. Australian consumers), where links between the innovation actant and other actants in the network (e.g. affordability, usefulness, communication paths, observability, opinion leadership) are constant and predictable, DoI provides a simple and adequate framework in which to analyse, influence or predict the diffusion path. Further, ANT analysis is likely to deliver qualitatively different insights, likely to identify what might need to be done differently to overcome adoption barriers. Combined explanations from both analytical approaches delivers a complete and convincing understanding of both problems and solutions, which is capable of supporting strong arguments for change strategies such as those generated by this research.

Scope of ANT application

My application of ANT in this research is not intended or claimed to be comprehensive. I use ANT as an additional theoretical framework through which to explain the role of network relationships between a diverse range of actants creating sustainable change in the AHI. In other words, I use it to add an extra level of connection between the practical contributions of my advocacy-driven action research methodology and the deeper theoretical contributions drawn from analysis of those actions. This usage is summarised by Bryce and Yasukawa: *ANT recognises that ideas and technologies are socially embedded, and that modes of thought and action are established as 'mainstream' by interactions of human and non-human 'actors' that generate a momentum of decisions and processes* (Bryce & Yasukawa 2004). Specifically, I apply ANT in two ways, communication and influence channel mapping, and intervention strategy planning.

Communication and influence channel mapping

I apply ANT as an additional analytical method within the theoretical framework of DoI to facilitate detailed analysis of the role of network interactions in diffusing SP in the complex AHI societal network. Additional perspectives and insights developed through this analysis deepen and strengthen DoI explanations of change phenomena observed or generated

through AR and underpin strategies to guide research partners in effective management of sustainable change.

The rationale for this application is succinctly summarised by Bryce and Yasukawa: *ANT offers a way of observing and analysing a process of change* and, *combined with action research, ANT can identify and guide interventions to effect change* (Bryce & Yasukawa 2004 unpubished). The AHI is characterised by complex, interconnected, interdependent factions, organisations and individuals. Each of these in turn is subject to multiple variables that influence rates of adoption of sustainable innovations.

This supplementary analysis overcomes the DoI limitations relating to social network analysis argued in 1.5.2. Conclusions drawn from it are incorporated into my DoI analysis and refined through application and analysis in the final cycles of AR to add depth to the network-related research recommendations in Chapter 6 to guide and inform AR programs.

ANT is applied therefore, as both a retrospective analytical tool to develop understanding and, a strategic planning tool to increase the effectiveness of AR change agendas in influencing socio-technical change.

Intervention strategy planning

My second application of ANT demonstrates its capacity in intervention strategy planning. This ANT capacity was described by Bryce and Yasukawa (2004) as *a process of idea-to-action that embodies experience legitimised by literature* (ibid). It involves applying ANT in an evaluative context through the analysis of selected AR case studies in their application of Callon's four phases of network configuration. This analysis yields important insights into why some projects succeeded where others failed.

According to Callon (1986), translating an idea into a reality using ANT, involves four stages:

- Problematisation: when a problem is identified and explored by one or more people or groups;

- Interressment: when a solution for the problem is put forward and the proponents start to persuade others of its merits and build alliances;

- Enrolment: the stage when others become part of an alliance to develop the solution;

- Mobilisation: the stage when the alliance reaches a strength and stability that mobilises the idea and solution to the exclusion of competing actions. The proposition then is not disputed. Indeed, it is an implicit assumption, belief or article of faith.

In ANT terms, the ideal outcome from a change agenda occurs at the end of the mobilisation phase where the change becomes an implicit assumption, belief or article of faith. ANT theorists often refer to this as achieving black-box status. A black-box contains that which no longer needs to be considered, those things whose contents have become a matter of indifference (Callon and Latour, 1981, in Stalder 1997). Stalder summarises black-box status as ...*any setting that, no matter how complex it is or how contested its history has been, is now so stable and certain that it can be treated as a fact where only the input and output counts* (Stalder 1997, p. 2).

Summary of ANT application in DoI

I apply ANT in DoI in two main ways:

- communication and influence channel mapping to:
  - map the industry network (individuals, organisations, policies and technologies);
  - position each DoI adopter group in the network;
  - identify knowledge and information (power) structures;
  - describe and analyse knowledge transfer (influence) networks;
- intervention strategy planning to:
  - evaluate selected case studies in Callon's network configuration to explain successes and failures;
  - identify important elements of communication in diffusion networks that contributed to these successes and failures;
  - develop strategies through which change agencies might have improved them for application in other projects.

1.6.2 Summary: Theoretical framework

Diffusion of Innovations theory provides an appropriate theoretical framework in which to analyse, understand and predict the complex and interdependent processes associated with the change phenomena investigated through this research. However, limitations in the capacity of DoI to analyse the complex communication and influence channels operating in the AHI led to adopting Actor Network Theory (ANT) as an additional analytical tool in DoI to expand its capacity in this area. ANT is also applied as a framework in which to plan future intervention strategies.

I have chosen to apply DoI as a theoretical framework in which to describe and analyse sustainable change in the AHI, to explain how the change process works, and to forecast future scenarios. I apply ANT as a purpose specific analytical method in that DoI framework to analyse the role of networks in the diffusion process. Additionally, I draw on the strategic planning capacity of ANT to develop and recommend intervention strategies to stakeholder change agencies.

New understandings developed through this triangulated research approach are presented and argued rigorously in my conclusions. This analysis and synthesis of quantitative and qualitative data drawn from a range of sources including reflective practice, action research and the literature of DoI and ANT theory, constitutes a novel and worthwhile contribution to knowledge in a social constructivist epistemological stance.

1.7 Methodology: Action research

1.7.1 Arguments for my action research methodology?

I argue that AR is an apposite methodology for change focussed research into the urgent set of problems associated with this rapidly evolving research field because it uses the research process itself to create change and evaluate its effectiveness, while keeping pace with the dynamic variables created by rapid change in a complex social system.

Specifically, my AR methodology enabled me to transform my existing role as an OL in the AHI, into a participatory AR role (Dick 1992; Grundy 1995) through which I monitored and analysed outcomes from various sustainable change agendas implemented between 1999 and 2008.

An important outcome from this was to generate the type of knowledge defined in Section 1.2.2 to inform the agendas of my change agency research partners in their attempts to apply the precautionary principle in a cost-sensitive, risk-averse industry. That knowledge includes both empirical survey data and AR observations from participating in change agendas (which was temporal in its usefulness) and socially constructed knowledge created through reflective practice and retrospective analysis of my AR case studies in DoI and ANT.

My application of this methodology addresses the crucial elements of interpretive AR nominated by Argyris et al. (1982) as a:

- collaborative process between researchers and people in the situation;
- process of critical enquiry;
- focus on social practice, and
- deliberate process of reflective learning (Argyris, Putnam & MacLain-Smith 1982).

In summary, I argue that my AR methodology facilitates timely application, testing and refinement of change-creating research outcomes in a TD approach to knowledge creation and is therefore, a valuable methodology for research into the socio-technological changes required to create sustainable futures.

How action research is applied in this thesis

This section describes my (arguably) atypical application of AR as a research methodology in a diverse range of projects and stakeholder groups. My AR application commenced with AR exploration of sustainable change creation in many early change agendas at a broad or meta level. Successive AR cycles focussed on increasingly specific aspects of selected change agendas as they developed and were refined in partnership with stakeholder partners through my AR 'observing player' role.

The most significant characteristic of this usage differentiating it from applications in the literature (Dupuy 1997; McTaggart 1991; Suri 1999; Winter 1987) is the diverse range of research contexts, stakeholder groups and projects in which AR is applied. Earlier AR literature describes typical applications of AR in which knowledge is socially constructed by testing and analysing increasingly refined research questions through successive AR cycles in the same subject group or project (Dick 1992, 1999; Zuber-Skerritt 1992).

Typically, an entire AR project would be conducted in this single level of focus, to generate data through consistent comparison with earlier cycles (Dick 1992). In this application, the distinct case studies investigated in each AR cycle are contextualised in the research focus by the previous cycle. Each successive cycle or level of focus informs the next through iterative analysis in DoI, which draws on the previous cycle for context in the AHI sustainable change agenda. In this way, different case studies are linked in the consistent research cycles typical of single project AR (Crawford, Jenkins & Murray-Prior 1999; Kemmis & McTaggart 1988).

The plan, act, observe, reflect (Carr & Kemmis, 1986) or intend, act, review (Dick 1999) AR refinement cycles typically applied in a single research project, are applied interchangeably in several projects over several years in this application. I argue that this flexible approach aligns with Walker and Haslett's (2002) application of systemic thinking in AR and is necessary to capture, analyse and cross-pollinate insights from the broad and evolving range of change agendas operating in my research field. I divide the AR into four main cycles, during which the focus tightens: 1) Action Learning and retrospective Reflective Practice to incorporate precious experience; 2) AR as a reflective practitioner and change agent (1998–1999); 3) AR as an author and OL in the developmental and early implementation stages of partner change agency agendas (2000–2002) and; 4) AR as a trainer, consultant and observing player in the evaluation, reinvention and mainstreaming stages of change (2003–2007). I describe these AR phases and explain their role in the research in Chapter 2.

In summary, my AR application uses a theoretical grounding in DoI to structure the analytical linkages of diverse AR case study cycles, which are later consolidated through theoretical analysis

within DoI and supplemented by comparative analysis in ANT. I argue that the lack of rigour noted as a potential AR weakness in the literature (Crawford, Jenkins & Murray-Prior 1999; Dick 1990; Dick 1999; Herschell 1999; Salner 1999; Smythe & Holian 1999), is embodied in both delivered AR change outcomes and theoretical change management strategies developed through retrospective analysis. This application of AR has important implications for the type of data collected during each phase, its use and the claims about it (Dick 1990). Specifically, I use data collected through AR in three main contexts: to identify opportunities and argue for the need for change; to argue for the refinement strategies recommended to change agency partners during AR, and to support and illustrate the arguments drawn from my retrospective analysis in DoI and ANT. The next section outlines the methods used to collect data.

1.8   Methods

1.8.1   Data overview

As argued above, AR is the overarching methodology applied in this thesis. The methods described below draw knowledge and data from the research actions conducted in the methodology. These include: experiential knowledge from previous practitioner experience drawn through reflective practice and subsequent AR roles, empirical data collected through questionnaires and other AR actions and socially constructed knowledge drawn from analysis of AR outcomes within DoI and ANT. In that context, these theoretical frameworks function as data or knowledge generation methods in my AR methodology, although that role will not be addressed separately here.

1.8.2   Reflective practice

I apply RP in three contexts. Firstly, retrospective RP analysis of my experience in roles as a designer and builder of more sustainable buildings is used both to establish my expertise in the research field and to identify potential opportunities and barriers for other practitioners embarking on a similar path (Cherry 1998; Dick 1990; Schön 1983).

Secondly, I apply RP as an iterative tool to draw additional insights from my AR roles as practitioner, OL and change agent in each AR case study and to ground them in the research. The qualitative data generated through this RP application is used to identify research questions in Chapter 2 and support analytical arguments in Chapters 3, 4 and 5.

Finally, I apply RP to evaluate my own effectiveness and professional development in my AR roles as design practitioner, OL and change agent (Rogers 2003; Schön 1983).

1.8.3 Action research case studies

In Chapter 2, I describe within three distinct phases or AR cycles, the case studies central to my Action Research. These case studies provide a source of qualitative data that is incorporated into my analysis examples (see Boxes) at relevant points in analytical arguments, to illustrate those arguments through an AR event. In other words, they are a story approach (Dart 1999) to AR. In Chapters 3, 4 and 5, theoretical arguments developed through DoI and ANT analysis of AR are supported by indicative quantitative data drawn from questionnaires and other AR activities and illustrated with qualitative data in the form of AR case study examples. The illustrative examples differentiate AR from DoI analysis while integrating both in my analytical frameworks. In other words, a triangulated approach is used to synthesise both quantitative and qualitative data through theoretical analysis in order to construct the new knowledge and understanding upon which I base my concluding arguments.

1.8.4 Survey instrument

Questionnaires were distributed to industry practitioner groups to gather data about a broad range of AR issues including: practitioner motivations and intentions to adopt change; attitudes and knowledge levels among would-be adopters; the penetration of change agendas in target audiences; rates of adoption; the needs of adopters and the effectiveness of strategies and resources to meet those needs. In this section, I describe the methods used to collect and analyse that data and declare its limitations.

Much of the quantitative data generated through the questionnaires is consistent with Gibbons' (1994) Mode 2 knowledge. The characteristic of discovery in the context of application is ideally suited to this application. The data were drawn from target practitioner groups at specific stages of the change process to evaluate early change strategies, identify practitioner skill levels, information needs and preferred information sources. Its purpose was to inform the change agendas of AR partners. The usefulness of the data diminished as the findings were assimilated and the change agendas were progressed, modified or discontinued (see Section 1.2.2. for detail).

The questionnaires also sought insights into practitioner attitudes to SP (especially decisions or intentions to adopt) that both informed and confirmed the first stages of my diffusion analysis. These results were expressed as a diffusion curve for each participant practitioner group (see Figure 18.

While temporal in application, I argue that the (partial) adoption by stakeholders of arguments presented (see Appendix 2) based on this data and the adoption of change by their target audiences, validates the knowledge that created it but, in doing so, renders much of the detail obsolete (see Appendix 2).

Richer subjective data drawn from AR case studies over long periods (e.g. audience changes in HIA GreenSmart audiences) replaced early quantitative data.

Data were collected for statistical analysis and to compare the attitudes, knowledge, skills and needs of diverse practitioner groups, in order to facilitate comparison before and after exposure to early intervention programs including SEDA's Energy Smart Homes policy and the *Your Home* suite of materials. The questionnaires were both objective or data oriented and subjective or opinion seeking. Identical questions were circulated in three separate questionnaires to building designers, architects and builders (See Appendix 1).

The structured data oriented questions used Likert scales, or yes/no answers to elicit numerical responses for comparison with responses from other practitioner groups. The questions were designed to be answerable by individuals with varying degrees of knowledge and understanding of SP and included explanations where relevant. In other words, questions were worded to assume no prior subject knowledge by the respondent, while allowing for detailed responses from those with prior knowledge (in comment boxes).

Question subjects included: demographic profile; business scale and specialisation, SP knowledge and skill levels, adoption motivations, barriers and pre-requisite needs and most importantly, a time frame (indicative or actual) for adoption of SP.

Opinion seeking questions were worded to encourage comments from which key words could be extracted. This data proved powerful when presented to change agency partners (see Appendix 2).

A simple statistical analysis of results was performed to establish norms, skews and swings in each stakeholder group. Results were compared to identify common themes and differences and used to identify specific barriers, opportunities and needs. Appendix 1 includes an example of a questionnaire and Appendix 2 is an example of an AR presentation to a stakeholder group based on analysis of questionnaire data (*Your Home* Stakeholder Group, 2006).

1.9   Summary

In the sections above, I described and argued the intellectual framework adopted for this research and positioned this thesis and my role in the research within the discourse of knowledge creation by: declaring the philosophical knowledge assumptions (epistemology) that underpin it; arguing my transdisciplinary (TD) approach; declaring Action Research (AR) as the main investigative methodology; defining the analytical frameworks through which I analyse my AR findings and, describing the research methods through which I record the findings.

My choice of a TD research approach necessitated rigorous definition of the intellectual framework underpinning my thesis because TD research is unable to draw on disciplinary assumptions about knowledge validity and positioning. Similarly, my choice of an AR methodology requires detailed definition to provide the reader with a clear understanding of the research objectives (change creation and increased understandings of the processes that cause it) and the role of various methods and analytical frameworks in achieving those objectives.

Having defined the intellectual framework within which I argue my contributions to be valid, Section 1.9.1 summarises those contributions and positions them within that framework. Section 1.9.2 then summarises the structure and flow of arguments throughout the thesis through which the contributions are developed in subsequent chapters.

1.9.1 Contributions

This thesis makes significant contributions on both practical and levels theoretical. I briefly describe them here and elaborate on them further in Chapters 6 (practical contributions) and 7 (theoretical contributions). To better position my contributions within the intellectual framework described above, I have framed my contributions within the *"three outcome spaces associated with TD research"* conceptualised by Mitchell and Willetts (2008) in their analysis of the *'consequential outcomes'* experienced by doctoral students engaging in transdisciplinary (TD) research (Mitchell & Willetts 2008 in preparation). Those outcome spaces are defined as:

1) *the situation or problem space which may be a sector, a situation, a societal issue or problem or an aspect of practice in some domain;*
2) *peer reviewed, academic knowledge in the more conventional sense and*
3) *transformational change in the researcher, and mutual (perhaps transformational) learning by stakeholders involved in, or influenced by the research (ibid).*

Outcome space one: accelerating the adoption of sustainable practices in the AHI
The contribution of my research to the adoption of (more) sustainable practices by AHI practitioners has occurred throughout the research process and, in the form of detailed theoretically informed recommendations for change agencies and other industry actors in Chapter 6. In broad terms, the research contributes to both the AHI sustainable change agenda through AR outcomes and, the body of industry knowledge regarding sustainable practices and change management through analysis of those outcomes within DoI and ANT.

During the research process, my role as an opinion leader (OL) and change agent was informed by my action research, and this contribution is evidenced through many of the AR case studies presented throughout the thesis. By updating my prospective analysis to current social dilemmas (e.g. climate change) in current change agendas (e.g. Green Loans and Mandatory Disclosure), I

have ensured that the thesis holds currency and potential for significant impact in the AHI and tested my analytical conclusions.

The following publications and presentations document my multiple contributions to sustainable change in the AHI during the research period.

- *Your Home* suite of materials (CoA 2004; Reardon et al. 2001a; Reardon et al. 2001b);
- Central Queensland University's BLAR11045 Built Environment 1 Course: Introduction to the environmental impact of the Built Environment (Reardon 2001);
- Course development and training delivery for: ABSA, BDAA, HIA (GreenSmart NSW);
- Keynote addresses: ANZSES Solar House Day (ANU), 2006; AIBS-HIA-AIBD Joint National Conference, Perth 2005; Central Coast Sustainable Business Conference, Gosford 2005.
- Conference presentations: GREX 2007; Hunter Douglas, Fiji 2007; Archicentre NSW 2004; MBA, Melbourne 2003; BDAA, 1999 – 2003; BDA NSW 1996–2007; BDA WA, 2001–2007; Enviro 2000 - Towards Sustainability Conference.
- Industry consultation committees: i) *Your Home* Steering Committee 2000–2007. Submissions include (Penman 2000; Reardon 2004a; Reardon & Penman 2000); ii) ABCB-BCA 2003 and 2006; iii) ABEC; iv) BASIX NSW 2003-5; v) SEDA Energy Smart Homes 1999–2002; and vi) Waste Boards and Resource NSW, 2000–2001.
- Submissions and testimonials to NSW and Victorian Government enquiries and hearings into Sustainable Communities (Reardon 2004b): Peak Electricity Demand (Reardon & Clarke 2003b); Energy Consumption in Residential Buildings (Reardon & Clarke 2003a); Solar Power Forum (Reardon 2002);
- Community presentations and forums: Orange Solar Fair, 2008; Bellingen Solar Fair, 2008; Goulburn Mulwarree Council, 1999, 2003, 2007; Murray Council and Albury BEC 2006; Shellharbour City Council 2003; Singleton Shire Council 2002; North Sydney Council 2002.

Outcome space two: theoretical and knowledge contributions

The contributions of my research to this outcome space are described in detail in Sections 1.2 to 1.8 and are summarised in Chapter 7. The research contributes to the body of theoretical knowledge about adaptation and application of the theories, methodologies and methods used in this thesis. These include an innovative application of DoI and ANT as theoretical frameworks in a change-focussed AR methodology to create socially constructed knowledge through a transdisciplinary approach. Mitchell and Willetts (2008) observe that this type of contribution challenges constructions of knowledge:

[Supervisors']...main concern with 'knowledge' was that it may be interpreted in a narrow Mode 1 sense (Gibbons et al, 1994) by some examiners. The idea of what counts as knowledge, and indeed, what counts as substantial or original, changes and is dependent on the disciplinary and epistemological stance of the individual [examiner]. Supervisors were clear that 'knowledge' should be broadly interpreted, and should include impact (Mitchell & Willetts 2008 in preparation, p. 17).

In this context, my role as principal author of the *Your Home* suite of materials (Reardon et al. 2001a; Reardon et al. 2001b) constitutes a primary theoretical contribution. It was rigorously peer reviewed by technical advisors, industry and community advisors and change agency partners. I and my fellow authors assimilated a broad range of disparate and seemingly conflicting knowledge into succinct, accessible information sources. The publication has been widely accepted and used throughout the AHI (see Section 2.5.2 for detail).

My roles in developing curriculum and delivering CPD training courses led to a discussion paper (Giffard and Reardon 2003) that began to develop a flexible and comprehensive sustainable skill learning hierarchy in the AHI through the Building Industry Training in Sustainability (BITS) project (see Section 2.6.5). Projects included: HIA GreenSmart, Central Queensland University, the Association of Sustainability Assessors, the Building Designers Association of Australia and recently, Home Sustainability Assessors for the Green Loans program.

Outcome space three: transformation in the researcher and other stakeholders

My AR roles in producing and applying the publications and presentations listed above, combined with reflective practice on my previous and continuing professional roles (see Sections 2.2.2 and 2.5.3) created transformational change in me as a researcher, OL and practitioner. Increased understanding of my role as an OL, combined with increases in skill and knowledge levels, have improved my effectiveness as an author, trainer and presenter, have increased my belief that sustainable futures are achievable and confirmed that my contributions have been and will continue to be worthwhile.

Additionally, my research generated mutual, transformational learning among practitioner stakeholders involved in AR training and applying professional development (see Sections 3.3.2, 3.3.3, 4.3.1 and 4.3.2). Finally, the presentation of research data and analytical findings to CA partners influenced their delivery and refinement of change agendas (see Sections 3.3.4 and much of Chapters 4 and 5).

Contributions within the three spaces above form the basis of my concluding prospective analytical recommendations to AR partners in Chapter 6.

1.9.2 Structure and flow of arguments

Research Phases

This thesis reports on three distinct phases of research. The first (Chapter 2, Sections 2.1 and 2.2) conceptualises the research field and the problems through a review the literature from which recognition of ecological limits originated and through which the contribution of the built environment to exceeding those limits was identified and quantified (2.1.1). I then ground my reading through reflective analysis (Argyris & Schön 1974; Schön 1983) of its effect in motivating, informing and guiding the practice-based responses of AHI practitioners (including my own). I apply retrospective reflective practice to my own roles as a sustainable design and construction practitioner and a change advocate to establish my expertise in the field and declare biases. This initial action learning cycle is described in Section 2.2, where I contextualise the outcomes of the literature review and reflective practice in early AHI change agendas and subsequently present them in a set of preliminary research questions and 'fuzzy hypotheses' (Dick 1992) in Section 2.3.

In addition to identifying research questions, this first phase of the research provides a knowledge base and understanding upon which the remainder of the thesis is built and generates useful insights and data that inform and support later arguments.

Research Phase 2 (Chapter 2, Sections 2.1 to 2.7), tests and refines the preliminary hypotheses and research questions developed during Phase 1 by applying AR to selected change agendas. This detailed AR application required a research focus on three fundamental, interrelated components of the change agendas identified in Phase 1:

- information provision;
- training and education provision and,
- development of measurement tools and regulation.

In the context of this research, each of these components is interconnected through participatory AR during the formation of change-supportive industry networks. While each AR cycle revealed an important change tool, AR observation during the development of each individual tool yielded deeper insights into how the complex network of AHI factions and entities interacts to accept or oppose change.

Two complementary methods are applied during iterative analysis of Phase 2 AR case studies. Firstly, analytically grounding case studies in the theory of Diffusion of Innovations (DoI) generates theoretical understandings and insights into the AHI as a 'societal entity'. It provides an explanation for how and why AHI actors interact to adopt, adapt or reject the change agendas developed by change agent partners during AR. In addition, it generates insights into how complex sustainable

innovations might be most effectively communicated to, and diffused in the complex structure of a risk-averse, cost sensitive built environment industry. A second method, reflective practice (see Section 1.8), grounds these insights in an applied context, to facilitate their AR communication to practitioners through publications in industry journals, industry conference presentations and continuing professional development (CPD) seminars and training.

Research Phase 3 (Chapters 3, 4 and 5) is the analytical phase where qualitative observations and quantitative data generated throughout Phase 2, are synthesised into cohesive arguments to identify barriers and opportunities for change. In Chapters 3 and 4, AR findings are analysed in the theoretical framework of Diffusion of Innovations (DoI) through a retrospective diffusion study. This study explains how, why and what types of change are occurring and positions industry progress on a typical adoption curve from which forecast scenarios for change are analysed. In Chapter 5, the role of the AHI social system, its actors and their communication and influence networks on change process is analysed through Actor Network Theory (ANT). This analysis develops deeper understandings of how the diffusion process works and insights into how that process might be accelerated.

In Chapter 6, the barriers, opportunities and understandings developed and described through DoI and ANT analysis of AR during Phase 2 are combined to support concluding recommendations to change agency partners and to argue for their potential to direct, streamline and accelerate future sustainable change in the AHI.

Flow of arguments

Figure 7 below summarises the flow of arguments within my intellectual framework and includes: arguments to support the use of diverse theoretical frameworks, methodologies and methods to understand, describe and explain the phenomena being investigated at each overlapping stage of this cyclically evolving, transdisciplinary, action research thesis.
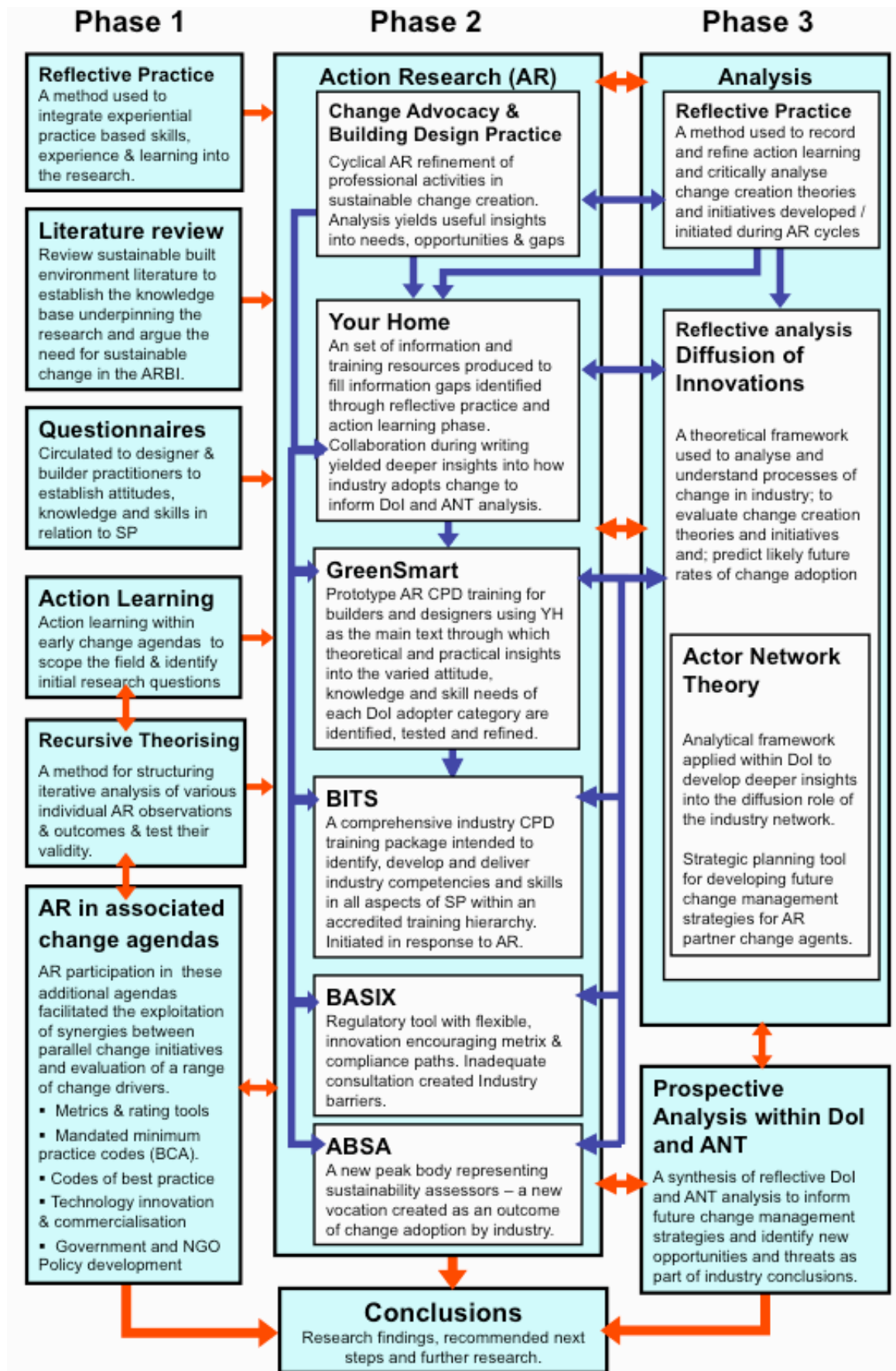
Figure 7: Structure and flow of arguments.

Chapter 2   Action Research Methodology

Chapter 1 addressed my epistemological stance and defined the theoretical framework for my research. In this chapter, I identify my initial research questions and introduce the cycles of Action Research (AR) methodology through which I explore and refine these questions. In Section 2.1, I scope the research field, declare my previous roles in it and argue my initial focus through a selective literature review framed in reflective practice. In my first AR cycle in Section 2.2, I apply action learning and reflective practice as methods to identify knowledge gaps, preliminary hypotheses and research questions. This process also developed relationships and established AR roles with potential AR partners.

The initial hypotheses are then tested and refined through increasingly focussed cycles of AR conducted in the case study projects introduced in Sections 2.4, 2.5 and 2.6 where their main objectives and AR outcomes are summarised to establish them as a source of data to inform later analysis. Whilst these case studies are introduced within a chronological time-frame that most closely represents their contribution to my AR, many were inter-linked and remained ongoing throughout both AR and retrospective analysis. Only in Chapter 6 does their full contribution become apparent.

Findings and observations drawn from each AR case study were grounded in diffusion theory and presented to AR partners in the form of recommended change strategies or refinements to existing agendas. This forms part of and ongoing process of AR focus refinement wherein hypotheses are tested and research questions answered through case study application or, analysis of probable outcomes when my recommendations were not applied. This analysis is documented as a diffusion study in Chapters 3 and 4 and the findings further analysed within ANT in Chapter 5 to develop deeper understandings of the sociological processes of sustainable change creation at work. Findings from both analyses are synthesised through prospective analysis in Chapter 6, where they are reconciled with the initial research questions to underpin concluding recommendations for future change management by AR partners. Contributions and outcomes are summarised through concluding arguments in Chapter 7.

2.1   Problem conception

This thesis consolidates 20 years experience by the author as a practitioner in three fields central to the research. With this background, it was neither possible nor useful to attempt an independent or detached approach to the research. Accordingly, I have adopted an approach that acknowledges and exploits my existing knowledge, roles and experience. Pre-conceptions or biases arising from this prior knowledge are addressed through critical reflection.

As a first step in problem conception, I describe the research field and my role in it before commencing the thesis by tracing sustainable built environment theory through a brief reflective review of the literature that motivated, informed and guided my practice-based responses (and those of many AR colleagues) during the last three decades. This is not intended as a comprehensive review of sustainable built environment literature. For that, I refer the reader to Pezzoli's exhaustive review (Pezzoli 1997). Rather, by framing a reflective review of my previous roles as an AHI practitioner and OL within a brief review of the literature that inspired them, I generate useful insights into their influence on the research and contextualise the research in the evolving global framework of sustainable development theory. Additionally, it establishes my expertise in the research field to validate later research observations and arguments based on it.

2.1.1 Literature review framed in retrospective reflective practice

How did we get into this mess?

A sustainable built environment is not a recent concept–it is a recently lost one (Reardon et al. 2008, p. 6). While history is littered with examples of extinct populations whose demise is attributable to their failure to recognise the implications of unsustainable practices in food production, these failures are rarely attributable to their built environment. Diamond (2005a) attributes the failure of the once great Mayan society to food shortages caused by soil degradation and erosion caused by over-farming and the similar downfall of Mesopotamian society to salination-related soil losses from over-irrigation.

The vernacular architecture of pre-industrial societies was inherently sustainable because it relied on renewable energy sources, local materials and local water supply to provide shelter from the elements. Environmental impacts were localised owing to transport and logistical restrictions. The use of sophisticated (even by today's standards) sustainable building practices by ancient civilisations is well documented. The Mayan civilisation made extensive use of passive solar design (Chrisp 1994), the Mesopotamians employed green roofs in the Hanging Gardens of Babylon (Foster 1998) and the Pueblo Indians created entire passive solar villages under the overhang of south facing cliffs at Mesa Verde (Arnold & Hewett 1992).

Earlier problems arising from the built environment in densely populated regions include resource depletion owing to unsustainable harvesting, such as the destruction of the forests that sustained the original Easter Island civilisation (Diamond 2005a), or disease epidemics such as bubonic plague, which are partially attributable to sanitation and food storage issues (Bishop 2003). While human settlements exceeded the capacity of their natural environments to meet their resource demands and absorb their waste for millennia, previously the impact of unsustainable practices remained local or regional. Only now, in the post-industrial era, do we face problems of global

magnitude that require local, regional and global solutions and, while recognising that these problems spawned the modern environmental movement, the troubled evolution of that movement created barriers to sustainability that prevail.

Pezzoli argues that environmentalism in the US began in the late 1800s when urban/industrial environmentalists began to examine how health, the environment and politics intersect (Pezzoli 1997). Diesendorf and Hamilton (1997) recognise *Silent Spring* (Carson, 1961) as the first publication to identify the potential for catastrophic outcomes from adverse anthropogenic environmental impacts and put politicians and governments on notice that people did care about human impact on the natural environment. *Limits to Growth* (Meadows 1972), reported to The Club of Rome, results from the first attempted computer simulation of the projected collision of human needs and the earth's capacity to meet them. It created a storm of reaction around the world but was quickly rationalised by economists and governments eager to return to business as usual and was soon forgotten (AtKisson 1999).

During the late 1960s and early 1970s, the relatively new physical science of ecology expanded into investigating human interference with natural systems and ecological cycles. In their analysis of human ecology, Paul and Anne Ehrlich (1972) described the potential for human population growth rapidly to exceed the limits of ecological systems to adapt to the spread of urbanisation and the demand this placed on energy, water, mineral resources, forests, food and air quality (Ehrlich & Ehrlich 1972). The Ehrlich's demographic projections aligned with the predictions of World 3, the computer model used by Meadows (Meadows et al.1972).

Evolving global awareness of the need for sustainable development was pursued by a minority of scholars globally (SSRS 1976) but most dismissed the warnings as over pessimistic and returned to business as usual (Meadows, Meadows & Randers 1992). While a few visionaries within the design and construction industry immediately addressed the warnings in their work and research (Vale & Vale 1975), most continued to produce buildings with scant regard for environmental emissions or depletions, preferring instead to align with 1970s Economics Nobel Laureate Robert Solow's statement that *the world can, in effect, get along without natural resources* (Worldwatch_Institute 2008, p. 5).

Indeed, economists actively opposed the precautionary arguments of ecologists and environmentalists throughout the 1980s and 90s, arguing that free markets would deal with 'scarcity' of environmental resources, because as supply diminished, price would shift demand to other plentiful or renewable resources. As Hamilton (1997) argues, a fundamental flaw in this simplistic, instrumentalist argument is its assumption that resources (including the natural environment) only have value to the extent that they satisfy human needs. The inability to value hidden environmental services (e.g. ozone's UV protection) or unforeseen reductions in the natural

environment's capacity to deliver services (e.g. temperature regulation), which are essential to biospheric integrity (and therefore human survival) until they are irreparably diminished or damaged is a dangerous limitation (Hamilton in Diesendorf & Hamilton (eds) 1997, pp. 35-41), to which our current predicament on the brink of irreversible climate change (IPCC 2007b; Pearce 2007) can be substantially attributed.

The 1973 'energy crisis' provides an important example of how this flawed economic theory created short, medium and long-term barriers to sustainable human futures in triple bottom line terms (Elkington 1997). The economic implications of Hubbert's predicted peak oil crisis (Hubbert 1956) were brought into sharp focus by world oil price volatility flowing from OPEC's response to the 1971 floating of US and other industrialised nations' currencies (Hammes & Wills 2005). That crisis culminated with large price spikes arising from the 1973 oil embargo placed on the United States, its allies in Western Europe, and Japan by the Organization of Arab Petroleum Exporting Countries (OAPEC).

While the 1973 crisis was triggered by political events, arguments used by economists and oil companies to restore market confidence and allay consumer fears concealed the real reasons for temporary remission from its economic impacts, the world oil glut of the 1980s (Gately 1984; Shojai & Katz 1992). The glut was interpreted by many as evidence that conservationists were wrong. Indeed, neo-classical economic arguments that the so-called energy crisis of the 1970s was unjustified, were so convincing that a counter-reaction occurred (Meadows, Meadows & Randers 1992) that persists today. Hubbert's predictions were again ignored until the present when, as the Hirsch report argues, their peak oil predictions are being confirmed (Hirsch, Bezdek & Wendling 2005) when an eleventh hour shift to alternative energy sources would be less effective in averting critical climate change (Lynas 2008). *The assumed independence of economic activity from nature, always illusory, is simply no longer credible* (Worldwatch_Institute 2008, p. 5).

An important implication for this thesis, arising from flawed arguments attributable to the 1970s oil crisis, is that consumers and policy makers became sceptical of arguments for energy efficiency because of its implications for climate change. I argue that this has contributed to the persistence of climate change scepticism during the last three decades, particularly in the US and Australia, where refusal to sign the Kyoto Protocol (UN 1997) was accompanied by resumed demand for the fuel inefficient vehicles that largely disappeared in the late 1970s. I contend that this may be a critical missed window of opportunity to avert critical climate change.

I further contend that this chain of events led to de-emphasising and, in some cases, abandonment of a sustainability focus in built environment courses in many tertiary institutions in Australia (Baggs & Cole 1997; Mitchell, McGee & Carew 2002; Mitchell et al. 2002). The School of Environmental Design at Canberra College of Advanced Education (now the University of

Canberra) is a good example. The school was renowned in the 70s and early 80s for its innovative integration of sustainable practices (SP) across Architecture, Landscape Architecture and Industrial Design, and counts among its alumni some of Australia's leading sustainability practitioners. This focus was lost during the 1980s and it was re-named the School of Design and Architecture. The removal of SP course content was so comprehensive that, in 2007, I was invited by the RAIA Canberra Chapter to contribute to an independent guest lecture series for students intended to impart critical SP skills to undergraduates.

In summary, two decades of apathy and scepticism towards environmental considerations in built environment academia has created a generation of practitioners and policy makers in Australia with limited skills and understanding of SP.

The beginnings of a solution

While the origins of the current sustainable reform agenda date back to the late 1960s and early 1970s, today's reform process commenced during the 1990s and accelerated during the late 1990s and early 2000s to become what is now arguably the single greatest challenge faced by the building industry. Despite the occasional success of a global reform during the late 1970s and 1980s (e.g. the Montreal Protocol, owing to overwhelming scientific agreement about the problem and the availability of a relatively low cost solution), solutions to other challenges were dismissed or delayed by economic rationalists (BBC 2006, Howard 2007, Bush 2007).

The first signs of more widespread recognition came with the publication of the Brundtland Report (WCED 1987) and the Earth Summit Conference that produced LA21 (UNEP 1992). Contemporaneously, a literature relating to sustainability theory, models, monitoring and change creation began to proliferate. Global warming was broadly recognised and world leaders began to develop and negotiate solutions such as the Kyoto Protocol (UN 1997). Resource allocation and consumption assessment systems such as Natural Step (Robèrt et al. 2002), triple bottom line accounting (Elkington 1997), the Russian Doll (Levett 1992), Three Pillars and other models (Pope et al. 2004) generated definitions of sustainable development that addressed social, economic and ecological considerations.

One of the earliest and most commonly accepted definitions is from the Brundtland Report: *Sustainable development is development that meets the needs of the present without compromising the needs of future generations to meet their own needs (WCED 1987).* In this definition, *needs* encompass social, economic and ecological considerations. Other definitions consider not just inter-generational equity (the rights of future generations) but intra-generational equity (equity of resource sharing between current generations to protect the rights of developing nations to the same standard of living that developed nations enjoy) (Diesendorf & Hamilton 1997).

The Bellagio Principles, developed in 1996 at an international meeting of measurement practitioners and researchers in Bellagio Italy, were intended to assist in the development of methods to measure, and assess progress towards sustainability (Hardi & Zdan 1997). They provide a useful set of guiding principles for the design professions, approaching many aspects of sustainable design and construction and are as follows:

- Taking a holistic perspective
- Providing adequate scope
- Adopting a practical focus
- Developing openness
- Ensuring effective communication
- Encouraging broad participation
- Conducting assessment
- Ensuring institutional capacity

My initial AR hypotheses, discussed in Section 2.3, are based on these principles and the precautionary principle (UNEP 1992), which justifies the research focus in the absence of positivist proof. Most definitions and mission statements intended to contribute to creating sustainable futures recognise that to achieve sustainability in the development sector, significant shifts are required in social attitudes, economic models and technological approaches to problem solving. Diesendorf analyses these definitions and recommends strategies to harness their potential to encourage sustainable change (Diesendorf & Hamilton 1997, pp. 64-97).

Most sustainability definitions and mission statements recognise that significant change across all levels of society takes time. However, the emergence of China as the world's largest GHG emitter (OECD 2008) and the pessimistic outlook on irreversible climate change (IPCC 2007b), demonstrate the contradictions in these well-intentioned, altruistic mission statements. While beyond the scope of this research, I postulate that these contradictions highlight our failure as a global community to recognise rapid changes in climate and to intervene urgently with radical carbon emission reduction strategies and investment in mitigation technologies. The seemingly exponential recent increase in adverse climate change predictions leads me to suggest that it is unlikely that viable mitigation strategies will be able to address intra-generational equity. I further explore the implications of this realisation for my own sustainable change advocacy in a closing reflection later.

A brief history of climate change

In 1896, Svante Arrhenius predicted that rising CO_2 levels would raise global temperatures and calculated the likely scenarios. In 1938, Callendar provided evidence that carbon dioxide levels in the atmosphere were rising (Callendar 1938) but his findings were ignored. Charles Keeling began a

continuous monitoring program in Hawaii in 1958 that revealed rapidly rising CO_2 levels in the atmosphere. Strong global warming, which is almost certainly attributable to these fast-rising CO_2 levels, began in the 1970s and has persisted (Keeling 1970 ; Keeling et al. 1976).

During the late 1980s and early 1990s, cumulative global recognition of environmental concerns led to the formation of a global network of agencies involved with sustainable change creation. The IPCC was established in 1988 by the UN through the World Meteorological Organization (WMO) and the United Nations Environment Programme (UNEP) to assess the risk of human-induced climate change, its potential impacts and options for adaptation and mitigation. Because the IPCC is an inter-governmental body, its findings are peer reviewed by experts before review by governments and NGOs. This review process continues to be an important driver of interaction in the global climate change network. Its role raising global awareness of anthropogenic degradation of the biosphere and depletion of natural resources led to creating new global change policies including, the UN Framework Convention for Climate Change (UNFCCC) (UN 1992 -b), Local Agenda 21 (UN 1992 -a) and the Kyoto Protocol (UN 1997).

In 1988 (the same year the IPCC was established), atmospheric CO_2 levels reached 350ppm (Thoning & Tans 2000). In 1989, the Global Climate Coalition (GCC) was formed by fossil fuel interests (including Dupont, Exxon-Esso, Ford, Royal Dutch-Shell, Texaco, British Petroleum, General Motors, Daimler-Chrysler and The Aluminum Association) to maintain uncertainty about climate change science. The IPCC's first report confirmed that global warming was occurring and likely to continue (IPCC 1990). This finding was disputed by the GCC and other scientists.

In 1992, the UN Framework Convention on Climate Change was produced at the Earth Summit Conference in Rio de Janeiro (UN 1992 -b) but calls for decisive action were blocked by the US. In 1993, Greenland ice core research confirmed that climate change had previously occurred in the space of a single decade (Alley et al. 1997), thereby accelerating research into its causes.

The second IPCC report (1995) detected the 'signature' of anthropogenic causes of greenhouse effect warming and declared serious warming to be likely in the coming century. At the same time, research was published revealing signs of warming in polar regions, including the deterioration of Antarctic ice sheets, suggesting they might break up (Blanchon & Shaw 1995 ; Woodroffe 1994). The Kyoto Protocol (UN 1997) produced a treaty to establish binding GGE reduction targets for developed nations, conditional on 80% of member nations adopting it. The US, Russia and Australia blocked its ratification by refusing to sign.

The GCC dissolved in 2000, as many of its funding corporations began to accept the increasing body of evidence. The third IPCC report in 2001, authoritatively stated that unprecedented levels of global warming (since the end of the last ice age) were 'very likely' and that their onset and severity

could be increased rapidly through one or more unpredictable carbon cycle feedback loops (IPCC 2001; Jones, Cox & Huntingford 2006). This effectively ended debate about climate change among all but a few scientists and shifted the research focus from proof to detailed understandings of the implications. In 2002, several research findings indicated the potential collapse of the West Antarctic and Greenland ice shelves to raise sea levels faster and further than previously thought possible (Blanchon & Shaw 1995 ; Scambos et al. 2004; Vaughan & Spouge 2002).

At the outset of this research in 1998, climate change was considered a substantial threat to the biosphere, although the scientific community was far from united in its recognition. In 2009, at its completion, climate change arguments are concerned with how soon and how severe its impacts will be. While that discussion is beyond the scope of this review, the likely consequences of each degree Celsius of temperature rise for most world regions, projected by Lynas (2006) in his comprehensive review of climate change literature, paint a grim picture. His projections to *avoid* these scenarios are summarised below:

Degree change	Action needed	CO$_2$ target
• 0.1–1.0°C	Avoidance probably not possible	350 ppm (current 380)
• 1.1–2.0°C	Peak global emissions by 2015	400 ppm
	▪ *Threshold for carbon-cycle feedback?*	
• 2.1–3.0°C	Peak global emissions by 2030	450 ppm
	▪ *Threshold for Siberian methane feedback?*	
• 3.1–4.0°C	Peak global emissions by 2050	550 ppm
• 4.1–5.0°C	Allow constantly rising emissions	650 ppm
• 5.1–5.8°C	Allow very high emissions	800 ppm
	Source: (Lynas 2008, p. 279).	

Recently published research findings on the need to mitigate climate change (IPCC 2007b; OECD 2008; Worldwatch_Institute 2008), has so far failed to translate into urgent responses. The Kyoto Protocol was ratified in 2005 eventually after Russia signed but the US still refused. Australia signed in early 2008 and although leading scholars have proposed viable climate change mitigation strategies, I suggest that effective intervention seems unlikely in the face of continuing reticence by governments and policy makers to act decisively owing to uncertain economic implications.

While a range of economic modelling has indicated that the cost of inaction is significantly greater than the cost of action (CIE 2007; Garnaut 2008c; Stern 2006), it would appear that applying the precautionary principle remains the exclusive domain of economists. In 2007, the IPCC estimated that the cost of curbing climate change by reducing GGE would amount to approximately 0.1 percent of gross world product annually (IPCC 2007b). While Stern (2006) estimated the cost of mitigation to be much higher, (around 1 percent of gross world product) he concluded that inaction

on climate change could reduce global economic output by between 5% and 20% for the foreseeable future.

In the Australian context, the Australian Business Roundtable on Climate Change (BRCC) recognised the viability of achieving a 60 per cent reduction in GGE by 2050, *while maintaining strong economic growth* and noted that *with early action, the economic impact by 2020 would be modest* (BRCC 2006, p. 5). Based on analysis by CIE (CIE 2007), ASBEC estimate that this scheme would save 60 Mt of equivalent (CO_2-e) per annum. ASBEC claims that this scheme would *save the economy around $38 billion by 2050, reducing the economic adjustment costs foreshadowed in the CPRS Green Paper* (ASBEC 2008, pp.V11, 36, 44, 47 & 49).

In his Final Report for the Australian Government (2008), Ross Garnaut argued that the central policy issue facing his review was to determine *what extent of global mitigation, with Australia playing its proportionate part, provides the greatest excess of gains from reduced risks of climate change over costs of mitigation?* (Garnaut 2008a, p. xxxv). He went on to say that, *while mitigation costs are experienced through conventional economic processes and can be measured through formal economic modelling* and argued that *only some of the benefits of mitigation are experienced through conventional market processes…Others take the form of insurance against severe and potentially catastrophic outcomes, and still others, the avoidance of environmental and social costs, which are not amenable to conventional measurement. The challenge is to make sure that important, immeasurable effects are brought to account* (ibid).

I contend that these arguments demonstrate the affordability of climate change mitigation, if for no other reason than that the cost of non-action is undeniably unaffordable. Pearce's (2007) summary encapsulates the uncertainty of climate change science and the threat of tipping points outlined in this brief literature review.

> *I am sorry if you have got this far hoping for a definitive prognosis for our planet. Right now, the only such prognosis is for uncertainty. The Earth system seems chaotic, with the potential to head off in many different directions. If there is order, we don't yet know where it lies. No scenario has the ring of certainty. No part of the planet has yet been identified as holding an exclusive key to our future. No feedback is predestined to prevail. On past evidence, some areas may continue to matter more than others. But the story of abrupt climate change will become more complicated before it is finished.* (Pearce 2007, p. 237).

Australian change agendas

Here, I briefly trace the origins of my AR case study partners and projects by discussing change agendas operating at the outset of the research, to identify initial research questions.

Australian change agencies (CAs) created in response to the global network centred around IPCC included: the Australian Greenhouse Office, the National Greenhouse Strategy (a strategic

Framework for Advancing Australia's Greenhouse Response), the National Greenhouse Response Strategy (Commonwealth_of_Australia 1992, 1998) and the NSW Sustainable Energy Development Authority, (SEDA). Actions by these Australian CAs led to specific strategies and new CAs, including those within the AHI that became the subject of my AR including: SEDA's Energy Smart Homes Policy (ESH) and Energy Smart Allies program; the built environment industry's Australian Building Energy Council (ABEC) and the AGO's *Your Home* project.

Because the original drivers of sustainable change in Australia were largely GGE and climate change related, the majority of CA funding was directed towards mitigating these impacts. CAs dealing with other impacts (e.g. waste boards, environmental protection agencies, water and waterways authorities and biodiversity agencies) initially struggled for funding. This observation prompted one of my earliest AR activities, advocacy for a holistic approach to sustainable change creation.

Early CAs were observed to have limited understanding of and ability to apply appropriate change creation theory in change agendas. NSW's SEDA was an exception that is explained later through DoI and ANT analysis. Additionally, CAs were observed to create change barriers in the AHI by separately developing (often conflicting) policies and duplicating resources. This motivated my initial research action to identify change creation methodologies relevant to the AHI. The outcomes, which led to adopting DoI and ANT as analytical frameworks, are documented in Section 1.4.

Many early CAs focussed on energy efficiency (EE) rather than climate change and GGE as a core problem. This focus within the housing sector led to the development of House Energy Rating Software (HERS) (Szokolay 1992) based on the existing thermal performance (TP) simulation tool NatHERS (Ballinger, Prasad & Rudder 1992). A range of similar tools known as first generation HERS followed. NatHERS and BERS (full thermal simulation tools) were followed by First Rate (a tool based on collated NatHERS simulations for Victorian climates). Inaccuracies in these tools (Soebarto 2000; Wheeler 2002; Williamson 2000; Williamson, O'Shea & Menadue 2001) and disparities between them (See Box 3-7), often arising from their use in unintended climate zones (Isaacs 2005a; Thomas & Thomas 2000) combined with their inability to model free running or user actions such as ventilation control (Kordjamshidi, King & Prasad 2005) led to the development of second generation HERS tools: Accurate, BERS Pro and First Rate v5.

An additional problem with HERS tools was the quality assurance (QA) of assessments. The Association of Sustainability Assessors (ABSA) was established in 2003 to replace the previous HERS Management Body (HMB). ABSA is a not-for-profit association managed by industry peak bodies and maintains close links with relevant government CAs. It accredits AHI practitioners who

specialise in assessing the environmental impact of buildings and provides training, support, QA and advice to industry and government.

I posit that this EE focus limited the range of climate change solutions addressed by CAs to a smaller subset leading to a narrow regulatory focus on building envelope EE which delayed viable, cost effective GGE reduction strategies (e.g. appliance efficiency, embodied energy, renewable energy systems, greenhouse intensity of energy sources and most importantly, household occupant behaviour). A research focus arising from this observation involves examination of potential increases in CA effectiveness arising from broadening the EE focus to GGE reduction. This focus includes extensive analysis of the roles (potential and actual) of BASIX (NSW's regulatory tool) in shifting the regulatory focus from EE to GGE by basing benchmarks on relative GGE reduction performance. BASIX assesses TP, appliance efficiency and carbon intensity of energy sources. BASIX' development, implementation and acceptance or criticism by AHI actors provides a rich source of AR observation data for analysis to inform my sustainable change creation research focus.

While supply-side initiatives such as the Carbon Pollution Reduction Scheme (CPRS) might reduce the carbon intensity of energy sources in longer term (DCC 2008; Garnaut 2008a, 2008b) and necessitate a shift back to demand reduction to offset carbon costs, sceptics argue that this is unlikely to occur in a timeframe that averts critical climate change (Angel 2008; James 2007). In addition to increased base load demand from housing, peak demand from residential heating and cooling loads is driving demand for new fossil fuel powered generators before sustainable or renewable energy supply options are fully commercialised (CSIRO 2005; Zammit 2006). This makes the interim or short-term potential GGE reduction strategies for the AHI discussed in this research even more critical.

Accordingly, in the next section I suggest stringent GGE reduction targets and outline the broad framework of additional sustainability goals that are tested through the collaborative development of viable AHI implementation strategies with AR partners. Findings and observations generated through these AR cycles are subsequently refined through retrospective analysis within DoI (Chapters 3 and 4) and ANT (Chapter 5) to support the prospective or future strategies argued in Chapter 6.

Setting meaningful targets.

At the outset of this research in 1999, I hypothesised that goals set within defined timeframes were essential to facilitate forward planning for innovators, manufacturers, suppliers, practitioners and home owners. Research, observations and prior practice-based experience led me to advocate a holistic approach to reducing the biospheric impacts of the built environment by addressing a range of impacts including: global warming and climate change; water consumption and pollution;

consumption of non-renewable resources; biodiversity impacts; soil loss and sedimentation and air quality (especially indoor air quality).

Accordingly, I adopted zero net lifecycle environmental emissions and zero net lifecycle environmental depletions as an overarching (although arguably unachievable) mission statement to underpin my research into sustainable reform in the Australian Housing Industry. This mission statement was drawn from objectives in the ISO 14000 series of standards for Life Cycle Assessment (LCA), adapted for application in the AHI through the RMIT Greening the Building Lifecycle project during 2000 and 2001 (RMIT 2001).

Recent research findings relating to climate change (documented above) added urgency to my search for solutions and necessitated a shift from my earlier holistic change creation approach to one that focuses on short and medium term GGE reductions from the housing sector. In keeping with my research mission statement, I posit that because the housing sector has had the capacity to achieve carbon neutral and carbon positive outcomes from freestanding, new homes for a modest cost for several decades (Reardon et al. 2008, pp. 11-14 & Case Studies), the achievement of carbon neutral status by all Australian housing stock should become a primary target of AHI change agendas. While a holistic approach remains an essential component of sustainable futures, failure to mitigate climate change may render those holistic outcomes redundant.

I hypothesise that, while pending carbon trading and increasingly stringent GGE reduction targets will likely generate strong societal support for climate change mitigation, the absence of specific goals within AHI change agendas inhibits both innovation development and regulatory 'bar creep'. For this reason, an important AR objective is the exploration of viable methods to introduce and mandate short, medium and long-term targets sending clear messages to industry to inform forward planning, stimulate innovation and accelerate skill acquisition across all AHI sectors. I further hypothesise that setting stringent energy efficiency targets is defensible from an economic and political perspective and test this position through AR advocacy based on modelling that suggests the net economic outcomes for Australia from such stringent targets would be positive (Garnaut 2008b, pp. 1-5, 27-31, 249-267; Stern 2006; Victorian_Government 2005).

Summary

Current building industry practice falls well short of my earlier definition that: the continuation of current practices will not cause depletions or emissions that impair the capacity of the environment to meet the needs of future generations. While specific projects with a sustainable focus do achieve considerable success compared to industry Business as Usual (BaU) scenarios, they remain far from sustainable within this definition. For this reason, I reluctantly hypothesise that true, holistic

sustainable outcomes are a distant and complex AHI goal that is more likely to be achieved through a gradual paradigm shift than it is through a sudden 'green leap'.

A consequent avenue of research enquiry explores the notion that each environmental impact from the housing sector be addressed through a holistic framework that sets short to medium priorities, targets and time frames based on urgency or imminence of threat to current and future generations. This guiding framework would identify both ultimate and interim targets whilst setting time frames for each target and describing viable, flexible pathways through which to achieve each. Additionally, it would emphasise the need for innovation to accelerate industry's cost effective progress towards sustainable goals and identify ways to encourage it.

The literature reviewed above indicates that time is very much of the essence in relation to GGE reductions if we are even to mitigate (much less avoid) the most severe consequences of climate change and global warming. This suggests that GGE reduction should receive the most urgent focus and the most stringent application of the precautionary principle to accommodate unknown and cumulative effects, potential global impact and the extended time lag between corrective action and delivered outcomes. Indeed, seemingly exponential increases in the scale and imminence of threats from climate change lead me to suggest that other sustainability agendas might be tempered to facilitate increased focus, effort and resources on mitigation strategies.

Based on the above literature review and professional reflection, my core research objectives are to:
- gain deeper understandings of the processes of sustainable change within the AHI to identify opportunities to accelerate it and barriers to avoid and;
- define and prioritise interim and ultimate sustainable goals for the AHI and;
- develop strategies through which to meet those goals and realise the AHI's fullest contribution to sustainable futures within narrow remaining windows of opportunity.

Closing reflection

Never before has humanity faced the need to overcome such universal global threats with such urgency (Lovelock 2006, p. iv).

Our current awareness, understanding and potential to avert this anthropogenically induced ecological disaster is unprecedented. The questions that arise from this realisation are: will we? can we? and how should we? go about this complex task in the most expeditious way. Despite first asking these questions in 1997, evolutionary biologist Jared Diamond observes in his second edition (Diamond 2005b) that while the ecological disaster continues to progress exponentially, humanity has made little progress in averting it. Current generations face unprecedented ecological, cultural and economic challenges and time is undoubtedly of the essence if more extreme outcomes for future generations are to be averted.

As argued above, the built environment sector has potential to make significant short and medium term contributions to such aversion strategies. This potential substantially exceeds that likely to be achieved under the current approaches examined through AR. The Autonomous House (Vale & Vale 1975) inspired me (as a student of architecture) to apply such principles in my own work and to invent new, sustainable solutions. I have done so ever since. For much of my 30 year career I assumed that my industry would recognise the common sense of resource efficient practices but, with few exceptions, the reverse occurred. The Vale's recent publication (Mithraratne, Vale & Vale 2007) grounds their early observations and principles in today's housing context and leads me to reflect on what might have been - had the simple innovations they advocated in 1975 been widely adopted.

This research is my attempt to explain why industry chose a different path and to identify workable new strategies through which the full potential of the housing sector might yet be achieved. While the closing statement by Gore below aligns with my motivations, I posit that continuing trends within government and industry indicate that this alignment remains atypical. My research objectives therefore became why? What can be done to change it now (participatory AR) and into the future (recommendations based on analysis of AR findings)?

> *We face a true planetary emergency. The* climate *crisis is not a political issue; it is a moral and spiritual challenge to all of humanity. It is also our greatest opportunity to lift Global Consciousness to a higher level* (Al Gore 2008).

2.2   Action Research Cycle 1: Action learning and reflective practice

2.2.1 Overview

Dick describes AR as successive cycles of think, act, reflect (Dick 1999). In this first cycle, thinking is drawn from the literature reviewed in Section 2.1 and retrospective reflective practice of my previous experience as a practitioner and OL in Section 2.2.2. I acted on that thinking by adopting an 'observing player' or reflective learning role within the Australian Building Energy Council (ABEC) in 2.2.3 and the NSW Sustainable Energy Development Authority's (SEDA) Energy Smart Homes Policy (see Section 2.3.3).

Through reflective review of these actions in Section 2.3, I consolidate the problems identified in Section 2.1 into a set of initial or 'fuzzy' research questions and hypotheses (Dick 1992) to be further investigated and refined through the subsequent AR cycles described in later sections of this chapter. These further AR roles were negotiated in relevant working groups and committees responsible for developing sustainable change agendas in the AHI.

2.2.2 Reflective practice

In this section, I describe and assert my previous experience as a sustainable builder, design practitioner, OL and change agent in the AHI. This establishes the background against which the research is set. I evaluate my effectiveness as a practitioner before commencing the research, to establish a performance baseline against which I compare and evaluate my improvement in these roles throughout the action research journey. Reflective analysis of both practitioner and AR industry roles yielded several important practical research outcomes that are referred to throughout the analytical chapters:

- identifying barriers and opportunities that might be experienced by other innovative practitioners in developing and applying sustainable solutions;
- developing deeper insights into how practitioner OLs and change agents (including myself) might improve our effectiveness through evaluating my own AR experiences and reflecting on them with peers;
- demonstrating reflective practice as a method through which researchers and practitioners engaged in AR in any field might improve their effectiveness;
- drawing on practice based experience to inform: publications (*Your Home* and various training initiatives); achievable targets; consumer (client) negotiation strategies; cost-effective solutions or practices and risk minimisation strategies for later adopters;
- comparing my SP motivations to those of less innovative (in SP terms) practitioners through AR to identify differences and develop strategies to overcome them.

Suntech Design

My building design and construction practice commenced trading in the late 1970s. I initially specialised in cold climate housing with high thermal performance, trialling various combinations of glass to mass ratios and insulation levels in a range of construction systems to achieve best practice passive heating. The practice expanded into warm temperate SE Queensland and sub-tropical Cairns in the early 1980s where my design focus shifted to passive cooling including stack and cross ventilation, reflective insulation, shading and low mass construction.

Rainwater harvesting and on-site waste-water treatment became a specialty due to a predominance of remote projects. These projects often required renewable energy systems due to unavailability or cost of grid connection. Low energy appliances including LPG-solar HWS, refrigeration and lighting minimised demand in these projects. The early unavailability (or cost) of appropriate technology necessitated constant innovation to resolve technical problems cost effectively.

A logical next step was the use of environmentally preferred materials – a difficult task in the absence of the sound research and certification systems that proliferate today. Ventures into design of eco-tourism resorts in the early 1990s lead to a focus on biodiversity positive construction

systems, landscape design and materials selection. Indoor air quality also became a focus – particularly in the design of child-care centres and public health buildings. Finally, the emergence of early climate change warnings led to a focus on low GGE housing solutions that progressed to carbon neutral and, in a few cases where client budget permitted, carbon positive.

This specialist background and experience led to OL and change advocate roles through partnerships with early government CAs including SEDA, the AGO and some local governments. These new roles exposed limitations in my knowledge and skills and presented opportunities to increase them through engagement with new networks of like-minded practitioners during the late 1990s. This learning experience inspired me to undertake PhD research to increase my knowledge and skills whilst researching effective ways to share them with other practitioners through AR partnerships with various CAs.

My roles in the Building Designers Association of Australia (BDAA)

The BDAA is the national industry peak body representing Building Designers in Australia with over 2000 practicing members and branches in every state and territory. Its members are responsible for approximately 40% (by value) of all building design in Australia (BDAA 2008).

My initial SP opinion leadership roles occurred within BDA NSW and established a link with AR partner, SEDA (See Section 2.4.2 below for more detail). BDA roles from 1996 onward included conference presentations, involvement in development and delivery of professional development seminars on SP, development and implementation of the BDAA Environment Policy (Moore & Reardon 1997), the introduction of SP design awards and judging criteria in 1999 and formation of SP focussed practitioner networks and e-groups through which practitioners asked SP related questions and shared solutions and experiences. Usage of this 'think tank' environment has been increasing since 2002 and is currently (2009) being expanded. Regular articles in BDAA's quarterly magazine (Designers Brief) and BDA NSW' newsletter (Perspectives) informed members and later provided AR opportunities to circulate questionnaires and report results back to members to progress the SP change related discourse.

Reflective Practice outcomes

In addition to exposing gaps in my knowledge and skill base, the opinion leadership activities outlined above required that I translate my best practice successes and failures into CPD programs for other practitioners. Reflective practice explanation of my naïve, initial assumption that my successes could simply be transferred to other practitioners through CPD led to DoI analysis of the many variables influencing SP adoption decisions by individual practitioners including the role of: industry position; cost sensitivity; practitioner skills and personal awareness; exposure to peer influence; communication and information channels; regulation and lack of consumer awareness.

My practice based experience working in different climate zones led to development of a broader suite of skills and necessitated a checklist of appropriateness for application in each climate that was formally documented in YH (Reardon et al. 2001a FS 1.1). This useful skill set was found to be atypical amongst practitioners, who tend to specialise in one region for large parts of their career. This was born out by feedback from Building Designers during a national tour to launch *Your Home* in which, after a presentation on climate responsive design, attendees were asked to prepare design responses to a simple brief in a randomly selected climate zone to stimulate thinking about appropriate climate response. One attendee commented: *if you think about design from this perspective, houses begin to design themselves*. Epiphany!

Additional insights developed through the added dimension of AR as a reflective practitioner yielded insights and understandings of client influence on the incorporation of SP and, the lack of commercially available technological solutions for SP problems. Reflective practice of opinion leadership roles within the BDAA identified that a comparative (with my own) lack of skills and confidence among practitioners represented a substantial barrier to their development, implementation and therefore marketing of SP solutions through their practices. This barrier is made even more significant by the inherent role of practitioners as AHI gatekeepers to the adoption of new practices within the industry.

Further important insights drawn from reflective practice of design practitioner and BDAA opinion leader roles that led to further analysis include the role of risk and cost as barriers to the adoption of SP and, the importance of recognition and promotion of best practice in encouraging adoption and diffusing it through peer influence.

The above indicative selection of RP outcomes is intended to demonstrate my use of RP as an initial source of research data to develop early research questions and focus my AR journey. Many other RP sourced insights are raised and referred to throughout the research. This source was supplemented by the Action Learning (AL) outlined in the next section.

2.2.3 Action Learning: Australian Building Energy Council (ABEC)

The Australian Building Energy Council was the first national industry body formed in response to an environmental issue. Prime Minister Howard's post-Kyoto ultimatum to industry to either self regulate to reduce GGE within 12 months or the government would mandate reduction strategies led to the formation of ABEC by the AGO in partnership with research institutions and industry peak bodies in 1998. After collating research and drafting a preliminary response, ABEC organised an initial industry consultation meeting, which remains one of the best attended and broadly representative industry initiatives conducted in Australia.

While its initial objective was to avoid regulatory approaches to GGE reductions from the built environment, deliberation by an expert panel, followed by rounds of industry consultation, led to a decision to adopt a dual code of practice, which called for mandated minimum standards for building energy use in parallel with a voluntary code of best practice. The unprecedented level of support for regulation negotiated by ABEC in 1999 (see Box 4-2) paved the way for Australian Building Codes Board (ABCB) to introduce the Minimum Energy Code in the Building Code of Australia. ABEC's dual codes of practice form the basis of many sustainable change agendas today and underpin many of the strategies subsequently recommended in my research.

ABEC's early success demonstrated high levels of awareness of and willingness to support built environment GGE reduction strategies by a majority of industry actors and actor groups. I posit that this initial effectiveness can be substantially attributed to a clear brief and a strong mandate from industry and government. However, that focus was subsequently eroded by a lack of funding that led to ventures in fields outside its core business. At the same time, other industry actors had recognised the potential for power and influence in relation to the built environment sector's responses to climate change and broader environmental impacts.

ABEC ceased operations in 2002, when increasing focus on sustainable built environment issues saw a proliferation of new, holistic organisations including the Green Building Council of Australia (GBCA) competing for funding, political influence and industry support. The Australian Sustainable Built Environment Council (ASBEC - see Box 4-2) is more recent and holistic re-invention of ABEC.

Action Learning outcomes

My observing player role in ABEC facilitated action learning through first-hand observation of how power and network position are used by industry leaders, factions and bodies to control or influence outcomes in their favour. It highlighted the role of key leaders and competing agendas among stakeholder organisations in determining the built environment network's potential as both opportunity and barrier to sustainable change. This highlighted the need for my research to include a focus on understanding, utilising and managing network interaction as a change tool. Specifically, this focus includes the critical importance of aligning industry peak bodies to support change agendas and addressing the differences between larger commercial sector (*big end*) and smaller residential (*little end*) actors in terms of needs and objectives.

Reflection on my AL experiences within ABEC generated the following observations and research questions:
- recognition of the complexity of the task of addressing GGE within the building sector;

- interdependence of GGE and other impacts and the need to broaden change agenda focus from Energy Efficiency (EE) to GGE through within a more holistic approach;
- need to address and reconcile tensions between different epistemological paradigms of various actors. (i.e. the positivist epistemology that underpins scepticism and the constructivist epistemology that recognises potential risk and advocates application of the precautionary principal);
- need for a multi-faceted or transdisciplinary approach to change creation including:
  o   information provision;
  o   raising consumer awareness and demand;
  o   mandating minimum standards to eliminate worst practice;
  o   encouraging voluntary best practice to accelerate innovation,
  o   agreeing long-term targets and timeframes for sustainable change and;
  o   working backwards to identify the interim goals, intervention strategies, incentives and resources required to achieve them.
- need for short, medium and long-term goals and accepted methods for measuring progress toward them;
- limitations associated with developing a regulatory framework within the ABCB's existing regulatory development structure including: extensive delivery time frames; limited amendment flexibility (potential for benchmark creep) and lowest common denominator outcomes arising from extensive industry consultation
- regulatory development methods that are inappropriate for dealing with thermal performance (i.e. four separate committees addressing each interdependent element).

2.3   Summary: Preliminary hypotheses and research questions

Preliminary or 'fuzzy' research questions and hypotheses developed during this Problem Conception research phase provide a focus for investigation during later AR cycles and facilitate identification of potential triggers or conditions that might promote or accelerate AHI adoption of sustainable practices including the need for change agencies to:

- develop a holistic guiding vision to achieve sustainability in the AHI;
- set achievable short, medium and long-term goals and publish progress toward their achievement;
- establish that vision and its objectives unambiguously by eliminating duplication and contradiction in and between change agendas;
- deliver the knowledge, information and skills required to achieve those goals;
- recognise and address barriers arising from cost sensitivity and risk aversion;

- develop metrics and tools that address ABEC's dual codes by measuring and quantifying progress towards goals through both mandated minimum practice (regulation) and voluntary best practice (information and skill development);
- develop clear understandings of the factional structure of the AHI social system and its competitive interaction to encourage change and minimise opposition;
- encourage innovation to create new and improved technologies and practices and incentivise their commercialisation.

While not claiming them to be exhaustive or final, I posit that these simple principles are fundamental components of effective sustainable change creation and that further exploration through AR within current change agendas will yield clearer insights into AHI change processes and deliver implementable strategies to accelerate it.

2.4 Action research cycle 2: 1998–1999

2.4.1 Overview

In AR cycle 1, I argued the need for my research focus, defined my scope and identified preliminary research questions for further investigation. In this Cycle, I identify early indications of sustainable change and assess the change creation potential of selected agendas through AR to identify gaps, weaknesses and opportunities within the theoretical framework of DoI. Through this process I refine my research focus and develop deeper understandings of the change processes at work in the AHI context to inform both my AR partners and my research process.

In this second AR cycle, I test and refine those research questions in terms of opportunities and barriers to change observed through an expanded AR role in the development and rollout of SEDA's ESH Policy within BDA NSW. Through this process I also identify the next round of AR opportunities. While acknowledging that the occurrence of AR opportunities influences my research focus to some extent, I argue that this influence is an expected and desirable outcome of my roles as an observing player in my AR methodology, because it aligns my research focus with current industry directions and allows me to focus on contributions that improve or add value those directions.

2.4.2 SEDA and BDA NSW

In this section, I provide a brief overview of this AR case study and summarise my findings as hypotheses and research questions to refine my AR focus and inform analysis in Chapters 4 and 5.

Recognising the need to address global warming in the post Kyoto political environment, the NSW State Government established a specialist change agency to develop and implement a range of

GGE abatement policies. The Sustainable Energy Development Authority, NSW (SEDA) was established in 1996 and the Sustainable Energy Authority to raise awareness of GGE abating energy supply and demand options (See Section 5.3.2 for detailed ANT analysis of the drivers for SEDA's formation).

My AR role as an OL engaging members of the Building Designers Association of NSW in implementing SEDA's change strategies began in 1996, facilitating first hand observation of their effectiveness. This role expanded to national level within BDAA after publication of YH, providing AR observing player roles during the development of equivalent bodies in other states including: the Sustainable Energy Authority of Victoria (SEAV), Queensland Office of Sustainable Energy (QOSE) and the Sustainable Energy Development Office (SEDO) in West Australia.

SEDA applied a range of strategies to build strategic alliances with business and industry to encourage the adoption of energy-efficient and renewable energy solutions, two of which became central to my research focus. The Energy Smart Homes Policy (ESH), a regulatory program reliant on voluntary adoption by individual councils focused on reduction of residential heating and cooling energy consumption by improving building envelope thermal performance. A second program, the Energy Smart Allies (ESA) program created a powerful and effective network of innovators and early adopters who acted as OLs throughout the AHI.

Multiple strategies were employed to convince both councils and individual practitioners to adopt its policies. These included: facilitating opinion leadership at multiple levels; championing innovators and early adopters; building expert innovator networks; providing information and training; engaging industry peak bodies and providing rewards and incentives to practitioners (see Sections 3.3.2, 5.3.2 and 6.2 for detailed analysis). These strategies led to voluntary adoption of ESH by the majority of NSW Councils and universal awareness raising and skill development amongst BDA NSW members – a successful outcome by any measure. My AR observing player roles in the rollout of similar programs in other states allowed me to compare a range of different strategies employed by various CAs providing a rich source of insight and observations regarding their effectiveness.

The following summaries are presented in dot point form to provide an indicative overview of these findings and identify early research questions that are more fully explored through subsequent AR cycles and detailed later analysis.

AR Observations

Opportunities and barriers affecting early regulatory agendas including:

- role of political leadership in initiating and supporting reform agendas illustrated through comparison of NSW' Carr government with Victoria's Kennett government and subsequent changes that occurred under Bracks);
- advantages, disadvantages and complexities arising from competition, duplication and poor communication between Local, State and Commonwealth regulatory bodies;
- limitations of the building envelope EE focus in terms of GGE reduction (e.g. the AAA showerhead campaign);
- recognition of a lack of agreement on what and how impacts should be measured including the need for rigorous measurement tools that measure more than just thermal performance of the building envelope;
- limitations of first generation House Energy Rating Software (HERS) tools and the implications of their sometimes inappropriate requirement for greater use of thermal mass in many climate zones for practitioners and manufacturers;
- the role of industry peak bodies in opposing or championing sustainable change;
- the important role of manufacturers and suppliers in the change process;
- problems experienced by practitioners in implementing these policies at the coalface of practice including: cost; lack of skill and information; paucity of risk assured, commercialised solutions;
- recognition of the existence of DoI innovativeness based adopter categories in the AHI and the need to adapt change agendas to address their varying needs;

Research questions

- To what extent is duplication by government change agencies a barrier to change and how might the role of competition between state regulatory bodies be better utilised as an opportunity? (e.g. resource sharing, interstate competition as political motivation).
- How might communication channels and funding synergies between Commonwealth and State governments be improved?
- What forums provide the most supportive environment for competitor organisations and NGOs to collaborate?
- What were the key contributing factors and how might they be improved?
- Where have such forums been ineffective or failed? (ABEC, ABCB).
- What were the key contributing factors to success or failure?

Summary of Outcomes from AR Cycle 2

Opportunities and barriers identified through SEDA's ESH policy included the need for:

- elimination of random policy variation and duplication by CAs to reduce practitioner and consumer confusion and resistance to change objectives;
- a 'holistic guiding vision' with clear, nationally consistent goals and transparent reporting of progress toward them to provide and AHI focus:

Hypothetical actions or interventions developed to accelerate progress toward those goals included:

- developing rigorous, holistic measurement tools with meaningful indicators;
- provision of clear, easily understood, 'one stop' information sources;
- training and skill provision for AHI practitioners;
- raising consumer awareness and demand;
- encouraging manufacturers to produce cost effective, risk assured SP technologies;
- incentivising the development and sharing of SP innovation by practitioners.

Through reflective practice, I recognised that:

- my specialist practice-based understandings of SP adoption were inappropriate to the needs of mainstream industry players and new approaches were required for this sector;
- the presentation of information and knowledge creates change amongst innovative practitioners but has little effect on the more conservative or cost constrained majority;
- my initial peer to peer role as an OL changed as my practice became more specialised and peers regarded me less as 'one of them'.

2.5 Action research cycle 3: Case studies 2000–2002

2.5.1 Overview

This AR cycle facilitated further application, testing and refinement of hypotheses; monitoring and evaluation of change that occurred; identification of additional opportunities and barriers and the development of additional strategies to capitalise on opportunities and neutralise barriers including:

- Continued investigation and analysis of existing policies, reform agendas and tools through AR participation in their development and implementation;
- Observing and recording interactions between industry actor groups in terms of their potential and actual influence on the adoption of SP.
- AR participation in the development and implementation of strategies identified in earlier cycles including: information provision (*Your Home*); measurement or rating systems and regulatory policy including NSW' ESH policy and the Commonwealth's Minimum Energy Code for the Building Code of Australia (BCA).

- Reflect on response strengths and feedback from action research projects to inform my change creation theories and refine them to better suit industry practice parameters.
- Review previously identified change opportunities and barriers and re-assessing the effectiveness of earlier hypotheses and strategies developed to exploit or overcome them.

2.5.2 Principal author: *Your Home*

Your Home (YH) is a major contribution arising from this research and AR lessons from its production and application permeate my research. For this reason, I include a detailed account of its origins, intended outcomes, production methodology and application.

During early investigations into potential AHI GGE reduction strategies, market failures were observed to create a scenario whereby the full environmental cost of resources was rarely transferred to the end user. Governments traditionally sought to address market failures through the education of stakeholders and best practice guidelines for each specific environmental issue. This approach had proliferated single issue guide materials in formats pitched at diverse technical levels, championed by numerous CAs, building peak bodies and community groups. Most publications dealt with the production of technically superior buildings assuming a market would naturally occur. My AR observations were beginning to suggest that this was not the case.

Inconsistency in publication type, format, technical content level, range of issues covered and the absence of a well developed market meant that the majority of AHI practitioners were reluctant to seek education in the area and reticent to use existing information resources. A study of house plans submitted for approval found that less than 3% of all houses had passive solar design features (AGO 2000).

ABEC's industry agreed dual code approach and the 1999 announcement of pending mandatory minimum energy performance standards for all new and refurbished buildings from 2003 magnified practitioner interest in technical information on energy efficiency and low GGE building design. The AGO received funding requests for greenhouse specific guides from community groups, industry peak bodies and other CAs leading to the 1999 decision by several Commonwealth CAs to fund a comprehensive guide covering a diverse range of sustainable building practices.

The AGO sought stakeholder support, corporate sponsorship and suitable technical expertise and called tenders for the Good Residential Design Guide project (later branded *Your Home*) which was to go beyond the single issue focus of previous information and be designed to communicate a range of practical solutions to a broad audience group with varying levels of technical understanding in the field. All partner organisations committed to using the materials to train and educate their members. This became a significant part of the dissemination strategy.

I saw this project as an ideal AR activity and convinced the Institute for Sustainable Futures, UTS to tender for the project. ISF was contracted as the primary consultants. A group of technical experts was also contracted by the AGO to support steering and stakeholder representative committees in providing systematic peer review of all technical materials. My research application of DoI strongly influenced ISF's approach to the project. The following extract from AtKisson (1999) encapsulates the theoretical underpinnings of YH in DoI terms and underpins many of my change creation approaches.

> *I call the early adopters Transformer. They are the real doorkeepers to the transformation of a culture, and they often work like an electrical transformer, stepping down the voltage of the innovation and easing it into the mainstream gradually, at a speed the system can safely absorb.*
>
> *Transformers are leaders among mainstream people (in the group, the company, or the society at large), who are open to new ideas but cautious about which ones they promote, because they want to maintain their status.*
>
> *If the Transformers embrace an idea, the Mainstreamers (the majority of the culture in question, who watch the Transformers for cues on what new ideas to adopt) are almost sure to follow (perhaps at a safe distance). To make sure that the Mainstreamers do follow their lead, the Transformers may alter the idea by toning it down, reducing its radicalness, using it in a way the Innovator never intended, or using only part of it* (AtKisson 1999, p. 183).

AtKisson's transformers were beginning to establish a presence in the Australian housing market aided by government and industry sponsored schemes that recognised, rewarded and promoted excellence in sustainable innovation. They included consumers, designers and builders who had embraced the ideals of sustainability, cleverly selecting and adapting innovations to fit in the real constraints of budget, climate and availability. As AtKisson observed, this process rarely meets the expectations of the innovators but is an essential step towards achieving mainstreaming.

YH is a 'transformer' by AtKisson's definition. It intends to break down the complexity of sustainable theory and ease it into mainstream home building practices allowing industry to absorb it at an achievable pace. While YH identifies and recommends best practice in every case, it also encourages partial implementation of all principles at every opportunity and encourages participation over perfection.

Methodology

An initial literature review revealed an abundance of literature and technical information on innovation to improve the sustainable performance of Australian housing stock. This literature had been available since the early 70s. Two key research questions quickly emerged:
- Why was the innovation transformation process stalled?
- How could the YH materials best act as a diffusion catalyst to achieve 'mainstreaming'?

Analysis of the existing literature led to the conclusion that it had not been 'designed' to effectively communicate with a mainstream audience. It was designed for an audience of innovators and was likely to remain the exclusive domain of that group until it was transformed into the language of AtKisson's mainstreamers. This aspect of information provision is addressed in greater detail in Sections 4.1.2 and 6.2.1 where it is described as Moore's Gap.

I adapted my previous DoI analysis of the AHI factions to the potential YH audience and mapped the complex interactions required between them to mainstream the subject material. The range of factions was summarised as: consumers, designers, builders, regulators, marketers, manufacturers, and researchers or innovators. These factions remain central to my research beyond this case study. Several key observations were drawn from that analysis:

- The information needs of each group were quite diverse. It was unlikely that a single document or media form would meet the information needs of all groups effectively.
- Many consumers had little knowledge of SP or its importance to the local or global community. Others had substantial awareness but believed that sustainable features were too expensive or unavailable to them.
- Consumers who did attempt to include sustainable features in their homes experienced difficulty accessing designers and builders with adequate skills to implement their ideas.
- While designers were aware of the basic principles, they lacked the specific skills and information to implement them.
- In the absence of demand from consumers or direction from designers, builders saw little incentive to make their products sustainable
- Marketers (eg. real estate agents, project home companies and developers) generated their own perceptions based on close observation and prediction of consumer behaviour. While influential in the market, their actions are driven by consumer preference.
- The information needs of regulators, manufacturers and innovators were adequately met by the existing technical literature. Regulators were driving reform as rapidly as market acceptance would allow. Innovators were restricted by the lack of market uptake and manufacturers were developing new products in line with market demand.

A clear picture emerged of the importance and mutual influence of three groups: consumers, designers and builders. Each had a distinct but essential role in mainstreaming SP in the AHI and equally importantly, the roles were interdependent. The research found that the range of information available to the three groups was inadequate, being either too technical, lacking in practical application or too diverse with the vast range of imperatives found to be confusing to most of the audience. In consultation with all stakeholders, it was decided that a focus on these three audience groups would best fulfil the objectives of the project in mainstreaming sustainable housing.

Audience research

A leading research consultant, Professor Robyn Penman was engaged by ISF to investigate the audience information needs and develop a communications strategy for the project. Exploratory research using in-depth conversations with small numbers of people exposed a range of differences and perspectives in the audience groups. The research focused on exploring information needs, priorities and concerns in the context of everyday lives using informal, open-ended, face-to-face discussions in a loosely structured protocol.

Participants were selected to ensure that a range of demographic characteristics in each of the specified target groups was covered. The sample was not intended to be a representative sample of each of the target populations but representative of the diversity of user needs. Choosing on this basis maximised the usefulness of data derived from small samples. The interview protocols for designers, builders and their clients had a common structure:

- Understandings: exploring what people understood a sustainable building to be and how much information they had about it.
- Information sources: explored the range and usefulness of information sources that the participants had used themselves.
- Evaluating specific sources: asked participants to evaluate information sources.
- Future possibilities: This section explored potentially useful solutions to information provision from within the participant's framework and everyday context of use.

The audience research yielded a clear understanding of the information needs (subject matter, language set and preferred media sources) of the audience and provided the basis for information design, content selection, writing style, media selection and presentation of the final product (Penman 2000).

Content and Media Selection

Research indicated the need for different media to be used to communicate to different sub groups of each target audience. By developing communication formats similar to the audiences' existing communication forms, the YH materials could replace or supplement those in use. The primary media forms chosen for each audience were:
- for consumers, a magazine style full colour glossy printed guide;
- for builder and designers, a printed ring bound folder of individual fact sheets and,
- for students, web and CD based electronic forms;
- a DVD of best practice case studies and interviews with their designers and owners was also produced. This DVD contains additional information in the form of animations, graphics and a short, informative video segment aimed at consumers.

To achieve adequate market penetration, a format suitable for high volume, low cost was chosen. When their awareness of the issues and benefits is raised, consumers often require the detailed information, often sourced as required throughout the course of the project. To meet this need, the entire YH Technical Manual (TM) was included on CD ROM in the back of the Consumer Guide (CG). This had the added advantage of keeping the two distinct levels of information separate, avoiding initial information overload.

Designers and builders were found to be reluctant to access internet or other electronic sources in their work practice at that time and preferred printed media in the form of a manual. The YH TM fact sheet format was designed to meet the audience need for readily available small parcels of information. The original TM format was an oversized loose leaf folder designed to allow practitioners to leave it open in the workplace, remove pages for photocopying, and to file additional information they collect to supplement the TM information. This format was discontinued in subsequent editions due to distribution logistics.

Varying levels of expertise and understanding in each audience group dictated that the information be presented in varying levels of technical detail. It was decided that two main levels of information would be developed, each with a dual purpose:

- The CG introduces concepts of good design to potential homebuyers and renovators in terms of comfort, lifestyle, health, economy and safety. SP messages are inconspicuous and incorporated within simple good design messages, giving a sense that SP is normal practice.

- The TM comprises some 87 fact sheets (17 added in subsequent editions), written in an easy to understand non-technical language, explaining the concept and possible solutions to the full range of environmental impacts. Where possible, existing solutions are demonstrated to reinforce the message that environmentally sustainable solutions are normal practice. A number of case studies of existing houses in different climate zones were provided as examples of excellence.

The TM was also designed to satisfy motivated designers with sound working knowledge in specific fields. For this audience each issue fact sheet lists additional reference materials and supporting organisations.

Uptake and use

YH was launched in August 2001. In terms of hardcopy material, about 200,000 CGs were produced (each including a CD of the TM), 23,000 TMs (16,000 retailed for $50 and the remainder wholesaled to partner organisations for on-selling to their members), plus an additional 500,000 CDs (about 400,000 circulated as a free item with a commercial magazine and thousands provided

to Universities and TAFEs as texts). Internet access figures are: 2001: 176,000 (5 months); 2002: 818,000; 2003: 1,520,000; 2004: 1,783,000; 2005: 1,941,000; 2006: 1,752,670; 2007: 1,785,488 (DEWHA 2008a). While not every visitor sought information on sustainable homes, the volume of traffic indicates that its contribution to the SP diffusion process is significant and continues to grow. After 7 years of accolades from later adopters, ranging from home owners to journalists and AHI practitioners the usefulness of the YH language and content requires no further confirmation.

Feedback from user groups after the 3rd edition (Reardon et al. 2005) showed a strong preference for inclusion of information on commercialised, off the shelf solutions. In particular, where to obtain them and how much they cost. I suggest that this is indicative of later adopters embarking on the adoption process. Unfortunately, this feedback was not acted upon. Instead, fact sheets addressing an even broader range of general issues were added – some written by sponsors without the usual standards of peer review (see Box 3-15). While some of these discrepancies were corrected in the 4th edition (Reardon et al. 2008), little was done to address the changing information needs of the users.

2.5.3 AR as HIA GreenSmart trainer and course developer

At the time of YH's release, HIA had commenced SP training and awareness through its Partnerships Advancing the Housing Environment (PATHE) program. HIA had produced limited information resources to support this program. While delivery of training to members is a significant source of revenue for HIA, the development of new training resources and constant updating and adaptation to regional relevance proved difficult to fund in the complex field of SP. The original course materials developed in Queensland with funding from the AGO had become out-dated. HIA's participation in producing *Your Home* (YH) led to further GreenSmart training development being funding by the AGO as part of the mobilisation phase of the YH project and YH was adopted as the primary text for GreenSmart training.

GreenSmart training overview

After initial development by John Moynihan, the training materials underwent a process of constant modification and adaptation to reflect the climatic and regulatory regimes of each state by myself and other presenters. That process continued over the next six years. Moynihan and I (as NSW presenter and course developer) produced guidelines and alternative course structures to assist other presenters in customising their GreenSmart courses to suit specific state and regional issues as well as their own personal preferences for training delivery. Two master course options were provided. Each had a different order and structure. These were developed to suit personal presentation styles and audience needs. Other presenters were advised to review each and choose the format that best suited them.

Each course contained the minimum amount of topics and content thought essential for GreenSmart training at that time. These included explanation of the main built environment environmental impacts: GGE and climate change; water demand management and waste-water treatment; biodiversity loss; soil loss and sedimentation; indoor air quality; environmentally preferred materials selection; waste minimisation and resource recovery. The level of emphasis placed on each topic varied according to the focus of SP change agendas in each state or region at the time of delivery. As each subject became part of industry BaU, the emphasis was reduced to reinforcement of the action as part of best practice.

For example, in Queensland and northern NSW, most attendees became familiar with the issues and prevention practices for sediment control so coverage became brief. However, when such regulations were introduced later in southern NSW, they were addressed in greater detail. Similarly, the 'green Olympics' left Sydney with a well-developed recycling industry. Most councils developed mandatory waste plans and attendees became familiar with the issues allowing a focus shift to other SP. In Queensland and regional NSW, recycling is more difficult and emphasis is placed on minimisation techniques and viable recycling strategies.

My AR presenter role of monitoring attendee feedback regarding relevance of content and regular liaison with presenters in other states provided a reliable source of data through which to monitor the adoption of change, thereby facilitating assessment of the effectiveness of the various state based change agendas that were also being explained during training. I refer to this and similar data sources as AR observations based on feedback from GreenSmart trainees throughout the research.

The course format became heavily reliant on presenter knowledge, skills and background. Because the AHI is risk averse and attendees were found to be more likely to accept new ideas and information presented in a context that demonstrates achievability. Most presenters were chosen on the basis of extensive experience in applying SP principles in projects as practitioners so that they could quickly and practically answer most questions using real life scenarios and examples. This built credibility rapidly and improved learning outcomes.

As a general observation, course participants were motivated to attend through a pre-existing interest or, due to awareness of pending regulatory reform and a need to stay ahead of the field. A combination of both motivations was often cited by attendees. A proliferation of SP innovations and regulations led to the course becoming information intensive. Reflective practice and attendee feedback indicated that few participants were able to take in more than a fraction of the materials presented. Because HIA initially proposed further specialist half and one day courses to reinforce and update earlier learning outcomes after workplace application, the course developers deemed the range of content to be relevant in the introductory course, the main purpose of which became to

convey the importance and urgency of GreenSmart practices and to encourage application of best practice through motivation of participants.

Unfortunately, the follow-up training was abandoned and it therefore became critical for trainers to explain where more detailed application information could be found in the TM when the need arose in the workplace. Participants were encouraged to access the TM at regular intervals to familiarise themselves with its content. While this was found to significantly increase the likelihood of their doing so at a future date, I posit that the overall effectiveness of GreenSmart training is limited by the lack of supplementary training.

Builders were generally observed to be visual learners. An additional limitation of the current course is that there is insufficient time to arrange site visits as part of the training. To offset this, the course relies heavily on visual material (photos and videos) and each presenter has a suite of sample materials to provide hands on learning paths. Participants were observed to be motivated by three levels of information:

- sound reasons to become GreenSmart including: competitive advantage; growing consumer demand and genuine contributions to reducing environmental impacts;
- practical, cost effective ways to apply and risk manage SP in their work immediately;
- the likelihood that pending regulation and benchmark creep will level the playing field and negate competitive advantage for those not pursuing best practice.

Reasons cited for attending GreenSmart training by NSW attendees were found to vary slightly according to attendee background and industry sector. Larger volume builders were most interested in how becoming GreenSmart might give them a competitive advantage and, that many GreenSmart options do not add to the cost of the buildings. Smaller tradesman builders were more interested in anecdotal evidence that GreenSmart skills might attract clients interested in better practice, thereby allowing them to move from high volume to high quality value added work with equivalent or increased profitability. This group also anticipated that being listed as a GreenSmart Professional would attract such clients without the need for costly advertising and marketing.

Most attendees responded strongly to:

- a detailed explanation of how ecological systems work and how the built environment is affecting the biosphere;
- the urgency of the problems and how their actions will make a difference;
- how pending regulatory tools will allow them to rigorously demonstrate and market how their work is different and superior to their competitors.

Trainers were instructed to address these motivations at every opportunity during the course and, where possible, to tailor these explanations to participant background and interests. In groups

where the majority of participants were from similar backgrounds, discussion, motivation and action were often observed to be more forthcoming. A training technique developed through RP to overcome inhibition from peer discomfort in mixed background audiences was the facilitation of debate or competitive discussion about the problems faced (and solutions used) by practitioners from very different industry sectors. This method proved particularly effective between builder and designers and, custom builders and volume builders and often resulted in interesting discussions and learning during breaks and interactive exercises. From an AR perspective, it delivered important insights into the differing pre-adoption needs of each industry sector.

Summary of AR outcomes

GreenSmart training provided a rich source of AR data in terms of:
- monitoring adoption rates and the effectiveness of individual change strategies in various states, regions and time-frames;
- gaining insights into the change adoption motivations and pre-requisite needs of practitioners working in various AHI sectors;
- testing and assessing the motivational effectiveness of various messages and background information (e.g. ecological footprint, explanation of basic principals of ecology, cost and risk minimisation strategies and availability of quality assured materials, information and consultancy services);
- identifying strengths and weaknesses of YH to inform future editions;
- improvement in my own training delivery through reflective practice.

These outcomes inform and illustrate DoI and ANT analysis in Chapters 3, 4, 5 and 6.

2.5.4   Building Design as a Reflective Practitioner (Suntech Design)

Two design projects were undertaken as AR case studies during this cycle to test and refine research questions and hypotheses drawn from RP in Section 2.2.2. Project 1 involved a new house for clients committed to achieving best practice sustainable outcomes. Project 2 was a large alteration and addition for a client committed to achieving sustainable outcomes but whose brief also called for outcomes counter to SP objectives including large floor area, over-glazing, central heating of entire floor area to above average thermostat settings. Both projects were in cool and cold temperate climates and had ample budget. Each received a BDA NSW 2004 Design Award for Environmental and Energy Efficient Building (winner and highly commended) and Best Design in their respective category.

Barriers to successful SP outcomes observed during the design and construction phases confirmed that lack of skill and understanding of SP by one client, both builders, both sets of council officers, manufacturers, suppliers and consultants delayed the projects, added cost and compromised SP

outcomes. Additionally, quality assurance and guarantees for many innovative SP applications were unavailable leaving Suntech Design and the clients exposed to risk. For example:

- solar-hydronic heating system roof panels on Project 2 leaked 'food grade' glycol into the rainwater tank destroying the bio-film, putrefying the water and rendering it un-useable mid drought on a remote property with no mains backup. The system supplier, the installer and the glycol manufacturer each blamed the other resulting in rectification costs being largely borne by Suntech, the builder and the client;

- During their first winter, Project 2 complained that the solar-hydronic heating system was drawing more on gas backup than predicted in this 6 star HERS rated home. After several rectification visits by Suntech and the installer, it was found that the client was re-setting the thermostat to 27^{0}C in a Canberra winter using up to 40% more energy than the design load;

- Council approval time for a simple (but innovative) reed bed grey-water recycling and a nutrient recovering permaculture black-water recycling system exceeded 12 months with the council, EPA and Water Catchment Authority each blaming the other for delays. This delayed Project 1 and significantly increased the approval process workload for Suntech;

- Energy use by an inefficient pump installed at Project 1 prevented carbon positive status until it was replaced;

- Project 1's builder: altered and compromised stack ventilation shaft details without approval; failed to properly install insulation (leading to expensive rectification) and refused to site separate waste streams or source environmentally preferred materials for which the clients had agreed to pay;

- Project 2's interior designer had over 50 energy efficient light fittings replaced with inefficient halogen (after they had been fitted and inspected by Suntech) resulting in air leakage from/to the roof space and required a 1.5 kW$_{peak}$ addition to the PV array to maintain carbon neutrality.

- double glazed timber windows were supplied with no air seals by a leading manufacturer who took more than 12 months to rectify the problem;

Summary

In the context of AHI training delivery, RP analysis of barriers and successes recorded during these projects yielded deeper insights into cost and QA risk management issues associated with the adoption of innovative SP by later adopters. (See Section 1.5 for DoI adopter categories and Chapter 3 for analysis). I also draw on these case studies during later analysis to illustrate arguments for: SP skill delivery across the entire AHI sector; incentives to accelerate commercialisation, certification and QA of SP technologies and recognition of the risk implications of some CA recommendations for practitioners. Successes included:

- lifecycle carbon positive status achieved in Project 1;
- zero depletion or emission water status achieved in both projects;

- both projects 6 star HERS rated passive solar design;
- both achieved high level indoor air quality using low VOC/toxicity paints and finishes;
- some materials were able to be certified as environmentally preferred;
- Project 1 reed bed grey-water treatment for WC flushing re-use and black-water re-use in permaculture garden irrigation confirmed as safe by council monitoring.

Barriers encountered included:
- lack of SP skill by the majority of actors involved in the projects
- limited availability of commercialised technologies and limited supplier/installer QA;
- client resistance to composting WCs and grey water recycling systems;
- Council reticence to approve on-site waste-water treatment systems;
- lack of understanding and commitment by one builder in applying SP;
- failures in communication and supervision between designer and builder;
- limited facilities for recycling and waste minimisation in regional areas;
- environmentally preferred materials incurred substantial additional cost;
- one project failed to achieve carbon neutral status;

2.5.5 AR Cycle 3 Summary of Outcomes

In this AR cycle, increased SP adoption within some AHI sectors and practitioner groups indicated that change agendas were beginning to succeed. This provided AR opportunities for analysis and refinement of 'next steps' to refine those agendas. Useful observations, insights and understandings developed during this cycle include.

- deeper understandings of the complex interdependence of individual practitioner innovativeness, AHI market sector and existing skill level as both barriers and opportunities to the adoption of SP;
- deeper understandings of the information needs of consumers, builders and designers through YH communications research;
- observation of barriers arising from duplication, inconsistent language, variable focus and competing assessment methodologies amongst CAs;
- collaborative production of the YH materials yielded insights into implications arising from industry actor group interactions in the implementation of change;
- application and preliminary evaluation of *Your Home* through industry training for consumers, builders, designers and university undergraduate students;
- training, practice and consultancy roles yielded insights into the needs of recent and would-be adopters in a wide range of industry scenarios and identified the need for training backup and information hotlines.

- initial application of DoI and ANT to describe and analyse the case studies created and investigated during this cycle and report back to CA partners.

2.6   Action research cycle 4: Case study projects 2003–present

2.6.1   Overview

In this AR cycle, data collected through questionnaires is synthesised with AR observations through RP and DoI analysis to confirm change occurrence and validate or reject hypotheses about the effectiveness of various change processes. These research findings are communicated to CA partners through two inter-related AR streams that broadly follow ABEC's dual codes of practice.

The first focuses on the expansion and refinement of practitioner training and skill delivery initiatives that earlier research confirmed as important drivers of the innovation required for better and best practice. These initiatives include continued development of GreenSmart, initiation of the Building Industry Training in Sustainability (BITS) project and its delivery (albeit unsuccessful in the first instance) through ABSA. Secondly, I extend my observing player role to the development and implementation of mandated minimum codes through the regulatory agendas BASIX and BCA and related assessment protocols developed by ABSA.

2.6.2   Questionnaire data collection, analysis and feedback.

Questionnaires were circulated within AHI designer and builder practitioner groups in 2001 and again in 2004-2005 to generate numeric data confirming AR observations of sustainable change occurrence. These quantified: practitioner declared timeframes for SP adoption; resource needs in terms of information and training provision, market creation and CA intervention including regulation. It also examined practitioner adoption motivations including responses to various change agendas in terms of skill and confidence levels. This facilitated comparison of change outcomes between state and regional change agendas.

This data source is positioned within my overall AR research context in Sections 1.7 and 1.8. Timeframe related DoI analysis is presented in Section 4.3. A sample questionnaire appears in Appendix 1 and Appendix 2 includes an AR presentation to stakeholder partners of results and conclusions drawn from questionnaire data.

2.6.3   BASIX

BASIX was the first of a second-generation of AHI regulatory tools to be introduced. My AR participation in its design, development and implementation yielded useful insights into maturing change agendas identifying new opportunities and exposing some additional barriers. The dot

points below are provided as an introductory summary of my observations and their implications that will be referenced during later, detailed analysis.

BASIX opportunities and advantages

- Addresses EE and GGE for the first time through its GGE based performance metric that considers thermal performance, appliance efficiency and carbon intensity of energy sources;
- Mandates minimum performance while also facilitating measurement of better and best practice to encourage competition (ABEC policy);
- Provides flexible compliance paths that encourage innovation;
- Includes capacity to add new indicators and impact categories in response to industry and market capacity to respond and adopt;
- Indicates relative progress toward ultimate goals of zero emission or depletion through relative (to average housing stock) percentage based impact reduction scores including 100%+ (carbon positive);
- Facilitates the setting of achievable short, medium and long-term goals and monitors industry progress towards them;
- Collects data about real outcomes delivered;
- Interfaces with existing measurement tools (HERS and MEPS)
- Web based format allows seamless benchmark creep and addition of viable compliance paths as they become available through innovation;
- Triggered review and amendment of other state and commonwealth regulatory policies;
- Demonstrated the dubious value of regulatory impact statements (RIS) by regulators by setting regulatory benchmarks and leaving cost-effective compliance innovation to industry;
- Stimulated R&D investment by industry suppliers, consultants and businesses in SP products, services, skills and QA delivery

Barriers and shortcomings

- Limited consultation during development generated significant industry opposition from a range of industry actors including sustainable change advocates. I posit that this indicates a maturing of the AHI sustainable change environment and exposes an error on the part of developers in not recognising the role of consultation in developing AHI ownership.
- BASIX placed NSW outside the ABCB - BCA nationally consistent regulatory framework adding to division and competition between CAs and adding complexity for practitioners.
- Delays and scope reductions during development of BASIX indicate that its developers underestimated the scale of the task in both political and program development terms.
- Over-reliance on rainwater harvesting in water reduction compliance attracted criticism from experts and sceptics concerned about the cost-effectiveness of this essentially

prescriptive approach. I posit that simple benchmarks with flexible compliance paths would provide an effective solution by encouraging innovative Least Cost Planning (LCP) solutions by industry.

- Exposed lack of QA product development in wastewater recycling options. Additionally, the encouragement of grey-water recycling without warnings raised questions about health, safety and cost-effectiveness.

- BASIX' use of simple deemed to comply (DTC) provisions as substitute for sophisticated HERS thermal performance simulation exposed limitations and attracted expert criticism.

- BASIX' proposed measurement of total GGE contributions (including transport) exposed political sensitivities to likely perceptions of government failure to provide key transport infrastructure. This led to abandonment of the transport component.

2.6.4 Building Industry Training in Sustainability (BITS)

A 2003 AR activity included the preparation and submission (to the change agency AGO) of a working paper proposal that outlined a strategy to meet the above needs (Giffard & Reardon 2003). The aim of the project was to eliminate or minimise duplication by bringing together and value adding existing training in SP so that it could be shared and positioned as part of a comprehensive set of competencies required for the sustainable planning, design, construction, operation, maintenance and de-construction of housing.

It was intended that this interactive hierarchy of SP-related training and skill building programs would order and expedite the development and delivery of comprehensive SP skills to every level of the industry (ibid). The hierarchy would have allowed practitioners to gain a recognised SP qualification by choosing from a range of competencies or CPD modules best suited to their workplace application or field of interest. Additionally, in response to ABEC's findings (ABEC 2002), the project was to facilitate the inclusion of these competencies and course materials into nationally recognised training packages and courses in TAFE and Universities by working collaboratively with relevant Industry Training Advisory Boards (ITABS) to ensure consistent recommendations to the Australian National Training Authority (ANTA) who administer the Australian Qualification and Training Framework (AQTF).

The program received limited funding for the development of four non-accredited introductory modules that duplicated existing training and, despite several attempts to resurrect it, the program failed. Throughout later analysis, I attribute several adoption barriers to this failure which limited practitioner skill development and led to ongoing duplication of introductory level training with no recognised structure or qualifications. See Box 4-14: BITS Case Study for more detail.

2.6.5 ABSA

The Association of Building Sustainability Assessors (ABSA) evolved out of the NSW House Energy Rating Management Body (HMB). The HMB was established to administer the training and licensing of HERS assessors. The national regulation of energy efficiency has mainstreamed HERS assessment in industry. Change agency AGO recognised the need for a national HERS management, training and accreditation body and has funded ABSA to develop to national status and trial 2nd generation HERS software. ABSA recognised the potential for a much larger role and adopted into its mission statement, the goal of becoming the national training, accreditation and certification body responsible for all aspects of sustainability.

In less than 12 months, ABSA expanded its portfolio of responsibilities to include commercial rating tools and industry CPD training in most aspects of SP. ABSA recognised the need to create a new vocation in the built environment industry called a Sustainability Consultant/Assessor and is attracting overwhelming support from CAs, industry peak bodies and regulators to develop and deliver the training and accreditation required by such professionals. My AR roles within ABSA included: contributions to early policy development; network building and training development and delivery. AR outcomes include deeper understandings of:

- the role of the AHI network and particularly ABSA in diffusing SP throughout the AHI (See Sections 5.2.4 and 5.3.5 for ANT analysis);
- the potential for ABSA's specialist practitioners to provide important new SP consultancy services in addition to their HERS assessment role;
- the benefits of assessor licensing in driving skill acquisition and professionalism and;
- differing information and training needs of innovators and early adopters (the majority of ABSA members) compared to later adopters (typical HIA GreenSmart attendees).

ABSA's rapid establishment as a central actor in terms of demand from later adopter groups suggests that the AHI sustainable change process has achieved critical mass.

2.6.6 Development and expansion of HIA GreenSmart training

My continued AR role as a HIA GreenSmart trainer, presenter and design award judge facilitated:
- monitoring of changes in attendee profile later attributed to shifts in DoI adopter category of attendees as the SP diffusion process matured;
- feedback of these research findings to CAs to shape new or revised information resource provision initiatives (*Your Home*) and training development and delivery (BITS and ABSA);

- observation of the role of opinion leadership by Clarendon-CPG through GreenSmart training influencing SP adoption by less innovative volume housing companies;
- insights into specific SP problems experienced by later adopter volume housing practitioners whose cost and risk parameters were very different to those of the innovator and early adopter practitioners who predominated in early training delivery;
- understandings of the motivations of GreenSmart award entrants (entrants consistently cited market differentiation, recognition and free publicity as their main incentives).
- outcomes from AHI SP awards in driving better and best SP adoption through competition based opinion leadership that closely followed DoI adopter categories.
- SP innovation diffusion through award publicity (entrants in subsequent years were often observed to have copied and improved features of previous winners).

My AR roles within the HIA GreenSmart program provided a rich source of AR data in terms of observing and recording progress in the AHI sustainable change process over 6 years of intense AR involvement with the practitioners on whom this research focuses. DoI provided a sound analytical framework within which to analyse and interpret the often subtle changes observed.

2.6.7 SP Consultancy to the volume housing sector

HIA's promotion of GreenSmart to its larger volume housing members led to a request for customised GreenSmart training delivery to the prestige volume housing company Clarendon Property Group (CPG) which included CPG Apartments, Clarendon and Bellevale Homes. Management, design and construction staff attended. Subsequent consultancy to assist with the implementation of SP within these organisations, led to the production of an SP Operations Manual intended to quality assure consistent application of SP principles through concept design, detailed design, working drawings, tendering, construction, commissioning and handover stages.

While the SP Operations Manual was eventually replaced by other management protocols, CPG's commitment to SP remains strong through a succession of owners. AR observations that are referred to during later analysis include: the role of CPG's CEO in initiating SP adoption including strengths and weaknesses of such a top down approach (See Box 6-4) and the perceived value of GreenSmart 'branding' for CPG and its opinion leadership influence on volume housing sector competitors. This opinion leadership (in combination with HIA marketing) led several project home companies to undertake similar training with varying levels of follow-up consultancy.

This AR activity provided opportunities to develop insights into SP adoption challenges specific to the volume housing sector as well as deeper understandings of this sector's important contribution to quality assurance and commercialisation of SP innovations through demand creation and mass market refinement.

2.6.8 Green Loans Assessor Training

A late AR opportunity to participate in the scoping of the Commonwealth's Green Loans program in late 2008 provided opportunities to test analytical findings from DoI and ANT through application. These included DoI findings related to training and skill delivery (Section 3.3.3) and ANT findings in relation to network configuration strategies (Sections 5.3.6 and 6.5.3).

2.6.9 AR Cycle 4 Summary of Outcomes

While several of the AR projects in Cycle 4 are ongoing, they provide valuable, additional insights into the progress of industry change agendas and inform the deeper analysis and conclusions of Research Phase 3. Because Phases 2 and 3 were often concurrent, some of the outcomes from Action Research Cycle 4 are reported in Section 2.5.6. The following dot points introduce important additional outcomes that will be analysed in detail later:

- baseline data collected through questionnaires informed critical analysis of hypotheses, refined research questions and informed AR partner change agendas;
- the importance of adapting SP innovations developed by smaller, innovative practitioners to meet the needs of high volume housing production companies was recognised;
- recognition of substantial differences in the information, training and SP resource needs of larger companies compared to smaller practices and the need for CAs to address both;
- questionnaire data confirmed skill gaps among industry practitioners and led to recognition of the opinion leadership implications of this in terms of practitioner confidence to advocate SP to their clients;
- recognition of the implications of 7-10 year time lags for practitioner skill delivery from TAFE and universities and the need to provide high level, structured CPD training to develop an interim SP skill base amongst existing practitioners;
- insights into rapidly changing practitioner information and training needs as the SP change process matured;
- deeper understandings of the relative merits of BASIX and BCA as regulatory tools in terms of: accessibility, flexibility, appropriate metrics, innovation incentives and industry options to apply least cost planning.
- recognition of the need to develop a new vocation – Sustainability Consultant (ABSA);
- observation of limitations and advantages of industry consultation during regulatory tool development (BCA vs. BASIX) including the benefits of consultation in developing 'industry ownership' of sustainable reform agendas;

2.7   Chapter 2 Summary

This Chapter established the AR methodology by briefly introducing the various case study projects and describing the information, insights and data each contributes to my cyclical research process. That process starts with a literature review to argue the research focus and retrospective reflective practice of previous practitioner roles to declare biases and establish the expertise that I draw on throughout the research. Whilst the analytical research phase is documented separately in Chapters 3 to 6, this analysis within DoI and ANT was applied to AR outcomes as they occurred and is therefore an integral component of the AR process. For that reason, key analytical findings and hypotheses arising from each cycle that informed subsequent cycles are briefly introduced above. These findings are expanded and fully argued in the following analytical chapters.

Chapter 3 is a retrospective diffusion study in which I frame my analysis of SP, the sustainable practices and technologies being diffused and the AHI practitioners whose task it is to adopt and diffuse them within DoI theory. This identifies both barriers to adoption and opportunities to overcome them and accelerate the diffusion process. Chapter 4 then examines the processes through which diffusion occurs (or fails) in more detail to draw deep understandings of important AHI specific diffusion processes associated with SP. These include the need for innovative re-invention of SP and the ways that this occurs, the decision making processes of AHI practitioners and key drivers of those decisions. Chapter 5 examines the role of the AHI network in facilitating or blocking the diffusion process and identifies ways that this network can be re-configured to enhance and accelerate the diffusion process.

In Chapter 6, I synthesise the analytical findings from chapters 3, 4 and 5 to support my concluding recommendations for future change management and finally in Chapter 7, I review my research outcomes from a scholarly perspective by describing their theoretical, practical and transformational contributions within Mitchell and Willeetts (2007) transdisciplinary outcome spaces.

Chapter 3   Retrospective diffusion analysis of SP innovations and the AHI social system

3.1   *Overview of AR analysis*

In this chapter, I commence the retrospective analysis of my AR. Because that analysis spans three chapters, each with a distinct purpose and focus, I provide an overview to position each in an analytical sequence to lead to my conclusions. Chapter 1 provided an introductory overview of Diffusion of Innovations theory (DoI) and Actor Network Theory (ANT) and established their roles in this research. In Chapter 2, I outlined the framework in which I observed, monitored and contributed to the diffusion of SP in the AHI through AR.

In Chapters 3, 4 and 5, DoI and ANT are applied retrospectively as analytical frameworks to explain the change phenomena (trends, patterns and behaviours) observed during AR. Chapter 3 examines the characteristics of both SP innovations and the AHI social system in DoI terms and in Chapter 4, I use DoI to explain the processes through which SP innovations diffuse in that social system. Theoretical arguments developed through diffusion analysis in Chapters 3 and 4 are supported by qualitative and quantitative data generated during the AR phases (introduced in Chapter 2) and illustrated through additional AR case study examples. Data are presented as illustrative examples formatted in boxes to differentiate them from the narrative of DoI analysis. In Chapter 5, I use ANT to analyse network interaction between SP, the actors who adopt them and the change agendas driving that adoption to identify intervention strategies with potential to accelerate it.

In other words, a triangulated approach is used to synthesise both quantitative and qualitative data through analysis in two complementary theoretical frameworks. These analytical findings are combined through prospective analysis in Chapter 6, to support concluding recommendations made to CA partners. This approach generates both implementable, industry specific applications (Chapter 6) and theoretical outcomes with broader, transferable scholarly application (Chapter 7).

The scope of AR analysis in Chapters 3, 4 and 5 includes strategies to address three impact categories: greenhouse gas emissions (GGE) and climate change (CC), water consumption and wastewater treatment, waste minimisation, and environmentally preferred materials selection. The focus of the prospective analysis in Chapter 6 shifts to climate change mitigation in response to its urgency. Other impact categories including air quality, biodiversity impact, soil loss and sedimentation are addressed as subsets of these categories.

3.2   AHI Sustainable practices as DoI Innovations

Rogers (1995) defines innovations as: *abstract ideas and concepts, technical information, and actual practices* and, as *an idea, practice, or object that is perceived as new by an individual or other unit of adoption* (Rogers 2003, p.475). In this section, sustainable building practices and technologies (SP) are analysed within DoI *innovation* definitions to yield important insights into barriers to their adoption. Rogers nominates five categories or characteristics that are generally agreed by diffusion scholars as being most critical in terms of creating opportunities or barriers to the diffusion of a given innovation. The five are relative advantage, compatibility, complexity, trialability and observability (Rogers 1962; 2003). I have included a sixth, *familiarity,* suggested by Wejnert (2002) and frame the analysis within these six categories.

The sections below demonstrate that SP innovations lack many advantages associated with the successful diffusion of innovations in other studies. This constitutes a significant barrier to the AHI adopting them, which needs to be overcome or offset by CAs. The analysis therefore identifies alternative strategies such as regulation, subsidies, increased utilities costs and other incentives that could serve this purpose. The most important of these strategies are then further expanded through prospective analysis in Chapter 6.

3.2.1   Relative advantage

The degree to which the innovation is perceived to be superior to current practice (Rogers 2003, p.229).

Relative advantage is often assessed in terms of economic advantage or imparting social prestige to the adopter. Diffusion studies from the DoI literature demonstrate how innovations with obvious or immediate benefits for the adopter diffuse quite rapidly (e.g. the mobile telephone and fax machine). The more immediate the benefit to the adopter, the more rapidly the innovation diffuses.

Unfortunately, in the case of SP, few immediate economic or personal advantages accrue to adopters of SP and the benefits are (at best) far from immediate or obvious. Indeed, the most likely beneficiaries are future generations and sceptics continue to argue that these benefits are far from proven. As argued in Section 2.1.1, it is expected that beneficial outcomes from adopting SP will become apparent during the next 50 to 100 years and yet, in the case of many potentially devastating impacts (e.g. climate change), immediate intervention is required to avert their impact. In the following sections, I examine intervention strategies applied or identified during AR as having potential to overcome or mitigate the lack of relative advantage associated with SP. These strategies will be re-examined in differing analytical perspectives throughout Chapters 3, 4, 5 and 6.

Incentives or synthetic advantages

Strategies to overcome this lack of short-term advantage were developed by CA partners during AR. Initially, these synthetic benefits involved introducing short-term incentives to create perceived relative advantage, thus offsetting the delayed benefits of SP innovations. These included promoting SP housing features to stimulate competition and market differentiation and they were often linked to subsidies and rebates. As industry acceptance of need grew, change advocates used Life Cycle Costing (LCC) (Langston 1996.) to overcome the arguments of sceptics (particularly politicians) and to support regulation to further diminish delayed benefits as an adoption barrier. More recently, assessment of the cost of doing nothing (Gore & Guggenheim 2006; Stern 2006) has informed the regulatory focus and combined with Regulation Impact Statements (ABCB 2005, 2006b) and cost benefit analysis (DoP_NSW 2003), has driven bar creep in cost effective ways. The ongoing role of regulation and appropriate regulatory strategies are explored through prospective DoI analysis in Section 6.3 where I argue that creating indirect benefits, motivations and incentives should be a component of every change agenda.

Consequential advantages (public and private)

Relative advantage is often linked to the consequences arising from adopting (or not) an innovation. It is useful for change agents to distinguish between and address both public consequences of an innovation's adoption (on entities other than the adopter), and private consequences (for the adopter) (Wejnert 2002). Failure to adequately address private consequences can create a barrier to an individual's initial decision to adopt or, lead to discontinuance of adoption after a limited period. This aspect is relevant when the cost of the innovation is low and discontinuance results in minimal consequences or cost (e.g. replacing a poorly designed efficient showerhead with an inefficient one to improve shower quality). This also applies to situations where the innovation requires the adopter to modify a behaviour where continued adoption has no perceived positive personal consequences but has perceived negative personal consequences (e.g. taking shorter showers). Box 3-1 demonstrates how SEDA attempted to address both private and public consequences in its Energy Smart Shower Heads campaign.

Box 3-1: SEDA Energy Smart Showerheads Campaign

SEDA encouraged the adoption of water efficient showerheads in its Energy Smart Homes program owing to the public consequences of reduced water and energy consumption use but also recognised that private consequences of quality of shower for the adopter were equally important in ensuring continued adoption. Accordingly, they encouraged staff to test a range of AAA showerheads to identify the best performers and used demonstrations and testimonials in their promotions.

Shower efficiency requires adopting both technological (AAA showerhead) and behavioural (shorter shower lengths) innovations. While SEDA was able to influence adoption of the technological component and to minimise its negative private consequences, the behavioural component was beyond their influence. Apart from increasing the cost of water and energy resources, mandatory disclosure is one of the few strategies with potential to encourage adopters to change personal behaviours that have adverse private consequences to achieve favourable public outcomes. This would only be effective if actual water and energy use were disclosed – not a rating (as is proposed). See Section 6.5.4 for detailed prospective analysis of this important intervention.

Relative advantage from financial savings

While some consumers are known to respond to the economic advantage of lower operating costs for their homes (Shipworth 2000), the additional upfront cost of SP features often negates this advantage (Haratsis 2003, HIA 2004). Lack of immediate economic relative advantage was observed to be especially significant as a diffusion barrier among practitioners and consumers in the most cost sensitive or risk-averse sectors of industry. This has been consistently confirmed by feedback from design practitioners during SP training delivery (Allam_Homes 2004; Clarendon_Homes 2007; HIA_GreenSmart 2003-7; Masterton_Homes 2005). Recent market research in a small sample indicates a slight shift in consumer awareness and demand for SP (City_of_Subiaco 2004; DET_&_SEDO_WA 2007) while in-house testing by one larger company predicts such shifts in two years (Investa 2007)

While mandatory disclosure of SP ratings at point of lease or sale is predicted by CAs to generate additional economic advantage, I suggest that it is unlikely to influence personal behaviour unless combined with declared 'actual' as well as predicted consumption (See Sections 6.3.6 and 6.5.4 for detailed discussion). While subsidies intended to offset the additional cost of SP features, or 'split incentives' (the builder pays but lifecycle cost benefits go to end users), enjoyed limited success among early adopting practitioners. They proved ineffective in later adopter groups because consumers saw little advantage in the minimal life cycle cost savings offered and were not prepared to make even a partial contribution (Haratsis 2003, HIA 2004). Additionally, the eventual withdrawal of many of these subsidies (e.g. SEDA's PV subsidies) added to the arguments of sceptics that SP innovations are not economically viable. Indeed, with current resource pricing, the sceptics' arguments are difficult to refute. This barrier is exacerbated by current industry marketing practice, in which payback periods for additional upfront capital investment in SP are cited. No other housing feature or inclusion applies this market technique.

One strategy is to add the additional upfront cost of SP to a standard mortgage and offset slight repayment increases against utility bill savings. For all but the most expensive SP inclusions (e.g.

photovoltaic arrays), this method of SP amortisation proves cost neutral or positive from day one – especially when inevitable water and energy cost increases and discounted green mortgage interest rates (e.g. Bendigo Bank) are included. *Your Home* Case study 7.1 (Reardon et al. 2001a) provides a detailed example of how minor modification to a low cost project home achieved this.

The current volume housing sales paradigm (where companies compete on the basis of lowest cost per square metre of dwelling) is a significant barrier to SP adoption owing to their additional costs. Early adopter and early majority practitioners (see 3.3 for adopter categories) have overcome this relative disadvantage by using limited demand for sustainable features by their early adopter clients to generate competitive advantage in their niche market. However, because consumer demand for sustainable features is limited, lack of relative advantage presents a significant innovation-related adoption barrier in early and late majority adopter groups.

For example, while mandated minimum standards for energy efficiency (EE) have overcome this barrier to the extent of enforcing minimum standards, they have little influence on better and best practice adoption. I assert that regulatory tools with the capacity to measure and recognise better performance, in addition to setting minimum benchmarks (e.g. BASIX), are more effective than those that simply set minimum standards (e.g. BCA), because they encourage innovation, competition and commercialisation by leading practitioners and drive regulatory bar creep for the mainstream (See 4.6 for detailed analysis). Box 3-2 demonstrates BASIX' capacity to recognise better than minimum performance, generating competition and (limited) product differentiation based on SP. While a failure to provide adequate training to sales staff on the advantages of SP limited the outcomes in this example, I contend that the capacity to measure better or best practice in addition to mandating minimum practice is a desirable feature in regulatory tools.

Box 3-2 BASIX application in Nelson's Ridge GreenSmart Village

In developing benchmarks for a proposed GreenSmart display village at Nelson's Ridge in western Sydney, HIA nominated a range of targets including HERS 5-star ratings under the (then) Energy Smart Homes Policy or, a BASIX + X% rating (where X is additional to the mandated minimum) under the proposed regulation. Because first generation HERS ratings (NatHERS) stopped at 5 stars, there was no opportunity to promote higher performance and BASIX ratings were preferred.

Many of the display homes achieved a BASIX +10 % GGE reduction score and were marketed accordingly. While higher ratings (e.g. BASIX + 20%) were achieved by some display homes and used to differentiate marketing for the whole estate during the initial, GreenSmart promotional environment, sales staff (who had received no training in marketing GreenSmart features) were unable or unmotivated to promote the advantages to consumers and this form of market differentiation was dropped.

Risk as an adoption motivation

Durfee (1999) examined problems associated with diffusing preventive or non-innovations in the SP-related field of pollution prevention and outlined strategies to overcome them.

Prevention is growing in importance as a method of reducing industrial pollution, though it is by no means easy to do. Diffusion of the prevention approach may be enhanced by increasing the risks associated with doing nothing or sticking to control technologies, while providing settings where trust can grow (Durfee 1999, p. 112).

Owing to its obvious consequences, industrial pollution can often be traced to its source and Durfee's risk factor can be introduced through imposing fines and penalties. Risk is difficult to introduce in relation to non-compliance with mandated SP performance in the AHI because consequences arising from non-compliance are less obvious and more difficult to detect. Indeed risk is virtually eliminated as an SP adoption driver in the AHI at present for several reasons.

Firstly, actual post occupancy performance benchmarks are non-existent because little or no research has been conducted into the actual performance of housing approved under the new standards. Secondly, user behaviour variables such as appliance use, switching off lights and appliances, duration of shower and occupant numbers mask performance deficiencies. Finally, certifiers and inspectors lack adequate skills and resources to enforce compliance. In other words, the SP adoption motivation potential of risk is under-utilised. Box 3-3 below demonstrates how this undermines the effectiveness of current regulatory agendas.

Box 3-3: Action Research client; Northern Beaches Project 2005.

An AR client company (who became GreenSmart partners and leaders in adopting voluntary best practice SP for the volume housing market) specified thermal performance levels exceeding minimum mandated standards in a voluntary better practice project. Their commitment was promoted by HIA and the author prompting a site visit by another GreenSmart professional who reported that walls were being sheeted with no insulation included and that reflective foil insulation (while specified) had not been fitted under roofing materials. These omissions would ensure that the project did not even meet minimum standards. When notified of the omission, the company reported that the problem had been rectified and explained that its QA procedures had failed owing to a lack of knowledge and skill concerning SP in its private certification firm. However, because the walls were sheeted in 24 hours, and there was no risk associated with unverified (through inspection) certification, it is likely that at least some of the walls remain uninsulated.

Conclusion. Firstly, this case study demonstrates how even the simplest of SP inclusions need to be integrated into the BaU scenarios of every practitioner or contributor constructing a new home, to overcome initial incompatibility issues. Secondly, it identifies the role of follow up support by change agencies to ensure that the SP adoption commitments made at design stage continue into

the completed project. To this end, improved quality assurance protocols, better trained project managers and certifiers and stringent SP certification are needed to create an on-site paradigm shift.

I contend that while substantial innovation and adoption of best practice is required to ensure sustainable future outcomes, current regulations (BASIX and BCA) are unable even to guarantee the elimination of worst practice because of low stringency standards. I posit that additional regulations mandating disclosure of sustainable performance at point of lease or sale would introduce commercial risk for both consumers and practitioners by linking property values to sustainable performance and, that competition based on performance would generate unquantifiable risk that might best be minimised through incorporating better and ultimately, best practice (See 4.2.7 and 4.2.8 for detailed analysis of mandatory disclosure). Introducing risk could create relative advantage by linking SP inclusions to arguably the most powerful driver of demand in the AHI, capital gain or wealth creation.

Summary: the relative advantage of SP innovations

The above analysis identifies that the current lack of relative advantage associated with SP adoption is an adoption barrier that should be addressed by CAs. While mandatory disclosure of an SP rating at point of lease or sale is likely to introduce relative advantage in the medium term, current low stringency levels for BASIX and BCA certification in conjunction with the difficulty and cost of post construction assessment continue to make SP adoption a low priority for the majority of designers, builders and consumers. I therefore argue that providing both adoption incentives and non-adoption consequences (including risk) for practitioners, certifiers and especially consumers should be integral to all change agendas whether mandatory or voluntary and address this through prospective DoI analysis in Chapter 6.

3.2.2 Compatibility

The degree to which an innovation is perceived as consistent with existing values, past experiences or perceived needs of potential adopters. (Rogers 2003, p. 240)

Rogers argues that an innovation can be compatible or incompatible with: socio-cultural beliefs; previously introduced ideas; or adopter needs for the innovation (ibid). Some current socio-cultural beliefs are incompatible with SP innovations (e.g. water and energy resources are a right; resources are abundant or infinite; the assumption that human ingenuity will solve environmental problems). Diesendorf demonstrates how the previously introduced ideas underpinning neoclassical economic theory (the capacity of supply and demand to regulate resource consumption are incompatible with society's current need to apply the 'precautionary principle' to avert the collapse of ecological systems (Diesendorf & Hamilton 1997).

Incompatibility between the precautionary approach required in relation to sustainability and the dominant free market socio-economic paradigm creates a barrier to SP adoption in the economy driven AHI sector because most SP involve applying the precautionary principle to some extent. Additionally, SP are not compatible with the current perceived needs of the majority of consumers. Macroplan reported that SP (specifically energy efficiency) did not register in the top ten items consumers considered important in their homes (Haratsis 2003). I argue that the success of SP change agendas depends on the effectiveness of CAs in developing community and practitioner attitudes compatible with SP innovation adoption through the strategies identified throughout this research (see case study examples in Boxes 3-4, 5 and 6 below).

Recent shifts in awareness of human caused environmental impacts evidenced by mainstream media reporting and analysis of climate change predictions (Flannery 2007; IPCC 2007b) and their likely economic consequences (Gore & Guggenheim 2006; Stern 2006) have aligned socio-cultural attitudes with the objectives of AR change agendas. However, as Shipworth (2000) argued, such favourable attitudes are likely to influence only low cost actions. Limited market research (Haratsis 2003; Investa 2007) confirms my AR observations (based on feedback and comments by practitioners and consumers) that many incompatible (to SP adoption) practices, beliefs and associated perceptions of need remain entrenched in the socio-cultural paradigm of housing. For example: summer over-cooling and winter over-heating are often associated with success, social prestige and superior lifestyle; long showers are often considered a personal luxury or 'reward'; green lawns constitute a status symbol and bigger houses are thought to yield greater capital gains.

Moral or ethical compatibility

While SP have limited immediate relative advantage for many would-be adopters, in terms of economic advantage or lifestyle improvement, many innovators and early adopters reported that high levels of moral and ethical motivation underpinned their decisions to adopt and personal pride and satisfaction provided relative advantage. My industry questionnaires indicated these values to be decreasingly prevalent in later adopter groups. This motivation has significant implications for change agents – most of whom are innovators and early adopters and explains why many (including the author) have attempted to diffuse SP through sustainable evangelism – with limited success. The differing language needs of the adopter groups defined in Section 3.3.2 is explored in greater detail in Section 6.2.

Compatibility through social prestige

Design practitioners specialising in best practice sustainable design and construction (Suntech Design, Environa Studio, Envirotecture, GCA and Sunpower Design) report that the minority of early adopter consumers who consider incorporating sustainable features prestigious has been

growing since the early 1970s. The motivations and views of these designers and their clients are well documented through interviews in the *Your Home* DVD (CoA 2004). Strategies to diffuse perceived social prestige in mainstream housing markets, by promoting and marketing SP through prestigious case studies and awards is integral to several successful change agendas (e.g. *Your Home* Case Studies, industry peak body design awards). Increasing recognition and commercial viability of SP branding (e.g. HIA GreenSmart, Energy Performance Stars and MEPS labels) and sales of glossy, upmarket SP housing magazines (e.g. Sanctuary and GreenSmart) indicate that a growing number of consumers are linking SP with social prestige and that this growth is increasing compatibility and driving pockets of growth in demand for SP features (Bunbury EcoHome 2006).

The following AR case studies demonstrate successful methods used by CAs during AR to overcome incompatibility barriers. Box 3-4 demonstrates the effectiveness of developing supportive attitudes among OLs in a target audience before introducing a change agenda.

Box 3-4: SEDA uses prestige and opinion leadership to change practitioner attitudes to SP.

In the early stages of its change agenda in the BDA, SEDA increased the prestige associated with SP achievement through sponsorship of design awards and creation of the Energy Smart Allies program. This created competition among innovators and early adopters and generated opinion leadership that led to attitudinal shift and increased knowledge levels among later adopters. I claim that the success of the voluntary Energy Smart Homes program is partially attributable to the creation of SP compatible attitudes among designers before its launch.

DoP used an alternative approach in their BASIX agenda where mandatory measures were used to overcome incompatibility barriers that might otherwise have restricted consumer and practitioner use of their innovative, informative regulatory tool to further shift SP incompatible beliefs.

Box 3-5: DoP/BASIX overcoming incompatibility through regulation.

DoP overcame incompatibility and lack of relative advantage barriers by mandating adoption through BASIX. BASIX also reduced complexity by making the whole process user accessible and transparent through an innovative regulatory tool which explained the principles, goals and targets whist providing high quality help levels and support information.

While BASIX' flexible compliance paths encouraged innovation by OLs and early adopters, DoP's decision to limit the time and resource consuming industry consultation alienated many of these OLs, some of whom actively lobbied against BASIX (ABSA 2005; Clarke 2006a; Isaacs 2005b; Lee 2005; Pears 2005). By underestimating the importance of consultation and collaborative development in building a supportive network of OLs in industry (e.g. SEDA's approach to the

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ESH program), DoP partially compromised outcomes from this most innovative of mandatory change agendas. This strengthened the position of sceptics (e.g. HIA and MBA), which cited constructive criticism by compatible industry experts to maintain AHI perceptions of incompatibility, to eliminate introducing additional indicators.

The next box demonstrates how a cleverly planned change strategy that addressed compatibility at several levels was able to effect lasting change with minimal input from change agencies.

Box 3-6: RESOURCE NSW- A change agenda that successfully overcame perceptions of incompatibility, complexity and lack of relative advantage.

The NSW Waste Boards embarked upon a change strategy to reduce waste streams. An initial problem was the industry perception that waste recovery was incompatible with BaU. This was overcome (in the context of this case study) by a change agenda that focussed on:

Attitudes: NSW Waste Boards renamed Resource NSW, waste disposal and recycling re-defined as resource recovery.

Knowledge: Resource NSW provided recycling directories to build the supply and demand network; case studies, videos, industry training and brochures.

Skills: the requirement for waste plan submission (within a soft regulatory approach) encouraged trialling and familiarisation with waste recovery methods by opinion leading practitioners (designers and builders). This led them to acquire new skills including on site sorting, waste stream quantification, awareness of high waste stream products and site management practices that generate waste which were passed on to other practitioners via change agency promotion of their achievement by blatantly exploiting their opinion leadership (Resource NSW Waste Video, GreenSmart training, Resource NSW best practice awards and case studies).

Incentives: Increased tipping fees were simultaneously introduced as both incentives and penalties leading to an attitude change (led by OLs) that recycling is both viable and profitable. This incentivised change agenda (with increasing regulatory stringency) was so successful that industry adopted the preferred practices to a high standard without a need for stringent regulation. The agenda is now expanding in line with improved economic viability of resource recovery.

Conclusion: Change agendas that address the innovation characteristics (profitability in this case) are likely to succeed. By introducing commercial viability (increasing the cost of non-compliance rather than mandating compliance), Resource NSW mainstreamed adopting its change agenda and minimised the need for compliance enforcement and monitoring by making it part of BaU.

Summary

While SP change agendas have created discernable shifts in attitude and made sound progress towards overcoming SP compatibility barriers among AHI practitioners and their clients (consumers), more needs to be done. An opportunity exists for CAs to seize on the recent wave of awareness to argue in the current SP incompatible neoclassical economic paradigm for the significant rises in resource costs that would (at least) make SP compatible with user needs. Current events provide powerful arguments to overcome previously held sceptical views and bring about shifts in socio-cultural beliefs across all adopter categories (consumer, practitioner and politician).

My AR observations suggest that increased knowledge about SP among members of each group has improved perceptions of compatibility and created opportunities for the diffusion of increasingly sophisticated SP. This leads me to suggest that developing compatible attitudes, knowledge and skill among practitioners is essential. It is also a fundamental driver of the innovation development process discussed in Chapters 4 and 6, where I argue that reinventing, refining and commercialising SP is essential to deliver cost-effective SP solutions and technologies.

3.2.3 Complexity

Rogers (2003) defines complexity as *the degree to which an innovation is difficult to use or understand* and generalises that *the complexity of an innovation, as perceived by members of a social system, is negatively related to its rate of adoption (Rogers 2003 p 257)*.

Sustainability is both an evolving science and a social change phenomenon in the AHI. As a social change phenomenon, its growth is arguably approaching critical mass with tipping points reached for climate change and water use. However, it is in its early stages as a science. Many of the practical, cost effective, quality assured, off the shelf solutions required by the AHI are yet to be invented (e.g. building materials with zero life cycle impact) or commercialised (e.g. amorphous photovoltaic coatings, approved wastewater recycling systems). This combination of variables relating to both the innovations and the social system within which they are diffusing adds an overarching layer of complexity to the diffusion of SP.

Several additional factors contribute to this complexity. Not only are the environmental impacts to be addressed diverse and complex, but validating arguments are far from agreed or proven. The precautionary principle is a good example because it was developed to overcome inaction due to uncertainty in knowledge and understanding of the multi-disciplinary causes and consequences of anthropogenic changes to the environment. The predominantly constructivist or subjectivist arguments and concepts underpinning the precautionary principle do not sit well in the objectivist or positivist industry research and development paradigm and provide fertile ground for the arguments of sceptics – no matter how likely they are to be proven. AHI risk aversion is limited to

legally enforceable standards, liabilities, warranties and time frames. The rights of future generations (or current generations in separate legal jurisdictions) currently fall outside that focus.

Complexity arising from regulatory and rating tools

Accurate measurement and rating tools have facilitated the extension of regulatory jurisdiction to partially cover the impact categories of energy and water use through mandatory minimum performance standards (BASIX and BCA 'plus'). An important outcome of these regulations is growing confidence among manufacturers and suppliers that their R&D investment in SP can be recouped through a guaranteed market. This is indicated by proliferating water saving innovations in NSW since BASIX. However, the urgency driving sustainable reform agendas means that many of these tools are being developed on the basis of incomplete or, at best, unverified data. Most are being refined and developed during application – adding additional complexity and risk. Most are too recent to have been subjected to any evaluation and arguments claiming that they are achieving little in genuine sustainable outcomes abound among sceptics (Walker 2003; Williamson 2005).

While urgently needed, post occupancy research to confirm or deny these arguments is yet to be conducted. Indeed, I argue that credible, holistic sustainability assessment for the full range of planning, development and construction fields is a critical and urgently needed component of sustainable change that is yet to be developed. Pope et al. (2004) observe: *there remain very few examples of effective sustainability assessment processes implemented anywhere in the world.* They argue for the development of an *alternative conception of sustainability assessment, with the more ambitious aim of seeking to determine whether or not an initiative is actually sustainable* (Pope, Annandale & Morrison-Saunders 2004, p. 595). While a range of assessment tools and regulatory instruments addressing aspects of sustainability have been launched globally since 2004, their focus remains impact or metric specific rather than holistic and sustainable outcome focused.

The recent publication of appropriate methodological solutions is encouraging. One such methodological approach to the holistic lifecycle assessment of housing was proposed by Mithraratne, Vale and Vale (2007) for housing in New Zealand. This outcome focussed approach includes life-time costs and environmental impact of buildings that address both design and construction (the implications of choices by both design and construction practitioners) and what happens once the building is occupied (the impact of user behaviour). In other words, it is a holistic methodology that assesses the impacts of both the home and the lifestyle of its occupants over the life span of the building.

In a similar proposal for Portuguese residential buildings, Bragança, Mateus and Koukkari (2007) observed that while the concept of sustainable building is usually related to environmental characteristics, the social, economic and cultural indicators are also of substantial importance. They

recognised that the introduction of qualitative criteria added complexity to sustainability assessment at whole of building level and added to confusion by introducing seemingly contradictory criteria (Bragança, Mateus & Koukkari 2007). Their research into building sustainability assessment using various tools agreed with Mithraratne, Vale & Vale (2007) in that it found the environmental indicators and metrics used in existing tools to often be of lesser importance than the 'soft ones' addressing occupant behaviour. Their final assessment method is based on the use of transparent, practical environmental assessment methods in the context of extended LCA (Bragança, Mateus & Koukkari 2007). Elements of both approaches are applicable in the Australian AHI context and their incorporation in an expanded regulatory tool with diverse purpose specific inbuilt metrics linked to flexible performance-based benchmarks would eliminate much of the complexity associated with sustainability assessment and compliance. This argument is developed further through prospective analysis in Section 6.3.

While BASIX has potential to be amended to meet these requirements, this must occur in a nationally consistent framework because additional complexity is generated by national and regional inconsistencies in regulations. One national inconsistency is diverse regulatory frameworks (e.g. BASIX in NSW and BCA in other states). While inconsistencies such as appropriate climate response for thermal comfort are unavoidable in many instances (See Boxes 3-7 and 3-8 below), it is important that regulators and change agencies minimise complexity disincentives by providing regionally appropriate training to practitioners and encouraging specialist consultant services (e.g. the Association of Building Sustainability Assessors) and peer education or consultant networks (e.g. SEDA's Energy Smart Allies) to reduce both risk and complexity for non-SP specialist practitioners.

While SEDA and the AGO recognised ABSA's potential contribution in this regard and provided 'incubator assistance', DoP chose to simplify thermal performance assessment in BASIX to do-it-yourself (DIY). While DIY (commendably) reduces compliance complexity for straightforward projects (e.g. many volume housing solutions), I claim that the closer linkages being developed with ABSA's specialist consultancy and skill building capacity are beneficial to practitioners involved in complex projects and will become valuable to the volume housing sector in meeting stringent future benchmarks.

Box 3-7: Clarke Davis Homes Albury Wodonga

This example demonstrates how discrepancies between versions of HERS software contributed to complexity for practitioners working on the NSW – Victorian border.

Victorian HERS software FirstRate yielded 2 stars higher rating than NSW's NatHERS on identical homes built less than 1 km apart on either side of the border. This exposed inconsistencies in the

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measurement tools and fed scepticism about the claimed effectiveness of both SEDA and SEAV's regulatory reforms. While this discrepancy has since been corrected through benchmarking of 2nd generation HERS software, other anomalies persist in state border regions or, between Commonwealth and State change agendas.

Additional complexity arises from inconsistent regulatory responses to climate variations in inflexibly applying benchmarks based on over-stated claims of accuracy in rating tools.

Box 3-8: Port Macquarie NSW. Climate zone border divides metropolitan area.

One side of the street required a distinctly different design and construction approach to the other owing to inflexible application of climate zone variations by council. While this particular problem was rectified by modifying regulations to allow practitioners to choose which climate zone was most appropriate for their site and to design at climate zone boundaries, it is indicative of the problems of complexity arising from over-reliance of regulations on the reliability and accuracy of specified rating tools rather than the use of flexible, performance-based benchmarks and compliance certification.

Nowhere are problems arising from complexity more evident than around improved thermal performance (TP) or climate responsive design. This involves skilful integration and balancing of seven interconnected and interdependent variables (orientation for passive heating or cooling, thermal mass, glazing, shading and insulation) with different combinations and permutations required for each of eight major climate zones and three main construction types (high mass, composite and low mass). While TP is among the most challenging of all SP skills required by AHI practitioners, it is also one of the most urgently needed. Practitioners traditionally accumulated the sophisticated skills required to successfully integrate complex TP variables within the host of other critical housing design parameters during a long working career. However, because of TP's contribution to household GGE reductions and its role in driving heating and cooling peak energy use, it is arguably the highest priority SP to be addressed by the AHI. Inadequate TP is also among the most difficult and expensive faults to rectify post construction. Box 3-9 demonstrates how the complexity of TP has created obstacles for change agencies.

Box 3-9: The use of First Generation HERS tools in Tropical Climates

First generation House Energy Rating Software (HERS) was developed primarily for use in cool and temperate climates. Assumptions about the value of thermal mass and the value of natural ventilation made it inappropriate for tropical climates. However, a change agency pushing for national consistency insisted on the use of 1st generation HERS software (NatHERS) in a Defence Force housing development in Darwin in 2000 to achieve a 5-star rating. The resultant buildings

were a totally inappropriate climate response for Darwin's climate requiring significantly more cooling than an average Darwin home while yielding poor human thermal comfort outcomes. This inappropriate application was publicised leading to an industry perception in NT and QLD that improved thermal performance (and in particular HERS tools) are inappropriate and unnecessary in those climates.

This perception prevails today and (at least partially) underpins Queensland's reluctance to apply BCA's nationally consistent 5-star mandatory minimum standard. Queensland is the only state not requiring new housing stock to achieve 5-star or equivalent TP on 2nd generation HERS software although it is anticipated that they will be introduced in 2008. (NSW's BASIX, while using a different methodology to BCA, calls for equivalent performance standards to the other states).

Further complexity arising from a solution to the above problem is described in Box 3-10 below to demonstrate how over reliance on simulation tools becomes problematic as benchmark creep exceeds the simulation capacity of the tools and necessitates introducing complex regulatory variations or exemptions. I assert that adopting flexible, verifiable performance-based benchmarks as an alternative to HERS simulation would overcome many of theses problems.

Box 3-10: Second Generation HERS tools – a solution or a new level of complexity?

The AGO funded development of 2nd generation HERS tools (AccuRate) to overcome the warm climate inadequacies of 1st generation tools. An important component of the upgrade was the capacity to model houses in free running mode, rewarding well designed cross ventilation and giving designers a choice between natural and mechanical cooling. During beta trialling of Accurate, it was recognised that houses designed to score well as free running could (and indeed should) never be mechanically cooled because they would be grossly inefficient. (Hockings 2006b)

Current HERS policy does not address this issue by requiring applicants to nominate whether the house is free running or conditioned meaning that open ventilated houses approved as free running can be retrofitted with grossly inefficient air-conditioning.

The above case study raises several important questions about the feasibility or usefulness of regulations that might require a designer to predict the thermal comfort needs of future occupants or, for local government authorities to regulate and restrict mechanical heating or cooling installation to dwellings with capacity to make efficient use of it. These questions are addressed through prospective DoI analysis in Section 6.3. In this retrospective analytical context, I argue that as the accuracy and sophistication of SP measurement tools increases, so too does the complexity of regulations and level of skill required to adequately comply with them.

Complexity arising from refinement and reinvention of SP innovations

For the AHI to produce genuinely sustainable dwellings, current SP innovations need continuously reinventing. Current practices, technologies and solutions can best be described as early steps in the right direction. Substantial, structured innovations (See Section 4.2) are required to achieve sustainable buildings as defined in Chapter 2. Targeted incentives encourage innovation development in a risk-averse, cost sensitive industry.

SP complexity in the AHI context means that to risk-manage adopting and applying SP innovations, practitioners require sophisticated knowledge and skills. Adoption for this group firstly means applying complex practices and skills to select, design, specify or build -in complex new products and technologies. Additionally, while the acquisition of appropriate skill levels requires a substantial financial and time investment on the part of every practitioner, additional complexity arising from the ongoing refinement of SP necessitates regular attendance at refresher courses. Current limited availability of such refresher courses means that some level of repeat attendance at training to receive updates is almost inevitable.

Ongoing innovation and refinement of SP also creates complexity problems for Registered Training Organisations (RTOs) and course developers. Course content and training materials require updating and re-structuring. Increasingly divergent skills and knowledge among trainees make it difficult to tailor training to audience needs. AHI training in SP is too recent to have developed a formal structure through which prior learning can be recognised. The majority of training in which I have undertaken an AR role (HIA GreenSmart, BDAA EcoSmart Designer, ABSA and the Building Sustainability Seminar Series or BITS) delivers a mix of motivational background material, introductory general principles and solution-oriented skills. While attendee feedback is invariably positive, learning outcomes are not measured and no formal, structured recognition of progressive skill acquisition occurs. The BITS program (Giffard & Reardon 2003) sought to address this but was abandoned owing to inadequate scoping and funding. Strategies for overcoming these barriers are further explored in Section 6.4.

A further complexity-related barrier in SP arises from the legal requirement for practitioners to assume responsibility for the proper function of those technologies and practices for lengthy warranty periods and their ongoing safety for the life of the building. In addition to the sophisticated skill levels discussed, practitioners require access to reliable, verified information and specifications for the performance standards claimed by manufacturers of SP technologies. While databases such as EcoSpecifier are reliable, detailed information is only available to paying subscribers. Additional, quality assured, openly accessible information sources are required because existing ones are often complex, confusing or inaccurate. Box 3-11 provides an example of how the rapid evolution of SP innovations contributes to an environment in which non peer-reviewed research claims by a manufacturer confused and potentially misled practitioners.

Box 3-11: Incomplete, non-peer reviewed 'research' by manufacturers ' adds to complexity.

In 2006, James Hardie® released a promotional and trade information book which claimed to provide a path through the jungle of eco-this and star-that, passive solar and active cooling, insulation and thermal mass; climate specific design strategies that give design essentials and best practice options; a grounding in the green attributes of James Hardie® products and claimed to be based on sound research (James_Hardie 2007). While including some useful information, the publication has not been peer reviewed and contains predictions and assumptions based on one-off HERS modelling of a single home in one climate zone.

Summary – Complexity

Complexity is an SP innovation characteristic that presents significant barriers to adoption and challenges for change agencies. The three main sources of complexity were identified as regulation and measurement tools, the evolution of SP and the AHI as a social system. The analysis identified three associated challenges for CAs.

Firstly, CAs should develop deeper understandings of the AHI as a DoI social system and adapt or tailor their change agendas to work with it rather than against it, to minimise conflicting advice to and from practitioners and to counter the arguments of sceptics. Secondly, CAs should move toward replacing complex, duplicitous and poorly targeted regulatory agendas with simpler, performance-based schemes that include flexible compliance paths and incorporate a range of appropriate metrics in a nationally consistent regulatory framework. Finally, CAs should actively engage in the coordinated delivery of reliable, accessible information and SP-related training and skill provision in a planned learning hierarchy, to minimise complexity barriers for practitioners and consumers.

3.2.4 Familiarity

Wejnert argues that familiarity of would-be adopters with an innovation can reduce perceptions of incompatibility arising from complexity (Wejnert 2002). Greve (1998) argues that the more radical an innovation, the more effective familiarity is in overcoming resistance owing to novelty. *Because people are naturally cautious in approaching novelty, the rate of adoption of an innovation—all other factors being equal—increases as its novelty decreases* (Greve 1998 as cited in Wejnert 2002, p. 303).

The AHI is considered to be risk averse (Berry 1999) and geared to produce repetitious standardised solutions (Commonwealth_of_Australia 1991). These characteristics are not conducive to adopting innovations perceived to be novel or radical. Because increased familiarity with an innovation decreases its novelty (Dewar & Dutton 1986; Rogers 2003; Wejnert 2002), rates of

adoption increase among adopters who are familiar with the innovations. Strategies such as regulation that familiarise would-be adopters with SP are therefore important CA tools.

Regulation stimulates SP-related discourse among practitioners, thereby increasing familiarity and decreasing perceptions of complexity. Such discourse would arguably be more effective were the regulations to address better and best practice in addition to minimum practice. Rogers (1995) demonstrated that information from homophilous sources (close peers accessed through social or organisational networks) is more influential than information from heterophilic sources (media, government or academic sources). Regulation exposes practitioners to peer discussion, expert opinion, information and training about SP. This increases their familiarity with better practice, increasing the likelihood of their adopting higher standards over time. Because BASIX facilitates trialling of better or best practice measures at design stage, its potential to increase familiarity with these SP concepts is high. I observe that this capacity of BASIX remains under-utilised due to a policy that discourages the use of BASIX to measure performance above mandatory minimum benchmarks. (Eckstein 2006) and suggest that this missed opportunity should be capitalised on.

BDAA surveys showed a 38% increase in practitioner intention to adopt best practice between 2001–2002 and 2004. The 2001–2002 survey also demonstrated that NSW practitioner confidence levels were more than double those of Victorian practitioners and less in other states) and their stated intention to adopt higher SP standards was consistently higher than other states (stated adoption intention varied between different SP). I suggest that this at least partially attributable to NSW practitioner familiarity with SP attributable to the introduction of SEDA's ESH policy some three years earlier than similar programs elsewhere (See Appendix 2). Additionally, while a significant drop in Victorian BDAA practitioner confidence relating to TP was recorded in the 2004 questionnaire immediately after the introduction of mandatory 4 and 5-star standards, the 2005 telephone survey indicated a strong rebound consistent with my arguments. The results demonstrate an important link between mandated minimum standards and the increased skill and confidence levels that sometimes lead voluntarily to adopting better practice. This link and strategies to strengthen it are addressed further through prospective analysis in Sections 6.2 and 6.4

Wejnert (2002) observed that familiarity with an innovation plays an important role in linking the usually separate sources of motivation arising from public and private consequences of adoption. While mandatory change agendas promote discussion and familiarity with the public consequences of innovations, the private consequences of change associated with such innovations rarely receive the same attention. For example, responses to regular audience questioning (by show of hands during CPD training) indicated that practitioners who specified or installed water and energy efficient appliances and supported the rationale for doing so in the homes of their clients had rarely

installed similar appliance in their own homes. In other words, they failed to translate those public consequence values into their private circumstance.

However, familiarity with innovations in the workplace was observed to trigger interaction between peers and friends (over time) that led to decisions to apply similar standards at home. Reports from individuals in AR partner organisations confirm that their decision to make this level of personal investment also influenced their adoption of related behaviours such as turning off lights and taking shorter showers – despite there being no measurable or accountable public consequences. Personal adoption also reinforced their commitment to applying best practice in the workplace and made them OLs as demonstrated in Box 3-12.

Box 3-12: Peer recommendation – opinion leadership – familiarity.

During training delivery, a sceptical sales representative asked the CEO of a large development company if he would use CFL downlights in his own home. The CEO reported that he had already installed the lighting in his own home and was very pleased with their performance. He offered to provide them to the sales representative at wholesale cost. The sales person acknowledged the CEO's endorsement as 'encouraging' and deferred a decision to install them in his own home before proceeding to ask specific questions about performance including light quality and intensity. When the CEO gave positive answers to the sceptic's questions, his final 'test' was to ask the CEO if he thought the company should make such lighting a standard inclusion in all their homes. The CEO's responded: *Get the quantity surveyors to do the sums and check volume availability and get back to me.*

The outcome was that the company did source a volume supply of comparably priced CFLs and install them as standard inclusions. However, this practice was discontinued when customer feedback indicated that the light output, warm up time and claimed lifespan for the budget range of CFLs was inferior to halogen. The CEO had installed top of the range product. The company policy now is to offer halogen as standard and offer better quality CFL or LED alternatives at additional cost. This further demonstrates the complexity-related barriers to SP adoption addressed in Section 3.2.3.

Summary - familiarity

The above analysis suggests that strategies to familiarise would-be adopters with SP (especially those associated with better and best practice) are important tools for change agencies and that familiarity with the SP associated with better and best practice should not be an assumed outcome of minimum practice regulation in isolation. Rather, regulation contributes to familiarity, which has been demonstrated to contribute to adoption of better practice in a supportive environment where other barriers such as complexity have been addressed.

Additionally, familiarity provides useful interconnection between the private and public consequences of change. Ideally, change agendas would encourage two-way transfer of familiarity induced enthusiasm for SP adoption between personal and professional adoption by practitioners because private consequences (including improved comfort and lifestyle, economic benefits and social status or pride associated with ownership) often increase practitioner enthusiasm to promote the public consequences of better and best practice adoption and vice versa. I suggest that such interaction will develop over time as adopting better and best practice SP accelerates beyond the point of critical mass.

3.2.5 Observability

Observability is *the degree to which the results of an innovation are visible to potential adopters.* Rogers generalises that *the observability of an innovation, as perceived by members of a social system, is positively related to its rate of adoption (Rogers 2003 p 258).*

In his summary of DoI on creating sustainable change at a community level in the Australian context, Robinson (2000) suggests that individuals are likely to adopt an innovation when they can easily observe the results of that innovation because such visibility stimulates peer discussion of a new idea, often leading to friends and neighbours requesting the adopter's evaluation of the innovation (Robinson 2000). I would extend Robinson's observation to include colleagues in the practitioner-focused context of this research. Observability can generate familiarity – particularly when there is a close connection between two actors in a social or work context (Wejnert 2002).

Increased availability of audience-specific case studies would be useful in this regard – especially for the first home sector. While the *Your Home* case studies in both Technical Manual and DVD (CoA 2004; Reardon et al. 2001a) format allow would-be adopters to share the experiences of designers, builders and consumers and to observe the outcomes of adopting and applying better and best practice, my questionnaire data and AR observations suggest that these resources are rarely accessed by first home buyers or marketing agents. It is hoped that the recently released *Your Home* Buyers Guide and Renovations guides (CoA 2007, 2008b) will overcome this. The *Your Home* resources are presented in the homophilous language of the practitioners and their customers and supported by expert (heterophilic) commentary (see Sections 3.3.2 and 6.2 for detail). Display homes and villages (eg GreenSmart villages, Tweed Home, Solar House Day, Subiaco and Bunbury Eco-Homes) allow would-be adopters to physically experience SP features. While these are useful to consumers, they have three important limitations.

Firstly, rapid advances in SP mean that many SP features in display homes date quickly. For example, the first HIA GreenSmart village in Jerrabomberra in the ACT was criticised by media

commentators as being 'greenwash' after only 12 months of operation, leaving HIA with no alternative but to withdraw its GreenSmart branding.

In the Nelson's Ridge GreenSmart village in Western Sydney, display homes were designed to achieve BASIX +10% while BASIX was under development (see Box 3-2). Indeed, rapid SP regulatory benchmark creep poses significant problems for volume housing in planning and designing their display homes.

A display home with a 5-year life expectancy would be designed at least one year in advance of opening, as demonstrated in Figure 8, where 'scenario analysis' for future display homes by Investa is summarised. That design needs to reflect projected consumer needs and demand up to 6 years into the future. As can be seen from Investa's predictions, demand for sustainable housing (vertical axis) was non-existent at the one-year design stage and is not expected to peak until the final operating year of a display home opened in 2007. The diagram also demonstrates industry anticipation of regulatory bar creep, utilities costs and community awareness during the life of the display home.
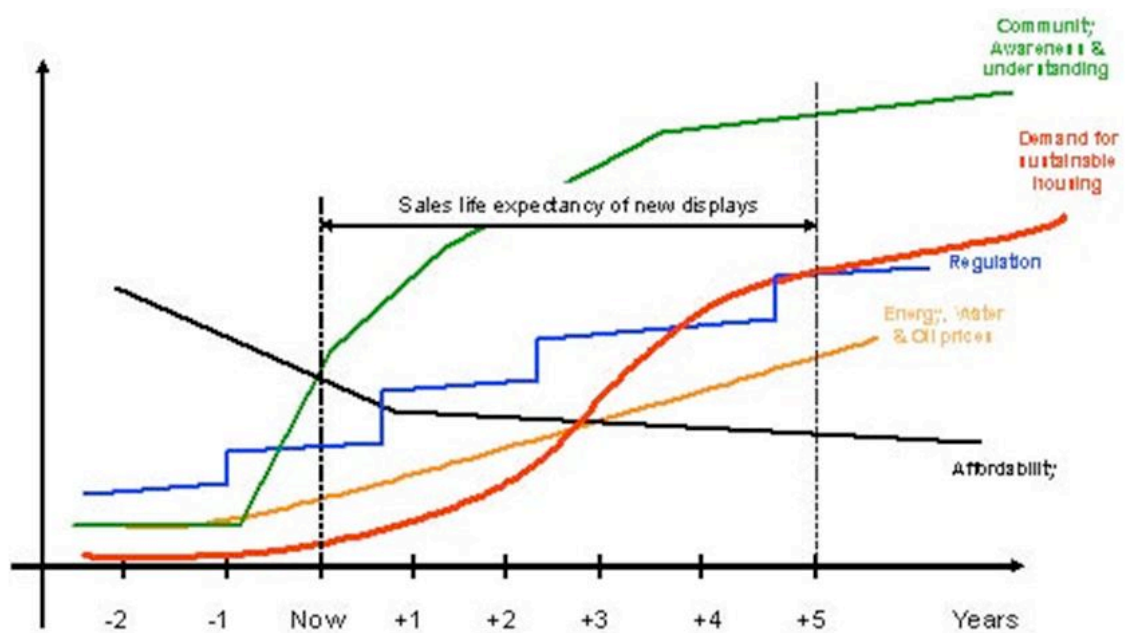
Figure 8 Future scenario analysis: Clarendon display homes. Source: (Investa 2007).

Figure 8 is intended to indicate the challenges experienced by project home companies in deciding the level of SP to include in their display homes and that they approach this task diligently. No claim is made about the validity of the data upon which the predictions are based. The red line represents Investa's predicted demand for sustainable housing; blue represents incremental and stepped bar-creep in regulatory standards; green expected increases in consumer awareness and black, the increasing affordability of SP owing to innovation, commercialisation and economies of

scale. Each of these interdependent variables has important implications for the marketability of each model.

Secondly, SP are rarely visible features and their benefits are subtle or long term. When incorporated into display homes, these characteristics do not lend themselves to the Wow! factor prized by property marketing professionals. For example, two 5-star energy-efficient display homes at Nelson's Ridge HIA GreenSmart village in western Sydney were running air-conditioners on a hot day in order to achieve a 19°C Wow, its cool in here! effect when, without because of the superior TP, the temperature would likely have stayed below 25°C air conditioning, allowing consumers to observe how the design contributed to comfort levels at no cost.

Finally, because the observability of SP is often low, display homes require well informed sales staff to show consumers what to look for and observe to promote the benefits. All too often, sales staff have little or no knowledge of the SP principles in the homes they are selling leaving visitors to make their own, often ill informed observations and conclusions. For instance, well trained sales staff (such as those at the Tweed display home) could have advised consumers entering non air-conditioned Nelson's Ridge homes to compare the superior comfort levels when visiting other less efficient homes. The importance of training marketing agents and sales staff has recently been recognised by change agencies through the initiative described in Box 3-13 below.

Box 3-13: Clarendon Homes volume housing Buyers Guide and Sales Staff training in SP

Clarendon/Investa (in partnership with several state and federal change agencies) developed the *Your Home* Buyer's Guide (CoA 2008a) in collaboration with ISF, UTS to raise awareness among their consumers. In 2007, Clarendon trained sales staff in NSW, Victoria and Queensland in marketing SP to consumers and intends monitoring the outcomes. Additional training has subsequently been delivered and evaluated. Extracts from that evaluation confirm many of the above arguments.

The vast majority of participants found the training of value and rated it as either 'helpful' or 'very helpful'.

Significantly, staff indicated that they found the Guide to be useful in a proactive way with some customers and that they felt confident about their capacity to use the Guide.

There appeared to be a movement in the level of comfort throughout the workshop series, with confidence increasing over time. A strong view was expressed that staff needed the establishment of internal processes and systems so that they have access to technical information related to the issues raised in the Guide as they require it.

There is a need to appear technically competent in front of clients and so staff suggested that Clarendon should establish an on-line question and answer system, so that they can find the answers to questions that they don't know (T_Issues_Consultancy 2008).

Summary - observability

While observability is recognised by diffusion scholars as an important driver of adoption decisions, the advantages of SP need to be experienced rather than observed. At best, they can be visualised by that small percentage of consumers who possess high-level visualisation skills. The remaining majority of consumers require assistance from well-trained sales staff who can assist in the visualisation process and direct their attention to the less obvious advantages of SP. The success of the *Your Home* Buyers Guide and Clarendon sales staff training summarised above is encouraging in this regard.

The role of experience is evident among second and third home buyers who are renowned among designers and marketing agents for being more discerning and demanding in SP features (particularly thermal performance) in their new homes because they have experienced thermal discomfort or high operating costs in a poorly designed previous home. In this sense, the SP characteristic of observability overlaps with the next, trialability. While both are powerful influences, neither is readily available or adequately promoted to first home buyers through encouragement to compare rental or family homes.

3.2.6 Trialability

The degree to which the innovation can be experienced on a limited basis. Rogers generalises that *the trialability of an innovation, as perceived by members of a social system is positively related to its rate of adoption (Rogers 2003, p. 258).*

Owing to the high cost and high risk associated with adopting many sustainable practices and technologies, trialability is very desirable for both AHI practitioners and their consumers but opportunities to do this are limited. Finding ways to offset these limitations is an important challenge for change agencies. Several AR change agendas achieved this to a limited extent by improving the observability of SP innovations for adopters before trialling. Because the trialling needs of practitioners and consumers are quite different, I will deal with each separately.

From a design practitioner perspective, thermal performance is arguably the most complex SP to get right owing to the extensive range of interactive variables that need to be balanced for each site and climate. The ability to trial scenarios is most desirable. HERS modelling tools (First Rate, BERS, AccuRate etc.) facilitate simulated trialling at design stage but are not available to or used by the majority of practitioners. Rather, owing to cost and degree of difficulty, they have become the tools of a few assessors whose skills are under-utilised in a trial sense, owing to the cost and inconvenience of using a consultant several times during the design development phase of a project, when many of the concepts may be rejected for reasons other than SP performance. The

BASIX program has made significant gains in this regard by making a user-friendly simulation tool available freely to practitioners and consumers. Interestingly, this facility was the subject of much criticism by sustainability assessors who argued that it was less accurate than HERS software (ABSA 2005; Clarke 2006a; Isaacs 2005b; Lee 2005; Pears 2005). From a trialling perspective, its performance is very different as demonstrated in Box 3-14 below.

Box 3-14: BASIX DIY as a design and trialling tool

During a facilitated discussion comparing the merits of BASIX DIY to HERS in a GreenSmart course, a licensed builder attendee who was also both an architect and an ABSA assessor recounted his experience in designing a home for his carpenter-leading hand through the following narrative.

The tradesman (client) wanted an impressive home with all modern features including large glass areas and high levels of thermal comfort. The architect was using NatHERS as a design tool and experienced difficulty explaining to his client why the glazing levels he was demanding would diminish thermal performance to the point where the building would not be approved under BASIX. The client expressed his strong mistrust of the NatHERS' modelling describing it as meaningless. Because (like most practitioners) he had no reason to invest the time and money required to learn how to use NatHERS, it remained an inaccessible black-box.

In desperation, the architect entered the project data into BASIX' DIY thermal modelling facility and suggested that his client should solve the problems himself. The tradesman reportedly spent all weekend modelling solutions through BASIX' user-friendly interface using the interactive advice to explain his failures and applying the recommended solutions. He returned to work on Monday declaring that he now understood why the glazing was problematic and accepted all the previous recommendations from his 'genius' boss.

Lack of opportunity to adequately trial SP is problematic for design practitioners in relation to quality assurance and liability for products and solutions they specify. From a practitioner perspective, quality assured 'product development' depends on extensive trialling and evaluation in real life applications over long periods and this applies equally in the case of SP. However, because of the associated costs and risks, practitioner capacity and willingness to trial SP in projects is limited. Instead, practitioners rely on research by others that is often incomplete owing to the relatively recent emergence of SP as a research field. This lack of rigorous, independent research combined with regulations based on partial understandings unfairly disadvantaged some industry sectors and led to vested interest groups using less rigorous research (often in house) to maintain or increase market share. (See Box 3-11 relating to a publication by James Hardie and Box 3-15 and Box 3-16).

Box 3-15: *Your Home* Fact sheet written by a sponsor allowed to bypass peer review.

Sponsorship earned Austral Bricks® the right to author a Clay Brick fact sheet in the *Your Home* Technical Manual, Edition 3 (Reardon et al. 2001a) which was not subjected to the same peer review and editing standards as other fact sheets in the manual. The fact sheet departs from agreed Communication Strategy (Reardon & Penman 2000) and introduces new terminology to create a favourable 'spin' on the embodied energy of brick. Austral then cite YH (Fact Sheet 3.4g) to support their arguments about consensus with their own research findings (Austral 2006).

This fact sheet was re-written in the 4th Edition of YH (to be published in 2008) to make it consistent with other fact sheets in the publication. I suggest that the continued inclusion of fact sheets in YH that address selected construction systems (often chosen on the basis of sponsorship or lobbying) sends a confusing message to consumers and practitioners about the relative sustainable performance of those systems not included.

Whilst often useful, privately funded research that adopts a specific focus or methodology preferred by the sponsor can add to complexity for practitioners and consumers.

Box 3-16: Manufacturer funded research slow to integrate with existing body of knowledge.

Brick company Austral investigated accepted performance assumptions in HERS and found inconsistencies in the actual performance of double brick construction in some climates. In response, Austral and Think Brick sponsored independent research into thermal performance of uninsulated double brick buildings and challenged the accepted HERS assumptions (Austral 2006; Sugo, Page & Moghtaderi 2004, 2006). This research involved construction and monitoring of the 'real climate' thermal performance of several test buildings using common construction systems.

While making a significant contribution to knowledge in the thermal performance field, publication of the research to date has been selective and its presentation to industry often associated with promotional publications, thus restricting rigorous peer review and creating uncertainty in industry about its validity. In response to criticism and requests from industry experts, Think Brick have now made their research findings available to other researchers for peer review.

An additional complication arises from the use of different climate data and terminology creating subtle discrepancies between these findings and earlier research and making it difficult to compare, evaluate and integrate the outcomes. The development and application of standardised metrics, methodologies and databases for research could ultimately overcome this problem but may not suit the marketing and product differentiation requirements of its sponsors.

I posit that a proliferation of research with claims and counter claims from supplier sectors (e.g. high mass versus low mass construction sector or bulk insulation versus reflective insulation) has already created significant confusion among would-be adopters and that without standardisation, such research may become a significant adoption barrier.

From a consumer perspective, Life Cycle Costing (LCC) advantages are an important source of relative advantage but unfortunately, this awareness is best learnt through experience or trial. Discussion with SP specialist practitioners (Clarke, Hockings, Sederof and Wheeler) during AR activities confirmed that, in their experience, second home owners are far more accepting of LCC considerations than first home buyers. These observations confirm my own as a reflective practitioner and were confirmed by comments from practitioners attending CPD training. Indeed, specialist practitioners report that the majority of their clientele are 2nd and 3rd home owners. This presents a 'catch 22' situation for SP developers and would-be adopters facing an urgent need to adopt expensive and yet untested SP and market them to the first home owner sector.

Trialling SP in actual projects (rather than case studies or simulation) is the domain of innovators, early adopter practitioners and their clients. Opportunities are limited for later adopters – especially the low volume practitioners who need to draw on the experience of others. CA subsidies or sponsorship are often used to offset the additional cost of sustainable features and encourage one off innovator decisions to trial otherwise high risk innovations. The outcomes are often publicised by manufacturers, suppliers and CAs as evidence of trialling for other practitioners. However, unless carefully presented, these one-off, sponsored trial adoptions are open to claims of bias that devalue claimed benefits and spawn scepticism about economic advantage. Notwithstanding these risks, one-off trial adoption presents significant opportunities for change agencies to encourage best practice competition in this sector and publish the outcomes in lieu of first hand trialling and observation by later adopter groups (e.g. the YH DVD and case studies).

In addition to the above publications, CAs also sponsor best practice awards and promote the winners and finalists as best practice case studies. This type of opinion leadership proved effective. Initially, the diffusion effect of competition was most evident in the medium to high-budget market sector but spread to the cost-sensitive sector as evidenced by recent growth in the number of volume housing sector companies using SP performance in their market differentiation strategies in the form of 'green packages'. For example: Clarendon Residential (Victoria, NSW and Qld.); Burbank Homes 'Futures Collection (Vic.); Henley's 'Verve Collection'(Vic.); Metricon's 'Shades of Green' (Vic.); and Cosmopolitan's 'Sustainable Design' series(NSW).

This argument is supported by the evolution of GreenSmart Awards in terms of both number and standard of entries since 2001. Early entries were one-off, high budget projects or owner-built

alternative projects with little appeal to the mainstream market. However, by 2005, the project home category was contested strongly and several highly commended awards were given. HIA split the category into two for 2006 as demonstrated in the Box 3-17.

Box 3-17: GreenSmart: prestigious awards, network development, promotion and training encouraging SP trialling and adoption of SP by the volume housing sector.

This case study demonstrates the role of HIA GreenSmart in communicating the outcomes of limited trialling of SP to practitioners by: encouraging skill and technology transfer from custom to volume housing sectors; encouraging technology commercialisation through sponsorship and network development and incentivising practitioner skill acquisition.

Awards: First launched in 2000, the GreenSmart Awards competition attracted very few entries despite active encouragement by HIA. Additionally, the standard of SP achieved by those early entries was minimal. Since 2000, both the number of entries and categories has grown progressively each year (except for 2006), until in 2007 there were 82 entries in 16 categories with the two volume housing categories being among the most highly contested. The judges' comments (including my own for five of the eight years) indicate that the standard of SP embodied in the entries improved significantly each year from 2000. The winners were widely promoted through industry media.

Network: In 2002, there were 16 GreenSmart Industry Partners and in 2007, the total was 72 (comprising: 14 GreenSmart Leaders, 6 National GreenSmart Partners and 52 Regional GreenSmart Partners). This network which includes CAs, manufacturers, suppliers, developers and consultants, is central to the diffusion process because it: disseminates information about SP (especially new technologies, practices and regulations); legitimises and adds prestige to the diffusion process for both consumers and practitioners and; provides a forum through which individual practitioners can observe, discuss, learn and adapt SP innovations to their own context.

Promotion: In addition to awards, HIA's GreenSmart developments, villages, display homes and badging of individual projects according to licensed and upgraded protocols provide an opportunity for practitioners to promote and market test their trial adoptions and for consumers to observe, compare and familiarise themselves with various SP advantages, often leading to adoption.

Training: training program commenced in 2002. Over 3000 GreenSmart Professional practitioners had completed the introductory training by 2007 and GreenSmart is a nationally recognised SP 'brand', with growing numbers of consumers ranging from Landcom NSW to individual home owners using HIA's GreenSmart Professional directory to identify practitioners with SP skills and interest. While skill and competency quality assurance for GreenSmart Professional is in the early stages of development, its rapid progress and growth in demand is encouraging and indicative.

The costs and challenges associated with trialling SP created barriers for some companies attempting to implement SP principles for the first time and this was observed to feed the arguments of sceptics in those organisations. For example, Masterton, Bellevale and Allam Homes in NSW undertook whole of company GreenSmart training during 2004-5 and, while committing to implementing GreenSmart principles in their products and trialling it in several, they cite a lack of market demand for their subsequent lack of progress. Regulation (and particularly benchmark creep) ensures a 'level playing field' in which businesses committed to adopting SP have a market advantage over their competitors in offering better performing homes (SP) at lower cost owing to their experience trialling SP in display homes.

Larger greenfield and brownfield developments by semi-autonomous Government agencies such a Landcom in NSW, VicUrban and (to a lesser extent) Landcorp in WA have been successful in accelerating diffusion by encouraging trialling among land developers and builders. Several examples exist including Rouse Hill, (Landcom 2002) and Aurora, (VicUrban 2002) (see Box 3-18). These agencies are in an atypical position because they have a mandate to lead the profession and set high SP performance benchmarks for developers wanting access to desirable land assets being disposed of by governments. Other CAs must find alternative incentive strategies.

Box 3-18: VicUrban' Aurora Project.

Aurora is a VicUrban new master-planned community of some 7000 homes in Melbourne's north which aims to set a new benchmark in sustainable urban development (VicUrban 2004a). Like Landcom in NSW, VicUrban is a corporatised Victorian Government land development agency, charged with delivering commercially viable urban development projects while implementing sustainability in their strategic planning and everyday operations. VicUrban are developing and trialling a Sustainability Charter which includes a number of innovative strategies to manage the implementation of its SP policy and to assess performance against goals.

The expected outcome from this trial is a framework for planning and implementing SP in urban development that includes organisational strategies, sustainability indicators which mirror the five core objectives of VicUrban and an environmental performance benchmarking tool that identifies eight priority areas: energy; water; transport; indoor air quality; building materials; waste; sites; and atmosphere. The benchmarking tool includes both mandatory hurdles requirements and optional performance measures. (Hurley & Horne 2007)

VicUrban has already generated transferable outcomes including the EcoSelector tool (VicUrban 2004b) based on RMIT research (Sibley, Hes & Martin 2003), and a published set of working examples used nationally by educators (e.g. GreenSmart, BITS) to demonstrate how high levels of

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SP can be achieved in mainstream volume housing projects at minimal cost and with minimal disruption of the BaU paradigm.

Summary - trialability

The encouragement of trialling has been an important component of several successful change strategies in diffusing SP among practitioners. Custom designers and builders are often the most innovative. This gives them both incentive and budget to trial innovative SP approaches. While the custom design and build sector remains the most prolific source of best practice case studies (owing to ability to attract one-off clients who are less cost and risk averse), rapid increases in both the volume and sustainable performance of volume housing entries in an expanding range of SP awards indicates that SP diffusion is progressing rapidly.

For the most part however, the outcomes of these trials are yet to be adequately communicated to consumers by CAs. In the absence of this final critical step, trial adoptions of better and best practice are less likely to translate into permanent adoption outside the artificial incentive environment created by specific change agendas unless they are mandated. I claim that a shift in change agency focus from design and construction practitioners to sales and marketing practitioners will rapidly accelerate SP diffusion beyond critical mass by increasing the number of award winning display homes be visited, observed and trialled by consumers. These arguments are explored further through prospective DoI analysis in Chapter 6.

3.2.7 Conclusions related to analysis of SP as DoI innovations

From the above grounding and analysis of AR observations in diffusion theory, I make the following arguments about the role of the innovations associated with SP in determining rates of adoption.

SP innovations are complex and have few immediately apparent benefits for would-be adopters – especially those who adopt later in the diffusion process. Additionally, they are difficult to observe or trial. Their compatibility and relative advantage in the current industry BaU paradigm is limited owing to cost sensitivity and risk aversion. The need to reinvent SP means that few of these adoption barriers are likely to be offset or overcome through familiarity in these groups over time and yet the reinvention is critical to developing and commercialising effective solutions.

In other words, while R&D reinvention represents a short-term diffusion barrier in terms of complexity, it is essential to overcome another barrier, the medium to long-term relative advantage of SP. This atypical (in diffusion terms) characteristic of SP requires special attention at many levels in each change agenda. While stimulation and encouragement are essential to deliver cost effective

and innovative SP, its adverse diffusion impacts in terms of complexity, familiarity, observability and trialability need to be offset through provision of flexible regulatory compliance paths in combination with effective skill delivery and accessible information databases.

In DoI terms, SP innovations possess very few of the attributes considered by diffusion scholars to be favourable for adoption. Indeed SP embody many undesirable attributes that have been associated with innovations that failed to diffuse.

Based on the above retrospective analysis of SP innovations, I argue that the technological characteristics of SP innovations create barriers in the socio-technological sustainable change processes at work in the AHI. In Chapter 6, I draw on this argument to suggest that a greater change agency focus on the sociological aspects is required to overcome them. In the next section, I use DoI analysis of my AR to draw deeper insights and understandings of the role of the AHI social system in the diffusion process. This informs the prospective analysis in Chapter 6 through which I explore ways to increase the effectiveness of AR change agendas in creating socio-cultural paradigm shifts in sectors of the AHI social system.

3.3   AHI as a DoI social system

3.3.1   Overview

In 3.2 above, I examined the role of the innovations in the diffusion process. Here, I examine the role of the adopters themselves in that process. Housing consumers, practitioners, researchers and suppliers are analysed as DoI *adopters* in the AHI *social system* to identify opportunities for, and barriers to, rapid adoption of SP. In the broadest terms, any person or organisation involved in the production or end use of a residential building is a potential SP adopter in the context of this research – albeit with differing roles, needs, language and expectations. Analysis of the complex, interdependent interactions between adopter groups and categories in the AHI societal system is fundamental to understanding the role of those adopters in the diffusion process. Indeed, network interaction is arguably the most important single variable in the SP diffusion process in the AHI. Accordingly, I further analyse the role of network interactions between adopter groups in Actor Network Theory (ANT) in Chapter 5.

Because my research focuses on the diffusion role played by CAs, my analysis commences in Section 3.3.2 by examining the communication and influence channels available to or applied by them in the diffusion process to identify associated barriers and opportunities. I then apply decreasing levels of analytical focus (referred to as micro and macro level) to examine the role of both individuals and organisations in the diffusion process. In Section 3.3.3, individual practitioners, consumers and change agents are categorised for analysis at the micro level according

to the important DoI adopter variable, 'innovativeness'. This explains why some individuals adopt SP earlier than others and delivers insights into how and why some change agendas were more effective than others in certain AHI sectors. Next in Section 3.3.4, I apply the above innovativeness-based definition of AHI adopters at macro level by grouping individual adopters according to their role in industry and examining their collective interactive influence through organisations including industry peak bodies. This provides insights into the role of these bodies in the diffusion process. Finally, in Section 3.4, I summarise my retrospective AR analysis of the AHI as a DoI social system by identifying those characteristics with further change creation potential for prospective DoI analytical focus in Chapter 6.

3.3.2 Communication and influence channels used by CAs

In this section, I examine AHI communication methods within DoI theory to explain their role in SP diffusion with a particular focus on the effectiveness of their use by change agencies and their agents. Analysis of the communication methods applied by CAs during AR illustrates how complex interactions between a diverse range of actors in the AHI social system influenced decisions by both individual and organisational adopters of SP. Through this descriptive analysis, I demonstrate the critical importance of the social system itself in driving the diffusion process and establish a baseline of understanding that is expanded through ANT analysis in Chapter 5 to support detailed prospective analysis of how it might be improved in Chapter 6.

Defining opinion leaders (OLs), change agents and change agencies (CAs)

Rogers (1983) defined opinion leadership as *the degree to which an individual is able to influence other individual's attitudes or overt behaviour informally in a desired way with relative frequency* whereas change agents were defined as *individuals who influence clients' innovation decisions in a direction deemed desirable by a change agency in a professional or semi-professional role (Rogers 1983, pp27–28).*

I argue that the DoI distinction between change agencies and change agents is more relevant in product or technology diffusion studies where an agency might be the parent company and the agents its sales persons. In this research context, where the analytical focus is change creation, the diffusion of the practices and behaviours associated with that change are pre-requisite to adopting SP technology. Accordingly, I define a change agency as a government body or NGO tasked with creating and implementing specified change policy in a target audience. In this context, change agents can range from government departments to companies who stand to gain from SP change (e.g. manufacturers of glass, insulation or renewables) and individual SP expert practitioners whose roles vary from professional change agent to unpaid OL. In other words, the roles often overlap. I use the terms change agent and change agency interchangeably in the acronym CA and distinguish between the

two only when the agent's actions contradict one or more of the agencies involved or, where the agent becomes the source of policy – effectively changing agency policy.

Homophilous and heterophilous communication

An OL's role is typically homophilous, *earned and maintained by the individual's technical competence, social accessibility and conformity to the system's norms* whereas change agent roles are often viewed by the system as heterophilous or outside the system norms. (Rogers 2003, p. 27) Homophily is the degree to which interacting individuals are similar in socio-economic status, education and cultural beliefs whereas heterophily is the degree to which they differ. Heterophily between clients and OLs can add to perceptions of competence and credibility whereas homophilous OLs are perceived as having safety credibility (i.e. not a snake oil salesman). Both communication types have useful roles.

Ideally, an OL or change agent who has previously adopted an innovation that he or she is promoting will have an ideal mix of homophily and heterophily yielding credibility in both competence and trustworthiness. Rogers (2003) notes that the better educated or 'elite' the client group, the more likely they are to view the change agent as homophilous. He generalises that positive outcomes from change agent contact are more likely when their clients (the adopters) have higher socio-economic status, greater social participation, higher formal education and *'cosmopoliteness'* (ibid p. 381-383) These generalisations were confirmed for the AHI through AR and are demonstrated through the following case study analysis.

My AR role began as a homophilous OL in the BDAA advocating the adoption of SP to fellow practitioners by explaining the principles and methods involved and demonstrating the benefits adoption had brought to my practice. During the course of my AR, my role transferred to one of change agent – working on behalf of change agencies (e.g. SEDA and the AGO) to influence both design and building practitioners and occasionally, other change agencies (e.g. DoP). In the early stages of diffusion, an innovative OL can be seen as heterophilous (as indeed I was to many non-innovative practitioners in the BDAA). As the diffusion process progresses, group norms and values change and innovative OLs again assume homophilous status. This is summarised in the following case study example.

Box 3-19: Homophilous v heterophilous OL communication. BDA NSW

Reardon and Clarke were engaged by SEDA in the mid- to late 1990s as OLs in the BDA NSW. Initially, Clarke and Reardon's communication was homophilous (practitioners communicating to peers with similar background and professional status). An unforseen outcome of Reardon and Clarke's roles as OLs was that the associated promotion of Suntech Design and Envirotecture as practices specialising in EE attracted innovative clients with particular interest in EE.

Over time, Reardon and Clarke's specialisation resulted in their communication to the same audience group being perceived as heterophilous (individuals with dissimilar knowledge, skills and professional status communicating to their peers as experts whose knowledge and opinions had less relevance in their own work). Until the introduction of SEDA's ESH Policy with mandatory EE requirements by Councils in NSW from 2000, further diffusion attributable to opinion leadership by Clarke and Reardon was limited. Mandatory EE requirements required practitioners in later adopter groups to seek information about the innovations promoting re-acceptance of Clarke and Reardon in a heterophilous or expert context.

An interim measure that succeeded in overcoming these perceptions among practitioners was the introduction of Wheeler (and others) as OLs. While Wheeler's high profile as an architect and academic created a heterophilous audience perception, his primary messages about EE and other SP were presented in a broad context of good design that was perceived by the audience to be homophilous. While Wheeler's stance on SP was clear, laggard and late majority attendees at CPD were able to relate it to their own circumstances easily through association with the homophilous good design content in his presentations. In other words, Wheeler did not focus quite as exclusively on technical aspects of SP as Clarke and Reardon. The usefulness of this approach was quickly recognised and subsequent CPD presenters were drawn from diverse backgrounds. Clarke and Reardon were then able to specialise as presenters who communicated the specific how to skills required to deliver the built outcomes presented by Wheeler and others in their generalist good design context.

I argue that similar issues may (at least partially) explain the current focus by change agencies on practitioner groups and the relative lack of progress in diffusing SP in consumer groups. Where perceived by clients as heterophilous, communication by change agents through homophilous OL aides is a useful strategy. Certainly, this is confirmed by the practice-based experience summarised in Box 3-20 below. I argue that the success of the now renamed Solar House Day program can also be attributed (at least partially) to homophilous communication between solar home-owning OLs and the would-be adopters who visit them.

Box 3-20: Overcoming heterophilous barriers in designer/client communication.

A communication barrier arose between me (as a design practitioner) and Client 1 during the design phase of a project in 1998. Client 1, who had a west facing block with substantial views, demanded large areas of glass facing in that direction – choosing to ignore my advice that the views could be captured obliquely through passive solar oriented glazing oriented 15⁰ west of solar north. Additionally, the client refused to consider the double glazing and shading solutions suggested –

asserting instead that he would rather *solve the problem by pushing a button on his heating and cooling system* – a solution he stated was preferable owing to his 'superior' socio-economic status.

The communication reached an impasse owing to heterophilic differences and, because there were no regulatory requirements relating to thermal performance at the time, I withdrew from the project. The problem was circumvented some 12 months later during homophilous communication between Client 1 and another client (Client 2) whose home Client 1 had rented while searching for another designer. Client 2's site had similar orientation problems but Client 2 had been innovative in his decision to adopt passive design. After 'experiencing' or 'trialling' Client 2's home for 12 months and finding it to be comfortable with minimal heating or cooling requirements, Client 1 asked Client 2 to explain passive design principles to him. Because of their homophilous socio-economic and educational status and a 12-month trial living in Client 2's home, Client 1 decided to adopt SP in his own home and again approached me to complete the project. Client 1 has become a powerful OL, recommending SP housing solutions to all and sundry.

The role of opinion leaders (OLs)

The importance of frequency of interactions with OLs by network members as a diffusion driver was first recognised by Katz and Lazarsfeld in their examination of the role of mass media in the diffusion process (Katz & Lazarsfeld 1955). Valente investigated and described personal network thresholds (the point at which an individual decides to adopt an innovation) and defined them according to the number of OLs that a potential adopter might need to be exposed to in order to make a decision to adopt. He observed that OLs have lower thresholds than later adopters and influence individuals with higher thresholds. Valente observed that the later the adopter category, the more opinion leadership an adopter required and argued this accounted (to some extent) for variations in adoption times between categories (Valente 1995).

In the AHI context, early adopters made their decisions to adopt SP owing to interest or innovativeness from the 1970s onwards (Source: BDAA and RAIA questionnaires) but few mainstream practitioners from later adopter groups were exposed to sustainable innovation leadership until the late 1990s when the rollout of sustainable change agendas commenced by governments (see AR case studies below). However, from late 1990s until the early 2000s, change agencies targeted OLs in their campaigns to promote the voluntary adoption of SP (See Box 3-21 below). More recently, they have relied on regulation to drive adoption and opinion leadership has become a less popular option. In the following case study, I compare the strengths, weaknesses and effectiveness of each of these strategies in DoI theory to identify opportunities and threats.

Box 3-21: Comparing ESH, BCA and BASIX in terms of the adoption drivers used and the outcomes achieved to illustrate the role of opinion leadership.

Opinion leadership and regulation are both important adoption drivers. During AR, I observed change agendas that utilised both drivers to deliver better outcomes than agendas that applied one or the other. While SEDA's reliance on opinion leadership and voluntary adoption in the initial stages of diffusion of its ESH policy was slower and less likely to deliver high adoption levels than agendas involving mandatory diffusion drivers, it led to the adoption of significantly higher standards of practice among early adopters. On the other hand, BCA, which relied entirely on mandated adoption, achieved adoption rates approaching 100% but tended to achieve the lowest common denominator of compliance among most adopter groups (innovators and early adopters were the exception).

In contrast, adopting SEDA's ESH policy was voluntary on the part of councils but then became mandatory for practitioners working in those adopting councils. SEDA focused its change agency at two levels - councils and individual practitioners. In both cases, SEDA relied almost entirely on peer leadership as the adoption driver in the initial stages but, as more councils adopted the ESH policy, ESH adoption rates began to resemble those of BCA.

Because ESH had begun as a voluntary initiative, SEDA had the opinion leadership resources of many early adopters whom it had groomed as OLs through its Energy Smart Allies and awards programs. These OLs had adopted best practice SP and SEDA were able to value add the ESH minimum practice mandatory adoption drivers through opinion leadership. The outcomes speak for themselves with the ESH program being ranked among the most successful AHI SP change agendas by many experts.

BASIX approached the challenge of achieving 100% compliance rates while maintaining high level outcomes by a different path again by mandating minimum practice through a tool that could also measure better and best practice. While BASIX has the potential to drive voluntary best practice through opinion leadership, DoP is not utilising this potential and BASIX outcomes have tended towards minimum practice. While DoP argues that minimum compliance by the majority is an inevitable outcome of broad-scale mandatory targets, I contend that not using BASIX' capacity to drive better and best practice adoption by a minority is a missed opportunity.

Monomorphic and polymorphic status of opinion leaders and change agencies

The range of topics addressed by an OL or CA has implications for the effectiveness of their communication role. These implications vary according to both the type of audience and its stage in the adoption decision process.

A polymorphic OL is an individual who acts as an OL for a range of topics whereas a monomorphic OL leads opinion with single topic expertise (Rogers 2003 p 314). Rogers generalises that in the early stages of diffusion, monomorphic OLs are often recognised as having specialist knowledge and application skills that make them sought after in the early, knowledge gathering stages of diffusion (e.g. when practitioner adopters first hear about SP), whereas polymorphic OLs are perceived as being too generalist and less likely to have equivalent knowledge levels (ibid). As the diffusion progresses and adopters become informed in the innovation and are considering trialling it (e.g. the full range of SP innovations and the need to avail themselves of synergies between the fields), monomorphic specialists become less popular (ibid). While the example in Box 3-22 below is drawn from my AR roles in the BDAA and my own practice, I suggest that it is valid for other practitioner groups on the basis of participatory observer roles in other AR change agendas.

Box 3-22: Suntech Design: shift from mono to polymorphic focus as SP diffused.

This example demonstrates how the sequential adoption of innovations associated with SP minimised complexity and, that while the simplification aspects of this sequence are relevant to both early and later adopters, relative advantage diminishes for later adopters. Secondly, it demonstrates how the role of opinion leadership (and change agency) needs to remain fluid to retain relevance during the diffusion process. Finally, the example demonstrates how the market advantage enjoyed by early adopters is decreasingly available to later adopters because of saturation and therefore should not be directed to later groups CAs as an incentive to adopt.

Initially, Suntech Design became known for its energy efficiency expertise. Clients, other design practitioners and industry organisations sought this type of monomorphic consultancy and opinion leadership. As energy-efficient design skills diffused in the BDAA, this demand would have diminished had Suntech not expanded its focus to include water efficiency, environmentally preferred materials and indoor air quality. Each of these in succession (including the final stage, holistic sustainable solutions) maintained or increased demand for Suntech's specialist SP skills and opinion leadership. Similar experiences were reported through personal comments by other designers (Clarke and Sederof) and observed in the RAIA (Wheeler, Cole and Baggs).

Mono and polymorphic differentiation also applies to CAs – particularly in situations where CAs adopt OL roles – either by delegation (through linked and managed associations with OLs) or by networking in the AHI system as OLs in their own right. Demand for monomorphic agency was observed to decrease as the diffusion process progressed. I suggest that this is because monomorphic focus facilitates rapid recognition and alliance building in industry networks whereas polymorphic agencies are less recognisable. For example, the CAs SEDA and the AGO were highly effective during their relatively short life spans because they were established with short term,

specialist mandates to initiate changes and were transformed into (or consumed by) more mainstream agencies after initiating those processes.

The role of change agencies and change agents

Rogers identifies seven change agent roles and suggests a preferred sequence for their application (Rogers 2003, pp. 369-370).
1. developing a need for change in others
2. establishing information exchange relationships
3. diagnosing problems
4. creating intent to change
5. translating intent into action
6. stabilising adoption and preventing discontinuance
7. achieving a terminal relationship by shifting new adopters from CA reliance to self-reliance.

I critique the agendas of AR change agency partners according to their performance in these roles throughout my retrospective DoI analysis in Chapters 3 and 4 and ANT analysis in Chapter 5 to explain why some succeeded while others encountered unexpected barriers. I briefly expand on each of Rogers' roles below to explain my interpretation and application of them in this research context and in so doing, have adapted Rogers' sequence above to better match my AR experience and align with ANT's four stages of configuring an actant network (Callon 1986) applied during ANT analysis in Chapter 5.

1. Diagnosing problems: equates to the DoI needs or problem identification stage of the adoption decision process and ANT's problematisation phase.
2. Establishing information exchange relationships: relates to the DoI adoption decision stage of seeking knowledge about an innovation and the ANT interressment phase.
3. Developing a need for change in others: most valid during the DoI persuasion stage of the innovation decision process or ANT's interressment phase of network configuration.
4. While this is arguably among the most important challenges facing CAs, it is also an area in which many have failed.
5. Creating intent to change: equates to DoI decision stage and the ANT enrolment phase.
6. Translating intent into action: equates to the DoI implementation stage and to the ANT mobilisation phase.
7. Stabilising adoption and preventing discontinuance: DoI confirmation stage and ANT transformation from mobilisation phase to 'black-box'.
8. Achieving a terminal relationship by shifting others from reliance on the change agent to self-reliance. DoI confirmation or sustained adoption stage and ANT 'black-box'.

Summary

This section explained important DoI concepts relating to communication and influence channels in the AHI (especially opinion leadership) and defined important DoI terms used to describe and analyse communication. Analysis was limited to illustrative examples because these concepts and terms are applied in retrospective analysis throughout the remainder of this chapter and Chapter 4.

While the analysis and case studies above indicate that the use of OL by CAs has played an important role in raising AHI awareness of SP, the extent to which it has contributed to the actual adoption of SP is less obvious because at any given time, several adoption drivers are in play. Examining pre-regulation adoption gives a clearer indication although even this is difficult to analyse in DoI theory because of limitations in the framework's capacity to plan or analyse change agency strategies. For example, SEDA's heavy reliance on OL in the rollout of its successful ESH policy provides a clear indication that OL worked but the question remains, was that leadership more or less influential than the financial incentives, network building and promotion components of the agenda? These questions are further addressed through ANT analysis in Chapter 5.

3.3.3   Micro analysis of adopters

Here, I apply Rogers' method of categorising adopters according to innovativeness (See Sections 1.4 and 1.5 for theoretical basis) to establish an analytical basis for my explanation of AR observations through retrospective DoI analysis. This micro level analysis of adopters based on their willingness to try new methods and technologies yields insights into the motivations and pre-requisite adoption needs of categories of adopters in each industry group. It identifies both barriers to diffusion that need to be overcome and, viable strategies for increasing future adoption rates.
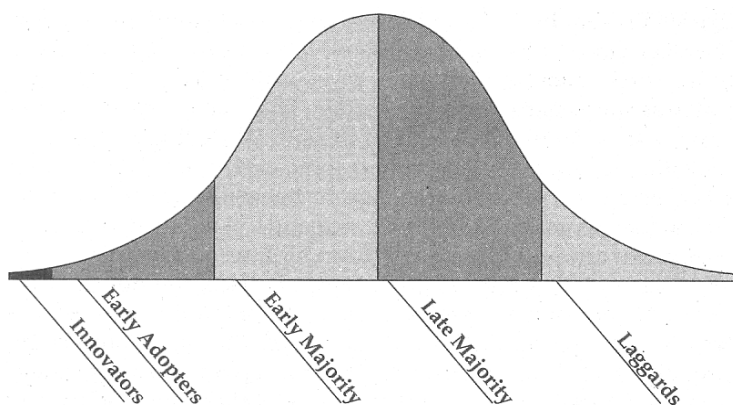
Figure 9: Sequential involvement of decreasingly innovative DoI adopter groups over the lifecycle of adoption of an innovation (Adapted from Moore 1999)

The adoption sequence and relative proportions of each adopter group common to countless studies of the successful diffusion of a diverse range of innovations are summarised in Figure 9 above. While this figure suggests that the diffusion of an innovation is a discrete event, the

diffusion of SP innovations in the AHI requires a flexible interpretation of the adoption sequence implied above. The AHI's diffusion process differs from those described for a number of reasons.

Firstly, minimal standards of SP have only recently been adopted by the late majority of AHI practitioners in many jurisdictions and this group made this decision because of regulation (see Authority decisions Section 4.1.4) not the informed choice commonly assumed by diffusion analysts. At the same time, innovative practitioners are adopting a range of better and best practice SP at varying rates. Analysis of interactive outcomes arising from the mutual influence of these 'parallel' adoption scenarios provides a rich source of insight into the AHI adoption process.

Additionally, SP (both practices and technologies) are continually evolving through a process often referred to by DoI scholars as reinvention. In other words, rather than adopting a single technology or practice, AHI adopters are adopting a series of interdependent innovations. That said, analysis of progress along the adoption curve at a given point in time or, for a specific aspect of SP provides useful insights into the differing needs of adopter groups as they become engaged by change agendas. These insights inform the evolution of change agendas, ensuring that they best meet the changing needs of adopters throughout the entire diffusion process, and are analysed further in Chapter 6 in order to argue for different CA approaches.

Through the following generalisations, I summarise my AR observations about adopter innovativeness by broadly categorising members of the industry practitioner groups identified above in the most commonly encountered innovation category. The qualitative assumptions underpinning this categorisation are drawn from successive cycles of iterative analysis of my AR observations in DoI over nine years and, on reflective analysis of my previous 20 years of participation in this arena as both a design and building practitioner.

Generalisation 3.3.1: Innovators: Typically venturesome individuals with sophisticated communication networks, substantial financial backing to underpin possible losses, capacity to understand and apply complex technical knowledge and low risk aversion (Rogers 2003, p283). In this context, AHI innovators are often researchers, designers, government advisers and regulators who recognise problems, invent solutions or develop policies to drive their diffusion.

Generalisation 3.3.2: Early adopters: Typically, this group is respected members of the local social system whose judicious innovation decision-making record exerts strong and effective opinion leadership by giving innovations their 'stamp of approval' by adopting them (Rogers 2003). In the AHI, this group include leading design practitioners and their clients working (at least partially) in less cost-sensitive and less risk averse sectors of industry who develop solutions, demonstrate achievability, drive competition and deliver working examples.

Generalisation 3.3.3: Early majority: This group is usually well connected in the social system and communicate with OLs but seldom take on that role. They deliberately adopt new ideas just ahead of the average adopter (ibid). In the AHI context, they are the mainstream operators seeking a competitive advantage (e.g. GreenSmart builders and their designers). This group commonly drives the commercialisation of new technology and solutions through negotiation with suppliers and manufacturers and may provide regulators with indicators of the AHI's capacity to accommodate regulatory bar creep.

Generalisation 3.3.4: Late majority: The hallmark of this group is scepticism (Rogers 2003). Robinson describes them as *environmentally conservative pragmatists, uncomfortable with green ideas…*[who are] *often influenced by sceptics* (Robinson 2000, p. 43). In this research context, I observe that this group typically is practitioners engaged in the most cost sensitive, risk averse market sectors, whose decisions to adopt SP are driven by a combination of regulation and competition from peers. Their consumers are primarily motivated by cost and size which they interpret as socially prestigious and have little or no interest in innovation. This group usually adopt minimum levels of SP and are often instrumental in driving down SP costs by simplifying and routinising implementation practices and increasing demand for the most efficient, effective products and solutions. While innovators argue that this process weakens outcomes, I assert that at this level of industry, optimal outcomes arise from volume rather than standard of adoption.

Generalisation 3.3.5: Laggards (and post regulatory sceptics): Rogers describes laggards as traditional, near isolates in the social network who exercise almost no opinion leadership and whose main point of reference is the past. He does not include sceptics in his definition (Rogers 2003, p284). While this definition by Rogers was useful in describing non-adopters or recalcitrants during the pre-regulatory phase of AR, it proved quite inadequate and misleading in the post-regulatory or authority driven decision environment where most laggards simply merged into the late majority category but, a small minority assumed strong, critical opinion leadership roles to either oppose or rationalise change agendas.

Robinson also observed this phenomenon and re-named Rogers' last category 'sceptics' which he described as *brown bombers* [who] *will act to block progressive change…* [but] *often identify real problems that need to be solved…* (Robinson 2000, p. 43). Accordingly, I refer to this last adopter group as 'sceptics' when referring to their important post regulatory opinion leadership role and use the term 'laggards' to describe both those who decide not to adopt SP in a pre-regulatory context and adopt minimum standards or engage in avoidance in the post regulatory context.

The disproportionate influence of sceptics

Because sceptics have been observed to exert strong opinion leadership in several AR case studies (ABEC, BDAA, HIA GreenSmart and BITS), I examine their role in detail. Robinson's (2000)

definition aligns with my post regulatory AR observations of a well informed group of individuals or organisations that challenge the validity or rigour of scientific quantification and remediation strategies for AHI environmental impacts – for example Williamson's consistent critique of NatHERS-based regulations to deliver energy efficiency related GGE reductions (Williamson 2005; Williamson, O'Shea & Menadue 2001). This group also commonly reject change agency arguments that their AHI change agendas can contribute to a reduction in those impacts (Johnston 2003; Wheeler 2002) and frequently use well informed arguments to defer responsibility for reducing them to other industries or nations as demonstrated in Box 3-23.

Box 3-23: Sceptic arguments during HIA GreenSmart courses

In my AR role as HIA's NSW GreenSmart trainer from 2002–2007, I asked attendees in each class to summarise their opinion of the relevance or usefulness of regulations intended to reduce GGE from Australian housing. A response received from at least one attendee in every class (average class size approximately 10) could be summarised as: why should we bother when our emissions pale into insignificance compared to China, India and the US?

These sceptical attendees are invariably well informed, often arguing their case articulately and frequently rejecting my follow-up question: don't you think that Australia has a leadership role as a developed nation? with arguments that include: why doesn't the government stop selling coal then or, what difference would it make? As if they're going to listen to us?.

By drawing out these sceptical attendees on the first day and seeking their permission to target them in discussion breaks throughout the course (which most agree to wholeheartedly), I elicit a full range of opinions from all attendees which often resembles Figure 9 above).

The stance of individuals and organisations in the sceptic category is often justified in socio-political or economic arguments which tend to emphasise supply side solutions rather than demand side solutions (e.g. Walker 2003). Laggard practitioners who were forced into a decision to adopt SP by regulation sometimes adopted a strong opposition stance which undermined voluntary adoption of best practice and encouraged lobbying by peak bodies to slow the rate of regulatory bar creep (See Box 3-29 for a case study example).

Network influences on innovativeness

While diffusion scholars have demonstrated that innovativeness in individuals is associated with formal education, socio-economic status and intelligence, network interaction also plays a significant role in determining the innovativeness of both individuals and organisations (Rogers 2003, p296–7). Indeed, I contend that in the context of SP diffusion in the AHI, network influences are among the most important determinants of innovativeness – particularly at

137

organisational or macro level. Accordingly, significant analytical focus is applied to the role of innovative organisations in accelerating the diffusion process among less innovative ones.

Innovative organisations such as local or state governments influence less innovative ones in the same way that innovative individual practitioners, consumers or politicians influence less innovative ones. The AHI diffusion process has benefited enormously from influences such as the voluntary adoption of SEDA's ESH policy by NSW councils. It is likened to Putnam's (1993) diffusion study and findings on Italian regional governments adopting new laws in Box 3-24. Putnam's study traced diffusion through the network of regional governments to demonstrate how those that rated higher on his innovativeness score adopted earlier and in doing so, influenced less innovative governments (Putnam 1993).

Box 3-24: Voluntary adoption of ESH by NSW Councils

This case study demonstrates how the DoI innovativeness categories applied to individuals also apply to organisations and government bodies. Putnam's (1993) research findings were reflected in the adoption of SEDA's ESH policy by NSW councils.

Because adopting ESH was voluntary, only a few innovative councils did so initially. As part of their pro-active change agency, SEDA partnered with those councils to generate OL and utilised network influences such as ROC (Region of Councils) alliances and the Local Government Association (LGA), as diffusion networks through which to convey information about the beneficial adoption experiences of these early adopters to other councils to influence their adoption decisions.

The diffusion followed a classical DoI S shaped curve with less than 10% of some 150 NSW councils having failed to adopt ESH by the time the program was replaced with DoP's mandatory BASIX agenda.

Competition between organisations is also an important network-related driver as demonstrated by Box 3-25 below where competition between two industry peak bodies created leverage for OLs to drive change in the laggard organisation.

Box 3-25: HIA –an early adopter influencing MBA- a later adopter

Industry peak body HIA became an early adopter and OL through its Partnerships Advancing the Housing Environment (PATHE) program in the late 1990s and later through GreenSmart (see Box 3-17). While contributing to industry consultation forums and supporting projects such as *Your Home* during this period, competitor peak body MBA was slower to adopt a national OL role and, while individual champions in the MBA achieved isolated regional adoptions (e.g. MBA Newcastle's Sustainable Display centre and house energy rating service in the Hunter Region was driven almost

entirely by Bernard Hockings), it was not until 2004 that national champion Dennis Wilson was able to convince the national body to make a similarly high profile commitment to opinion leadership through the MBA EcoLiving project.

While not conclusively explaining MBA's adoption decision (several other drivers were also in play), I claim that this example indicates the role of early adopter influence on later adopters at an organisational level and demonstrates that DoI's innovativeness categories apply to organisations.

Adopter innovativeness in AR training delivery

Here, I discuss my AR application of DoI innovativeness categorisation in the AHI through case study observations drawn from AR in HIA's GreenSmart program. The purpose of this part of my analysis is to explain AR successes and failures linked to adopter innovativeness categories and to identify some resultant barriers and opportunities arising from its application in change agendas. For example, Box 3-26 highlights some limitations associated with the tailoring of training delivery to small, random groups of practitioners based on their innovativeness.

Box 3-26: Adjustment of GreenSmart and ABSA training in response to shifts in attendee innovativeness as SP diffusion progressed.

Innovativeness trends were observed among training attendees over a 5-year period of AR as GreenSmart and ABSA trainer in NSW. AR observations (reflective practice) and attendee feedback data demonstrated that pre-regulation attendees (2001–2002) were from innovator and early adopter groups, that their information needs were technical and that cost and risk were secondary considerations.

As awareness of SP and pending regulation diffused throughout the AHI during 2003-4, the audience makeup shifted noticeably to early majority practitioners whose primary interests were staying ahead of the market and using SP to differentiate their products. Questioning and feedback from this group demonstrated that they were conscious of cost and risk but considered it a fundamental component of their market differentiation and simply wanted advice on how to manage it while achieving superior outcomes to their competitors. This group were quite receptive to the concept of voluntary best practice adoption and had often trialled SP (e.g. in projects where councils had adopted SEDA's ESH policy).

The post BASIX regulatory environment (July 2004) saw the most obvious shift in audience profile because attendees began to stream according to adopter category in a pronounced way. First time attendees were markedly more sceptical and their questioning challenged most aspects of the change agenda. Their information needs were so specific that ABSA developed two BASIX courses – the first of which was a half-day course that was ideally suited to laggards and later adopters

whose interests were narrowly focussed on the simplest, most cost effective minimum compliance options. The second was a full day course better suited to the innovative end of the late majority group because it covered risk management and alternative compliance options that facilitated better (than minimum) practice. A third course was also developed for early adopters and innovators who were primarily ABSA assessors whose clients were seeking consultant advice on cost effective BASIX compliance. While these courses were developed in response to demand (rather than DoI analysis), they demonstrated the relevance and usefulness of tailoring future training to the innovativeness-based needs of attendees.

When HIA offered the ABSA's BASIX courses in parallel to GreenSmart training, the GreenSmart audience shifted once again. More than at any other time, attendees had markedly different information and learning needs that aligned with the five DoI adopter categories. The first group might best be described as the next generation of innovators and included recent employees of innovative companies and, technical and marketing personnel from supplier/manufacturer representatives seeking a better understanding of practitioner needs in technological and information solutions to identify product development options and market opportunities.

The second group, best described as early majority adopters, continued to attend seeking to improve their skill levels and develop cost effective solutions in response to BASIX' innovation encouraging, performance-based compliance paths. A general characteristic of this group was their interest in selective application (on a project by project basis), of BASIX' capacity to measure both minimum and better practice.

A third group whose knowledge and questioning indicated that they were from a late adopter background, attended GreenSmart (often after having attended a BASIX half day course) seeking to leapfrog to best practice. This group were from larger building and development companies who needed to acquire SP skills and demonstrate best practice capability to gain preferred tenderer status on Landcom projects (e.g. Little Bay or Rouse Hill) or meet best practice SP conditions set by other developers for specific projects (e.g. Homeworld's Central Coast GreenSmart Village or ACT's Ford and Elmslea GreenSmart Villages.

A fifth group could best be described as sceptics – often from positions of power in industry peak bodies (sometimes attending anonymously) who were seeking knowledge to confirm their scepticism. Their questioning sought to identify problems and failings in SP change agendas – especially those that exposed practitioners to unreasonable cost or risk.

Finally, some laggards (who should ideally have been directed to the BASIX introductory courses) attended and either struggled to keep up or delayed the whole class through their questioning.

The case study above demonstrates the succession of decreasingly innovative categories of adopter being exposed to SP innovations during the diffusion process and highlights how the pre-adoption

needs (in this case – information) of each category differ. It highlights the need for change agendas (in this case- training) to address the needs of each adopter category to the greatest extent possible and identifies some barriers that arose from failure to do so due to commercial or logistical limits.

Finally, the case study leads me to assert that while the sequential involvement of successive categories of adopters throughout a diffusion process occurred in this instance, its recurrence in other situations should not be assumed. Variations arising from the complexity of the innovations, the continuous reinvention of those innovations and the introduction of increasingly stringent regulations are inevitable and these variables increase the potential for fluidity of innovativeness among adopters as the diffusion progresses. (See Chapter 6 for detailed analysis of this observation and its implications).

Innovativeness-based adopter categorisation has many additional potential contexts of application for CAs and OLs as demonstrated by the example in Box 3-27.

Box 3-27: The role of interaction between adopter groups in GreenSmart training delivery.

Facilitating interaction and exchange of views by trainees from different adopter categories proved to be an effective training method.

Reflective practice after successive HIA NSW GreenSmart Training courses identified subtle changes in the innovativeness profile of attendees. This led me to hypothesise that learning outcomes might be improved by allowing the use of audience specific language, topic coverage and depth of coverage had the audience been streamed according to adopter category. However, because categorisation or streaming of attendees proved unachievable due to commercial pressures to combine limited attendee numbers into viable class sizes, I found it necessary to adopt a flexible approach to language content and delivery to maximise learning outcomes for each adopter type.

This mixed adopter category environment provided its own instructional opportunities by facilitating opinion leadership between each of the groups – particularly the innovators and early adopters (who often attended to gain GreenSmart accreditation for marketing purposes) and later adopters (especially those from the volume housing sector). Early adopters and innovators experience difficulty accepting the cost and risk constraints experienced by later adopters and this group quickly identified cost barriers and liability risks in the innovative solutions suggested and used by innovators. Such interaction was observed to create multiple learning outcomes including: stimulating fresh approaches by innovators, cherry picking of viable solutions by later adopters and normalising SP in the BaU scenarios of most attendees.

Indeed, on occasions when groups were streamed (e.g. customised GreenSmart training for the entire staff of project home companies), the absence of opinion leadership from innovative practitioner peers was observed to allow higher ranked sceptics (project managers and quantity surveyors) to dominate the views of lower ranked innovators (draftspersons and designers), suggesting that training sessions that include a variety of adopter groups are more effective and, that hierarchical input according to organisational power structure requires careful management.

Training content according to adopter category

As discussed above, practitioner information needs were observed to vary according to adopter category during AR training delivery leading me to suggest that where possible, training developed to meet specific adopter category needs would deliver improved learning outcomes. While audience streaming is not often possible on an individual class basis, assumptions about likely levels of innovativeness in the market sector trainees are engaged in can prove useful in determining the level and complexity of content, case study examples used and SP solutions recommended. The following broad generalisations summarise key observations regarding the information and training needs of various adopters and adopter categories.

Generalisation 3.3.6: Innovators and early adopters have higher levels of prior knowledge and require more technical, skill-based information. However, while many had already formed their moral and ethical stance, they were quite receptive to motivational and knowledge-based information (especially recent research) because it affirmed their position and strengthened their commonly held roles as OL in later adopter groups.

Generalisation 3.3.7: Early majority attendees had often trialled better or best practice SP in more than one project and often stated their reason for attendance as broadening, completing or topping up their skills. These attendees were less receptive to attitudinal or motivational content but responded well to a broad or complete definition of built environment impacts with rapid progression to a detailed focus on the most urgent (and often regulated) aspects. Their questioning indicated high levels of interest in innovative or new SP.

Generalisation 3.3.8: Late majority attendees were observed to have rarely trialled SP beyond minimum compliance with regulations and the solutions they reported using were often inefficient or ineffective – particularly immediately post regulation when large numbers began attending. They were generally receptive to motivational knowledge content and often created productive discussion by challenging these concepts but responded positively to a focus on knowledge and core skill content. Their adoption and attendance decisions were driven by regulation and whether they agreed with change agendas or not, their purpose in attending was to acquire compliance skills.

Generalisation 3.3.9: Later adopters (whether by nature or role) are generally more risk averse and cost sensitive than early adopters. They require brief attitude and knowledge overviews linked to arguments that adopting SP is inevitable and critical mass is imminent. Requested or useful information and skills include: cost effective, easily implemented, commercially available solutions; where to get them and how much they add to BaU costs. Knowledge provision for this group should be limited to key points associated with the impacts most related to their field of influence or impact. For example, carbon intensity of energy mix in a home is important knowledge whereas supply side measures to reduce carbon intensity (e.g. carbon trading) rarely drew questions or discussion and were therefore addressed in minimal detail. Positive arguments on the role of housing in '*holding the line until the carbon trading cavalry arrive'* proved effective in conveying the need for an urgent response.

As the SP diffusion process progressed, the information needs of both early and late majority adopters became more sophisticated and detailed - highlighting the need for information design to be based on both existing knowledge and market sector of attendees. This approach was found to be most useful for choosing case study examples and class exercises (e.g. project home or best practice custom design).

Generalisation 3.3.10: Regional practitioners and those in un-regulated (or recently regulated) states were observed to be at a much earlier stage on the diffusion curve to those in capital cities – particularly Sydney, Melbourne and Canberra. However, diffusion progress is unpredictable and should be tested to ensure training relevance. For example, Perth's relatively slow adoption rates accelerated very rapidly in the year following BCA introduction which coincided with effective change agency by the Sustainable Energy Development Office (SEDO) and other West Australian CAs.

Generalisation 3.3.11: SP novices who enter the built environment field with no previous experience (e.g. sales staff, trainees, apprentices and managers) are an additional category that warrants specific attention. While the information needs of novices to the field are changing due to increasing community awareness, training developers should not assume that attendees understand the basic principles underpinning the need for sustainable reform in the built environment. For example, the vast majority of GreenSmart attendees had no understanding of the principles of ecology and many were therefore inclined to dismiss the importance of minimising local and regional impacts.

Further, while novices might fit into the sceptic or laggard category in terms of information and training needs, their individual motivational needs will spread across the entire spectrum depending on background, industry position, aspiration and personal stance on the rights of future generations. Training developers should not assume that all novices are laggards or late majority

adopters because this group demonstrated the greatest potential for fluidity of innovativeness – often changing jobs or institutions after attending GreenSmart, ABSA or BITS training. High levels of attitudinal and knowledge-based content remain critical for this group. As specialist or 'advanced' training becomes more commonly available, some of the skill-based content in current introductory courses (e.g. HIA GreenSmart) could be deferred in favour of more interactive learning.

Because the streaming of audiences was rarely possible during AR (and is likely to remain so for introductory courses), adjustments were made to the content of courses after each round of analysis. The reactions of participants were informally monitored for signs of increased acceptance, motivation and stated intention to adopt. Because each of the sample groups consisted of an unpredictable, random mix of practitioners with varying industry roles and from diverse industry positions, a range of information with potential to influence attitudes, provide knowledge or impart skills was included in the base curriculum. Individual presenters then varied the emphasis on each in response to the questioning and comprehension of each group.

While it is too early to measure whether stated adoption intentions have translated into actual adoption, it is reasonable to assume that the tailoring of information to a specific audience in these strata would improve the likelihood of adoption of higher standards of practice at some future time. Other improvements to training delivery are examined in Sections 4.1.7, 4.2.5 and 6.4.3.

Summary of adopter micro analysis

The above micro analysis of SP adopters (whether individual practitioner or organisation) was based on the explanation and grounding of AR observations according to generalisations drawn from DoI's innovativeness categories. Key findings with potential for application in other AHI change agendas and adaptation to broader change initiatives are presented as generalisations.

Adopter innovativeness is an important component of diffusion theory that has significant potential for specific application by CAs in fine-tuning their change agendas and for application in the planning and development of new ones. While effective streaming of participants according to adopter category in practitioner-focused AR agendas remains difficult to achieve, the above analysis leads me to conclude that change initiatives undoubtedly benefit from consideration of audience needs in terms of innovativeness category. For example, the effective learning outcomes achieved through facilitated interaction between practitioners from diverse categories (Box 3-27) and the important but distinctly different contributions to SP development by each category demonstrate the potential for innovativeness categorisation to inform and guide a much wider range of intervention strategies. These are examined in greater detail through subsequent analysis.

Additionally, as argued throughout this thesis, an important next step for change agencies involves a shift of focus from new housing to existing housing. I suggest that larger existing home consumer audiences are better suited to change agenda streaming according to adopter innovativeness. I examine ways that this might be achieved through prospective DoI analysis in Chapter 6.

3.3.4 Macro analysis of the AHI as a DoI social system

Rogers (2003) describes a social system (in diffusion terms) as a set of interrelated units engaged in joint problem solving to accomplish a common goal and, that members or units of a social system may be individuals, informal groups, organisations, or subsystems. Indeed the AHI consists of a multitude of units working in combinations and permutations to accomplish a series of complex goals intended to ensure sustainable futures.

I contend that at macro level, it is useful to examine the AHI social system in five groups (units) defined according to their predominant role or network position in diffusion terms. Below I ground my AR observations about the interactive communication and influence roles of these groups in the diffusion process. The macro groups are:

> **Consumers** of both new and existing housing as tenants, owners or investors;
> **Practitioners:** designers, builders, consultants and their professional peak bodies;
> **Financiers and marketers**: banks, property valuers and realtors;
> **Researchers and technology developers**: manufacturers, suppliers, academia, governments, NGOs and practitioners;
> **Change agents:** governments (including: politicians, policy developers and regulators); NGO change agencies; educators (including: universities and tertiary institutions, industry peak body RTOs); individual OLs.

While each group has a defined role in the diffusion process, there is significant role overlap between the groups and the individual actors in them. Indeed, the groups are interactive and interdependent in the AHI network. Network alliances usually form between individuals and groups with compatible interest in, opposition to or application for a specific range of SP innovations. Innovativeness is a critical determinant affecting the timing of an individual adopter's decision to engage in the diffusion process that was addressed at micro (individual adopter) level in Section 3.3.2. While innovative individuals have important roles in influencing SP adoption by groups and organisations, at the macro level my primary focus is on the influence of the network and the role or interaction of macro actors and sub-groups in it. Where useful, I look beneath this macro level to identify and explain critical diffusion roles and alliances (both positive and negative) between individuals in these groups.

The most common interaction or influence paths observed between the five macro groups during AR are summarised in Figure 10, which also indicates the complexity of their interaction. Differing arrow weights approximate the strength of those interactions. The position of groups in the regulatory agendas of change agencies (shown in heavy dotted line) is a significant determinant of adoption behaviour that is addressed separately in Sections 4.1.4, 5.2.4 and 6.3. However, while minimum mandated levels of SP are adopted in groups affected by regulation, I argue that without simultaneous voluntary adoption of better and best practice, AHI contributions to the goal of averting the ecological crises identified in Chapter 2 will be ineffective.

Analysis of the flow-on effect of regulation to non-regulated groups via network links yields important insights into less obvious opportunities and barriers. Indeed, I argue that the flow-on effect to non-regulated groups via network links is important and warrants greater attention by change agencies. While the predominant current focus of CAs is regulation, Figure 10 illustrates its limited range of influence in the AHI network. Section 4.1 examines the types of adoption decision defined by Rogers (2003) as optional, collective and authority and the role of the AHI network in cross pollinating each type of decision.
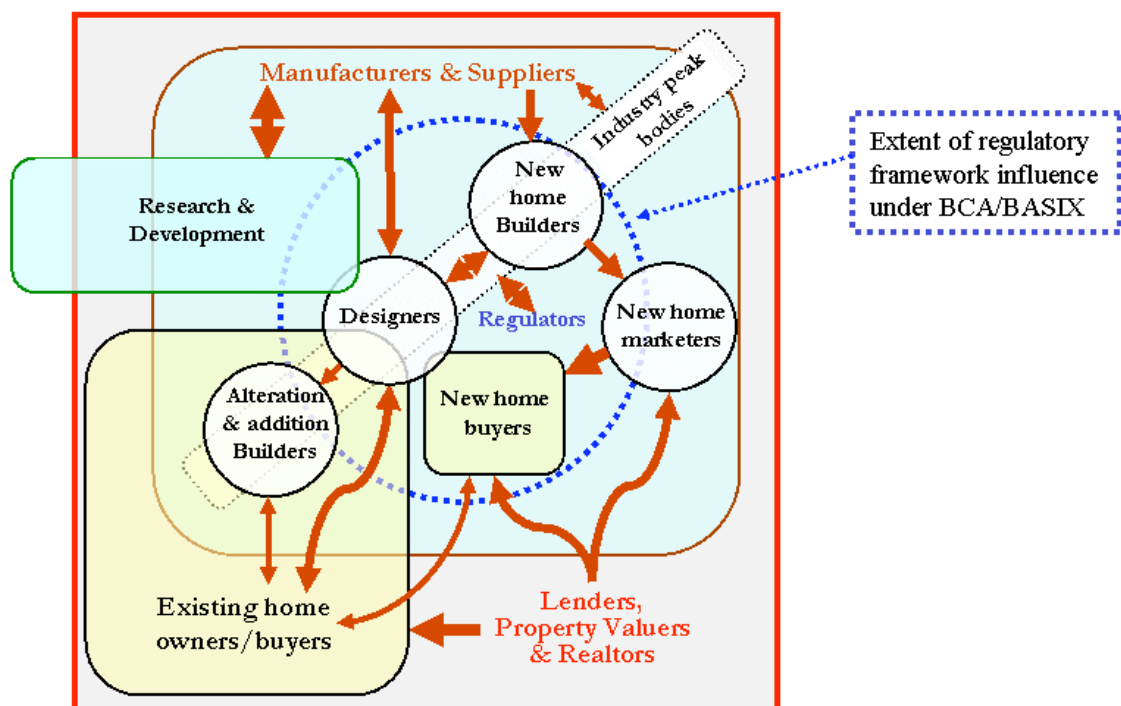
Figure 10 AHI adopter groups and their primary network interaction and influence.

Macro network interaction

DoI provides an extensive framework in which network interaction or communication can be analysed (Rogers 2003, pp 300-364). However, this section does not intend to apply that framework comprehensively. Indeed, the complexity of the AHI network and its interaction matrix defies

comprehensive analysis. Rather, DoI analysis is applied selectively in order to explain the interactions between macro groups observed to have the greatest effect during AR, and to identify gaps and opportunities arising from these interactions with potential for transfer or application in other change agendas for further prospective DoI analysis in Chapter 5.

Industry peak bodies as macro level opinion leaders

At a macro level, the political processes associated with sustainable change are closely linked with the role and contribution of macro group actors in the diffusion process. In other words, these macro actors can inadvertently influence the opinions of their members by their political stances on related issues. While industry peak bodies are supportive of SP change agendas, their OL roles in the SP diffusion process can sometimes become negative through collateral consequences arising from lobbying on unrelated issues (See Chapter 5 for analysis of the political characteristics of diffusion through ANT). Indeed, I argue that barriers to diffusing SP are created or maintained by these bodies as part of their negotiations on partially related issues such as housing affordability.

For example, HIA overstated SP compliance costs to strengthen its lobbying arguments related to the contribution of government taxes and charges to new housing affordability (Crouch 2005; HIA 2003b, 2003c, 2005b) and again in its lobbying for less stringent or rigorous DTS provisions in BCA and DIY compliance paths in BASIX. HIA's justification for such lobbying is the reduction of cost and complexity of regulatory compliance for its members (Crouch 2006; HIA 2005a). This stance directly contradict its GreenSmart commitment to sustainable change where it acknowledges that SP compliance is a relatively small component of both new housing costs and additional planning approval workload for practitioners.

Sustainable outcomes are often traded off in the political process owing to their lack of immediate relative political advantage (see 3.2.2) when ranked against other objectives perceived to be popular with voters. Endorsement of SP reforms by industry peak body lobbyists has (at times) been conditional on the granting of unrelated or partially related concessions or tradeoffs. For instance, HIA and MBA support for BASIX stringency levels was on condition that concessions were given to simplify compliance or reduce the stringency required for volume home builders (a powerful component of the membership base of each organisation).

The spin often associated with such lobbying can be mistaken for well researched opinion leadership and contributes to confused perceptions about the consequences of SP adoption among would-be adopters through the linking of unrelated matters. For example, HIA linked housing affordability, stamp duty reductions, mandatory SP minimum standards in its lobbying arguments for additional greenfield land releases by the NSW government before the 2003 elections in NSW (Totaro 2003). Box 3-28 below demonstrates how lobbying by an industry peak body based on

partial truths, untested arguments and outdated thinking was able to weaken a change initiative by combining with other arguments were similarly lacking in rigor.

Box 3-28: RAIA lobbys the NSW Government to modify NatHERS in SEDA's ESH policy.

This case study illustrates how strong opinion leadership by industry peak bodies (whether positive and negative), influences both: the evolution of SP innovations through reinvention by macro organisations and; their adoption by individual practices through the diffusion of attitudes, knowledge and skills.

When some NSW Councils voluntarily adopted SEDA's ESH policy, a minimum 3.5-star NatHERS rating became mandatory. This introduced many architects to NatHERS for the first time and many found compliance difficult to achieve due to the now well-recognised tendency to over glaze. Although thermal performance simulation tools had been available since the 1970s, very few designs were subjected to simulation until it became mandatory. A steep learning curve ensued wherein architects needed to re-think clichéd passive solar design concepts with entire north facing walls of single glazing that arose from the 'energy efficient' design paradigm taught in many architecture schools before climate change drove the introduction of rigorous modelling. During this learning curve period, the RAIA and individual members challenged the accuracy of NatHERS (with some justification) and negotiated exemptions or exceptions in ESH and other regulatory regimes. (Johnston 2003; Wheeler 2002; Williamson, O'Shea & Menadue 2001)

While many RAIA criticisms of NatHERS were valid, many others were attributable to a lack of knowledge in thermal performance – particularly glazing. Several best practice case studies in YH designed during the learning curve period illustrate the limitations of these misconceptions. (Reardon et al. 2001aCase Studies:7.2a,7.5c,7.6b, 7.6e.)

Other peak bodies lobbied against NatHERS simultaneously on the basis of cost and accessibility (HIA 2003a; Murray 1999) or commercial disadvantage owing to a bias toward a particular material (AFIA 2003) or construction system (NAFI 2005).

The eventual outcomes from this lobbying were twofold. Firstly, several of NatHERS earlier limitations were rectified through 2nd generation HERS software – an example of innovation development or reinvention. Secondly, (and I argue more important), the peer to peer discourse generated in the architectural profession during this period created a window of opportunity through which monomorphic OLs became established – many of whom progressed to polymorphic opinion leadership by contributing to the diffusion of a much broader range of SP. (See 3.3.2 for an explanation of mono and polymorphic opinion leadership)

Box 3-29 below demonstrates how the ABCB's extensive consultation process during regulatory development provides a forum for lobbying to protect the commercial interests of manufacturing sectors that often translates into negative opinion leadership. Robinson (2000) identifies this as the role of sceptics and defines sceptics as generally well informed individuals and organisations who may oppose the innovation because it has no relative advantage for them or, is incompatible with their needs and interests. (See 3.3.3 for explanation of my variable use 'laggards or sceptics' in relation to the DoI adopter group laggards).

Box 3-29: Manufacturer and supplier bodies rally sceptics to lobby the Commonwealth Government over BCA 2006 5-star HERS benchmarks.

In their regulatory impact statement (RIS) research for BCA 2006, the ABCB used First Rate (HERS software known to have a bias towards high thermal mass buildings). The incorporation of such a bias would commercially disadvantage lightweight construction systems. NAFI and other lightweight construction sector actants lobbied the AGO and ABCB to remove this bias.

At NAFI's Future Forests Workshop in Canberra (from which came a submission to the ABCB), CEO Catherine Murphy argued: *The timber industry is dismayed at the Australian Building Code Board's decision to press ahead with mandatory five-star rating systems in residential construction for all States and Territories from 2006…The Productivity Commission's report recommends that an evaluation should consider 'how effective the standards have been in reducing actual energy consumption' and 'whether the financial benefits to individual producers and consumers have outweighed the associated costs'…* (NAFI 2005)

Citing HIA's estimates for BCA 2006 compliance (which were based on untested comments by one builder), Murphy expressed concern that the mandatory five-star ratings would increase the average cost of a new home by around 6% or $15,000. She then followed HIA arguments further and linked the BCA reforms to housing affordability and the erosion of affordability initiatives such as the Federal Government's First Home Owner grant. Ms Murphy also argued against BCA 2006 based on its thermal mass bias, arguing that this did not consider embodied energy savings (ibid). While this argument had some merit, limited research on embodied energy at that time made it impossible to factor into regulations (Reardon et al. 2001a) and continues to do so.

In their submission to the ABCB, NAFI and others called on State and Territory governments to review their support for BCA 2006 while the mass bias prevailed and received some high level political support. In a speech to the NAFI workshop, the then Environment and Heritage Minister pledged his support for the timber industry in its opposition to BCA 2006 because (he argued) it discriminated against the use of timber as a building material. (NAFI 2005)

Williamson also presented his work on energy efficiency regulations in housing at the NAFI workshop stating that: *There is little or no evidence to show that energy efficiency standards and regulations (including HERS [house energy rating systems]) will be in any way effective (Williamson 2005, p. 28)* and

arguing that his research could find little evidence of direct relationships between thermal performance and energy use in homes.

HIA's view on possible BCA 2006 impacts on the AHI was presented at the NAFI workshop by Elizabeth Crouch (a published NatHERS sceptic) who stated that moving from the current 4-star system to the 5-star system will deliver only a minimal 0.8% reduction in GGE by 2020, while significantly decreasing housing affordability. Crouch did not cite the source of her figures or acknowledge RIS costing showing a substantial contribution to the Victorian economy by the 5-star program – effectively offsetting the 0.8% GGE reductions when other sectors of the economy are struggling to achieve much smaller reductions at much greater cost.

The above example demonstrates how misleading or deceptive arguments by macro actors in the AHI network are often combined during lobbying to sway politicians into overriding research by change agencies. Box 3-30 below demonstrates how this level of lobbying was able to influence the Productivity Commission.

Box 3-30: Division between government agencies: Productivity Commission findings contradict ABCB, Victorian Building Commission and AGO arguments.

An enquiry into the ABCB's 5-star rating proposal for BCA 2006 by the Productivity Commission (PC) in October 2005 received submissions from many of the sceptics in Box 3-29 as well as many pro-5-star macro actors including CSIRO, BRANZ, and the specialist building physics faculties of several universities. The PC's final report cast doubts over the software used in calculating energy loads in buildings and included strong recommendations that the ABCB should commission an independent evaluation of the systems 'as matter of urgency' (Productivity_Commission 2005).

Not withstanding this, the Australian Building Codes Board decided to increase the energy efficiency measures to a 5-star HERS rating for housing pending the release of 2nd generation HERS software and, to include energy efficiency measures for commercial buildings.

I posit that the ABCB made a decision to act on the research that had been submitted and ignore the arguments and lobbying that had influenced the PC in the knowledge that 2nd generation HERS software would resolve most of the issues raised in their recommendations. This demonstrates the capacity of the ABCB to act unilaterally at times and leads me to question the value of their extensive consultation processes, especially in the developing field of SP where it arguably creates a forum through which poorly researched or misleading claims can be presented to industry. By comparison, DoP's (much criticised) non-consultative approach to the algorithms underpinning BASIX excluded expert technical critique by sceptics until after its release and avoided claims of commercial disadvantage and bias by manufacturers by providing flexible compliance paths.

Summary

The AR observations above demonstrate how change agendas are rarely based on the scientific research we might expect and that this is attributable to the complex interaction of macro actors in the AHI societal network protecting their commercial and power base interests through the political process. I argue that CAs could minimise false or misleading claims arising from this process by setting higher standards for submissions during industry consultation (e.g. peer reviewed papers), and developing regulations with flexible, performance-based compliance paths capable of seamless amendment and benchmark creep post-implementation, to limit the need for pre-release consultation (e.g. BASIX) and by funding rigorous, independent research into the outcomes and impacts of their regulatory agendas.

3.4   Chapter 3: Conclusions

My retrospective DoI analysis of nine years of AR into the processes of socio-technological sustainable change occurring in the AHI has exposed several significant adoption barriers associated with SP innovations. Additionally, it identified both limitations and opportunities arising from the complex influences and interactions that characterise the AHI societal system. This scenario creates significant challenges for my AR change agency partners whose responsibility it is to initiate, manage and accelerate that change and explains shortcomings and successes observed in their current change agendas.

SP innovations embody very few of the attributes observed to encourage adoption in other diffusion studies and this leads me to conclude that a greater change agency focus on the sociological aspects is warranted. I argue that, while effective in raising awareness of the need for change nationally in the AHI, the current technology centric focus on the new housing sector (and an even narrower focus on the role of thermal performance in that sector) has left the existing housing sector (and therefore the majority of consumers) unaffected by change agendas. Further, this focus has led to a failure by change agencies to capitalise on the potentially powerful change creation role of the marketing and financial sectors that control the primary motivators of consumer housing choices, wealth creation and capital gain (see Figure 10). This would have the additional benefit of partially countering one of the most commonly cited arguments against sustainable change, its (arguably overstated) contribution to the complex and politically powerful issue of housing affordability. This failure is addressed in detail in Section 6.3.6.

The need for innovative, refined and commercial SP creates another important challenge for CAs. While the need to constantly reinvent SP was identified through DoI analysis as a short-term diffusion barrier, its essential role in creating efficient and effective medium to long-term outcomes necessitates specific attention by change agencies. While some addressed this challenge effectively,

(e.g. BASIX) others introduced prescriptive, innovation-suppressing regulations (e.g. BCA) that did little to encourage the voluntary adoption of better and best practice. I argue that this shortcoming is attributable to the disproportionate technological focus on the thermal performance of new housing associated with over-reliance on house energy rating software (HERS) in the regulatory agendas.

A further shortcoming of change agencies identified through this analysis is that outcomes from AR change agendas are evaluated rarely and that quantifying agenda-specific results such as GGE reductions or reduced resource consumption has yet to be conducted. This has several adverse implications including a lack of informed direction or focus in change agendas and creating an environment in which the arguments of sceptics flourish. Additionally, this lack of accountability has contributed to a failure by change agencies to set real targets and measure progress toward them- arguably contributing to lower adoption rates among later adopters owing to diminished public perceptions of the importance and need for change. Accordingly, I argue that CAs should fund rigorous, independent research into the outcomes and impacts of their regulatory agendas as a matter of urgency.

Finally, adopter innovativeness was identified as an important component of diffusion theory with potential for use by CAs in refining both the content and language of the resources they provide, to better meet the needs of their intended audiences. These resources include effective skill delivery and accessible information databases for practitioners and consumers, understandings of the need for change, how their choices create it and where to get advice on how to implement those choices.

The above retrospective grounding of AR in diffusion theory identified and provided preliminary explanations for sustainable change related trends, patterns and behaviours observed in a broad range of AHI actors. In Chapter 4, my retrospective DoI analysis examines these observations in detail to develop deeper understandings of the decision-making processes undertaken by those actors in adopting change and identify the drivers that underpin their decisions. These findings are then summarised in likely adoption timeframe scenarios to inform the prospective analysis in Chapter 6, which explores future strategies through which change might be accelerated.

Chapter 4   How SP diffuse in the AHI

Chapter 3 explored the individual roles of SP innovations, the practitioners and consumers who are adopting them and the AHI social system into which they are diffusing. However, for an innovation to successfully diffuse within a social system, the majority of actors in that social system must decide to adopt the innovation, or as in this case, the evolving continuum of SP innovations that results from their ongoing refinement.

In this chapter, I examine the interdependent influence of SP innovations and the AHI social system on two critical diffusion processes. The *innovation decision process* (Section 4.1) informs analysis of the role of various interventions in influencing decisions to adopt SP, the standard of practice adopted and the time frames involved (Rogers 2003, p. 20, 168-218). Analysis of the *innovation development process* (Section 4.2) is then used to explain how the essential and ongoing processes of SP refinement and reinvention influence those decisions and time frames and, why some AR change agendas were able to assimilate and incentivise this process while others failed (Rogers 2003, p. 137, 161, 164). I assert that CA focus on these processes is essential to deliver effective change in terms of both absolute adopter numbers and standard of practice adopted.

I then project likely DoI adoption curves (Section 4.3) based on interpolation of data collected through industry surveys and AR observation and analysis. These projections enable assessment of the potential for adoption level trajectories to deliver meaningful outcomes for future generations (Section 4.3). Chapter 4 concludes with a summary of conclusions drawn from retrospective analysis of nine years of AR findings expressed as a diffusion study.

This retrospective DoI analysis yields important insights into the effectiveness of CAs in catalysing the SP diffusion process. Outcomes include insights into how, why and what change occurred, opportunities to accelerate it and barriers that might limit it. This baseline of understanding underpins prospective analysis in Chapter 6 through which future strategies to manage and accelerate ongoing sustainable change are argued.

4.1   The innovation (or adoption) decision process

4.1.1 Overview

A critical variable in the diffusion process is the length of time taken by an individual or organisation to adopt or reject SP innovations after first becoming aware of them. Rogers refers to this as the innovation decision period and generalises that *earlier adopters have a shorter innovation-decision period than do later adopters* (Rogers 2003, p.214). He states that this is because they have more favourable attitudes to new ideas, use more technically accurate information sources and place

higher credibility in those sources. Additionally, he observes that innovators and early adopters often possess high-level visualisation skills and a pre-disposition towards coping with uncertainty (Rogers 2003 p. 213-5). This is consistent with my empirical AR findings (BDAA, RAIA and HIA surveys conducted during AR) that architects and building designers formed the majority of OLs and early adopters of SP among practitioners. One outcome of this phenomenon is that many change agendas were developed by or for these early adopters. This raises the question, are such agendas appropriate for the (numerically) more significant early and late majority adopters?

A second, and arguably more important variable in the context of SP, is the standard of practice adopted. Unlike the innovations in a typical diffusion study, which either are adopted or rejected, (e.g. the mobile phone or the fax machine) the vast, constantly changing array of innovations associated with SP can be adopted and applied at varying levels, leading to outcomes ranging from exacerbating the problems to resolving them. Because SP innovations are complex, costly and evolving, recently introduced AHI regulations mandate the adoption of only minimum standards. While regulation has significantly altered the innovation decision process at minimum practice level for all AHI adopters, optional decisions to adopt better and best practice SP remain essential if change agendas are to ensure that critical reductions of impact are achieved in necessary timeframes to ensure meaningful, long-term sustainable outcomes. Accordingly, I consider the implications of various types of innovation decision-making processes.

I commence by contextualising Rogers' (2003) 'continuum' of decision types (optional, collective and authority) in scenarios observed through AR and examine implications of each type for the level or standard of adoption achieved in my AR change agendas. Optional decisions by individual adopters are examined in Section 4.1.2. Collective decisions where individuals have input to decisions by a body or society are examined in Section 4.1.3 and the most common AHI scenario, authority decisions where the individual has limited influence in Section 4.1.4. In Section 4.1.5, I explore the potential for regulatory tools to address all three decision types by mandating minimum standards of practice while encouraging optional adoption of better practice. Finally, Section 4.1.6 examines the innovation decision process and where Rogers' (2003) stages of adoption decision are adapted to this research context. This analysis identifies important issues central to analysis of the innovation development process in Section 4.2 and diffusion time frames in Section 4.3.

4.1.2 Optional decisions

Rogers (2003) defines optional decisions as *choices to adopt or reject an innovation made by an individual independent of the decisions of other members of the social system* and observes that the optional decision maker's decision will be *influenced by the norms of the system or communication through interpersonal networks* (Rogers 2003, pp. 28-30). These influences are critical to the non-mandated adoption decisions of consumers and, the best practice adoption decisions of practitioners. During the initial pre-

regulatory AR phase, optional decisions were the only diffusion strategies available to CAs (e.g. the voluntary adoption of SEDA's ESH policy by NSW Councils). In the post regulatory environment, some of these strategies to encourage optional adoption decisions by practitioners have been discarded by CAs who focussed on authority decisions at the minimal practice end of the adoption spectrum to overcome the innovation-related adoption barriers identified in Section 3.2. However, I assert that drivers of optional decisions are very relevant at the best practice end of that spectrum and should continue to be adapted by CAs to encourage the application of regulation driven awareness and knowledge in important non-regulated AHI sectors.

Nowhere is this focus on optional decisions more important than in adoption decisions by consumers. New home buyers and some renovators in some states are the only housing consumers subject to authority adoption decisions (e.g. in 2008 BASIX mandated minimum SP for projects over $50,000). Adoption is an optional decision for all other housing consumers. I suggest that diminished CA emphasis on voluntary change agendas is an important contributor to the lack of consumer demand for SP. Prospective strategies to address this are explored in Chapter 6.

In practitioner terms, optional adoption decisions are the hallmark of early adopters and innovators. Industry questionnaires confirmed that innovative leaders made optional decisions dating back to the late 1960s and early 1970s (e.g. Vale & Vale 1975). Optional decisions taken by these individual innovators were observed to provide an important source of opinion leadership for later adopters throughout the early AR phase of this research. However, in the post-regulatory environment where the late majority adopter groups are making decisions about what standard of SP to adopt, signs exist that opinion leadership by these early innovators is decreasingly effective because their motivations and language differ from those of later adopters. Several promising information technology (IT) diffusion failures have been attributed to this phenomena, sometimes referred to as Moore's gap (Moore 1999), when the innovators who developed and understood the technologies were also responsible for explaining and marketing them to later adopters whose perceptions, needs and applications for the technologies were very different. See Section 6.2 for a more detailed analysis of the implications of Moore's gap in marketing and explaining SP to later adopters.

In summary I posit that, while regulation is a fundamental and essential component of the SP diffusion process, its current scope of influence is insufficient and should be augmented with strategies to accelerate optional adoption decisions to both better and best practice adoption by AHI practitioners and voluntary minimum practice adoption by existing home owners.

4.1.3 Collective decisions

Here I examine the contribution of collective decision-making to the AHI SP diffusion process. Defined by Rogers as: *decisions made by consensus among the members of a* [social] *system. All units of the*

system usually must conform to the system's decision once it is made (Rogers 2003, pp. 28-30). Two examples of such collective decision-making were observed during AR. Firstly, AHI industry peak bodies were observed to be important contributors to such adoption decisions either internally (Box 4-1, HIA GreenSmart) or as a part of the broader AHI social system (Box 4-2, ABEC). Peak bodies gain (or assume) consensus to adoption decisions on behalf of their members relatively easily – something CAs find difficult to achieve due to their heterophilic relationship with practitioners.

Box 4-1: GreenSmart: a collective decision by HIA to promote voluntary better or best practice adoption decisions – particularly by later adopter groups.

The HIA made an internal collective adoption decision when it launched its PATHE (later GreenSmart) program in 1998. As a result of this decision, GreenSmart opinion leadership, awards, training and promotion have played a key role in diffusing SP innovations throughout the AHI-especially into the cost sensitive, risk averse, later adopter sectors such as the volume housing market. Because member awareness of SP was limited at the time this decision was made (late 1990s), it is reasonable to assume that it was not consensual. However, I maintain that it can be characterised as a collective decision because it was made and implemented by a national industry body that (as stated above), such bodies assume consensus among their members.

Box 4-2 below is an account of the earliest collective decision by the AHI on SP adoption. That decision continues to underpin industry SP change agendas ten years on, indicating the strength of consensus driven collective decisions.

Box 4-2: The AHI reaching a collective decision to adopt SP through ABEC

Through ABEC, the Australian Built Environment industry made a collective decision to adopt SP. While there was disagreement about the detail, the dual code objectives were unanimously accepted by members in what was described as one of the most representative forums ever held in the industry for any purpose.

While ABEC's initial objective was to avoid regulatory approaches, extensive deliberation by a panel of industry experts followed by rounds of industry consultation, led to a collective decision adopt a dual code of practice (see Section 4.1.5) which called for a mandatory code of minimum practice and a voluntary code of best practice (see Section 2.2.3 for an overview of ABEC)

The second type of effective collective decisions observed during AR involved decisions by groups to adopt SP at better or best practice level for specific projects. These decisions were often sponsored or stimulated by CAs interested in the flow-on effect of such 'one-off' decisions to trial adoption – particularly in terms of familiarisation, in-house skill acquisition

and the eventual diffusion of those skilled practitioners throughout the AHI through 'head hunting' (See Box 4-3 below).

Another important flow-on effect was the creation of perceptions of compatibility with BaU through the successful marketing of these projects – especially prestigious or high profile projects such as the Landcom NSW projects described in Box 4-3. While the origins of the Landcom decision are arguably not strictly collective (the decision is largely attributable to one director whose opinion leadership convinced the then Planning Minister), the processes and outcomes associated with its application are collective, because all units of the system conformed to the system's decision once it was made in accord with the second part of Rogers' definition (Rogers 2003, pp. 28-30). This important distinction between the decision and its application highlights the potential for collective decisions to streamline the often time consuming, divisive and erosive processes associated with achieving consensus. In other words, while the initial decision might be authority driven, its application is collective.

Box 4-3: Landcom NSW projects.

Landcom, the NSW government's property development and disposal agency, made a collective decision to apply high levels of SP in the greenfield and brownfield developments it was responsible for (e.g. Rouse Hill; Prince Henry, Little Bay; Edmondson Park – to name but a few). This was achieved (partly) by creating relative advantage for SP by designing-in or conditioning development opportunities on desirable sites to include best practice SP.

Collective application of this decision (in collaboration with the NSW Government) created incentives and opportunities for designers, builders and developers large and small to acquire high-level SP skills and to train property marketing practitioners to develop SP-based market differentiation and sales strategies. Landcom's leadership led to new SP-based networks and partnerships and growth in broader AHI awareness through awards and promotions.

In summary, two types of collective decision were observed: one in which the collective decision was achieved through broad, representative consensus among group members or representatives (e.g. ABEC) or, one where the initial decision is at management level in an organisation and then implemented in a way that engages individuals collectively in its implementation. Collective decisions of either type have an important and powerful diffusion role because they expedite adoption by 'bypassing' the often time consuming processes of individual optional decision by making it the responsibility of the system. The role of collective decisions is explored further in ANT analysis in Chapter 5 and prospective analysis of its role in diffusion networks in Section 6.5.3

4.1.4 Authority decisions

Rogers defines authority decisions as: *decisions made by relatively few individuals who possess power, status or expertise* and observes that they *generally deliver the fastest rates of adoption* because individuals are excluded from the decision-making process although, he warns that *authority decisions may be circumvented by individuals during implementation* (Rogers 2003, pp. 28-30). Certainty of widespread adoption of even minimum SP alternatives can (arguably) only be guaranteed through mandated minimum standards via regulatory instruments such as the Building Code of Australia (BCA) and NSW's Building and Sustainability Index (BASIX). The role of such authority driven minimum-practice adoption decisions in triggering voluntary decisions to adopt higher standards is further explored in Sections 4.1.5 and 4.1.6 below. Its network-related roles are examined in ANT in Chapter 5 and future directions and applications are identified through prospective analysis in Sections 6.3, 6.5.4 and 6.5.5.

The extent of regulatory influence after BCA and BASIX introduction in 2005–2006 is summarised in Figure 11. It is important to note that while regulation is a powerful driver of adoption of minimum SP standards by the new housing sector, its influence is limited to around only 2% of all housing stock in any given year (Tennent 2002). I argue that adopting minimum practice is unlikely to ensure adequate sustainability outcomes - particularly in relation to the aversion of irreversible climate change (Flannery 2007; IPCC 2007b) and that to achieve such outcomes, the adoption of substantially higher levels than those currently mandated is required.

In NSW, BASIX mandates GGE reductions ranging from 25% to 40% depending on building type and climate zone (NSW_DoP 2003). It is one of few regulatory tools in the world that regulate greenhouse outcomes rather than energy efficiency. Other states and territories are yet to specifically address GGE reductions from new housing in a regulatory context – preferring to persist with the BCA approach of mandating minimum standards for building envelope efficiency in the hope that reduced heating and cooling energy use will deliver equivalent GGE reductions. While many scholars support this approach (Clarke 2006a; Isaacs 2005c), others argue that it is by no means guaranteed (Watson & Hyde 2001; Williamson 2005).

Indeed as argued further in Section 6.3.1, the AHI's potential role in limiting CO_2 levels to the 450ppm limit nominated by the IPCC (2007) as a likely threshold for dangerous climate change (Schneider & Lane 2005) is significant. While improbable within current economic and socio-political constraints, it is technologically possible to achieve 100% or better GGE reductions (carbon neutral or carbon positive) across all housing (new and existing) in the 10 year time frame set by IPCC (IPCC 2007b) using only existing technologies and practices as described and demonstrated in the *Your Home* Technical Manual (Reardon et al. 2008).

On that basis, I assert that the AHI is one of few industries capable of achieving (and indeed exceeding) the IPCC targets in their 10-year time frame. However, this depends on introducing the range of additional mandatory minimum and voluntary best practice adoption drivers for new housing examined throughout this research and the different set of adoption drivers for existing housing addressed prospectively in Chapter 6. In Box 4-4, I examine potential outcomes from existing regulations (e.g. BASIX) and contextualise them within IPCC timeframes to argue the need for these strategies and urgent benchmark creep.

Box 4-4: Projected GGE reductions under BASIX and BCA and potential for improvement.

BASIX calls for new housing to achieve a 40% (or better) reduction in GGE compared to an average benchmark for existing houses (NSW_DoP 2003). While the methodology underpinning this benchmark and the accuracy of some compliance paths accepted for achieving it have been challenged by several experts (ABSA 2005; Clarke 2006a; Isaacs 2005b; Lee 2005; Pears 2005), I take the position that it provides an adequate baseline metric at this stage of progress towards sustainable housing. During the final stages of SP diffusion (GGE neutral and GGE positive housing), more accurate tools will be required.

While approximately 2% of Australia's total housing stock is new in any given year with an average of 150,000 new housing starts annually, less than 35% of those new homes replace existing housing stock (ABS 2008 3236.0; Tennent 2002). On that basis, I estimate that only around 2.5 million of Australia's 8 million existing houses (DEWHA 2008) are likely to become BASIX (or BCA) compliant within 50 years of the regulation's introduction in 2004 without significant upgrading of existing stock. However, if we assume that (pending) regulations aimed at existing housing stock (e.g. mandatory disclosure) are introduced (and are successful) and that BASIX-compliant (or equivalent in other states) new housing stock achieves a 40% reduction in GGE, it is reasonable to assume that the AHI can deliver in the order of 40% GGE reductions from operational energy use in housing by 2055 based on current benchmarks.

Further, I suggest that with regular bar-creep applied through effective change agendas and the additional strategies identified by this research (see Chapter 6), a target of 100% is achievable using available technologies and practices (including increased renewable energy contributions). With 10%- 20% of total GGE emanating from the housing sector (AGO (1999) Baseline Study estimated that approximately 17% of Australia's total GGE were housing related, DEWHA 2008 does not calculate GGE), the achievability of this target in the short window of opportunity set by IPCC ranks it among the most important climate change initiatives available. This position is supported by (ASBEC 2008; CIE 2007; Pears 2007).

The influence of current, proposed and probable regulation is summarised in Figure 11. The inner dotted circle depicts the current influence of BCA and BASIX and the dashed oval indicates their extended influence which is approved and likely to be implemented by 2010 (DEWHA 2008).
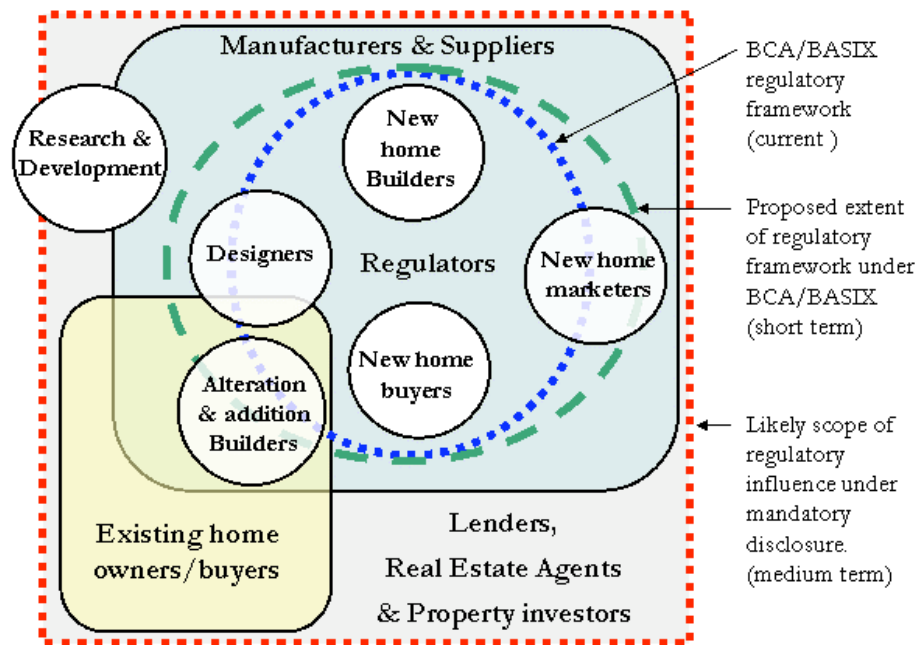
Figure 11: Schematic indicating scope of current and proposed regulatory influence.

The outer dotted rectangle represents the likely influence of mandatory disclosure on the entire Australian housing stock (new and existing) and the broad industry sectors with key roles in its application. This diagram demonstrates and emphasises the limited influence of BCA and BASIX on existing housing stock and more importantly, the powerful opinion leadership potential of the finance and marketing sector.

In summary, the above analysis indicates that while authority decisions are a fundamental component of the SP diffusion process, their effectiveness can be enhanced through additional strategies that encourage optional and collective decisions to adopt higher (than mandated minimum) standards of SP. While some of these strategies were briefly outlined above, these and additional strategies will be explored and expanded through subsequent analysis. As a first step in this further analysis, I explore the role of the dual codes of practice proposed by ABEC (mandated minimum and voluntary best practice) in Section 4.1.5 below. I conclude my DoI analysis of the adoption decision process in the framework of DoI's innovation decision process in Section 4.1.6.

4.1.5 Dual codes: mandated minimum standards and voluntary best practice

Regulation encourages the adoption of minimum practice by the whole of industry which increases demand for innovation in sustainable technologies and practices and creates economies of scale

that drive commercialisation of products and solutions. This in turn encourages skill acquisition by later adopting practitioners, often leading to better than mandated minimum practice being adopted by these groups. However, I postulate that regulatory tools that measure and mandate minimum practice only are of limited use in the medium and long term. In the sections following, I draw support for this position through DoI analysis of my AR observations. However, firstly, I explain the role of the dual codes concept in more detail.

The application of ABEC's 1999 recommendation for a dual code strategy observed during AR is summarised in the diagram below. Minimum codes of practice were developed and mandated and a voluntary code of best practice was developed and encouraged through provision of a range of resources (e.g. information and skills) and incentives (e.g. best practice awards and recognition, subsidies to incentivise the adoption and trialling of vanguard technologies and practices). The diagram demonstrates how regular, cost-effective benchmark creep is facilitated through innovative improvements in SP performance and cost effectiveness to progress the AHI towards the ultimate target of sustainable housing defined in Chapter 2. The processes involved in the voluntary code will be analysed in greater detail in Section 4.2 where I explore the role of the 'innovation development process' in driving advances in SP.
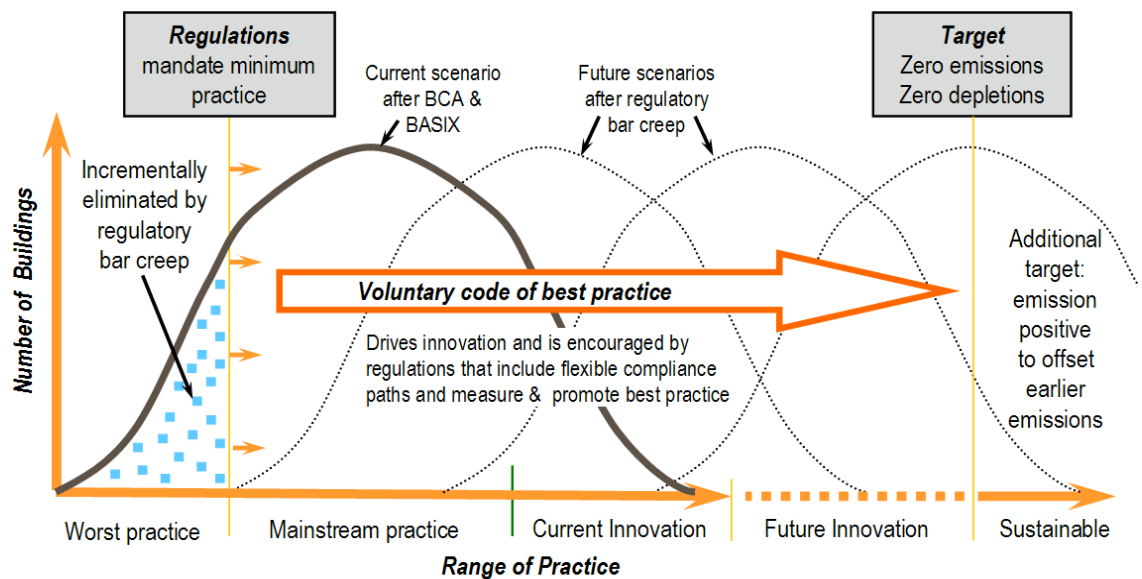
Figure 12. The combined effect of minimum benchmark creep and voluntary adoption of best practice (adapted from ABEC 2000).

Two effective minimum regulatory frameworks (BCA and BASIX) have been developed and implemented to deliver ABEC's mandatory minimum code within the AHI. However, I observe that the voluntary code of best practice has received significantly less attention from CAs within these frameworks, especially BCA which is quite limited in its capacity to drive voluntary best practice (a position that is substantiated through additional analysis in Sections 4.2.4 and 6.3. Additionally, while BASIX has strong potential to address both codes with equal effectiveness,

161

DoP's current decision to de-emphasise its capacity to stimulate best practice (Eckstein 2006) has limited its effectiveness in this regard to date.

I observe that BASIX embodies several of the characteristics identified by my analysis as useful (if not essential) in a regulatory tool that facilitates and encourages simultaneous advances in both codes. These are discussed further in section 4.2 below and include seamless updating (including benchmark creep) and the capacity to measure and compare minimum, better and best practice. Additionally, BASIX' capacity to collect performance-related data is an important feature through which progress can be monitored to inform mandatory minimum benchmark bar creep in terms of both need (goals) and achievability (practical solutions). I assert that SP adoption would be significantly increased were the ABCB to develop similar capacities within the nationally consistent regulatory framework of BCA.

In summary, the dual codes of practice recommended by ABEC in the late 1990s continue to provide an effective framework for SP reform agendas in the AHI. However, since its introduction, I contend that the mandatory code has dominated CA focus and, while market forces in the AHI have continued to drive the voluntary code, an expanded CA focus would deliver better outcomes.

4.1.6   Stages of adoption decision

Five stages commonly occur in the decision-making process followed by an adopter (individual or group) deciding to adopt or reject an innovation (Rogers 2003). These are depicted in Figure 13. These stages are agreed by diffusion scholars to be representative of the decision-making process involving the optional adoption of an easily defined innovation in DoI theory. However, I argue that they require modification in authority-driven diffusion circumstances where the adoption decision is mandatory (as frequently occurs in this research context) and the innovations are complex and constantly developing.
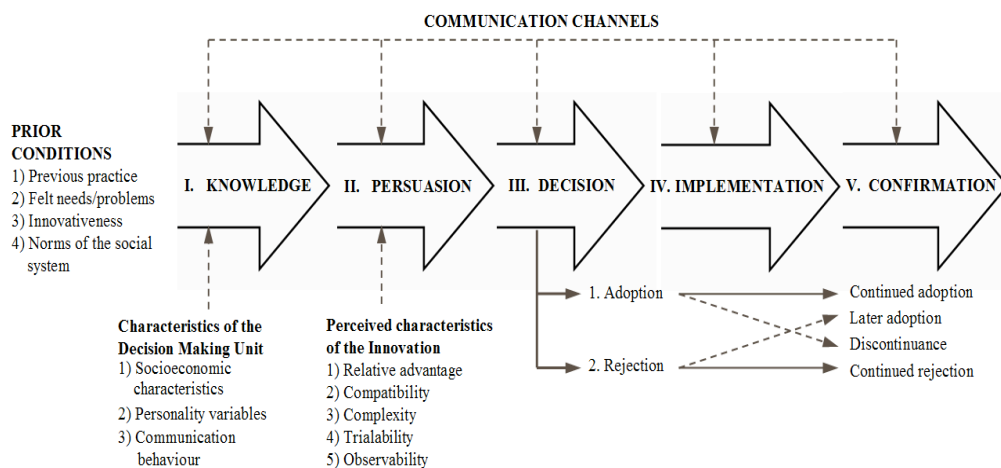
Figure 13. Five Stages to the Innovation Decision Process (Rogers 2003, p170)

My adaptation of the above diagram to fit the post-regulatory AHI adoption decision process is depicted in Figure 14. In my diagram, the pre-requisite conditions, knowledge and persuasion at the start of Rogers' process are eliminated by the mandated decision. In this scenario, the knowledge stage appears post-decision, although the characteristics of the innovation become less relevant and are replaced with investigating the implications of compliance.

An additional stage, skill acquisition is added followed by implementation in the mandatory context. For the majority of practitioners, the choice of what standard to apply leads to the 'adoption' of minimum compliance because their initial skill levels are low. However repeated compliance and marketing of SP to consumers increases practitioner skill levels in each adopter category and, combined with diffusion-related market forces an environment is created in which competition and the need for innovation drive the voluntary adoption of additional or higher standards of practice.

Reinvention (triggered by mandated adoption of minimum SP) stimulates the 'innovation development process' examined in Section 4.2. Put simply, this process involves development and commercialisation of improved SP to facilitate cost effective regulatory 'bar creep'.
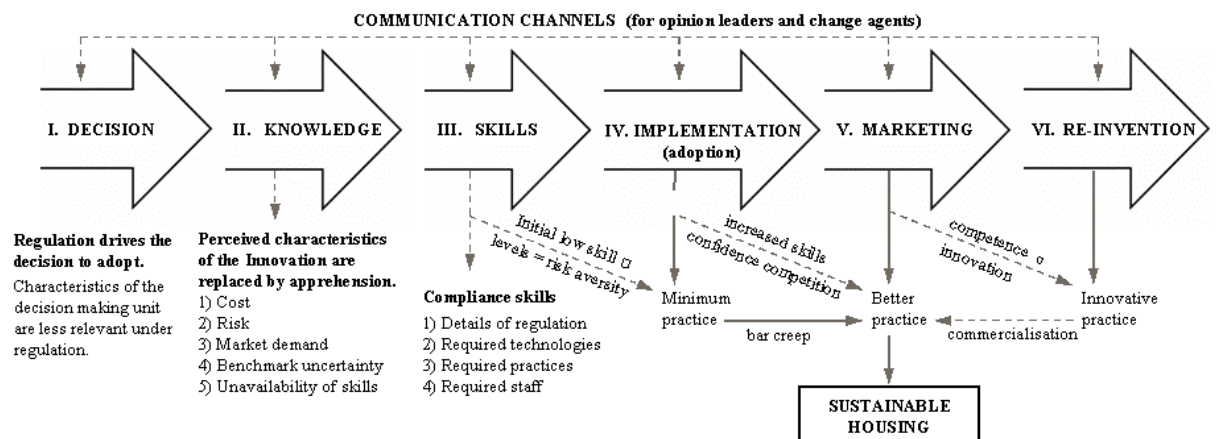
Figure 14: Modified post-decision stages of adoption by practitioners when their initial decision is mandated (substantially adapted from Rogers 2003 to the AHI context)

Both of the adoption decision processes depicted in the figures above are operating in the AHI SP diffusion process at any given time because many non-mandated SP adoption decisions are also being made. Accordingly, CAs should identify and address the appropriate decision-making process(es) within each agenda to capitalise on the opportunities they provide to increase voluntary adoption of better (than mandated) standards. Strategies include: skill provision, stimulating competition and incentivising the commercialisation of innovative new SP generated through the reinvention process – all of which support cost-effective regulatory bar-creep. Each of these opportunities and their inter-dependence is examined in detail through subsequent analysis to support my argument that, if well designed and managed, such strategies could contribute to a series of critical mass cycles that drive benchmarks up more rapidly than envisaged by regulators.

I commence by examining the role of skills in the innovation decision process in Section 4.1.6 below. Additional links between skill development, reinvention and innovation development are addressed in Section 4.2 where potential innovation development contributions by later adopters (in terms of cost and risk reduction) are also recognised as an under-utilised resource. In Chapter 5, I use ANT analysis to explore the role of the network in facilitating the interactions that link the various decision stages (depicted by arrows in Figure 14) with a specific focus on the interactions shown as dashed arrows to indicate their current under-utilisation. In Chapter 6, I use prospective analysis to further explore their potential to accelerate progress towards critical mass in the adoption of better and best practice.

An important assumption underpinning this analysis of stages of decision involves the potential for fluidity of innovativeness among adopters. My AR observations indicate that the adopter category characteristics of participants vary from those defined in traditional diffusion models because a level of fluidity exists whereby adopters who fell into early and late majority categories often demonstrated characteristics aligned with innovators and early adopters as their SP skill levels grow or, they move to a new job or market sector.

In summary, the above analysis adapted the optional decision focus of DoI's five stages of adoption decision to address the predominantly authority driven initial decision context of this research. Importantly, both types of decision-making process are operating in relation to SP diffusion in the AHI at any given time because, while the initial decision is often authority driven, effective SP change outcomes are very much dependent on a range of subsequent optional and collective decisions on better and best practice. Accordingly, the 'tailoring' of change agendas to increase the effectiveness of both processes is central to my remaining analysis wherein I identify strategies through which CAs might increase their effectiveness both interactively and individually.

4.1.7 Knowledge and skills in the innovation decision process

The post mandatory adoption decision stages shown in Figure 14 (II, III and IV) are linked to variable outcomes (dotted arrows) that are largely dependent on practitioner skill development. While growth in SP knowledge levels among practitioners (and to a lesser extent, consumers) has created discernable shifts in attitude and made sound progress towards BaU adoption of SP by AHI practitioners during the 10 year AR time frame of this research, my analysis indicates that training levels and standards remain inadequate. This is particularly important in relation to decisions to adopt better and best practice that are often driven by SP based competition and the adoption of opinion leadership roles by practitioners. My questionnaire data confirmed AR observations that practitioners with higher skill levels are likely to advocate higher levels of SP to their clients than those with lower skill levels (see Appendix 2 for an industry presentation of survey results).

The need for an accredited SP skill hierarchy

Reflective practice by trainers identified barriers to the delivery of effective learning outcomes. Here I examine the need for a structured approach to training development and delivery to overcome these barriers. A lack of SP training assessment protocols and course accreditation makes recognition of prior learning (RPL) difficult or impossible. This problem is further exacerbated by a poorly defined skill hierarchy that precludes the imposition of pre-requisite skills that leads to duplication of introductory training material and failure to develop higher level training.

I commence this analysis with a review of the Building Industry Training in Sustainability (BITS) proposal (Giffard & Reardon 2003) to draw out specific problems identified during AR and develop a baseline of understanding of how innovation development drives both demand for SP training and the need to continually update that training to keep pace with SP advances. Section 2.6.4 provides an overview of the BITS proposal and Box 4-5 below examines how an AR proposal to create an SP training hierarchy failed due to inadequate scoping and funding by CAs.

Box 4-5: BITS Case study

This case study outlines the development of the BITS project and describes its key objectives.

Demand for SP training in the AHI was observed to increase exponentially after the introduction of BCA and BASIX in 2003-4. However, at that time, very little formal SP training was available through universities and TAFEs (ABEC 2002) – much less CPD. Even if such institutions responded to this need urgently, a minimum time lag of 5 years was inevitable before new students graduated and became sufficiently skilled as practitioners to apply those skills in the workplace. Something had to be done urgently. In response, a group of SP presenters at a BDAA conference in 2003 (Vale, Clarke, Hockings, Giffard and Reardon) decided to develop a framework and lobby change agencies to develop it into a permanent, comprehensive SP education framework capable of imparting a wide range of skills to practitioners and certifying their attainment.

A scoping paper was prepared and presented to the AGO in September 2003 (Giffard & Reardon 2003) through which it was proposed to:

- *develop and disseminate a comprehensive range of new skills by developing a sustainable education framework to*
- *direct, order and expedite the cohesive development of an interactive hierarchy of training and skill building programs in sustainability at every level of the industry and to identify:*
    - *appropriate training formats for skill building in sustainability in the AHI;*
    - *existing competencies, training courses and materials and;*
    - *gaps or deficiencies in existing competencies and training courses (ibid).*

It was intended that the program to would deliver:

• *a comprehensive set of competencies for the sustainable planning, design, construction, operation, maintenance and de-construction of the built environment;*

• *a cohesive, industry agreed framework for sustainable education at all levels of industry;*

• *a complete set of generic resource materials to facilitate delivery of urgently needed CPD in core competencies to the AHI workforce by Industry Peak Bodies and TAFE (a YH training manual)* (Giffard & Reardon 2003).

It was intended that all existing individual training initiatives would be positioned within an accreditation framework and, that this would allow individual practitioners access to training specific to their needs from a range of courses and training providers. Expected benefits were:

 1) The encouragement of lifelong learning by individual practitioners who would be able to acquire skills relevant to their specific role or field by choosing from a range of specialist CPD training in the knowledge that, over time, they could acquire a certificate, diploma or award recognised as prior learning by institutions of higher learning for credit in undergraduate or post graduate studies.

2) Minimising duplication by encouraging interconnection of existing and new courses from diverse training providers who would collectively provide prerequisite or complementary training packages for each other's courses via a recognised framework. This would enable individual practitioners to access a range of complementary courses from diverse providers while maintaining individual IP ownership and commercial viability for existing courses and encouraging the development of new ones (ibid).

Intended outcomes included:

• *a collection of competencies owned and agreed by all stakeholders that could be used to form any course from short CPD to national qualifications and be transferable i.e. a competency could be credited from CPD into a national qualification in TAFE or university;*

• *a national framework (based on competencies) for education in sustainable building practices in which new or specialist courses can be developed and accredited allowing individual practitioners to acquire recognised qualifications by choosing from a range of courses and subjects that suit their own needs and time frames;*

• *a set of resource materials generic in nature allowing them to be badged and adapted to suit the resource needs of any CPD, TAFE module, Unit of Competence or university curriculum (ibid).*

While a primary aim of BITS was to minimise duplication of work (and funding) in developing new materials and courses, the eventual outcome was the complete opposite. BITS was first proposed in response to market demand observed to be at its peak in 2003 but was not delivered until 2006 due to funding delays. In the interim period (2003 – 2006), HIA's long running GreenSmart training combined with a proliferation of new introductory courses (e.g. MBA Eco Living, RAIA CPD seminars and ABSA's Sustainability Seminars and BASIX introductory courses) met industry demand for introductory courses.

Despite this, AGO funded four additional introductory courses on Thermal performance, Energy Use, Water Use and, Materials Use and Waste Minimisation. It was intended that these courses would be badged and delivered to practitioners by the industry peak bodies but the initiative failed because the courses effectively duplicated existing training already being delivered by these peak bodies. At their own cost, BDAA are currently (2009) delivering substantially modified (more advanced) versions of the original modules. In other words, the original modules diverted scarce funding from advanced courses and were never used. I attribute this to the absence of an SP learning hierarchy and suggest that the associated failure to deliver advanced skills in a timely manner has limited innovation decisions to adopt better or best practice SP.

While the original BITS proposal is now unlikely to be funded by any CA, I assert that the incorporation of its core aims in the planning of training-related initiatives is essential to inform future training and avoid further duplication. Issues that arose during development of Green Loans Assessor training by ABSA in 2008 summarised in Box 4-6 below provide a succinct example of this need (See Section 6.5.3 for more on Green Loans. The following case study demonstrates the need for a program that addresses the objectives and needs identified in the BITS proposal.

Box 4-6: Green Loans Assessor Training

DEWHA was briefed by a new minister to develop a framework through which to deliver a 2007 election commitment to provide green loans to householders to encourage sustainable upgrades and retrofits to existing housing stock. I was engaged as a training consultant to ABSA who were primary consultants to DEWHA's Green Loans program – a role that also provided final AR opportunities (the Green Loans program is discussed further in Section 6.5.3).

A scoping study conducted by ABSA (Johnson & Milne 2008), found that, while several *in-house (ibid)* training programs had already been developed and delivered by NGO and state government CAs (Energy_SA 2003; Holmesglen_TAFE 2007) and, despite *widespread industry support for a national qualification in household sustainability assessment to develop a skilled assessor workforce* (Johnson & Milne 2008) no current courses were specifically suited to that project. Due to tight timelines, the absence of formally recognised training modules within existing courses and a lack of collaboration between Commonwealth and State government CAs, it was recommended that the most expedient (but arguably least cost-effective) course of short-term action was to develop a new series of short courses specifically for Green Loan household sustainability assessors. In the medium term, those courses should be converted to an AQF recognised training course for Household Sustainability Assessors- possibly at Certificate IV level (ibid).

The short-term solution involved duplication and reinvention of various courses and this waste of resources led to lower quality training being delivered to first generation assessors. The more expensive, medium term task of gaining AQF accreditation is yet to commence and will also be complicated by the need to replace or re-invent existing, inadequate competencies already accredited (and protected from duplication) by the AQF framework. In other words, the lack of a recognised training hierarchy has added to training costs, lowered training standards and (arguably) might lessen the effectiveness of the Green Loans program.

I suggest that were BITS to have been fully implemented, these courses would have been available as recognised 'units of competency' (components of an AQF recognised competency standard that describe the key elements of each function or role in a particular occupation) in an AQF recognised framework of modules (or subjects) available for delivery as components of the new training package by any RTO in Australia. In Chapter 6, I examine alternative paths ways forward through prospective analysis of the above AR analysis and observations in relation to BITS.

Information strata: attitudes, knowledge and skills for AHI practitioners

Retrospective analysis of successive cycles of action research of industry training led to my categorisation of the information provided during training within three distinct categories. I observed that by varying the amount of information presented within each stratum according to participant adopter group or industry sector, I was able to more effectively engage each group. My information categories are:

- Attitudes: moral & ethical judgements about what we need to do.
- Knowledge; why and how we should act on those judgements.
- Skills: how we implement those actions.

A subsequent literature review identified an expanded version of these categories developed at a 1977 UN Intergovernmental Conference on Environmental Education where five categories were agreed by delegates (UNESCO 1978 in Monroe & Day 2000): These are:

1. Awareness: of the of the total environment and its allied problems;
2. Attitudes: a set of values and feelings of concern for the environment and motivation for actively participating in environmental improvement and protection;
3. Knowledge: to gain a variety of experiences in, and a basic understanding of, the environment and its associated problems;
4. Skills: skills for identifying and solving environmental problems;
5. Participation: to encourage citizens to be actively involved at all levels in working toward resolution of environmental problems (ibid).

Whilst awareness and attitudes are merged within my definition, the important component of participation is a notable omission from most AHI CPD training and can only be assumed in the absence of any formal evaluation or ongoing training. HIA attempted to include annual attendance at half day refresher courses as part of their GreenSmart Professional licence renewal but this practice was discontinued due to logistical barriers. However, increases in the number and quality of entries in the GreenSmart Awards program indicate that participation rates are increasing amongst some trainees. Other programs such as BITS and ABSA training rely on regulation to ensure participation. The shortcomings of this lack of follow-up to SP related CPD training within the AHI is succinctly summarised in the following quote from Robinson and Glanznig (2003).

Research tells us that awareness and attitudes alone do not lead people to undertake voluntary actions or change their behaviour. Nowadays most people who are capable of acting positively for the environment probably know enough about the costs and benefits of their actions to make the necessary personal changes. And yet the damaging behaviour continues. There is obviously much more to the ecology of personal change than merely possessing knowledge.(Robinson & Glanznig 2003, p. 27)

Prospective analysis in Sections 6.2 and 6.3 examines the role of communication and regulatory strategies in encouraging such change in terms of the voluntary adoption of better and best practice by AHI practitioners. In the following section, I examine the potential of additional learning motivations to encourage greater levels of voluntary change as an outcome of training.

Learning paths.

Vocational Education and Training (VET) principals recognise that different kinds of messages are required to motivate various learners depending on their attitudes, backgrounds, education, socio-economic position, or industry role (ANTA 1999). Additionally, all learners from all backgrounds require a reason to adopt a new or varied behaviour (ibid). Regulation now provides this incentive in the case of minimum SP levels but additional incentives are required to drive better and best practice adoption. Simply providing would-be adopters with information about SP innovations does not guarantee advances in their innovation decision process – particularly within later adopter groups. As Robinson observes: "*people need a grab bag of beliefs and arguments they can use to rationalise change to themselves and others' (Robinson 2006b).*

The following analysis draws on reflective practice (RP) observations by ABSA, NSW GreenSmart and BITS trainers Hockings, Clarke and Reardon in relation to course content and multiple learning paths. An important outcome was the recognition that rapid increases in the volume of SP knowledge and skill required by practitioners had exceeded the capacity for coverage within current typical one or two day courses. As a result of this, many of the courses had inadvertently become too information intensive at the expense of alternative learning paths such as interactive discussion and site visits. Whilst attendee feedback remained positive, reflective practice indicated that this

incremental change in course structure had limited the learning outcomes and behaviour change – an observation confirmed by Monroe and Day (2000):

Training provides a supportive foundation for new behaviours that are instrumental in achieving societal change [however]…*engaging participants in discussions should never be jettisoned in favour of a shorter workshop or providing more information (Monroe & Day 2000, p. 71)*

Because the streaming of training attendees according to learner type is not possible, a variety of learning paths are required in CPD training. Whilst this was recognised through the above reflective practice, time constraints (for both trainers and trainees), limited training budgets and content expectations from RTOs, CAs and attendees also limited opportunities to include multiple learning paths. Suffice it to say, this aspect of training for those reflective practitioners is a 'work in progress' that would greatly benefit from the informed pedagogical approaches recommended in BITS.

Practitioner learning paths.

Many builders are visual learners who learn by seeing, touching, experiencing the subject. Site visits, practical examples, photographs and real life examples where SP can be observed within a BaU context are important learning paths. On the other hand, because many designers are conceptual learners, the provision of an overarching sustainability framework and the subsequent positioning of potential contributions from the day's training within that framework was found to be an effective pathway – particularly prior to coverage of detailed solutions.

Building end-users are consumers of a product (buildings) rather than creators of that product. Their needs, motivations and interests are often quite different to those of builders and designers. Visually pleasing results, lifestyle benefits, health factors and lifecycle cost reduction are the main decision triggers for this group. There is therefore, a need to address these issues within SP training for designers and builders to contextualise the learning outcomes within the broader constraints of their workplaces.

Other sectors of the AHI are primarily concerned with risk minimisation and compliance. For this group (engineers, detailers, quantity surveyors, supervisors etc), benchmarking data, standards and regulations are important. However, these concerns receive lower priority amongst builders and small design firms who are more involved with the conceptual end of the housing production continuum. This suggests the need to stream attendees – an option that is not viable within current 'ad hoc' training initiatives. For all the above groups, cost is the main determinant for what is ultimately applied in a project. Most groups will listen to, understand and agree with opinion leader advocacy of the adoption of better and best practice but, when it comes to implementing them, cost invariably overrides all other motivations in all but a few cases.

Planners and regulators often have very little understanding of industry constraints at 'the coal face'. Whilst this is sometimes an advantage in that they are not constrained by the practical implementation issues when developing policy, many new sustainable planning initiatives have created significant reaction and resistance on the part of industry practitioners – to the extent that they have had a net negative result (e.g. Liechardt Council Solar HWS Policy, Gosford Council rainwater tank policy). This group (planners) respond well to international examples, benchmarking data and tools and case studies showing evaluated, effective policies that they can adapt to their local context.

The final major industry group are the marketers, lenders and valuers. This group is the most risk averse and is unlikely to adopt any new idea or technology without demonstrated precedents with sound sales/economic performance records. Whilst the trainers whose reflective practice was summarised above have had no direct involvement with SP training for sales staff, their training feedback to RTOs and employers consistently included strong feedback from practitioner attendees that lenders, valuers and marketers act as 'gatekeepers' to SP adoption. In other words, until SP favourable attitudes and knowledge are imparted to the property marketing industry and volume housing sales staff, design and construction practitioners are limited in their capacity to apply SP. Accordingly, I examine training opportunities and requirements for this important (and currently least trained) group in greater detail in Chapter 6.

I posit that many of the barriers observed in relation to assimilation and uptake of knowledge are traceable to pre-conceptions based on prior experience (This is the way we have done it for years. It works. Why change it?). This is symptomatic of a lack of sustainable education in the formative career training years. My questionnaire results and AR analysis suggest that, the earlier an individual is introduced to sustainability principles, the more likely these principles are to endure throughout that career – providing there is reward. At al levels of training delivery (including TAFE and undergraduate courses), an important motivational trigger arises from the concept that sustainability is the way of the future for the industry and that it is a growth field likely to provide abundant opportunity for career path expansion.

In summary, multiple learning paths are an important component of CPD training delivery that is frequently omitted from current CPD training. Much more needs to be done to address this need

4.1.8 Summary of the innovation decision process

The innovation decision process is arguably the most critical point of focus for CAs. The analysis above yields important insights into that process by examining each of the three main types of decision defined by DoI and contextualising them in the AHI SP diffusion process. Three key findings emerged.

Firstly, while regulated or authority decisions are essential components of the change process for adopting minimum codes of practice, I submit that reliance on regulation alone will not deliver adequate outcomes. Accordingly, I suggest that it be augmented through additional, more effective strategies to encourage increases in optional decisions to adopt better or best practice. In other words, I recommend the continuance and expansion of the dual codes approach embodied in ABEC's strategy to maximise change outcomes. More detailed analysis of this recommendation occurs in Sections 4.2 (retrospective DoI), 5.3 (ANT), 6.3 and 6.4 (prospective DoI).

Secondly, while demonstrating that the processes associated with making each type of decision involve different stages or steps, I argued that creating effective linkages between each of these stages is fundamental to effective management of the change process. Those arguments are developed through further analysis in Sections 4.2.2, 5.2.4, 6.3.3 and 6.3.4 and 6.4.1.

Finally, the above analysis introduced the concept of reinvention or the evolutionary development of SP as an essential component of effective change. The 'innovation development process' is further defined in the next section (4.2) where its role in the diffusion process and potential improvements are examined in detail.

4.2   The innovation development process

4.2.1   Overview

In this section, I analyse the innovation development process over the lifecycle of an SP innovation in terms of decisions, actions and consequences leading to and arising from its rejection or sustained adoption. The process commences with recognition of a problem or need and progresses via research, development and commercialisation of solutions to adoption and evaluation (Rogers 2003, p. 137 & 164). As argued earlier, innovation development plays a critical role in both the time taken for SP innovations to diffuse and more importantly, the permanence of that adoption. The importance of SP innovations undergoing continuing evolutionary development through the process referred to by Rogers as reinvention is explained in Sections 1.4 and 1.5 and its role is further is further explained through ANT analysis in Chapter 5 and prospective DoI analysis in Chapter 6. Here, I focus on the process of reinvention and how the resulting cycles of reinvention can be best used to accelerate the diffusion process.

4.2.2   Cycles of innovation development or reinvention

Innovation development or reinvention encourages investment in and ownership of SP by innovators while delivering affordable, low risk solutions to later adopters. In this section, I draw insights and examples from AR to analyse and explain the critical role of innovation

and reinvention in the diffusion process and argue the importance of regulatory compliance flexibility and innovation incentives in change agendas. Such features encourage the refinement and commercialisation of cost effective SP through R&D by innovators and early adopters while accelerating the delivery of commercial leading edge innovations to the early majority. This encourages the uptake of cost effective, quality assured solutions by the late majority. This process is summarised in Figure 15, which depicts the complex matrix of actors involved in each stage of the development and adoption of an SP innovation and indicates their most common network interactions.

The innovation development processes are cyclical because they either start with recognition of a new problem that has been identified by researchers (Step 1) or the creation a new research problem requiring reinvention or commercialisation after being adopted, applied and evaluated by successively less innovative sectors in the AHI. Each of Rogers' adopter groups is represented by an octagon. Processes and stages are rectangular while CAs and their interventions are circled. While CAs make direct input to each process, their role is linked to each level of adoption via the innovation development and commercialisation process for simplicity.
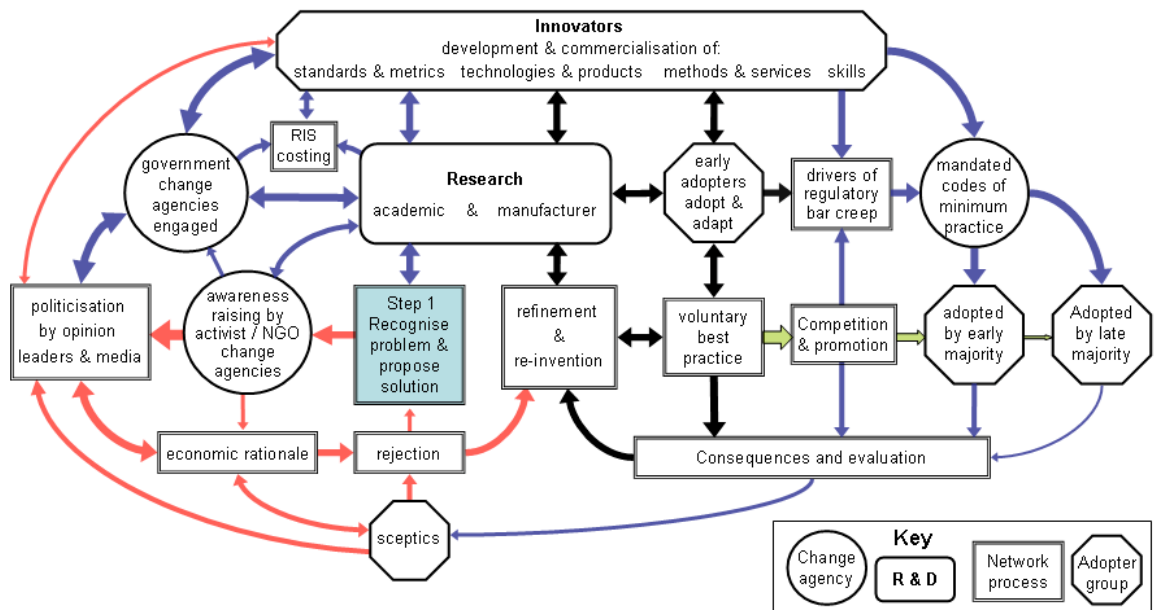
Figure 15. The innovation development Cycle

AHI innovation development occurs through multiple, interdependent cycles that frequently overlap or occur simultaneously. Arrows indicating the most common interactions are weighted according to influence. In the innovator and voluntary best practice adoption loop, the arrows are black and many are bi-directional to indicate high levels of interaction between the actors involved. Socio-political interactions are shown in red (light grey in greyscale) and are also typically bi-directional. In the mandated minimum practice loop, the arrows are blue (mid-grey) and likely to be mono directional (representing authority decisions). Green (or outline) arrows indicate the

competitive or market driven network influences. Variations of this diagram depicting a specific set of actors and interactions are used in later analysis to highlight specific research focus.

Sequential contributions to the refinement and reinvention process from each innovativeness-based adopter group are depicted becoming less influential as diffusion progresses. While it could be reasonably expected that innovators and early adopters make the most substantial contributions, the low contributions from later adopter groups give cause for concern because these groups are most responsible for cost-effective refinement and commercialisation. I explore this barrier (and suggest ways to overcome it) in Section 4.2.3 below.

4.2.3   Appropriate roles and actions for each adopter category

The BaU adoption pre-requisites and subsequent diffusion roles of adopters vary according to their innovativeness category. In this section, I explain the conceptual diagram above by presenting AR based examples to illustrate how my analysis of these needs and roles was informed and argue the need for different diffusion strategies, technologies and practices for each group.

A natural selection process was observed to occur in voluntary AR change agendas indicating that the cost or risk associated with the SP adoption correlates with adopter innovativeness. However, mandatory change agendas were observed to interfere with this market driven correlation and, in some cases, this caused innovators to implement less effective, standardised solutions or forced risk averse, later adopters to implement higher cost or risk strategies. Figure 18 shows how these influences relate to different adopter groups.
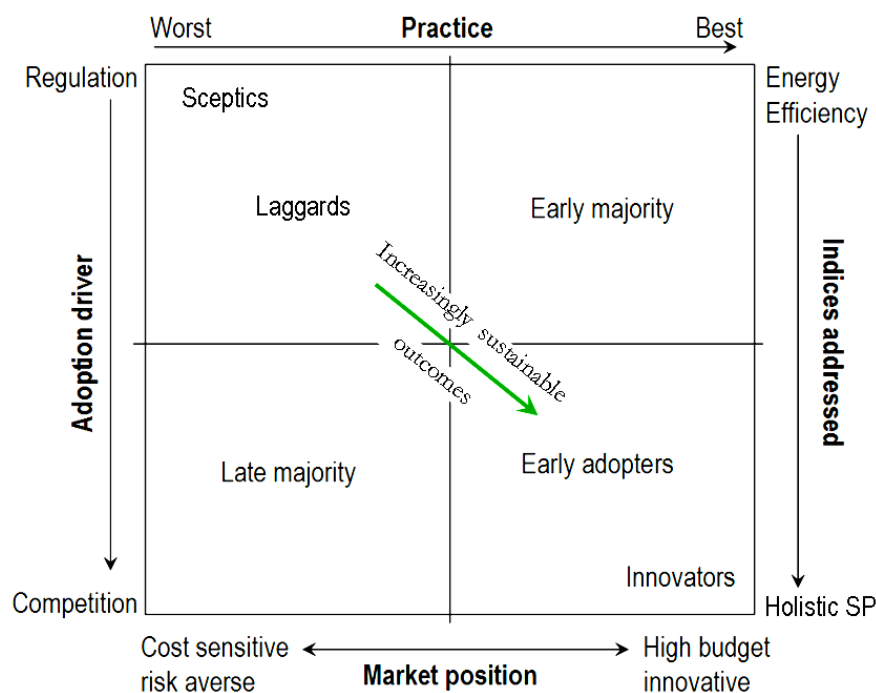
Figure 16. Adopter categories, industry position and adopting sustainable practices.

My AR categories of adopters according to market position, innovativeness and capacity to address the risk and additional cost of better and best practice adoption is summarised in Figure 16. While each gradient applies across all four quadrants (horizontally and vertically), the closest quadrant to the scale is affected to a greater extent. For example, the top horizontal axis addresses the standard of SP applied while the bottom one addresses market position. While each is related, early majority adopters were observed to apply higher standards than the late majority, owing to larger budgets and innovative clients whereas the late majority (who had cost sensitive, risk averse clients), applied only minimum mandatory standards until the additional driver, competition from the early majority competitors (left vertical axis), provided sufficient incentive to drive the adoption of better SP.

Appropriate adoption drivers, ranging from regulation (mandatory) to competition (voluntary), are indicated on the left vertical axis, whereas the right axis indicates the range of indices or impact categories addressed. At the lower end of the scale, minimal building envelope thermal performance and HWS efficiency are addressed, whereas at the higher end, holistic SP that deliver outcomes approaching sustainable housing as defined in Chapter 2 (carbon neutral or positive, self sufficient in water and waste water treatment, best practice LCA of materials, biodiversity positive and air quality friendly). While the early majority adopted higher standards of SP earlier than late majority, they began to address more indices only to compete with the innovators who attracted the most innovative, wealthy clients.

This categorisation is presented as an indicative summary of my AR observations and analysis and is intended to yield useful insights into the ongoing change management strategic analysis in Chapters 5 and 6. Such analysis fits well within Gibbons' Mode 2 Knowledge definition.

The following AR case study examples illustrate the AR observations and experiences upon which this analysis is based. Box 4-7 shows how voluntary adoption decisions in SEDA's non-mandated ESH program correlate with the adoption pattern in Figure 18. Initially, innovators sought information and skills. Over time, these translated into adoption or application of SP in projects.

Box 4-7: SEDA's ESH program. Linking SP adoption risk to adopter innovativeness.

ESH was a voluntary program. It provided an opinion leadership platform and network through which early adopters and innovators were able to diffuse the adoption of energy-efficient practices to the early majority in a 'non authority' (Rogers 2003) diffusion context. While adoption rates were slow in terms of actual applications, attitudes were changed – leading to decisions (by innovative practitioners) to acquire new knowledge and skills.

Partial or trial applications proliferated as these specialised practitioners attracted or were able to convince their consumers to accept the slight additional risks and costs associated with adoption of

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SP. Many (including the author) trialled various SP in their own homes to develop skills in a low risk (in liability terms) environment of trial and error and minimise risk in subsequent applications for clients. These early consumers were rarely cost sensitive and those who were risk averse were won over by innovative practitioners. Such practitioners operating in SEDA's ESH or SEAV's change agenda environment produced many of the initial case studies in YH. These programs facilitated familiarity, observability and trialability for all practitioners and consumers without threatening late majority adopters and sceptics who were able to learn from the innovators successes and mistakes.

In the SEDA example above, practitioners were able to choose levels of risk and cost appropriate to their skills and budgets during the trialling phase of adoption (as indicated in Figure 18). In contrast, BASIX unintentionally encouraged less innovative practitioners to adopt the high risk, commercially untested innovations by providing disproportionately high rewards for the high risk water strategies indicated by the heavy arrows linking mandated codes of minimum practice to early and late majorities on the top, right of Figure 17 and demonstrated in Box 4-8.

Box 4-8: BASIX encourages the adoption of a relatively high risk SP by later adopters

BASIX encouraged the adoption of grey-water re-use (recycling or diversion) by all adopters – regardless of innovativeness and included few warnings about the associated risks. Adoption of such SP (in this case technologies and installation practices were equally critical) by late majority and sceptics (particularly at uninformed consumer level where careful management is essential to avoid health risks and soil contamination) was a relatively high risk, high cost strategy with only limited yield in water savings (Mitchell, Turner & White 2005) that attracted criticism by sceptics.

In this case, later adopter groups were encouraged to adopt relatively untested and unproven SP before completion of the usual cycles of selective trialling by informed early adopter practitioners and their clients followed by evaluation and refinement by innovators to minimise risk (see Figure 17). In a voluntary adoption environment, the SP would have been quality assured through such cycles prior to gradual, selective (i.e. in suitable projects) adoption by the early majority in mainstream installations as part of the commercialisation and cost effectiveness phase.

This example demonstrates the inherent risks arising from the capacity of regulatory change agendas to create atypical diffusion patterns that override both the cost and risk sensitivity filters that would normally ensure initial adoption by appropriately skilled and qualified market sectors.

Traditional, prescriptive regulatory approaches such as those used by the ABCB on energy efficiency provisions were observed to create adoption barriers by inhibiting the reinvention cycles depicted in Figure 17 and restricting the application of rapid advances in SP (both practices and

technologies) by innovators and early adopters. Additionally, such prescriptive regulations unfairly penalised less innovative industry sectors (top right sector of Figure 18) by introducing unnecessary complexity. This is summarised in the case study box below.

Box 4-9: BCA 2006 – an example of diffusion barriers created by prescriptive regulations.

In this case study, diffusion barriers were created through complexities associated with ABCB attempts to apply prescriptive deemed to comply formulas to complex thermal performance design processes that are arguably best addressed through HERS simulation during design.

Initial RIS research by the ABCB for 2006 Energy Provisions in BCA (ABCB 2004a, 2005) was challenged by industry groups because it failed to address an unjustifiable regulatory bias against lightweight buildings (ABCB 2005, 2006b). First Rate (a first generation HERS software package with a known bias for buildings with high thermal mass which was also proven to be less accurate in warmer climates) was used to model the thermal performance of a range of housing types in which assumptions were made about solar access and construction type. The mass bias was shown (by lightweight manufacturer, builder and designer groups) to be valid in only one or two climate zones and only when careful attention was paid to thermal performance variables not typically found in volume housing. Additionally, the 'lightweight construction' industry sector put forward innovative solutions with potential to overcome low mass limitations in most housing types in every climate zone demonstrating how such prescriptive regulations would limit future innovation.

Rather than abandoning its prescriptive approach to regulation, the ABCB succumbed to lobbying against exclusive reliance on HERS simulation compliance methods by HIA and MBA who represent later adopter groups in the volume housing sector (Osterhage 2005). This stance failed to recognise the complexity of thermal performance and created an additional set of complex and confusing alternative verification methods and 'deemed to satisfy' provisions (ABCB 2006a Part 2.6) which the majority of practitioners find confusing and intimidating.

The AR observations and analysis above suggest that flexible compliance paths are preferable to prescriptive ones because they encourage applying industry BaU risk and cost parameters. While innovation development and reinvention by innovators and early adopters is low risk and desirable, separate strategies are required to ensure that later adopter groups are advised of the higher risks or costs (relative to their market position) associated with these SP. When the risks are better known, strategies to encourage more widespread adoption by early majority adopters to facilitate refinement and commercialisation (as shown in Figure 17) are useful.

Ideally, only tried and proven innovations should be mandated for adoption by the cost sensitive, risk averse late majority indicated in the top left corner of Figure 18. At this final stage of SP

innovation development, the specialist skills and knowledge required by innovators to minimise risk has diffused throughout the industry to facilitate cost effective, low-risk adoption. I assert that such specific strategies will deliver the most cost effective outcomes and minimise criticism by sceptics.

4.2.4 Reinvention opportunities and barriers

Regulation has potential to drive reinvention or innovation development more effectively than my AR observations indicate. Rogers (2003, p183) generalises that reinvention occurs at the implementation stage and that higher degrees of reinvention can accelerate adoption rates and ensure sustained adoption for many adopters and innovations. Additionally, he argues that inherent flexibility in innovations allows and encourages higher levels of reinvention ensuring their compatibility with a wider range of adopter conditions and implementation in a wider range of circumstances. This was confirmed by AR among innovators and early adopters of SP, who 'invested in' or acquired new high level skills in order to adapt and re-invent SP to better suit their own applications in the pre-regulatory environment. As discussed in 4.2.3 above, prescriptive regulation can suppress or bypass such reinvention.

While detailed examination of how regulation might be adapted to play a more innovative role in the diffusion of SP can be found in Chapter 5, AR observations of its current role in driving innovation development are addressed here. Amongst AR case studies, two distinctly different regulatory approaches were observed to deliver markedly different outcomes in this regard. In Box 4-10, I compare BASIX and BCA to demonstrate how BCA is less effective in driving innovation development than BASIX.

Box 4-10: Comparing BASIX and BCA as drivers of innovation development

BCA mandates minimum standards of practice but does not measure and therefore (arguably) encourage better and best practice. BASIX does. While BCA includes diverse pathways to compliance, they are quite limited in scope compared to BASIX for several reasons.

Firstly, BCA's narrow scope (mandating improvements to the energy efficiency of the building envelope) limits the range of available compliance paths (and innovation incentives) whereas envelope thermal performance is just one component of BASIX' focus on reducing Greenhouse Gas Emissions. For example, BASIX mandates minimum levels of thermal comfort to restrict and cap heating and cooling loads but then examines both the efficiency of heating and cooling appliances and the GGE intensity of energy sources in measuring comparative improvements (to average housing emissions in the area). BCA simply mandates minimum thermal comfort levels as assessed by House Energy Rating Software (HERS) and fails to address potential GGE reductions from other areas.

Both regulatory regimes encourage innovation in improving the thermal performance of the building envelope. However, BASIX encourages the pursuit of even higher performance by measuring it and allowing and encouraging its promotion through a relevant, outcome-based and transparent metric (e.g. comparative percentage reduction in GGE or water use). While BCA mandates heating and cooling performance expressed in megajoules per square metre per annum $(mJ/m^2/a)$, this performance is usually communicated to all but an expert audience in a star system which bands performance from region to region – disguising actual energy use (Reardon et al. 2001a Case Study 7.1).

Secondly, because of the ABCB's time-consuming update process and BCA's reliance on expensive printed media, only one annual amendment is released. This acts as a disincentive to innovation development because amendments are at least 6 months out of date before printing. Innovative new practices and technologies have often been superseded before they are recognised or offered as BCA compliance paths.

Additionally, the ABCB's extensive but cumbersome consultative regulatory development process often means that stringency levels are reduced to the 'lowest common denominator' of acceptance by State, Territory and Commonwealth Governments in addition to a host of industry peak bodies. By comparison, BASIX' seamless upgrade process allows for 'behind the scenes' upgrading of algorithms to reflect technological advances on a day to day basis and, when its data collecting functions indicate that benchmark creep is affordable and achievable, benchmarks can be raised universally or, in a targeted sector (e.g. new homes in some climate zones or, alterations and additions of a certain value).

Finally, BCA's prohibitive cost combined with the time investment required by practitioners to familiarise themselves with any amendments mean that only a small minority become aware of or apply amendments for up to twelve months after their introduction. By comparison, the internet-based BASIX is able to incorporate new innovations into its flexible compliance paths and make them available to innovators freely within weeks (e.g. AAAA rated toilets were able to be selected within a few days of their market launch by manufacturer Caroma).

The reinvention process observed during AR led to the refinement and commercialisation of many SP, lowering risk and making them more accessible to later adopter groups. However, such high levels of reinvention were observed to sometimes create short-term adoption disincentives among later adopters because they increased complexity (and therefore risk) and limited opportunities to develop familiarity through observation and trialling (See 3.2). While this short-term adoption barrier was largely overcome by introducing mandatory minimum standards (BASIX and BCA), regulation itself produced another undesirable outcome in that rapid obsolescence occurred in 'state of the art' SP applications due to bar-creep. Box 4-11 demonstrates the potential for regulatory bar

creep to limit the useful life of display homes and marketing materials and Box 4-12 illustrates how it also necessitates the regular updating of the BaU compliance solutions developed by practitioners

Box 4-11: Reinvention causing obsolescence in GreenSmart display villages.

Problems arising from accelerated obsolescence of display homes due (in particular) to SP benchmark creep associated with reinvention and innovation development affect most volume housing companies.

In 2003, Delfin's Nelson's Ridge development in Western Sydney was accredited as a GreenSmart Village by HIA. This required project home builders to achieve significantly higher (than mandated minimum) SP outcomes in their display homes. Several major project home builders embraced this requirement eagerly and achieved higher benchmarks than would be required by BASIX upon its introduction in July 2004 in display homes completed in early 2004.

While those display homes would no longer receive GreenSmart accreditation owing to BASIX benchmark creep and rapid development of SP technologies and practices, they were being used by those companies to market their products to would-be new home owners in May 2007. This 'shortened shelf life' for GreenSmart display homes has drawn criticism from innovators including accusations of overstated claims (Cole G 2007) and creates a disincentive for sales staff to market the GreenSmart features. A similar fate befell one of HIA's earliest GreenSmart Villages, at Jerrabomberra, ACT which, after being described as 'greenwash' (Reardon 2003), had its GreenSmart accreditation withdrawn by HIA to maintain the integrity of the GreenSmart brand.

The limited regulatory bar creep already introduced has increased the complexity of SP regulations forcing practitioners to acquire new skills and apply project specific compliance solutions as demonstrated in Box 4-12. This outcome has proved problematic for the volume housing sector and has driven demand for more effective, commercialised technologies to facilitate a return to standardised practices (in some cases nationally). While the volume housing sector has always faced similar problems in meeting a diverse range of state and local government requirements, these generally required one-off development of a standard variation using well understood, risk assured off the shelf technologies and practices. While this was the case in the early stages of SP reform, subsequent benchmark creep often calls for more complex solutions as demonstrated in Box 4-12.

Box 4-12: Relative simplicity of ESH and BCA 2003 3.5-star thermal performance compared to BCA 2006 5-star complexity demonstrating the need to adjust regulations

Early, low level TP benchmarks could be achieved relatively simply through the adoption of practices that were already widely used within the industry. In NSW from 1998 to 2003, SEDA's Energy Smart Homes Policy required that new dwellings achieve a minimum 3.5-star thermal performance rating on NatHERS software. In most climate zones, this required the installation of:

minimum levels of ceiling insulation; wall insulation (in cooler climates); shading and occasional size reductions in large west facing windows.

While initially opposed to the ESH policy by councils, the volume housing sector quickly found that compliance was simple - requiring minimal changes to existing designs and achievable at minimal additional cost by practitioners using existing knowledge and skills.

The success of the NSW ESH experience was repeated in Victoria a few years later and again in other states and territories through BCA 2003. However, when 5-star benchmarks were introduced in BCA 2006, cost effective compliance became significantly more complex and expensive for most volume housing companies – eliminating some standard models and necessitating modification of many others to respond to specific site conditions, orientation and climate. The resultant requirement for a customised design approach did not sit comfortably in the BaU paradigm of the volume housing sector – leading to the lobbying of regulators to include prescriptive or standardised compliance pathways as described in Box 4-13.

Due to its acute cost sensitivity, the volume housing market makes a substantial investment in developing cost effective, low risk solutions to all new regulatory requirements (not just SP). For this reason, many volume housing sector companies prefer prescriptive regulation because compliance is less skill intensive. Additionally, costing and implementation are straightforward. This led the volume housing sector to lobby for simplified compliance measures through their industry peak bodies (as illustrated by the HIA and MBA arguments for 'deemed to satisfy' (DTS) provisions in BCA summarised in Box 4-13).

Box 4-13: HIA arguments for Deemed to Satisfy (DTS) compliance paths in BCA.

BCA 2006 includes a complex and confusing array of DTS provisions that often deliver outcomes inconsistent with HERS ratings. This occurred because industry peak bodies HIA and MBA arguing strongly for the inclusion of DTS provisions in the BCA Energy Efficiency Provisions as an alternative compliance path to HERS simulation.

The 2003 version of BCA required that designs achieve a nominal thermal performance standard equivalent to a 3.5 to 4-star HERS rating. As discussed in Box 4-12, DTS were relatively simple to achieve for this level of performance. However, when it was decided to raise the benchmark to 5 stars in BCA 2006, DTS became onerous and cumbersome and yet HIA and MBA persevered with their insistence on DTS provisions. The majority of industry representatives attending the ABCB's Housing Technical Committee Meeting No 6 during the scoping phase argued that DTS should be eliminated in BCA 2006 but the HIA representative opposed this. Indeed, my motion to this effect was defeated due to HIA dissent – despite receiving unanimous support from all other industry representatives present (ABCB 2004a).

Recent AR in the SP training delivery field (HIA GreenSmart and BITS) has identified a shift in this position towards a preference for performance based regulations, owing to the gradual acquisition of higher level 'in house' skills in response to benchmark creep (see Chapter 5 for detailed prospective analysis of prescriptive vs. performance-based regulation). Increased market differentiation on the basis of SP by the volume housing sector suggests that this 'investment' in increased skill levels is increasing competition. Indeed, rapid increases in both the number and standard of entries in volume housing categories of the HIA GreenSmart awards indicate that some operators in this sector are adopting a leadership role.

4.2.5 Skill provision as an innovation development driver

Regulation is an effective driver of the acquisition of minimum skill levels by practitioners. However, regulation has also increased demand for advanced skills by innovative practitioners from every AHI sector or adopter category. Analysis of AR training roles (Section 4.1.7) indicated that this demand is yet to be adequately met. While skill development continues among the innovators and early adopters responsible for SP reinvention and refinement, its potential role in driving SP diffusion is limited by the current lack of structure and planning in the SP learning environment. An associated (and arguably more critical) problem is that the dissemination of appropriate skills to later adopters remains limited to introductory concepts. My analysis suggests that this limited transfer of skills to later adopter market sectors has slowed the commercialisation of cost effective SP technologies and created barriers to benchmark creep.

Many practitioners see skill acquisition as an investment from which they seek a return through provision of value added services to their clients. Such value adding often leads to innovation – especially among early adopters. This suggests that skill provision is an important innovation development driver. Practitioners require different types of skill to meet minimum compliance benchmarks in a cost-effective, risk-minimised way depending on their innovativeness and market sector. Because of this, innovation development ranges from the invention of new technologies and practices through refinement and commercialisation to adoption, application and reinvention in each housing type.

This important aspect of training delivery and development has been overlooked by training developers (including myself) until recently. The bulk of training to date has been developed by innovators and early adopters on the assumption that all practitioners require similar skills and skill levels. As demonstrated in Box 4-14 below, the assumption is flawed and in need of urgent review.

Box 4-14: Reflective practice recognition by trainers of 'preaching to the converted'.

This case study demonstrates the need for change agents and OLs to recognise the different language and skill needs of each adopter category, to monitor the diffusion process in each and to

adjust and adapt resource provision to match the needs of each group as the diffusion process matures. Additionally, it demonstrates that some practitioners from later adopter categories have important contributions to make to the innovation development process.

In reflecting on our perception of disappointingly limited outcomes from training delivery in terms of diffusion of skills gained by attendees to other practitioners, fellow trainers Hockings and Clarke posited that the practitioners who regularly attended successive training sessions knew almost as much as we did about the field and did not represent a true of cross section of industry. Retrospective DoI analysis and consideration of Moore's gap (See in Section 6.2) indicated that because the training was promoted on the basis of delivery by well known, expert presenters, the audience attracted comprised predominantly innovators and early adopters who, while applying the learning outcomes in their own practices, often failed to communicate them to colleagues in later adopter groups due to differences in motivation, language, application and outcome focus.

Further reflection and an opportunity to present training to known later adopters (in BASIX introductory courses) led us to change our delivery style and content for this audience. Rather than teaching the innovation characteristics only and relying on the attendee's innovativeness to apply them (as early adopters would), we focused on familiarising participants with off the shelf, quality assured, commercialised solutions and imparting skills that allowed them to select the most cost-effective combination of these for each project with minimum risk. In other words, we recognised that later adopter groups did not share our excitement about the newest and most innovative practices and technologies – much less be sufficiently innovative to find ways to apply them effectively. However, many practitioners in this group proved highly innovative in identifying sources of cost and risk and suggesting ways to minimise or overcome them.

Early adopter questioning tended to focus on the latest research underpinning our responses to climate change and other impact categories whereas later adopters were far more prepared to accept expert arguments on the need for sustainable reform. Innovators and early adopters also requested details of vanguard SP technologies and practices – including those yet to be fully tested or commercialised. Their predominant interest was in design concepts and principles. By comparison, after a very brief overview of 'why do it', later adopters were more interested in 'how to do it' solutions involving simple modification of BaU practices and 'where to get it', available, off the shelf technologies and consultant services. These generalisations were drawn from reflective practice with other trainers of training feedback data and AR observations of attendee questioning. They indicate the differing training needs of the various adopter categories.

My observation about potential for innovation development contributions from later adopters in relation to cost and risk minimisation strategies (noted in Box 4-14 above) leads me to suggest that

a formalised feedback structure is required to capture such valuable contributions. See Section 4.1.6, Figure 14 (Modified post decision stages of adoption by practitioners when their initial decision is mandated) for a graphic indication of the pathways through which such contributions could be effective.

The above experiences on training demand also apply to information provision. Box 4-15 reinforces the above arguments about the importance of addressing the full range of audience needs according to their innovativeness category and the tendency of innovators and early adopters to overlook this during the peer review process applied to the *Your Home* Materials.

Box 4-15: Critique of *Your Home* by innovators.

Despite their success in their intended audience, the *Your Home* materials received frequent criticism from experts and innovators. I suggest that this can be attributed to Moore's gap (Moore 1999). *Your Home* communications research (Penman & Reardon 2000) identified a language set that was common to all members of the intended audience set (designers, builders and their consumers). It was recognised that the majority of information to be communicated by YH already existed in technical publications so the main purpose of YH was therefore to 'transform' this technical information into an accessible, non-technical language and style that would be useful to those who needed to apply it (AtKisson 1999). Some experts on the YH peer review panel consistently challenged the language used but other experts and the industry steering committee representatives on the same panel were able to convince these innovators that their preferred language and content was not that of the industry users and consensus was eventually achieved

Post publication critiques of YH by two SP innovators (Hodgkins 2001 in Blueprint and Wright 2001 in NatSpec) were also critical. These reviewers failed to recognise its purpose and focussed on omissions of technical content unlikely to be required by the YH audience. These experts were expecting yet another innovator or early adopter publication and were unable to adequately evaluate YH's appropriateness for its intended audience. Seven years of accolades from later adopters, ranging from home owners to journalists and AHI practitioners indicate that the usefulness of the YH language and content requires no further confirmation (See 2.6.5 for more detail).

Feedback from user groups after the 3rd edition (Reardon et al. 2005) showed a strong preference for inclusion of information on commercialised, off the shelf solutions. In particular, where to obtain them and how much they cost. This suggested that later adopters were embarking on the adoption process, an indicator of progress in the diffusion process. Unfortunately, this feedback was not acted upon. Instead, additional fact sheets addressing an even broader range of general issues were added – some of which was written by sponsors without the usual standards of peer

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review (see Box 3-15). While some of these discrepancies were corrected in the 4th edition (Reardon et al. 2008), little was done to address the changing information needs of users.

YH was launched within the BDAA via a national tour in 2001 during which key concepts were explained through presentations and interactive exercises. However, its subsequent lack of use by the majority of practitioners did not generate the substantial change hoped for at that time. Despite its user-friendly language, many practitioners found the volume and complexity of SP information covered in YH off-putting until mandatory regulations drove them to access it again – often after attending follow-up CPD sessions. Audience research through industry questionnaires indicated that for the early and late majority of practitioners, a range of YH-related CPD was required to ensure that practitioners became sufficiently familiar with the content to ensure its use as an 'in house' technical reference manual as originally intended. Additionally, it was recognised that, in the absence of provision of any substantial SP training by universities and TAFE, such YH-related CPD needed to become detailed and specialised as SP diffusion progressed. Section 4.1.7 identified the need for an overarching hierarchy and my failed AR attempt to create one. This need is further explored through prospective analysis in Section 6.4.3

The above analysis demonstrates a strong link between increased adoption rates and demand for training. Additionally, it demonstrates that when early and late majority adopters entered the adoption decision process, training and information needs changed. This required that existing courses and materials be amended and updated to better meet the needs of later adopter groups in a way best summarised by answers the questions where do you get it? how much does it cost? and how do I guarantee quality assured installation and operation? This change in adopter profile did not require duplicate resources for each group because innovators and early adopters were found to source their own information from conferences, research papers and growing on-line sources.

4.2.6 Summary

The critical processes through which SP innovations are refined and reinvented were grounded and explained in DoI theory in Section 4.2. These processes operate cyclically and rely upon varied contributions from each adopter category through the interactive network summarised in Figure 15. I generalised that these contributions include: innovation by innovators; commercialisation by early majority and cost effective, risk assured application by the late majority while noting that exceptions to this generalisation often create opportunities to accelerate diffusion that should be recognised and exploited.

A second generalisation (summarised in Figure 16) observes that a process of natural selection occurs in an optional adoption decision environment whereby adopters choose the SP innovations that best suit the cost, risk and complexity of their application. Additionally, I argued that while

authority or mandatory adoption decisions are essential, prescriptive regulation can interfere with this natural selection process, leading to less skilled practitioners inappropriately applying high cost or high risk SP when adopted by less skilled practitioners.

Finally, I demonstrated that by disseminating knowledge about SP among practitioners (and to a lesser extent, consumers), SP change initiatives have created discernable shifts in attitude and made sound progress towards overcoming SP compatibility barriers among design practitioners. Additionally, improved knowledge about SP among practitioners has created demand for training and the diffusion of the sophisticated SP skill levels that drive further cycles of innovation development where reinvention, refinement and commercialisation of cost effective sustainable solutions and technologies occurs.

In Sections 4.2 and 4.3, I examined both the adoption decision-making process and the innovation development process in terms of their interdependent roles in driving SP diffusion during my AR journey. In the next section, I examine the outcomes of that diffusion process by comparing the change that has occurred or is in the process of occurring to the change that needs to occur to meet the goals set in Chapter 2 within timeframes that might meaningfully contribute to the creation of sustainable futures.

4.3   Diffusion time frames

In this section, I commence the transition of analytical focus from retrospective to prospective by summarising change outcomes during AR and identifying additional pressing outcomes required. In other words, I conclude my retrospective DoI analysis of AR (explaining how and why change occurs, or not) by summarising the analysis in likely change outcome scenarios and translating them into a range of desirable scenarios to inform my prospective analysis in Chapter 6.

4.3.1   AR timeframes and change outcomes

During the initial phases of AR outlined in Chapter 2, I argued that sustainable change in the AHI is required as a matter of great urgency and, while acknowledging the diminishing uncertainty associated with such arguments, nominated targets for sustainable change outcomes likely to deliver meaningful outcomes for future generations. While the targets (zero net lifecycle environmental emissions and depletions from housing) remain valid, the timeframe in which they need to be achieved has decreased exponentially during the research time frame as climate change and its associated outcomes (e.g. water shortages) increase exponentially (IPCC 2007b).

In this section, I reconcile the likely outcomes identified though DoI analysis within current understandings of diminishing timeframes to assess their likelihood of meeting targets in a time frame that maintains potential to avert irreversible climate change. In this recent context, the targets

nominated in Chapter 2 converge to focus almost exclusively on the critical objective of achieving carbon neutral or positive status in the AHI sector in the most expeditious way.

The AHI has an arguably unique (compared to other industries) potential to make a substantial contribution to GGE reductions by achieving carbon neutral or positive status for all housing in a very short time frame and in doing so, exert significant community opinion leadership in terms of the achievability of a carbon neutral economy.

4.3.2 A summary of change that occurred during AR (1998 – 2008)

Substantial increases in residential energy use and predictions that these increases will continue (DEWHA 2008b) suggest that in absolute GGE terms, sustainable change agendas in the AHI have failed to offset the increases in population, energy demand and GGE intensity that have occurred during the research timeframe.

The following statistics indicate the scope of the problem. In 1998, the housing sector accounted for 11.5% or 373 petajoules (PJ) of total Australian energy use (GWA 1998). Housing energy consumption increased by 34% from ~299PJ in 1990 to ~402 PJ in 2008 and is expected to increase to ~467 PJ by 2020 (ibid). This amounts to a 56% increase in residential sector energy consumption from all sources between 1990 and 2020 – an outcome attributed to increasing ownership and use of electrical appliances since 1990 (ibid). This trend is expected to continue until 2020 (DEWHA 2008) and coincides with increasing GGE intensity in the residential heating energy mix owing to an increase in the contribution of electricity (GGE intensity 1.0) and natural gas (GGE intensity 0.33) and a corresponding decrease in wood (GGE intensity 0.02) (DEWHA 2008 p ix). Clearly, significant additional change that delivers genuine and measurable GGE reductions is required as a matter of great urgency.

While the trends outlined above give cause for concern, the positive outcomes from ten years of reform should not be overlooked. Since 1990, average energy consumption per household has remained constant and is expected to decline by ~6% (relative to 1990 levels) by 2020 despite substantial increases in floor area, supply service delivery expectations (appliance use and comfort levels) and decreasing occupancy rates (DEWHA 2008). According to DEWHA, this is primarily attributable to outcomes from existing change agendas (including many examined throughout this research) and predicted outcomes from planned agendas (DEWHA 2008). Additionally, energy demand for water heating is predicted to decline between 1990 and 2020 because CA success in increased uptake of solar and gas and decreased use of electric storage hot water systems. Further, while energy use from space heating has risen steadily by 1.3% per annum, this rate of increase is expected to slow because of energy-efficient envelope measures introduced between 1998 and 2008

(DEWHA 2008). In other words, without the limited contributions from the reform strategies examined through AR, the current situation would undoubtedly be much worse.

I argue that while mandatory minimum practice is an essential component of change, over-reliance on regulation by CAs has contributed to a failure to achieve critical mass in the voluntary adoption of better and best practice – an equally important component of change that may well have delivered better outcomes than those reported above. Rogers observes that: *Rates of adoption before achievement of critical mass are slow. When enough individuals in a system have adopted the innovation, future adoption becomes self sustaining* (Rogers 2003 p343). Change agenda support before critical mass is an essential change agency role and in this case, failure to provide it amounts to a missed opportunity Questionnaire data reported in 4.3.3 below, demonstrates high levels of pre-regulatory awareness of the need for sustainable change and stated intention to adopt SP by AHI practitioners. This early awareness and declared willingness has been revitalised by current levels of climate change awareness and bodes well for a belated change agency focus by on the voluntary adoption of much higher levels of SP.

4.3.3　Encouraging signs at mid-term of AR

Encouraging indications of sustainable change in the AHI were reported between 2001 and 2004 in my questionnaires. At the outset of my research in 1998, my AR focused on identifying, recommending and participating in implementing the most time effective SP diffusion strategies achievable. My initial GGE reduction scenarios (1999) were based on the assumption that the AHI would need to adopt and apply all available, viable GGE reducing innovations by 2050, to deliver its maximum contribution to climate change aversion in an adequate timeframe. This assumption was based on arguments in Chapter 2 which considered a range of scientific opinions published at that time and applied the precautionary principle (Diesendorf & Hamilton (eds) 1997). In Figure 19 below, these minimum hypothetical scenarios are plotted against the decision or stated intention of practitioner groups to adopt energy-efficient innovations reported in questionnaires.

Defining the point at which SP might be considered to be adopted by a practitioner is problematic because the standard of practice adopted and the number of projects in which they are applied is variable. Two additional variables that influence the effectiveness of outcomes from SP diffusion in the AHI are: the time taken to adopt SP and; the standard of practice adopted. In the analysis below, I applied certain assumptions to deal with uncertainty in these variables. It was assumed that a declared intention by a practitioner to adopt would translate into actual adoption within a few years due to mandatory minimum standards (pending at the time of the surveys) and, that minimum outcomes from adoption would be mandated (this occurred through BCA 2005 and BASIX). In this retrospective analysis, the results below confirm the AHI's conformance to DoI theory and

support my hypothesis that declared adoption intentions by practitioners are indicators of likely pre-disposition to the voluntary adoption of better and best practice.

Assuming that the diffusion of these innovations in the AHI would follow a typical '*S*' shaped diffusion curve, I plotted a range of indicative adoption curve scenarios for pivotal AHI adopter groups (architects, building designers and builders), based on their stated intention to adopt SP (captured through data collected in industry surveys in 2001, 2004 and 2005 as part of AR). Predictive analysis of these curves (through comparison to outcomes from other diffusion studies) assessed potential for the adoption curve trajectories to deliver meaningful outcomes for future generations. The '*S*' curves of adoption below represent the cumulative response of practitioner respondents to the energy-related component of the question: *When did/might you first decide to use ESD principles in all your projects: (circle energy and square ESD).* Appendix 1 includes a copy of the questionnaires and aims, objectives and methods underpinning them. The questionnaires were designed to evaluate the effectiveness of change agendas (including the *Your Home* suite of resources) in raising practitioner awareness, knowledge and skills to a level likely to convert declared intention to actual adoption of SP. It also identified additional resources or factors that might accelerate adoption rates.
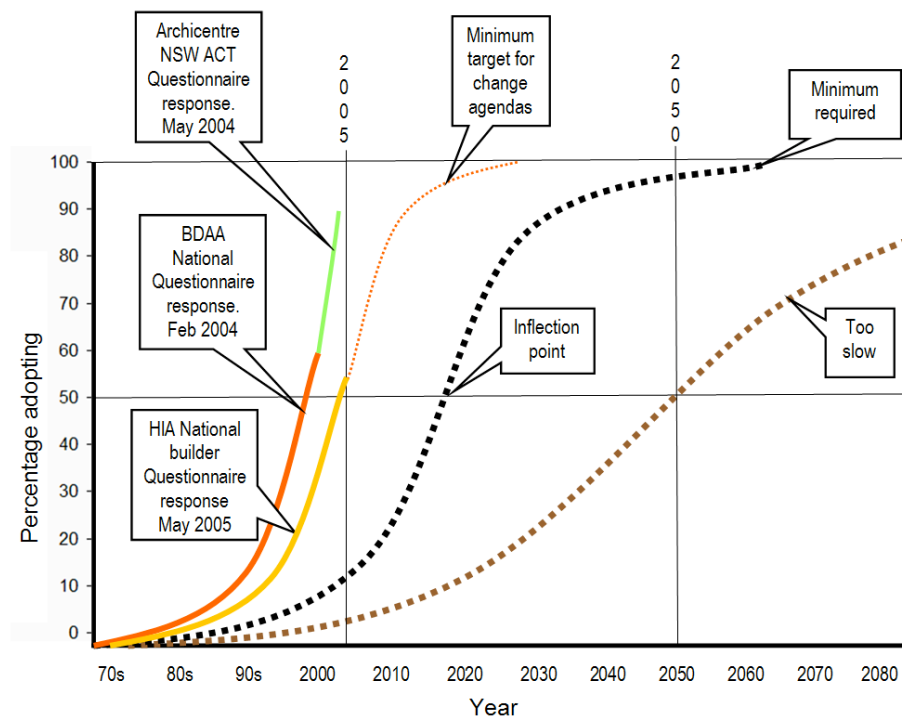
Figure 17 Indicative adoption curve timeline scenarios.

The above timeline scenarios compare a minimum baseline scenario (black dotted) for effective change (nominally 95% diffusion by 2050) to practitioner adoption intention rates reported in 2004 and 2005 questionnaires (solid orange green and yellow) that are then projected to indicate a minimum target that could be expected by CAs (orange dotted). Whilst indicative only, Figure 17

indicates that practitioner adoption rates were in line with or ahead of adoption rates that might have met targets appropriate in 2005. However, significant upward revision of those targets has subsequently made these projections redundant and mandatory codes of practice meant that the planned comparison of these projections with later surveys became impossible.

While the primary questionnaire focus was adopting energy efficiency (EE) measures, time scenarios also addressed the range of sustainable innovations described as Ecologically Sustainable Development (ESD), the industry term most clearly understood as representing the practices referred to in this research as SP. Figure 20 below depicts the actual plotted data from each sample group on EE adoption and the BDAA 2001 response to ESD questions.

BDAA were the first group polled in 2004 with 136 responses and, because there was little variation between the timing of their decision to adopt energy-efficient practices compared to ESD practices, this division was discontinued for the sake of simplicity in the Archicentre (44 responses) and HIA (1072 responses) questionnaires (Archicentre is a small, accessible organisation whose members are architects). An additional telephone poll of 136 BDAA members confirmed that the views expressed by 2004 questionnaire respondents were representative of the BDAA membership – not just those who responded to an SP-related poll. The responses from each group demonstrated consistent exponential increases in each industry sector confirming (and exceeding) projections from an earlier BDAA questionnaire circulated in 2001 (81 responses).
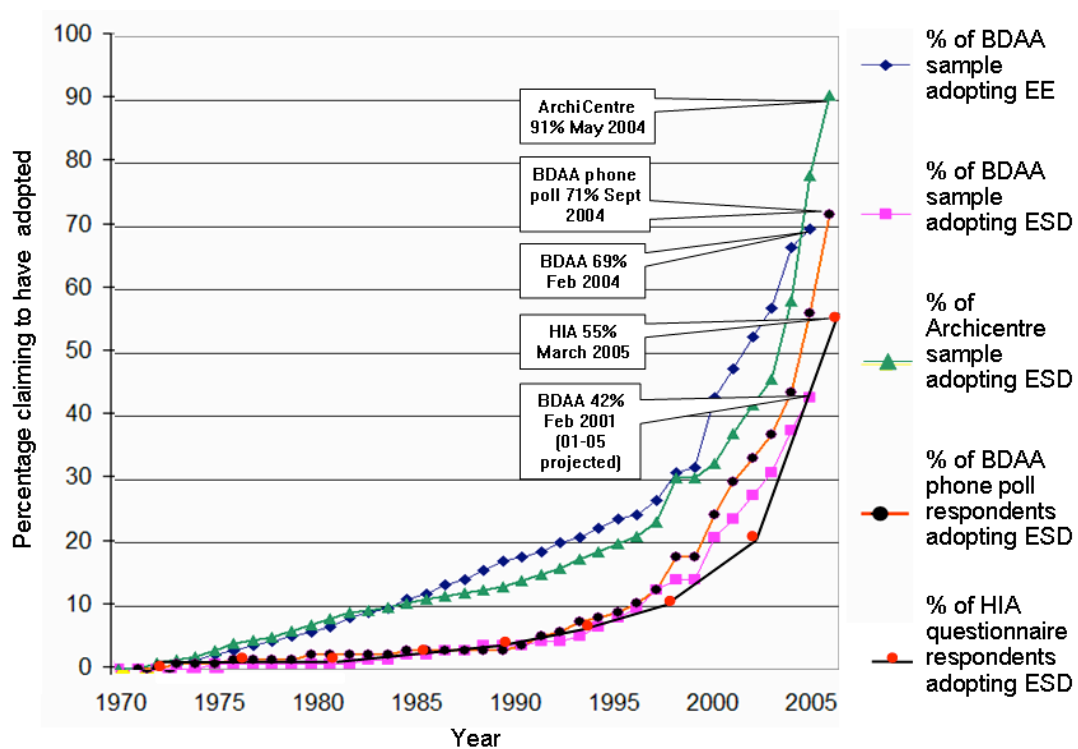
Figure 18. Adoption curves generated by plotting cumulative totals of declared intention by BDAA, RAIA and HIA practitioners to adopt Energy-efficient and ESD principles.

These findings were presented to AR change agency partners to advise them that substantial progress had been made in practitioner awareness and intention to adopt SP but that more needed to be done to convert those stated intentions to adopt into permanent, actual adoption. This informed the forward planning of some change agendas (particularly those involving training; HIA GreenSmart, ABSA and BITS) because the broad focus shifted from 'why to' to 'how to'. Appendix 2 provides an example presentation to AR partners of detailed data and conclusions they generated to demonstrate their AR application as temporary knowledge (Gibbons et al. 1994) resulting in adopting some recommendations. Important recommendations concerning future directions for YH were only partially introduced even though they were confirmed by independent research commissioned by the AGO (ATA_MOTUS 2004).

The results were also presented to AHI practitioners through media articles, CPD training and conference presentations as part of AR implementation of Rogers' second strategy for reaching critical mass for interactive innovations such as SP: *shaping individuals perceptions about the innovation by implying that its adoption is inevitable or that critical mass has or is about to occur (Rogers 2003, p. 361)*. Because the findings summarised in Figure 20 leave little doubt that AHI practitioners reached critical mass in their declared intention to voluntarily adopt SP in the mid to late 1990s, their subsequent publication in industry media (e.g. BDAA Designers Brief, HIA newsletter and an Archicentre CPD presentation) was seen as a valid application of the above DoI strategy. The influence of that strategy in transforming declared intentions into actual adoption remains unknown because the optional decision was subsequently mandated.

In the post SP regulatory environment, DoI voluntary adoption-decision timeline scenarios became difficult to differentiate from authority decisions and my AR focus shifted to strategies with potential to accelerate regulatory change outcomes rapidly in response to the urgent forecast scenarios published throughout the research (Alcamo & Bennett 2003; IPCC 2001, 2007a; Pearce 2007; Schneider & Lane 2005). These strategies include refining regulatory frameworks, facilitating benchmark creep, training and skilling industry and identifying and implementing strategies to accelerate better and best practice in a wider range of projects, through competition and skill and technology transfer. Scenarios with potential to achieve such urgent change are addressed through prospective DoI analysis in Chapter 6.

4.4 Conclusions from retrospective diffusion analysis of AR

Diffusion study outcomes include case study documentation of sustainable change that occurred during the AR phase and the identification of change barriers and opportunities that yielded preliminary insights into how and why change occurred for further analysis in Chapter 6. The analysis documents the development and application (through AR) of the 'temporary' or 'Mode 2'

knowledge (Gibbons et al. 1994) created in this rapidly evolving, transdisciplinary AR field (see Sections 1.2.1 and 1.6). The diffusion analysis has generated both implementable, industry specific applications and theoretical outcomes with broader, transferable scholarly application.

4.4.1 Industry outcomes

The insights and understandings developed and argued throughout Chapters 3 and 4 consolidate my AR observations and findings by grounding and explaining them within DoI. This analysis identified both significant barriers to SP and opportunities to accelerate its adoption. Initial responses to these opportunities and barriers were outlined in Chapters 3 and 4, for further resolution through ANT analysis in Chapter 5 and prospective synthesis of both analyses in Chapter 6. Key findings associated with these opportunities and barriers are summarised as generalisations in the following two sections.

Generalisation 4.4.1: DoI attributes of SP innovations embody few of the characteristics considered favourable to rapid adoption and include many unfavourable ones. Thus, CAs need to better understand the adoption barriers in SP in order to inform the strategies to overcome or mitigate them. Such strategies include:

- disseminating knowledge about SP among practitioners (and to a lesser extent, consumers) to create attitudinal shifts and overcome SP compatibility barriers.
- reducing regulatory complexity by replacing complicated, prescriptive and duplicitous agendas with nationally consistent performance-based schemes with flexible compliance paths and impact appropriate metrics.
- introducing risk, reward and consequences in relation to SP adoption to overcome barriers associated with lack of relative advantage and compatibility.
- offsetting the adverse diffusion impacts of reinvention on complexity, familiarity, observability and trialability through skill delivery, provision of accessible information databases and flexible regulatory compliance paths.

Generalisation 4.4.2: The innovation decision process is arguably the critical focus for CAs and yet it was observed to be poorly understood. Important observations were that:

- reliance on regulation or authority decisions in isolation is unlikely to deliver adequate outcomes leading me to recommend the continuance and expansion of ABEC's dual code strategy to maximise change outcomes.
- processes associated with making each type of decision involve different stages or steps, which suggests that the creation of effective linkages between each of these stages is fundamental to effective management of the change process.

Generalisation 4.4.3: The innovation development process. The constant refinement and reinvention of SP was observed to create a short-term diffusion barrier in added complexity but is essential to overcome another barrier – the medium to long-term relative advantage of SP. This cyclical process relies on varied contributions from each adopter category and those contributions and the process through which they are typically incorporated were analysed in Section 4.2, where related opportunities and barriers were identified. Key observations include that:

- a process of natural selection occurs in an optional adoption decision environment which allows adopters to choose the SP innovations that best suit their application in terms of cost, risk and complexity. This can be disrupted by prescriptive regulation, leading to application of SP in inappropriate circumstances.

- flexible, performance-based compliance paths such as BASIX were observed to facilitate the natural selection process thereby overcoming this barrier.

- both the adoption decision process and the innovation development process have interdependent roles in driving SP diffusion.

Generalisation 4.4.4: Skill development. AR observations indicate that increased knowledge about SP improves perceptions of compatibility and creates opportunities for the diffusion of sophisticated solutions. This leads me to advocate that:

- providing knowledge and skills is essential to ensure further development of compatible attitudes, knowledge and skill among practitioners.

- inadequate practitioner skill delivery is primarily attributable to a lack of funding to develop a training hierarchy to establish an efficient and effective framework through which skills can be delivered by training providers.

- skill development is a fundamental driver of the innovation development process and increased skill levels drive both competition and innovation.

Generalisation 4.4.5: Regulation is perceived by some CAs to be a universal solution to change management. AR observations indicate that, while it is an important diffusion driver at minimum practice level, additional strategies are required to drive innovation through voluntary adoption of best practice. This re-emphasises the need for clearer understanding of the adoption decision process embodied in DoI. Key related observations and findings include that:

- over-reliance on regulation to drive adoption decisions was observed to limit the engagement of adopters in the deeper objectives of the change process during early stages of decision thereby shifting focus from best practice objectives to minimum compliance.

- competition (or lack of collaboration) between change agencies has created duplicitous and contradictory regulatory agendas inconsistent with AHI needs for a consistent national regulatory framework and sends confusing messages to industry.

- adoption of a nationally consistent regulatory framework that ensures mandatory minimum bar-creep while encouraging voluntary better and best practice adoption through a capacity to benchmark and compare best practice would overcome both these barriers.

Generalisation 4.4.6: Change agenda focus. The current regulatory focus on the new housing sector by CAs and an even narrower focus on the role of thermal performance in that sector has left the existing housing sector (the majority of consumers) unaffected by change agendas. This leads me to conclude that:

- an important next step for CAs involves a shift of focus from new housing to existing housing. A failure by change agencies to address existing housing stock, consumer demand and consumer behaviour is among the greatest barriers to meaningful change outcomes.
- the new housing focus has led to a failure by CAs to capitalise on the potentially powerful change creation role of influence and opinion leadership of the marketing and financial sectors that control the primary motivators of consumer housing choices, wealth creation and capital gain.
- notwithstanding the previous two points, an additional shift in CA focus from design and construction practitioners to sales and marketing practitioners is required within new housing change agendas to accelerate SP diffusion beyond critical mass in the volume housing sector.

Generalisation 4.4.7: Adopter innovativeness was identified as an important component of diffusion theory, with potential for use by CAs in refining both the content and language of the resources they provide to better meet the needs of their intended audiences. In particular, the important but distinctly different contributions to SP development by adopter categories demonstrate the potential for using innovativeness categorisation by CAs and OLs to inform and guide intervention strategies.

Generalisation 4.4.8: Communication and influence channels. DoI theory holds that opinion leadership is a fundamental and powerful diffusion tool. AR case study analysis confirmed that its application by CAs played an important part in raising SP awareness in the AHI and identified important additional opportunities to:

- engage the powerful finance and marketing sector as OLs by introducing new agendas (e.g. the linking of SP performance with property value).
- capitalise on the current surge in awareness related to SP issues to progress voluntary SP adoption among consumers.
- improve communication and collaboration between innovativeness-based adopter categories to encourage effective reinvention through 'cross pollination' of innovation development contributions.

Generalisation 4.4.9: Evaluation of the outcomes from AR change agendas is rarely conducted. I suggest that this omission has contributed to a lack of informed direction and focus in developing change agendas. Barriers arising from this include:

- the continued failure by CAs to set real targets and measure progress toward them.
- criticism by sceptics can be powerful.
- a lack of focus among adopters.

I suggest that CAs urgently fund rigorous, independent research into the outcomes and impacts of their change agendas.

Generalisation 4.4.10: The complexity of the AHI as a DoI social system was observed to create barriers to adoption and challenges for change agencies. The observation led me to suggest that CAs should develop clearer understandings of the AHI in DoI social system terms to facilitate the development or adaptation of change agendas to work with it rather than against it. This barrier and its associated opportunities are explored within ANT in Chapter 5.

4.4.2 Scholarly outcomes from retrospective DoI analysis of AR

DoI provided a theoretical framework within which I retrospectively examined change agendas and processes observed during AR through both a sociological (adopter) and technological (innovation) focus and in doing so, raised questions about the capacity of such approaches to deliver meaningful outcomes for future generations. These questions were identified earlier by Chappells and Shove (2003) through their critique of agendas that focus exclusively on the uptake of more sustainable practices or on changing the behaviour of end users. While not claiming to have resolved the issues, they argued that such agendas would benefit from the adoption of a transdisciplinary approach to change creation that addresses the *interplay* of multiple issues, including *collective conventions, social institutions and technical infrastructures* that *frame practices of consumption in the household* (Chappells & Shove 2003, p. 7).

The interplay of multiple issues noted by Chappells and Shove (2003) is also fundamental to my research and my transdisciplinary approach has facilitated analysis of the 'interplay' of technological and sociological issues in relation to SP adoption. The retrospective diffusion analysis in Chapters 3 and 4 completes the first stage of this analytical process by generating theoretical insights into change that occurred during AR by:

- positioning that change within DoI theory while drawing on the body of knowledge associated with it to explain its causes and effects,
- testing, refining and validating my contributions to AHI sustainable change agendas and,
- positioning the contributions in the context of knowledge relating to sustainable change creation in my conclusions.

During this analysis, it became evident that the DoI framework required adjustment to suit my research context. While DoI's innovation decision and innovation development frameworks facilitated detailed analysis of the socio-technological components of SP diffusion, I found this innovation focus (examined in more detail in Section 1.5.2) limiting in terms of its capacity to analyse the critical diffusion role of the complex socio-political interactions that characterise the AHI environment. To overcome this limitation, I apply ANT as supplementary analytical framework within (or in addition to) DoI in Chapter 5. A gap in the DoI literature relating to its application in similarly complex socio-political contexts suggests that a requirement to address this limitation is yet to arise or, that scholars have applied alternative theories in such contexts. In Chapter 7, I posit that the success of my application of ANT to extend the capacity of DoI constitutes an original contribution to the evolution of DoI with potential for use by other scholars facing similar research challenges.

In Chapter 6, I apply ANT and DoI interchangeably in a prospective analytical context to yield deeper understandings of future implications and opportunities arising from the interplay of individuals, organisations and SP innovations in the sociological and technological transformation associated with SP diffusion. These understandings are presented as socially constructed TD conclusions communicated through a series of strategic recommendations. The conclusions have potential to (at least partially) expand the disciplinary focus of current change agendas by overcoming barriers and capitalising on more opportunities through a broader transdisciplinary approach.

The scholarly conclusions summarised above are further expanded in Chapter 7, where they are combined with additional theoretical outcomes from Chapters 5 and 6 and positioned within the intellectual or knowledge framework defined in Chapter 1.

Chapter 5   ANT analysis of the AHI network

5.1   ANT in this research

In this chapter, Actor Network Theory (ANT) is applied as an analytical framework within DoI. This facilitates deeper analytical insights into the network roles of the multiple layers of actants in the AHI societal system in responding to the socio-technological actants introduced to the system through sustainable change agendas. For a detailed overview of ANT and arguments supporting its application in this research, see Section 1.6.

The DoI literature reviewed in Chapter 1 (Section 1.5.2) and subsequent application of DoI as retrospective analytical framework in Chapters 3 and 4 identified a limitation in diffusion theory to address the role of complex network interactions in the SP diffusion process. ANT analysis yields additional (to DoI and reflective practice) understandings of the socio-political aspects of sustainable change creation to strengthen arguments developed through retrospective DoI analysis through. Tensions and agreements arising from and between reflective AR practice, DoI and ANT analysis generate additional triangulated perspectives and understandings about the diffusion process to inform my prospective analysis in Chapter 6.

I apply ANT in two analytical contexts. The first (Section 5.2) draws on ANT's capacity to structure the examination of interactions between multiple actants (human and non-human) at varying levels of deconstruction described as punctualisation by ANT theorists (Law, 1992 p.5) (see Section 1.6.1 for more detail). This analysis identifies actants and interactions critical to the process of sustainable change creation in the AHI network by reviewing the role of Change Agencies (CAs) as ANT mediators (see definition below) to explain successes and failures and identify strategies through which CAs might increase their effectiveness from an ANT perspective.

In the second application (Section 5.3), I draw on ANT's strategic planning capacity to retrospectively analyse selected AR case studies to identify viable opportunities available to CAs to re-configure existing and emerging AHI actant networks to accelerate change through increased adoption of SP. This analysis is framed in Michael Callon's four stages of configuring an actor network through negotiated alignment of allied actants (human and non-human). These are: problematisation, interressment, enrolment and mobilisation (Callon 1986). Bryce and Yasukawa describe actant networks as: *conglomerates of humans, documents, institutional relationships and former beliefs that interact through these four stages to effect cultural change (Bryce & Yasukawa 2004).* Micro network characteristics and trends observed in individual AR case studies are analytically linked in ANT's flexible, interconnective framework to inform macro level analysis and explanation. Section 5.4 summarises ANT analytical outcomes and these findings are synthesised through prospective analysis to generate strategic recommendations for future change management in Chapter 6.

5.2 AHI actants and network interactions

5.2.1 Overview

In this section, I analyse the AHI in ANT to explain the critical role of industry actants and their communication networks in the diffusion of sustainable innovations. The data informing this analysis is drawn from Action Research (AR) and includes observations of relationships and interactions between actants that lead to shifts in interest or goals, forming new alliances, changes to work practices and the role of change agencies in generating these changes. Bryce and Yasukawa (2004) observed that: *ANT offers a way of observing and analysing a process of change* and, *combined with action research, ANT can identify and guide interventions to effect change* and described this aspect of ANT as its capacity of to *focus on understanding and influencing the dynamics of socio-technical change* in terms of: *socio-technical change as a political process; society and technology as mutually shaping and changing; society as both local and global and; technology as an embodiment of particular social practices and values* (Bryce & Yasukawa 2004).

In this analytical approach, I posit that the actor network involved in the SP diffusion process described in Chapters 3, 4 and 5 is the primary driver of sustainable change in the AHI and, that sustainable innovations or technologies play a secondary role owing to atypically high (in DoI terms) rates of technological reinvention. In other words, as argued in Chapter 3 from a diffusion perspective, because the innovations in this diffusion study are complex, constantly evolving and difficult to define, their successful diffusion depends on a very different set of drivers to those found in typical diffusion studies. I illustrate this argument through critical analysis of case study examples to demonstrate how and why network-focussed AR change agendas were more successful than those with a technological or single actant (regulation) focus.

Additionally, I postulate that socio-technological change in the AHI is driven by interactions between a sophisticated and dynamic network of human and non-human actants. Through this network, social and technological actants mutually shape each other to satisfy political objectives developed by government and NGO change agencies (CAs) in response to global and local social values and needs. The following simplified example illustrates this process.

The incorporation of new, sustainable technological solutions into vanguard housing developments by market leaders is encouraged by change agencies that then promote the outcomes. This raises awareness among competitors, the media and consumers leading to the eventual embodiment of those technologies and the global values that spawned them in social practices and values via mainstream housing stock. (See HIA GreenSmart Case study in Box 3-17)

Sustainable outcomes from technological innovation are a primary motivation for the uptake of SP by early adopters and the diffusion of these technologies within the mainstream market is the goal

of CAs. However, I posit that their adoption by producers and consumers of mainstream housing stock is substantially attributable to socio-political motivations. In other words, effective CA requires that network links (communication) or new actants (communicators or mediators) be created to bridge the gap between the problem solving focus of the innovative minority and the socially motivated needs of the majority. The ANT analysis in Sections 5.2, 3 and 4 explores strategies to achieve this.

Intermediaries and mediators

In this section, I define important ANT terms and concepts and relate them to my application. The distinction between intermediaries and mediators is important in ANT. Intermediaries have no influence in the network other than to transport the influence of another actant more or less without transformation. Mediators are entities that multiply difference (i.e. their influence in the network is transported my multiple intermediaries) and therefore become the focus of CAs who mediate these mediators.

The role of a mediator (or translator) in ANT socio-technical networks is described by Callon (1999) as one of integration and adaptation to create the 'compatibilities' (Callon 1999 cited in do Nascimento 2000) that enrol other actants in the network during the interressment and mobilisation stages of network configuration. Beagle (2001) argues that *Socio-technical networks emerge through a process of enrolment, as they serve to mediate among divergent or conflicting motivations and beliefs of potential actors (ibid)*. He observes that networks *typically pass through a period of struggle as these divergent beliefs are translated and conflicts are negotiated (ibid)* by mediators. Successful mediator negotiations *lead to a state where the network stabilises around a modified set of actors (ibid)*. In a stable network, the *activities and behavior of all actors have been modified to the degree necessary to allow network operations to address their common interests in a mutually beneficial way* (Beagle 2001, p. 423).

In this analytical context, sustainable socio-technological change is seen as a political process that manifests through the embodiment of the technologies and practices associated with SP in social practices and values. For example: photovoltaic panel installation as a status symbol; thermally comfortable, passive housing as a consumer lifestyle expectation and home owners and AHI practitioners viewing the use of water demand reduction technologies as part of BaU.

Bryce (2002) cites Callon's (1991) picture of a network as an entity that …*contains actors, macro-actors (representing a collection of actors, or factional views), and mediators (providing facilitation, tools and resources), connected and stabilised by the existence of a growing set of stances, beliefs, assumptions or understood documents, that become non-negotiable accepted wisdom* (Callon 1991). I use this description as the basis of a simple punctualisation framework in which I describe AHI actants involved in socio-technological sustainable change and examine their role in as mediators or intermediaries.

Punctualisation levels are indicative of the type of network influence channel that might be available to an actant. In this context, power describes the relative influence of an actant over other actants in the network and is drawn from both the number and the strength of that actant's network linkages. Stalder (1997) describes intermediaries as *the language of the network* through which *actors communicate with one another* and *translate their intentions into other actors*. He argues that *the possibility to command intermediaries lies at the heart of action itself, which is translating an actor's will into other actors (Stalder 1997)*. Weak or non-influential actants can be empowered by developing or inheriting network links. Creating, strengthening and duplicating such links is the role of the CAs.

In this research context, a mediator is any actant that is instrumental in diffusing the attitudes, knowledge, skills and technologies associated with SP in the AHI context by shaping or aligning existing actants, creating new ones or re-configuring networks. In this way, their role is similar to that of OLs in DoI. Many different types of mediator are involved in reconfiguring the AHI network to sustainable change. These include: politicians, regulators and the regulatory actants they create; change agencies (government and NGO) and the network of links they create; researchers, suppliers, manufacturers and the practices and technologies they create; practitioners, consultants and their consumers; marketing agents, lending authorities, valuers and non-construction service providers.

Two important network configuration strategies exist through which CA mediators expand and strengthen their network influence. Firstly, the empowerment of additional mediators in associated networks (e.g. OLs in each practitioner stream) has the potential to create and align new actors through interressment and enrolment (See SEDA ESH case study in Chapter 3 and Box 3-4). Secondly, CAs can strengthen the network influence of strategically important weak actants (e.g. voluntary best practice) by creating new allied actants (e.g. mandatory disclosure regulations).

The key message here from an ANT perspective is that it is not the characteristics or power of an individual actant in a network that creates change but rather, that interactive communication between all of these actants in the network creates change – often in response to one or more 'catalytic' or 'driver' actants (e.g. regulation). This argument is illustrated in Box 3-4. Further analysis of the AHI network below identifies strategies to assist CA mediators in creating non-existent actants or empowering weak ones and, strengthening linkages to mobilise and ultimately stabilise or 'black-box' their sustainable change agendas. Black-boxing occurs when new actors entering the network are obliged to accept the dominant paradigm of change without challenge (Bryce, Johnston & Yasukawa 2002b).

A diverse range of mediator or 'driver' actants with potential for use by CAs to catalyse change were identified during AR and examined through DoI analysis in Chapters 3 and 4. Most were observed to have been applied in varying combinations within AHI sustainable change agendas

since their outset - with varying rates of success. I suggest that these variations are (at least) partially attributable to additional, supportive network interaction being stimulated as an unexpected (and therefore unrecognised) consequence of some combinations or sequences of mediator actants and not by others. In other words, I contend that the coordinated application of strategically chosen combinations of complementary driver actants by change agencies can improve the outcomes from their isolated or conflicting application observed during AR (See comparison of SEDA ESH and DoP's BASIX in Box 3-21).

For example, a range of new mediator actants intended to improve the performance of existing housing stock are about to be released by governments nationally as part of new change agendas (DCC 2008; Garrett 2008; NFEE 2007a; SBE & Hansen 2007). Mandatory Disclosure of an SP rating at point of lease and (later) sale is seen as central to this agenda. Other components include 'green loans' to encourage retrofitting of SP features by consumers and awareness raising promotions. I argue that while likely to be somewhat effective, the change outcomes achievable through these strategies could be increased several fold through the simultaneous introduction of complementary mediators drawn from the lending, marketing and wealth-creation network sector. These powerful actants have potential to enrol extensive new complementary networks whose motivations and interests align with the needs of the majority, thereby bridging the gap between the innovative mediator minority and the intermediary majority. (See Section 6.5 for further analysis).

Easton succinctly summarised this strategy through his observation: *for an innovation to succeed the network must be capable of being mobilised. The resources must be available in the network and under the control of – or accessible to – the actors with an interest in the success of the innovation (Easton 1992).*

For example, I suggest that announcing a schedule of planned increases in utility charges in combination with mandatory valuation of SP performance would amplify the effect of mandatory disclosure. Additionally, it would align or enrol the powerful mediation potential of the finance and investment network by linking SP adoption to the actants 'wealth creation' and 'capital gain'. I expand these arguments through the strategic ANT analysis of AR case studies in Section 5.3 where I identify specific combinations and sequences of individual mediator actant interactions observed to generate beneficial outcomes during AR and adapt them into strategies with potential for application in other change agendas. (Refer to Box 3-4 : SEDA Energy Smart Allies, Box 3-17: HIA's GreenSmart training, awards and network of allied professionals and Box 3-21 ESH, BCA and BASIX comparison).

Such network amplified outcomes include: opinion leadership and enhanced political power (network connections) developed by SEDA through its Energy Smart Allies program and Green Globes Awards for outstanding mediators; Commonwealth CA support in developing the HERS mediation actant and in facilitating the development of BCA Energy Provisions; empowering and

seed funding of new national mediator actants ABSA and EcoSpecifier. (Each of these actants is addressed on a regular basis throughout the thesis. Refer to the index for locations).

In Section 5.2.2 below, I broadly categorise AHI actants as socio-political, technological or spatial and in Section 5.2.3, I examine the role specific sub-networks of actants operating in the AHI to analyse how the common interests and characteristics that link them in their networks might create opportunities or barriers to change. In Section 5.2.4 my analysis broadens to examine the complex network of interaction between significant actants (mediators) in the AHI and finally, in. Section 5.2.5, I summarise the outcomes of this analysis and argues my analytical conclusions. Boxed case studies drawn from AR are used throughout this analysis to illustrate the processes of mutual shaping and changing of technological actants through network interaction by socio-political actants from global to local level with specific focus on the role (actual and potential) of CA mediators.

5.2.2 Actant categories

Here, I commence the process of contextualising AHI actants in ANT by describing two broad, open ended sets of actors according to the socio-political or technological network interactions that define them (Stalder 2004) to facilitate an analytical focus on the role of socio-political network interactions in creating change and diffusing SP innovations throughout the AHI network. This is not intended as a comprehensive typology of AHI actants involved in the socio-technological sustainable change or, a map of their network interactions. Indeed, a typology of actants would contradict ANT's principle of generalised symmetry in which all actants are viewed as being the same until a difference is established through network interaction. Rather, it establishes an analytical framework through which actants linked to technology (whose role is addressed in greater detail through DoI analysis in Chapters 3 and 6) can be analytically back-grounded to facilitate a socio-political focus, where analysis of technological links is limited to their role in creating, maintaining and re-configuring socio-political actants within the network (especially in relation to the processes of innovation and reinvention required to create, develop and commercialise them).

Socio-political actants

Socio-political actants are broadly categorised below as meta, macro or micro 'level' and, while this categorisation may imply a hierarchy, actants of each type have potential to influence change through their interaction in the network (albeit via different links). Actant 'level' is a general indicator of the types of dominant network influence channel that might be available to each actant rather than their relative power (See Box 5-8: The strength of weak network links). Effective change (durable and capable of delivering meaningful long-term outcomes) requires effective interaction at every level.

In my analysis, meta-level actants are those that contribute to or influence sustainable change policy at a global or national level (e.g. climate change; the global economy; global governance and research bodies; international lobby groups, change agencies and media). Macro level actant interaction is instrumental in translating and adapting global policies to the Australian context (e.g. the Australian economy and environmental challenges; Commonwealth and State Governments; research institutions, manufacturers and suppliers; Australian media and; AHI industry peak bodies). Micro level actants typically ensure the adaptation and application of those policies on the ground at regional or local level (e.g. interactions between local governments and AHI practitioners) or influencing that process (e.g. local experts lobbying councils; or individual practitioners influencing consumers with variable knowledge, preferences, lifestyles and budgets).

While meta actants play an overarching mediatory role in driving sustainable change through interaction that permeates throughout the entire network (e.g. the role of IPCC and former US Vice-President Al Gore's network interaction in raising global awareness of climate change), my AR focuses predominantly on the role of macro level mediators in building favourable (to SP adoption) network linkages between micro and macro actants.

An important outcome from this analysis is new understandings of the current network functions which, when applied to AR case study analysis (Section 5.3), facilitate the identification of weak or missing links with potential to contribute to sustainable change or, strong links that oppose or inhibit such change. Subsequent strategic planning identifies opportunities for CA mediators to create, strengthen or re-configure networks accordingly.

Geographic or spatial actants

One set of macro actants with powerful influence over both technological and socio-political actants is what I term geographic or spatial actants. These include Australia's:

- eight state and territory regulatory jurisdictions and hundreds of local governments;
- eight distinct climate zones, each of which requires adaptation of practices and technological solutions to suit;
- enormous variations in distance from service providing infrastructure (e.g. power stations, natural gas pipelines) influences the availability of cost-effective GGE reduction solutions;
- variable access to materials determines the use of various technologies and practices;
- geographic distance from other community or network influences governs access and exposure to peers, training and learning opportunities for practitioners, personal experiences of change by consumers, regulators and politicians.

While these actants do not pose technological problems that cannot be resolved, a failure by some change agencies to address them in their regulatory initiatives has weakened network links to

sustainable change agendas by strengthening the arguments of sceptics. This was evident in BASIX'
failure to address regional climates and consumption variations (Box 5-1).

Box 5-1: BASIX' failure to address regional variations.

Failure of the BASIX agenda in NSW to address varying regional water consumption and
availability conditions created an opportunity for opponents to challenge the validity of the
program in regional areas. These challenges opened political dialogue between state government
politicians, local governments and regional practitioners (new network links) and spawned adverse
political sensitivities. Once established, these new links facilitated an ongoing dialogue that partially
contributed to regional reductions in BASIX' GGE targets.

I suggest that, had DIPNR been more thorough in its interressment and enrolment activities, these
concerns would have been identified and could easily have been addressed prior to the introduction
of BASIX in regional areas. These would have included: enrolment of industry peak bodies for
localised member feedback; interressment of local governments who would have consulted their
local community and created favourable links with local media to feed back positively into the
political loop.

Geographical and spatial actants have also drawn criticism of other regulatory and rating tools
(particularly HERS) by exposing weaknesses and shortcomings that prevented the adoption and
implementation of standardised, nationally consistent regulations. While long-term negative
outcomes are unlikely (regulation will prevail), I suggest that short-term negative outcomes include:
weakening of regulatory stringency (lowering mandated benchmarks); slowing of change agenda
rollout momentum; weakening of the political support base and, adding to the arguments and
power base of sceptics. (For further examples, see Box 3-7: Clarke Davis Homes in Albury
Wodonga and Box 3-8: Port Macquarie NSW. Climate zone border divides metropolitan area.)

On the positive side, this criticism has created healthy and productive competition between state
and commonwealth CAs to refine and improve regulations and metrics. On balance, more
thorough problematisation could and should have avoided these oversights by recognising the
limitations of the regulatory tools in regions and either amending them before launch or
incorporating flexible compliance paths to overcome them.

5.2.3 Important sub-groups or hubs in the AHI SP change network

Here I describe selected communication sub-networks observed in the AHI during AR that are of
particular relevance to my ANT analysis of the socio-political aspects of SP change creation. While
'hub' is not a term used in the ANT literature, I use it to describe a central mediator actant or sub-
network with extensive, powerful links to a large number of AHI intermediary actants. Relevance is

assessed on the basis of AR observations of both the actual and potential power of each sub-network to influence change. In ANT terms, power is derived from the strength, number and nature of network links or communication channels. This assessment informs later strategic recommendations to mediators on how these networks might be re-configured to more closely, effectively and powerfully align them with sustainable change agendas.

Figure 19 depicts the main AHI networks and hubs referred to throughout this analysis. The arrows indicate principal paths of influence and weight indicates the relative power of that influence in numbers or strength.
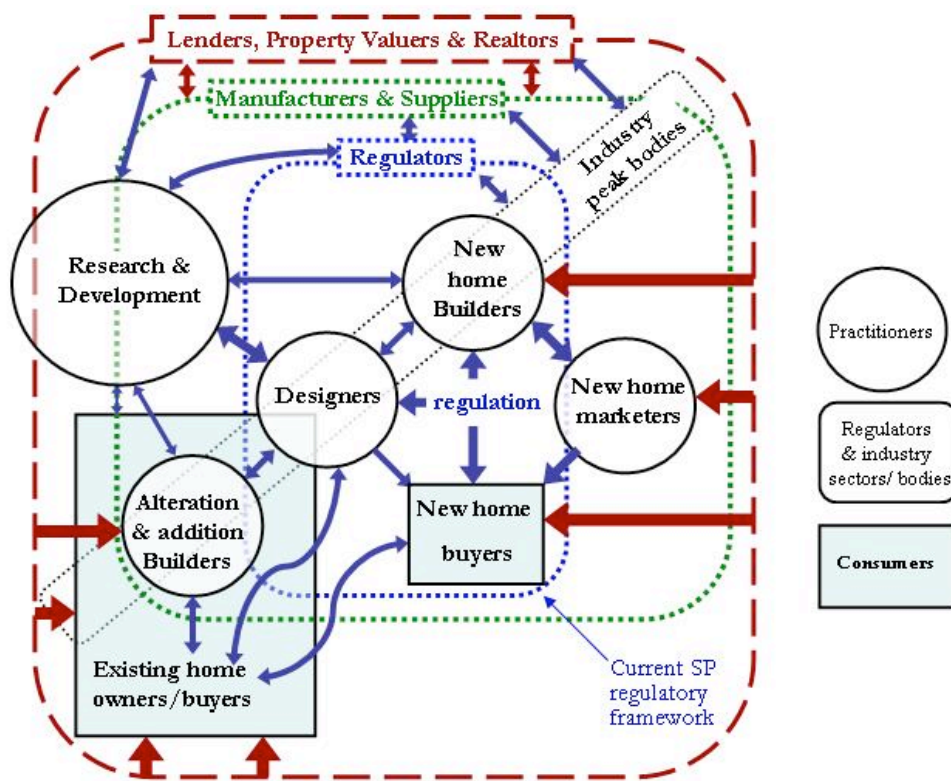
Figure 19 AHI network hubs and their principal paths of influence and interaction.

Designer network hubs

The macro actant 'designer' is among the most powerful mediator actants in the SP diffusion process because its involvement in the creating a building from concept to completion creates powerful network links to every actant in that process, facilitating unparalleled opportunity for effective mediation or translation roles by aligned designer actants.

Three distinct punctualisation levels observed in this broad actant group are: individual practitioners (Draftsperson, Building Designer, Building Design Professional), industry peak body or association (e.g. RAIA, BDP, BDAA, UDIA) representing the collective interests of each group, and at the broadest industry role level – designer. Several different groups were observed at both

practitioner and industry association level each of which has a distinct role, professional development path, market position and clientele. Each group has a discernibly different language set, information sources and approach to problem solving (see summaries below). In other words, each has a very different set of network connections that require recognition, understanding and, in some cases, actant specific strategic management by CAs.

Building Design Professionals: most have at least some training in SP (although SP incorporation in university courses for building design professionals decreased from mid 1980s onward until a resurgence in early 2000s (ABEC 2002; Baggs & Cole 1997). This group often see regulation as restricting their design freedom and are (decreasingly) among the most vocal critics of SP regulations. OLs in this group are important actors to engage in the interressment and enrolment phases. Members have high levels of response to ethical arguments; SP oriented CPD; peer leadership (leading designers winning SP awards and promoting SP adoption). This group have strong links to the commercial built environment sector and are more likely to be exposed to change agendas in that sector than designers in other networks.

Building Designers: Typically made up of partially qualified architects, builders and draftspersons with sound design skills gained through a long career of experiential learning. This group were observed to be more likely to allow the client to drive SP inclusion and are therefore less likely to be in the vanguard of SP adopters until their SP knowledge and skill levels are sufficiently developed to facilitate confident design and specification of SP. Because this group tend to outsource knowledge and skills through consultants to a much lesser extent than BDP members do, they develop high-level in-house SP skills in response to regulations more rapidly than do BDP members. I suggest that this distinguishing characteristic led to them adopting SP mediator roles earlier than many of their BDP counterparts.

OLs in the BDAA saw SP competence and leadership as a market differentiation opportunity for BDAA members over their BDP competitors. Owing to incomplete or low levels of academic training, BDAA members were observed to be eager participants in CPD initiatives and responsive to initiatives that legitimised them as industry professionals. The acquisition and application of SP skills gained through AR CPD programs was observed to be higher among BD attendees than other practitioner groups. The new vocation of sustainability consultant or SP specialist is attracting a high proportion of BDs (e.g. a disproportionate number of ABSA assessors are BDs).

This group play an important network role in stimulating SP-based competition in the design network, trialling and adapting innovative SP and providing a convenient indicator of the uptake of SP in a range of climates, regulatory jurisdictions and market sectors.

Designer builders generally work in a niche market of less cost sensitive clients (often 2nd and 3rd home owners) who are more aware of the lifestyle advantages associated with SP inclusions. This group is highly responsive to market differentiation based on SP as evidenced by their consistent presence in high profile industry awards such as HIA GreenSmart.

Designer builders were observed to play an important role in trialling and refining leading edge SP innovations through application and promoting them in the mainstream housing construction sector (e.g. HIA and MBA industry awards; feature articles in mainstream housing media) thus creating consumer demand and demonstrating their viability to the volume housing sector.

Draftspersons: While freelance drafting practitioners operate in most states, their network links are aligned with those of building designers addressed above. Here, I am discussing draftspersons employed by medium to large construction companies – especially those in the volume housing sector. 'Champions' from this group working in larger organisations are potentially powerful OLs and SP adoption drivers in those organisations and warrant specific recognition and empowerment by change agencies. Individual practitioners in this group are less likely to attend CPD (time and cost constraints) but are high users of printed and electronic 'how to' materials as observed during AR and confirmed by YH communications research (Penman 2000) and industry questionnaires in which practitioners were asked to nominate their industry role and preferred information sources.

In general terms, they are most influenced by internal (to the company) actants such as quantity surveyors (costing) and sales staff or local government requirements to obtain development consent. This group is frequently informed of regulatory changes and minimum compliance paths by council officers. They have little or no contact with clients and are less influenced by design awards and glossy publications. Typically, this group is acutely cost sensitive (because cost per square meter is still the dominant market differentiation factor in this sector) but, are less risk averse than other design actants due to affordability of 'one off' input by skilled consultants to multiple standardised applications.

An important contribution to change by this group is their role in adapting innovative SP applications from the custom design housing sector to the volume housing sector by simplifying, and standardising them. These contributions to innovation development effectively 'black-box' minimum SP adoption when they are mandatory through regulatory updates.

Industry peak bodies: (RAIA, BDP, IEAust, BDAA, UDIA etc.).

These actants function as network hubs, building strong network links through which they represent the needs and interests of their members including: representation on planning and regulatory bodies; information dissemination and CPD on regulatory changes, design trends and

technological innovations; professional practice and indemnity issues. They compete to protect and increase member market share and monitor each other's actions. With the exception of BDP member organisations, these actants rarely collaborate or share resources. This often necessitates audience-specific duplication of information, CPD and promotional resources by CAs. Such actants often have strong political links in the network through which they were observed to exert significant influence for and against SP change agendas during AR as demonstrated in Box 5-2. (See also Box 3-28: RAIA lobbys the NSW Government to modify NatHERS in SEDA's ESH policy.).

Box 5-2: *Your Home* v EDG.

This case study exemplifies the power of knowledge and information in competition in the AHI network. It also illustrates the network linkages (power) of professional associations such as RAIA, BDP, IEAust, in being able to set up meetings with three ministers and separate meetings with three departmental heads at very short notice to oppose an SP reform agenda for purely commercial advantage reasons.

During the initial scoping phase of YH, the BDP attempted to have funding for YH withdrawn because it was seen as a competitor to their equivalent EDG. When offered management of the YH materials in return for making EDG and YH more widely available to industry (i.e. at reasonable cost to non-BDP members), they declined.

Summary

I have framed the above observations within ANT's stages of network configuration introduced in Sections 5.1 and 5.2.1. The interressment, enrolment and mobilisation of designers are important steps in the configuration of AHI sustainable change networks. Successful methods used by CAs to achieve this within the designer network included: 1) developing and implementing ABEC's dual codes of practice as part of the problematisation phase; 2) providing information and training to develop a broad base of SP knowledge and skills for dispersal throughout the AHI via the diverse and powerful linkages of the designer network hubs BDAA and RAIA and 3) the introduction of SP-based design awards by designer peak bodies to create new SP-based competition and market differentiation actants and to empower homophilous mediation champions.

Several separate role-determined networks were observed within the macro actant 'designers' and each has distinctly different information needs and access methods. While each network requires similar information and skills (for SP problem solving), member actors have differing learning paths, language preferences and application environments that require careful information design by CAs. This includes: content emphasis (e.g. innovation or risk management focus), source (e.g. research findings or applied case study), presentation style (heterophilic expert or homophilous peer- see Box 5-3 for an example), media type (e.g. internet, industry magazine, technical manual,

CPD or conference presentation) and market sector approach to product differentiation (e.g. prestigiously innovative or cost-effectively repetitious).

Box 5-3: Choice of audience appropriate presenters by ABSA for BITS training.

The following example illustrates variations between designer networks in the way they define and respond to homophilous opinion leadership.

ABSA found it advantageous to have architects or academics presenting to architects, specialist builders presenting to builders. Enrolment numbers and interest in the training among architects were significantly lower for presenters from differing backgrounds – regardless of their expertise. BDs are less sensitive to presenter background but are likely to attend CPD presented by hands on practitioners who draw on their own first hand experiences in solving SP related problems.

Enrolment timing is also an important consideration for change agencies in configuring this network. The developed problem solving skills of innovative designers (and researchers) were observed to make useful contributions to the problematisation phase of change agendas (e.g. ABEC- see Section 2.2.2) whereas risk management input from detailers and project managers is critical during the interressment and enrolment phases. This sequence reflects the order of design input in larger projects and capitalises on the variety of problem solving skill sets found in designer networks.

Builder network hubs

Builders are arguably an even more powerful macro actant than designers within the AHI due to their numbers, contribution to the economy in GDP terms and highly developed network. In the sections below, I examine the role of that network in SP diffusion through a specific focus on the mediation roles of its peak body hubs whose powerful network influence extends into most sectors of Australian society.

Developers

The principal network linkages between this group and SP are the powerful peak bodies who have a strong commitment to its diffusion (e.g. the Property Council of Australia, Green Building Council of Australia and Australian Sustainable Built Environment Council) and the planning policies and regulations of state and local government (Clarke 2006b). Competition for access to developable land is a powerful incentive link used effectively by the CA Landcom in NSW, Vic Urban in Victoria and Landcorp in WA (See Boxes 3-18 and 4-3) in addition to state and local government development consent conditions. A significant threat to the growth and strengthening of these pro SP linkages in the AHI is independent political lobbying by developers for commercial advantage.

Strong existing network links to anti-regulation or sustainability sceptics in the developer network represent potential barriers to SP reform worthy of detailed attention by change agencies. Many existing linkages in this network are to powerful actants (including politicians and media) who have traditionally opposed regulatory reform as an un-necessary impediment to development (and an incursion into profit margins). These links take the form of powerful multiply linked lobby networks and, while regulation can render these links ineffective in the short term, its introduction without extensive consultation with this group has been observed to provide a catalyst for these lobby networks to oppose SP reform. (E.g. Meriton Apartments using their strong, multiple links with HIA to align HIA to their own agenda of opposition to BASIX). For this reason, regulation affecting this group requires extensive negotiation in sound interressment and enrolment strategies to avoid the possibility of catalysing opposition lobbying.

In addition to regulating developer practices, CAs have further potential opportunities to enrol, mobilise and black-box participation and support of SP by this group including incentives that offset developer costs for provision of sustainable infrastructure (e.g. dual pipe water supply, on-site cogeneration plant or water sensitive urban design) or, reduce water and energy supply augmentation charges by authorities. Further, regulations that recognise the savings offered by development-scale inclusion of SP in property value (e.g. developer provision of dual pipe non-potable water supplies eliminates the need for builders to install rainwater tanks for BASIX approval) also add incentive. While mandatory disclosure of energy and water rating at point of lease or sale is likely to create an indirect network link between sustainable performance and the powerful incentive actants property value and capital gain, mandatory valuation of such features by property valuers would create a more direct and powerful link. (See Section 6.5 for further analysis).

Project home and volume builders.

This group tend to adopt an intermediary rather than mediator role because it responds to, rather than drives SP reform. It is engaged in the sustainable change network through regulation (BASIX and BCA). Owing to strong cost sensitivity, any attempt to take a leadership role in applying SP is difficult before introducing a 'level playing field' of minimum practice by introducing mandatory minimum codes of practice. However, the involvement of this group at even minimum practice level generates significant GGE and water savings, owing to the volume of housing they create. Additionally, as argued in Sections 4.1 and 4.2, their contribution to innovation development through the commercialisation and risk minimisation of SP is critical to the diffusion process. The acute cost sensitivity of this group, suggests that change agendas that drive closer links with lenders and realtors are likely to deliver meaningful outcomes than benchmark creep.

An important SP-related network role of this group involves generating high volume demand for SP products and technologies leading to economies of scale and improved quality assurance

standards among SP manufacturers and suppliers. While limited (relative to the custom designed and built market), early attempts by one or two volume housing companies to use SP performance as part of their market differentiation strategy (Investa 2007) are driving competitors in the network to investigate competitive responses. For example, Masterton Homes and Allam Homes had their entire staff GreenSmart trained shortly after market leaders, Clarendon Homes-Investa became the first to do so (see Box 3-13).

Custom renovation, alteration and addition builders:

While exposed to only minimal mandatory SP standards, the range of practice in this group is diverse with SP inclusion being driven almost entirely by consumer demand. Very few specialist alteration and addition companies have sought GreenSmart training. Indeed the specialised one day GreenSmart Renovations course has only been run on two occasions in NSW and the ACT owing to lack of demand.

CAs are optimistic that the introduction of mandatory disclosure in conjunction with benchmark creep in BCA and BASIX alteration and addition provisions will stimulate greater participation by this sector. I assert that this sector is a critical 'next step' target for CAs and that additional, supportive actants such as mandatory valuation of SP and minimum pre-sale performance benchmarks associated with mandatory disclosure are necessary to ensure meaningful outcomes (See Sections 6.5.4 and 6.5.5)

Industry peak bodies: (MBA, HIA)

These actants are: focussed very specifically on the needs of their members; competitive in protecting and increasing member market share; monitor each other's actions carefully and rarely collaborate or share resources. This requires audience specific duplication of CPD and promotional exercises by change agencies. These actants often have strong network associations with politicians through which they exert significant influence for and against SP change agendas. Their motivations are varied and their stance unpredictable. Often, their stances are motivated as much by a need to be 'seen to be acting' on behalf of their members as by sound corporate ethics. The outcome often results in dualistic stance as demonstrated by Box 5-4.

Box 5-4: Opposing stances in regard to BASIX within HIA

HIA continue to take an active SP supportive mediation stance through their GreenSmart program (Boxes 3-17, 3-25) while also opposing SP change agendas on other grounds including affordability (Crouch 2005; HIA 2003b, 2003c, 2005b) and over-regulation (Crouch 2006; HIA 2005a).

In 2004-5, HIA's then president (NSW) took a strong stance against SP regulation with particular attacks on BASIX. At the same time, HIA had engaged 6 of NSW's top 10 volume housing companies in GreenSmart training and were establishing the landmark Nelsons Ridge GreenSmart village where these companies achieved voluntary SP outcomes that exceeded BASIX requirements when they were introduced some 12 months later. So strong was the commitment by these actors that, in most cases, they re-designed their entire product range to embody SP.

These actors also provide powerful network influence and communication channels to little known, individual practitioners whose stance on election and appointment does not necessarily reflect that of the organisation. Indeed, representing the voice of sceptics in these organisations is a frequent source of political power and network influence (See Box 5-8 and discussion of the role of assumed consensus to collective decisions by peak bodies in Section 4.1.3). Drivers (incentive actants) observed during AR to be effective tools available to change agencies to enrol these actors in their change agendas and maintain or black-box that commitment are briefly discussed below.

Firstly, consultation and engagement of peak body mediator actants in regulatory development networks is an important strategy through which CAs can interress and enrol these actors during network configuration (see Box 3-5 where DoP's failure to do this is analysed in terms of adverse opinion leadership outcomes and Section 5.2.5 where it is addressed through critical analysis).

CA funding of SP initiatives that form part of the mediator's core business (e.g. CPD training, conferences and design awards) through provision of individually badged generic resources (e.g. BITS) was observed to be an effective enrolment and mobilisation strategy. The associated 'branding' and commitment of resources by the mediator organisation encouraged longer-term commitment through ownership and positioned SP advocacy within the corporate image of the organisation. Successful partnerships between CAs and specialist SP mediator organisations to develop proprietary information and rating actants (e.g. Green Building Council's GreenStar Tool, EcoSpecifier, HIA GreenSmart or MBA Eco-Living) further demonstrate the effectiveness of such strategies.

Consultants and certifiers

Sustainability consultants (SC) are a new AHI mediator actant and, whilst still few in number, my observations confirm their effectiveness in bridging the gap between innovation actants (whose focus is on research rather than practice) and the intermediary majority of practitioner actants. These observations are drawn from reflective practice of my own SC role during AR and reviewing the extensive literature of contributions by other SCs to the sustainable change process over 10 years. SC roles are being filled by practitioners who have specialised in SP (especially engineers, architects and building designers) and quality assurance is determined by reputation.

To date, the potential contribution from increased numbers of these specialist SP actants remains a low priority for CAs and yet, my observations suggest that their mediation role in linking mandated minimum and better or best practice throughout the AHI network is critical. This leads me to recommend the development and recognition of a specific new SC vocation by defining the range of competencies required by a SC and establishing an accreditation framework to establish SCs as part of BaU. As argued earlier, certified compliance with SP regulation is poor or non-existent and, intermediary practitioners struggle to keep their SP knowledge current. I claim that these barriers and many more could be overcome by training and certifying SCs in a range of fields including thermal performance, energy use, renewable energy, water, materials, biodiversity, indoor air quality and social sustainability.

Sustainability Assessors, a new and rapidly expanding profession of specialist mediatory actants created by regulation and trained and certified by ABSA exemplify the above argument. This group provide SC consultancy in relation to TP throughout the AHI and, in response to BASIX, quickly developed certified skills in relation to water and appliance use. As argued earlier in DoI analysis, DoP failed to recognise and capitalise on this opportunity to increase BASIX' network links by engaging these individual mediators to influence large numbers of practitioner intermediaries (See Box 5-7 in Section 5.2.4 below).

Marketing networks

Marketing networks are another powerful mediation resource that remains untapped by CAs). As argued within DoI in opinion leadership terms (Sections 3.3.2 and 3.3.4), the marketing sector requires urgent CA intervention in the form of new incentive actants with potential to integrate and adapt SP to create compatibilities with their own interests (Callon 1999). These include regulatory actants (e.g. mandatory disclosure and valuation of SP) to create new SP supportive networks by mediating the divergent and conflicting motivations and beliefs associated with SP in this sector (Beagle 2001, p. 423). The potential of such mediatory strategies to 'command' the promotion of SP by marketing intermediaries is further addressed in Section 6.2.3.

Consumer networks

Consumers are an actor group whose potential to influence sustainable change in the AHI network remains largely untapped by CAs. This group is characterised by weak and even negative SP network interaction because the task of opinion leadership has been left to the property marketing network that, as argued earlier, remains almost unaffected by SP change agendas and regulatory regimes. The result is that the powerful traditional wealth creation paradigm of interaction between consumers, investors, lending authorities and property marketers continues to flourish, creating significant barriers to SP change agendas.

While consumers are the largest network of actors involved in the SP change process, only limited attempts have been made to develop compatibilities between SP and the competing needs and interests of intermediaries in this network (beyond those of new home buyers). I contend that this is partially attributable to the disempowerment of consumers in the housing selection process due to the complex and seemingly competing actants that influence their decision-making. These include cost, comfort, capital gain potential, socio-cultural norms and image. The home buying process is often the consumer's first introduction to this confusing array of powerful actants and understandably, most seek a mediator to help them choose an appropriate pathway. That mediator is usually a property marketer or real estate agent.

While more is understood about the creation and marketing of change in consumer networks than (arguably) any other, the cost of re-aligning this network using traditional marketing methods is often cited as a barrier by CAs with limited, project specific budgets. While beyond the scope of this research, I suggest that many alternative, lower cost strategies are available to CAs including those commonly used in social marketing (McKenzie-Mohr & Smith 1999; Robinson 2007): internet promotions and e-learning opportunities; school curricula; joint funding of television infomercial and print media advertorial promotions (currently used successfully in regional television networks and media). Current incompatible network influences should be addressed to create new SP supportive networks through mediation of the divergent and conflicting motivations and beliefs associated with SP in this sector including:

- finance network (lenders valuers, agents);
- investment network (capital gain and wealth creation);
- marketing network (by addressing lifestyle, health and social responsibility).

Strategies to address each are addressed in Sections 6.4.2, 6.5.1, 6.5.2 and 6.5.3.

Lending authorities

This network is arguably the most influential and under-utilised actant in the AHI network with powerful links to every sector and actant. Indeed, the finance sector is arguably the most critical hub of power in the network and yet it remains un-aligned to SP change agendas by CAs. I argue that the alignment and enrolment of this group as a central hub in SP change agendas is an essential outcome from the next round of regulatory network re-configuration that centres on Mandatory Disclosure (MD) of energy rating at point of sale.

My ANT analysis in Section 5.2.4 suggests that introducing MD as a stand alone reform is unlikely to enrol lending authorities in any significant way and DoI analysis in sections 6.3.6 and 6.5.4 confirms this. Both analytical approaches identify the importance of strong supportive regulatory actants such as mandatory valuation of SP and increased utility prices in creating strong links

between SP performance and wealth creation around capital gain and reduced operating costs for new housing, home improvements and rental returns from investment properties. Flow-on benefits from enrolling the finance sector would likely include: the enrolment of marketing agents, provision of adoption incentives for home owners, linkages with proposed government subsidies for 'green' loans and visible, corporate, ethical leadership for industry.

Change agency and mediator networks

While a well developed, collaborative, cooperative network hub of aligned actants in this category is critical to effective change creation, this group arguably remain the most disparate and poorly aligned of all mediator actants in the AHI change creation network. Competition and duplication between commonwealth, state and local government CAs is the current BaU scenario in this sector where collaboration and pooling of resources is the exception rather than the norm.

I contend that a coordinated, network approach to change creation by actants in this group is the single most important next step in mobilising sustainable change in the AHI. Where this has occurred to even a limited extent, the outcomes have been outstanding (see Boxes 5-5 and 5-6). By comparison, DoP's non-consultative, non-collaborative approach to developing and implementing BASIX – which is arguably a world best regulatory and assessment tool – proved divisive and counter-productive (see Boxes 5-7 and 5-12) and disappointingly, may lead to its early failure. For this reason, much of the following ANT analysis focuses on developing better understandings of why BASIX failed to gain national acceptance and how to avoid similar failures in future. Box 5-5 provides a partial explanation in ANT terms.

Box 5-5: DEWHA, SEDO, Armadale and Subiaco network stronger than DPI – BASIX.

DoP's strategy to have BASIX adopted as a national SP regulatory tool by encouraging its adoption by individual states encountered a barrier in WA. While the then WA Planning Minister and her Department for Planning and Infrastructure expressed interest in adopting BASIX, a competitor alliance aligned to BCA and HERS that did not enjoy similar ministerial support proved to have a stronger or more extensive network.

Collaboration between the WA Government's SEDO and the Commonwealth DEWHA to implement the BCA and its assessment tool HERS through initiatives by local governments including Armadale and Subiaco, had created a strong and extensive network of alliances in the WA building industry. SEDO's network configuration had started several years before the DoP approach and its SEDA-like approach to the voluntary enrolment of practitioners and their industry peak bodies in its network proved stronger than the network approach by DoP, DPI and their Minister who had intended making an authority decision to introduce BASIX.

While BASIX' failure is not entirely attributable to the above network influences, the case study demonstrates the importance of thorough network configuration in successful change creation.

Box 5-6 below demonstrates how a well configured change network contributed to the introduction of Australia's highest mandatory code of best practice with very little opposition.

Box 5-6: Sound network configuration limits opposition to SV's stringent mandatory code.

This case study demonstrates how thorough network configuration contributed to the achievement of high benchmarks in Victoria's mandatory code of practice.

Sustainability Victoria's (SV) decision to implement the highest levels of stringency available under the Commonwealth's BCA (5-star thermal performance) in 2006 and its planned introduction of more stringent 6 star 'plus' (water and materials initiatives) performance standards through the Victorian Energy Efficiency Target (VEET) Regulations 2008 has received very little opposition

My ANT analysis suggests that this is at least partially attributable to SV's continued expansion of the collaborative networks with industry peak bodies and other CAs (AGO ABCB and ABSA) developed by the sustainable Energy Authority of Victoria (SEAV) during Victoria's early adoption of mandatory TP benchmarks in 2003, which was accompanied by a comprehensive and positive Regulatory Impact Statement (RIS) (Allens_Consulting 2002) that was updated and presented again in 2005 (Victorian_Government 2005) in response to industry apprehension about 5-star HERS ratings for new housing (ABCB 2004b). While SEAV applied an authority approach, their implementation strategy was based on the consultative and inclusive strategies employed by SEDA in their earlier introduction of voluntary standards in NSW.

SV's current network configuration strategies include the trialling of 6 Star energy efficiency with selected home builders in tandem with innovative water and materials provisions developed by Port Phillip, Darebin and Moreland Councils (SBE & Hansen 2007). Additionally, they are working collaboratively with industry peak bodies and the (Victorian) Building Commission to develop strong supportive practitioner networks through CPD skill provision and industry consultation forums. A comprehensive RIS (DPIV 2008) was also published in association with this initiative.

Victoria and West Australia are leading other states in the advancement of their sustainable housing agendas. I argue that this is substantially attributable to a collaborative, value adding approach between CAs at each level of government.

5.2.4 Network interactions. Who is linked to whom and how?

The purpose of this section is to analyse both existing and potential network interaction between the micro, macro and meta actants described in Sections 5.2.2 and 5.2.3 to explain the role of network dynamics in socio-technological change. Selected case studies are used to demonstrate the processes of mutual shaping and changing by these socio-political, technological and spatial actants through their network interaction and identify those effective in creating both opportunities and barriers to change. Analysis of these yields insights into effective intervention strategies through which CAs might re-configure the network to mobilise and ultimately 'black-box' their agendas.

Actors act upon and react to each other, thereby aiming to translate (change) the aims and goals of those they act upon to align with their own. (Bryce & Yasukawa 2004)

The actant categories described in 5.2.2 and the network links in 5.2.3 above are broadly depicted in the schematic below. Important actants and their sustainable change network linkages are positioned in the research and numerically referenced in subsequent analytical sections. The schematic describes the whole network while subsequent analysis focuses only on links relevant to this research that provide additional insights to DoI analysis in Chapters 3 and 4.

While power and influence increase at each punctualisation level, exceptions exist where individual micro-actants have considerably more influence due to their access to and application of power enhancing actants including: prestige, ethical and moral, regulatory, personal links to powerful actants, access to power within a meta or macro actant group and economic means. Conversely, powerful actants can be ineffective because power exertion by such actants is often seen as a threat by smaller actants who align weaker allies to counteract the powerful actant's influence (see BASIX case study). Until recently, many strong, established network associations with unsustainable practice existed in the AHI network making it difficult for the few weak associations with SP to prevail. The recent proliferation of supportive socio-political actants has created a supportive environment to develop strong associations with SP – substantially increasing rates of adoption.

Socio-technical change initiating network formation in the AHI

New networks form in response to problems identified by 'initiating' actants (Clarke 2006b) during Callon's (1986) 'problematisation stage' of network configuration. Initiating actants identify and engage allied actants (societal and technological) to collectively participate in creating change to resolve these problems. This 'alignment of allies' begins during the interressment stage, continues throughout the enrolment stage and concludes in the mobilisation stage (Callon 1986).

The problematisation stage of forming a sustainable change network in the AHI is described in Chapter 2 through a literature review tracing the development of sustainable built environment

theory. That review also touches on interressment, enrolment and mobilisation but justifies the need for this research by concluding that these stages are very much a work in progress.

Socio-technological change as a source of power

This analysis is based on the socio political actant categorisation in Section 5.2.2. It examines a selected range of network interactions between those actants at varying levels of punctualisation and generates new insights into the role of power in determining network influence. ANT holds that socio-political actants influence rates of change in a network through their application of the power that emanates from the number and strength of their network links (Callon 1991; Stalder 1997). Knowledge, skill, prestige, wealth, success and history are just some of the factors that combine to determine the number and strength of network connections available through which a mediator actant can influence the networks invention, refinement, commercialisation and adoption (or rejection) of sustainable practices. The purpose of this focus on power is to identify potential for transfer of power by informed CAs as part of their network configuration strategies.

Strathern (1999) identified a type of socio-technical network in the political arena that he described as *an alliance of empowerment between 'knowledge organisations' and the state (Strathern 1999 cited in Beagle 2001, p.426).* Beagle observed that in this network interaction *the knowledge held by certain actors is translated into a power-wielding competence* [motivated by] *a definition of competence in the particular arena of specialised knowledge the actor can demonstrate, and how it can exercise political power through it (Beagle 2001, p. 426).*

While Beagle and Strathern's analysis examines alliances between 'knowledge organisations and the state', my AR observations suggest that similar alliances exist between expert actants and CAs. I suggest that advocacy of (or opposition to) sustainable change is a substantial source of power for knowledgeable actants and, that the alignment and empowerment of such allies through mutual recognition is a useful interressment tool available to change agencies. The identification and empowerment (by CAs) of key homophilous actors in each specialised sub-network was observed to rapidly build strong new peer influence and opinion leadership links that would otherwise have remained inaccessible to the CA because of its heterophilous status outside the network. Case studies that demonstrate both strong outcomes from this approach include: SEDA's Energy Smart Allies Program (Boxes 3-4 and 3-21); SEDA's empowerment of OLs (Box 3-21) and the rise of ABSA in Box 5-7 below.

Box 5-7: Empowerment of ABSA by change agencies AGO, SEDO and SEAV contrasted with its disempowerment by DoP-DIPNR.

ABSA's unique positioning within the sustainable change network between industry, government and SP specialist actors was immediately recognised by established researchers, consultants and

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CAs who were drawn to working collaboratively with ABSA towards common goals. (See 2.8.2 for overview of ABSA). ABSA 'inherited' important network links from these actants and multiplied them by providing an interconnective hub for aligned actors.

These extensive, high level network links transformed ABSA from a small NSW based actant representing low numbers of specialist practitioners to a nationally (and internationally) recognised actant responsible for accreditation, management, training and developing of a brand new set of actors, sustainability assessors, throughout Australia and New Zealand. I attribute this rapid success to the transfer and empowerment of critical network links by CAs at commonwealth (DEWHA, formerly AGO), state (Sustainability Victoria, Qld Department of Housing, SEDO in WA and the ACT, NT and Tasmanian governments) and most recently, international (the New Zealand government) level. In each of these jurisdictions, ABSA plays a key role in mobilising CA agendas by enrolling practitioners through provision of quality assured assessment to AHI practitioners through accredited assessors whose increasing skill base (due to ABSA's mandatory CPD requirements) is strengthening these links.

While ABSA have a HERS accreditation role in NSW, the developers of BASIX (DoP- DIPNR) took a strong stance against HERS as a measurement tool (See earlier arguments) and developed a user-friendly tool that allowed individual practitioners and consumers to perform the task of ABSA assessors. While this created new, accessible links to the BASIX agenda for a few motivated individuals, it divided the growing network of aligned professionals by weakening ABSA's network linkages in NSW, arguably slowing mobilisation the NSW SP change agenda and stalling its progress towards black-box status.

The above case study suggests that, as part of their research to argue the need for a new regulatory actant and scope its role, CAs should also identify likely network scenarios whereby the new actant and the existing SP network can mutually shape and strengthen each other to avoid scenarios where new actants weaken or eliminate existing actants – especially important network hubs such as ABSA. While Box 5-7 demonstrates constructive use of strong links created by CAs, weak links can also play an important role in change creation as demonstrated in Box 5-8.

Box 5-8: The strength of weak network links

In 2004, the HIA NSW president, an elected (not appointed) actor with a relatively weak link to HIA's mainstream SP change agenda (GreenSmart) had significant influence over the rollout of sustainable change agenda BASIX by the NSW Government based on incomplete arguments presented from a temporary platform of influence. (Walker 2003) While his opinion did not accurately reflect HIA SP policy because his temporary political appointment constituted a weak link between his platform and these policies, his arguments were not rebutted by HIA or other

network experts because DIPNR's divisive, non-inclusive BASIX interressment process left very few BASIX supporters in the network.

Conversely, a HomeWorld manager attending a NSW GreenSmart training course as a sceptic (weak link), became convinced that SP were a fundamental part of the future for the AHI volume housing sector and this exposure to opinion leadership added to his motivation to apply GreenSmart benchmark standards (significantly higher than mandated minimum SP) in Home-World Display Villages, thereby taking SP to mainstream consumers.

The above analysis suggests that while damaging, negative weak links are difficult if not impossible for CAs to identify or manage individually but supportive weak links arise from strong healthy networks with little or no management or resource input from CAs. By strategically managing networks to maintain strength and diversity, CAs can increase the occurrence of positive weak links to offset negative ones.

I argue that the DoI phenomena of development of ownership of innovations by engaging adopters in the reinvention process (see Section 4.2.4) is confirmed by ANT analysis in terms of the network strengthening role of collaboration and consultation. While bureaucratic and time-consuming, the ABCB's regulatory development process satisfies these requirements and strengthens the network whereas DIPNR's policy of excluding the network from BASIX' development weakened or destroyed many of the positive SP network links created by SEDA that BASIX should simply have inherited. I argue that this difference is the principal reason for BCA's adoption as the national regulatory framework in preference to BASIX even though BASIX is arguably the best tool – albeit with some modification (which DIPNR refused to allow other states and territories to carry out).

In summary, the above analysis demonstrates the advantages of change strategies that encourage the creation or strengthening of supportive networks. The question then arises, what other strategies exist and how might CAs recognise and implement them? In Section 5.3, I analyse selected AR case studies in Callon's four stages of network configuration to demonstrate how ANT can be applied as a strategic framework or checklist to identify such opportunities and inform the design of change agendas to capitalise on them.

5.3   Critical analysis and strategic planning of selected AR case studies

ANT pictures both human and non-human 'actors', interacting in a process in which a specific 'solution' can be accepted, to the point of being sustainable without further 'nourishment' or external direction. The process involves human actors becoming interested, and then enrolled in the network for change to that 'solution'. Enrolment involves acceptance of the principal change actions (the obligatory passage point). Given sufficient enrolment, the network is mobilised in the sense that it can act collectively and cohesively. Sustainability of the change is achieved when others entering the stakeholder space are obliged to accept the dominant paradigm, or 'solution' to the previously perceived problem (Bryce, Johnston & Yasukawa 2002a, p. 4).

5.3.1 Overview

In this section, I analyse key AR case studies in Callon's four stages of network configuration: problematisation, interressment, enrolment and mobilisation (Callon & Law 1982b). This analysis explains successes and problems in ANT terms and demonstrates how ANT's simple network configuration strategies can be applied as a strategic framework to guide the future alignment of allied actants by CAs to enhance opportunities or remove barriers (See 1.6 for detail). My analysis is based on change indicative data drawn from AR participant observation and includes: relationships and interactions between actants; shifts in interest, alliances or goals by actants; changes to work practices and the role of CAs in mediating favourable (or unfavourable) actant interactions.

The outcomes of evaluating the AR case studies within ANT are combined with ANT analysis of the AHI actor network in 5.4.1 and summarised as a series of transferable generalisations in Section 5.4.2. The outcomes of both DoI and ANT analysis are synthesised in Chapter 6. This application of ANT is succinctly summarised by Bryce and Yasukawa as: *a way of observing and analysing a process of change* [that] *combined with AR…can identify and guide interventions to effect change (Bryce & Yasukawa 2004).*

Network influences leading to the configuration of the meta network that created the AR case study change agendas are described in Section 2.1.1. The following is a brief summary of these in ANT terms.

During the late 1980s and early 1990s, cumulative global problematisation of environmental concerns led to the interressment of powerful global actants in a change network. The Intergovernmental Panel on Climate Change (IPCC) was established in 1988 by the UN through the World Meteorological Organization (WMO) and the United Nations Environment Programme (UNEP) to assess the risk of human-induced climate change, its potential impacts and options for adaptation and mitigation. Because the IPCC is an intergovernmental body, its findings are peer reviewed by experts before review by governments and NGOs involved in the change process around the world. This review

process was (and continues to be) an important driver of interaction in the global climate change network and its problematisation role led to the creation of important new global change actants including: the UN Framework Convention for Climate Change (UNFCCC) (UN 1992 -b); Local Agenda 21 (UN 1992 -a) and; the Kyoto Protocol (UN 1997).

Australian actors created through flow-on from this global change network include: the Australian Greenhouse Office; the National Greenhouse Strategy (a strategic Framework for Advancing Australia's Greenhouse Response); the National Greenhouse Response Strategy (Commonwealth_of_Australia 1992, 1998) and the NSW Sustainable Energy Development Authority, SEDA. These early Australian mediator actants led to the creation of additional, specific strategies and CAs including those in the AHI that became the subjects of my AR focus and, whose network configuration strategies I critique below.

5.3.2 SEDA NSW Energy Smart Homes

Overview

SEDA's Energy Smart Homes program provided my first opportunity to adopt an AR role as an observing player, by linking my roles as an SP specialist Building Designer and opinion leader to the ESH program.

SEDA's ESH policy was the first Australian sustainable change agenda to directly target the housing industry. It pre-dated state and commonwealth government mandated energy targets and relied on voluntary adoption of energy-efficient (EE) regulations for new dwellings by local governments. Despite being voluntary, ESH achieved significant change outcomes and, by changing attitudes, imparting knowledge and (to a lesser extent) skills among AHI practitioners, ESH prepared the NSW actor network for mandated SP standards. (See Section 2.4 for ESH case study details and Section 6.4.6 for detailed discussion of the role of attitudes, knowledge and skills in creating change).

I largely attribute ESH's success to SEDA's consultative, inclusive network building approach which in ANT terms, identified and publicised the problem, aligned allies and enrolled them as participants in a well planned, cumulative change process. The SEDA success story demonstrates how effective interressment simplified and streamlined the enrolment process and set up what should have been a simple mobilisation task. SEDA was disbanded during a NSW government CA network reconfiguration and the final mobilisation phase of their change agenda was transferred to DoP and BASIX, fragmenting SEDA's strongly aligned network of actants in the process. I posit that DoP's failure to maintain or re-configure this network contributed to many of the barriers encountered during its mobilisation of BASIX (see Section 5.3.5).

For these reasons, I critique this case study in greater detail than others to establish a baseline against which I compare and contrast other AR change agendas.

Problematisation of SEDA's change agenda

The problematisation phase of network configuration occurs when:

> *a problem is identified and explored by one or more people or groups (Callon & Law 1982a).*

Problematisation by global and national (meta) actor networks identified climate change as an imminent threat and provided a strong framework to guide the formation of state and local change networks. The NSW government embarked upon problematisation of state-based issues by commissioning an investigative report tabled in 1995 (NSW Electricity Reform Taskforce 1995). This report recognised that *the (NSW) electricity industry has major impacts on the environment, both in the fuel production and generation processes, and in electricity transmission and distribution (ibid)* and recommended that a number of supply and demand side reform measures be implemented.

The Sustainable Energy Development Act (NSW_Parliament 1995) was created in response to this report. Its stated objectives clearly and concisely problematised NSW's response to climate change and created three important new change network actants to

> *…bring about a reduction in the levels of greenhouse gas emissions and other adverse by-products from the production and use of energy, and to encourage the development, commercialisation, promotion and use of sustainable energy technology, in accordance with the principles of ecologically sustainable development (ibid).*

These actants were: SEDA, a dynamic new CA *to exercise functions in relation to the development, commercialisation, promotion and use of sustainable energy technology (ibid)* ; a Sustainable Energy Fund to *provide financial assistance to persons engaged in the development, commercialisation, promotion and use of sustainable energy technology (ibid)* and the Sustainable Energy Advisory Council *to advise the minister (ibid)*.

Interressment

Interressment occurs *when a solution for the problem is put forward and the proponents start to persuade others and build alliances (Callon & Law 1982a).*

The problematisation role of the Sustainable Energy Development Act provided a very clear directive for the interressment phase of SEDA's change network configuration. SEDA was able to capitalise on interressment momentum from the Earth Summit (manifesting through the meta network actants LA21 and the Kyoto Protocol) to build a solid foundation for its change agenda. Construction programs for the 'Green Olympics' (another powerful and influential actant in the AHI network at the time) added to this already receptive environment by providing interressment incentives for political, corporate sector and AHI practitioner actants. These unique supportive

network influences and linkages began to diminish post Olympics. The network influence of sceptics increased in this environment and subsequent change initiatives in NSW did not enjoy the same ease of interressment of political and business networks in particular (see 5.3.5).

SEDA adopted a broad range of interressment strategies through which it aligned a strong and influential network of allies. These strategies included: aligning innovative, early adopter practitioners as homophilous OLs in their respective peak bodies and associations; encouraging competition by initiating and sponsoring Energy-efficient (EE) design awards; creating 'EE champions' by recognising and promoting excellence and leadership by individual practitioners, councils and corporations and providing training and accessible information to AHI practitioners. SEDA consolidated the network of individual, innovative practitioner actants created through this interressment process by publishing an Energy Smart Allies Directory (SEDA 1998) that networked hundreds of EE actors from every industry sector.

Enrolment

> *…when actors are enrolled into the network and become part of developing the solution (Callon & Law 1982a) …acceptance of the principal change actions- the obligatory passage point. Given sufficient enrolment, the network is mobilised in the sense that it can act collectively and cohesively* (Bryce, Johnston & Yasukawa 2002a).

The broad range of interressment strategies applied by SEDA created a powerful matrix of network inter-connections that enrolled a broad range of practitioner actors in the EE change agenda and raised awareness of most- particularly design practitioners. This pre-disposed industry towards support and acceptance of EE regulation through local government.

SEDA's approach to encouraging voluntary adoption of the ESH policy by individual local councils was an important contributor to the success of the enrolment phase. A consultative approach minimised the cost, risk and workload for councils adopting the policy. SEDA organised and facilitated community consultation programs. A simple policy package was developed to ensure ESH policy was seamlessly incorporated into council planning instruments (Development Control Plans and Local Environment Plans). A range of assessment tools was provided (including HERS assessment or a simple scorecard) in addition to training and promotion resources.

Incremental adoption by NSW councils activated many of the network drivers discussed in 5.2, including competition (between councils), peer leadership and a knowledge and skill base in local government and industry. This curbed opposition by sceptics and opponents in the AHI network because it dissipated an important source of power for dissidents – opposition to heavy handed, 'over' regulation of the AHI. The local and regional rollout over a 5-year period (longer than a

council term) also facilitated opportunistic interressment and enrolment of political actants by SEDA and its network of allies.

An important 'obligatory passage point' achieved in the ESH change agenda was acceptance by a critical mass of actors in the AHI network that the mandating of EE standards was both inevitable and desirable. NSW Councils implementing SEDA's Energy Smart Homes Policy influenced the development of over 95,000 Energy Smart dwellings between 1996 and 2004 and the program is estimated to have saved over 244,500 tonnes of CO_2. Sixty councils (representing 80% of NSW's new residential development) adopted minimum energy performance standards for the building fabric, under the Energy Smart Homes Policy. Of these, 53 Councils mandated installation of greenhouse friendly hot water systems (SEDA 2004, p. 10).

Mobilisation

> *…when the actor network has achieved a level of stability and the solution is blackboxed in a way that makes it apparently irreversible* (Callon & Law 1982a).

> *Sustainability of the change is achieved when others entering the stakeholder space are obliged to accept the dominant paradigm, or 'solution' to the previously perceived problem* (Bryce 2001).

Performance indicators developed during SEDA's problematisation phase contributed to the mobilisation and eventual 'black-boxing' of many individual initiatives. It did this by quantitatively validating both economic and environmental benefits. The indicators adopted were: value of lifetime energy savings committed through programs (estimated at over $1.3 billion); value of investment of non-Government funds in sustainable energy projects (in excess of $539 million between 1996 and 2004) and greenhouse gas emission reductions committed over the life of projects (over 35 million lifetime tonnes of CO_2). (SEDA 2004, p. 11)

By 2003-2004, 80% of new residential development in 60 New South Wales councils was covered by the ESH policy. SEDA's network success in NSW contributed to enrolling other government actants in similar change initiatives. The Sustainable Energy Authority Victoria was established in 2000 and the Sustainable Energy Development Office in Western Australia in 2001. The Building Code of Australia (BCA) drew from the policy requirements in the ESH program and adopted a 4-star NatHERS rating in 2003 (rising to 5-star in most states in 2006).

Adopting economic rationalisation strategies similar to SEDA's by change agencies in other states has helped to mainstream or 'black-box' residential EE policies as a GGE reduction strategy nationally. The Victorian government's regulatory impact assessment of mandatory minimum 5-star House Energy Rating standards before their introduction in Victoria found that the new regulations would *boost Victoria's economy* by *up to $570 million* with *potential to create 1100 new jobs*

(Government_of_Victoria 2002). While it is reasonable to assume that a similar scenario would exist in NSW were 5-star standards to be introduced, no equivalent assessment was conducted by the NSW government before launching BASIX. (See BASIX case study below).

Adoption of the House Energy Rating Software NatHERS as the technical tool to assess design compliance in ESH required industry to develop a capacity to deliver HERS ratings. For this reason, the House Energy Rating Management Body (HMB) was created by SEDA to train and accredit House Energy Rating Assessors. Key residential building associations formed network alliances with SEDA through the HMB. With the BCA and BASIX pending, SEDA facilitated the transition of HMB to the Association of Building Sustainability Assessors (ABSA) (see Section 5.3.6 for detail). Creating these new actants was a network outcome of SEDA's EE program and provided a strong indicator that mobilisation of the EE change agenda achieved a 'black-box' status likely to be sustained and refined by this new profession (see Section 5.3.5 for detail).

Summary

ANT analysis of the SEDA AR case study demonstrates how a well-planned change strategy that addresses each stage of network configuration thoroughly has a high probability of success. Rigorous problematisation of climate change at meta-level contributed to the interressment of significant numbers of powerful meta actants in a global change network by creating strong arguments for change and a well defined strategy for achieving it. The overwhelming scientific consensus generated through this meta-level interressment expanded and contributed significantly to the network's capacity to enrol important actants such as Australia and the former Soviet Union who might otherwise have challenged the primary change objectives.

Direct and indirect network links between this global actant and the Australian government were effective in enrolling national and state government actants in acceptance of the primary change objectives and engaged them in creating strong national, state and regional networks to mobilise the change agenda. The analysis emphasises the importance of thorough problematisation and interressment in ensuring effective flow of network influence through successive levels of network punctualisation from global, through national to state, regional and individual.

SEDA created a diverse network of smaller actors and then acted as a catalyst to their interconnection in that network. The expansive and interlinked network of Energy Smart Allies (ESA) was able to counter and eventually overcome the negative network influence of sceptical actors. Rapid growth of the ESA network created new business opportunities for practitioners acquiring new skills and for researchers, manufacturers and suppliers commercialising new technologies. In other words, the network had

....gathered enough momentum, through accepted non-human actors (conceptions, documents, structures and agreed paths), for cohesive progress to be made along a path that is difficult to retrace. With many of the processes now opaque to newcomers, the 'solution' is said to be 'black-boxed' (Bryce, Johnston & Yasukawa 2002a, p. 7).

The Sydney 2000 'green' Olympics created a supportive interressment and enrolment environment that contributed to SEDA's success. In the years since, other change agendas have struggled to enrol similar levels of support in the AHI network due (in part) to an absence of meta and macro motivational actants. Russia's ratification of the Kyoto Protocol in 2004 and its entry into force in February 2006 was another meta actant. Recent macro actants include advances in climate change science and the manifestation of its predictions through a proliferation of extreme weather events (including the economic impact of prolonged drought in Australia). While this coincidence of change catalysts appears to have weakened the arguments of sceptics and precipitated a 'tipping point' in public awareness and concern about climate change, CAs need to act quickly to convert it into meaningful outcomes.

5.3.3 Your Home

The *Your Home* case study provides insights into specific benefits arising from networked approaches to developing change agenda policy and resources. The production phase of YH demonstrates how effective problematisation by the AGO, in partnership with other CAs and industry peak bodies, identified the need for a single source of information relating to SP in the AHI and contributed to successful processes of interressment, enrolment and mobilisation.

The YH case study interressment phase was effective in several ways. Collaboration between four Commonwealth government agencies (AGO, DTRS, EA and ISR), three State governments and the Australian Local Government Association (ALGA) to fund the project led to the engagement of a diverse range of stakeholders with a variety interests, roles and potential contributions to the project. These included experts from competitor tender teams (whose alignment with the project in a peer review capacity allowed them to contribute their individual perspectives on how the project might be made more effective) and industry peak bodies (whose developing role as SP mediators with practitioner intermediary members informed their contributions to the YH content).

Ownership and network alignment that developed during the interressment phase contributed to the enrolment phase. Mediator partner actants including HIA, MBA and BDAA enrolled practitioner intermediaries through YH-based training provision while the government CA partners contributed through distribution to students and community groups. The later introduction of new incentive and regulatory actants by CA partners ensured YH's ongoing mobilisation as an

information source although the enrolment and mobilisation of consumers was less successful due to limited participation by local government partners.

In summary, YH succeeded in meeting the information needs of its target audience, actors already in the early stages of voluntary SP adoption. Its subsequent use by those adopters undoubtedly contributed to industry progress towards critical mass. However, I suggest that its (unintended) contribution to the adoption of best practice in a mandatory minimum practice environment will remain limited whilst implementation remains the responsibility of a risk averse industry geared for repetitious production of a standardised product using a limited suite of construction systems and solutions. As suggested through AR feedback to the YH stakeholder group (see Appendix 2), the current audience requires 'how to' and ' where to get it' and 'how to implement it' information in addition to the better and best practice explanatory information provided in YH that was intended for an audience of voluntary adopters.

Additionally, I contend that YH's current low rates of mobilisation in the consumer sector will remain low until additional regulations such as mandatory declaration of environmental performance at point of lease or sale shifts implementation responsibility back to householders, making the current YH information format stronger.

Finally, the above ANT analysis of the YH project provided useful insights into benefits arising from the strategic network configuration approaches used during problematisation and interressment and identified some limitations attributable to the enrolment and mobilisation phase and changes in audience needs due to progress in the SP diffusion process.

5.3.4 HIA GreenSmart

ANT analysis of HIA GreenSmart training demonstrates ANT network configuration strategies at both macro and micro level. At macro level, it demonstrates how network integration and adaptation creates 'compatibilities' through which new actants *translate their intentions into other actors (Stalder 1997)*. At micro level, I explain how I applied ANT to guide and inform my development and delivery of the course as a trainer.

HIA had limited information resources to support its GreenSmart training program. YH's publication coincided with HIA's decision to re-brand PATHE as GreenSmart and provided a solution. YH was adopted as the primary text for GreenSmart training. In this way, the weak or non-influential actant (in SP terms) HIA, was empowered by inheriting network links created through the YH project and pending new regulatory actants BCA and BASIX. I was engaged by HIA as GreenSmart course developer and trainer in NSW and the ACT, an important AR role that facilitated observing participation in a broad range of network interactions that inform this analysis.

GreenSmart training

Network links established through HIA's participation in producing *Your Home* (YH) led to GreenSmart training development being funding by the AGO as part of the mobilisation phase of the YH project. The training was subsequently modified and adapted to reflect the climatic and regulatory regimes of each state by myself and other presenters. That process continued over the next six years.

In the following micro analysis, each two-day GreenSmart training course is treated as an ANT micro network configuration exercise, where the trainer is required to problematise (identify, explore and explain the need for sustainable change in the AHI) and then attempt to interress, enrol and mobilise attendees as practitioner actors in the sustainable change network. This analytical exercise generates useful insights and strategies with potential when configuring sustainable change networks at macro level. The analysis is informed by insights drawn from reflective practice grounded in DoI in Chapters 3 and 4.

Problematisation for attendees in each training session was found to be critical to achieving good learning outcomes. Reflective practice and review of feedback from early courses suggested that very few attendees understood the fundamental ecological principles that underpin sustainable reform. Adding a simple explanation of ecosystems and their interdependence throughout the biosphere followed by thorough discussion was observed to produce an immediate and discernable shift in attitude towards acceptance of the need for mandatory minimum codes and greater interest in better and best practice solutions.

This observation is relevant to all sustainable change agendas and leads me to suggest that the effectiveness of change advocacy by experts commonly is compromised by their failure to adequately problematise the subject because they assume that the audience has a similar understanding of the problems underpinning the change they are advocating.

Interressment commenced through the above problematisation steps and was extended in the post-regulatory environment by exploring SP that facilitated cost-effective regulatory compliance and innovative ways to exceed it. While regulation allows SP adoption to be presented as a 'black-boxed' socio-technical change phenomena during training, I submit that this is an inadequate interressment strategy that limits the effectiveness of GreenSmart training as a mediator of change towards higher standards. The implications of mandatory minimum codes for best practice are analysed retrospectively in DoI in Sections 4.1.4-6, 4.2.4 and prospectively in DoI and ANT in Section 6.3.

Enrolment. In the pre-regulatory environment, GreenSmart training effectively ended at interressment because attendees were encouraged to enrol in the voluntary change agenda based on arguments presented to them during the course. As the courses developed in response to six years of evolution in SP change agendas, the introduction of regulations mandating SP adoption effectively black-boxed the adoption of minimum SP standards. This created an opportunity to explore additional enrolment strategies for better and best practice based on market differentiation.

Practitioners from the luxury market sector readily embraced these strategies. However, while most mainstream practitioners (volume or low cost housing) saw these solutions as an important short to medium-term market differentiation strategy, they consistently complained that their consumers were not prepared to pay for better practice solutions. These practitioners are enrolled in the pursuit of better practice by consumer demand rather than skill and information provision and, while competition is an important driver, low consumer awareness and demand make SP-based competition unlikely. Group discussions (especially those that occurred un-facilitated during breaks) confirmed this observation and provided strong indications of the need for a structured approach to post-training network configuration to stimulate consumer demand and report demand growth to practitioners to encourage competition.

Mobilisation in the GreenSmart training initiative was to have included half-day refresher courses linked to GreenSmart Professional licence renewals and regular network events to reinforce learning outcomes from the initial training, to update practitioners on new SP developments and to build stronger network links between practitioners with SP innovators, consultants, manufacturers and suppliers. HIA abandoned this for commercial reasons and while lucrative, the continued enrolment of SP suppliers and manufacturers as GreenSmart sponsor partners is ineffective in enrolment and mobilisation terms. This leads me to suggest that the enrolment and mobilisation aspects of GreenSmart training are minimal in encouraging practitioners to become actively involved in developing solutions to the problems embodied in the GreenSmart principles by applying them in their work and exchanging experiences, solutions and enthusiasm with other practitioners.

Summary

The above analysis demonstrates ANT's capacity to inform change agendas by identifying weaknesses and opportunities at both macro and micro level.

Micro analysis of training outcomes informed strategies to improve learning outcomes. While little follow-up evaluation of GreenSmart training has been conducted, post training enquiries and a healthy growth in the number and quality of GreenSmart design award entries indicate that the GreenSmart actant has been successful in providing SP-related knowledge and skills and enrolling

actors in the SP change network. The analysis also identified opportunities to ensure that these outcomes translate into widespread mobilisation with potential to black-box the pursuit of best practice through network expansion to provide support and mediation.

The continued construction and promotion of GreenSmart homes and developments and the increasing success of the GreenSmart magazine and awards system indicates that such mobilisation is occurring (albeit indirectly). I assert that these initiatives are the most effective enrolment actants in the GreenSmart network and clearly indicate the value of network expansion beyond the current new housing focus of CAs, to link with change agendas in related networks such as mandatory disclosure and consumer demand. (See Chapter 6 for detailed arguments).

For example, in 2006, Investa Property Group (a GreenSmart partner that provided customised GreenSmart training to their entire volume housing staff) was rated number one in the world on the Dow Jones Sustainability Index for real estate related businesses (Investa 2007). While GreenSmart training and design awards are a small component in Investa's investment in sustainability in its $9.5 billion property portfolio (Investa 2008), its contribution demonstrates the potential for a well-configured network to facilitate interaction between a diverse range of actants to solve common problems.

5.3.5 BASIX

BASIX is an innovative regulatory initiative that was expected to build on the strengths of SEDA's ESH program but is yet to realise its full potential. Responsibility for the mobilisation phase of SEDA's ESH change agenda was transferred to the then Planning NSW Sustainability Unit as part of the BASIX program. My ANT analysis identifies and partially explains unexpected (by AHI sustainability advocates) industry opposition to the BASIX agenda – especially by SP mediator actants with strong links to the AHI sustainable change network.

As previously argued, DIPNR effectively weakened many of the network links previously created by SEDA through their failure to adequately re-visit the interressment phase during BASIX' development. Industry challenges to some methodology and assumptions underpinning BASIX appeared to be interpreted by DIPNR as opposition to BASIX. The DIPNR response was to engage in less and less industry consultation leading to a failure to negotiate strong alignment of these industry allies during the interressment phase.

DIPNR refused to make public much of the data underpinning BASIX effectively making it a regulatory black-box. Because 'knowledge' actants (whose expert opinions are a powerful network influence) were not given the opportunity to 'contest' BASIX' algorithms through a typical interressment and enrolment process, its inputs and outputs were challenged. A consultative

regulatory impact assessment of the BASIX change agenda would arguably have neutralised much of this industry opposition to BASIX that has seen residential EE standards in NSW slip to among the lowest in Australia (3–4 stars) (Hockings 2006a).

Instead, DIPNR adopted the view that high level political support would guarantee mandatory BASIX targets and that industry would have no option but to accept them. Accordingly, interressment was minimal and BASIX was presented to industry in a non-consultative way. I posit that this failure to 'interress', generated barriers to enrolment very different to those experienced by SEDA in their change agenda. Further, the failure of DIPNR to enrol sufficient industry peak body mediators in the BASIX network created delays in reaching the obligatory passage point. This meant that the debate was not 'squeezed' (Strathern 1999) to reduce the centrifugal effects of dissent arising from perceptions that the specific interests of practitioners were being compromised by BASIX.

BASIX' interressment phase was also characterised by competition and criticism between the NSW government (DIPNR) and the Commonwealth (AGO) and Victorian (SEAV) governments. DIPNR criticised the AGO and ABCB for moving too slowly and too narrowly with BCA's HERS based thermal performance approach to energy efficiency rather than their GGE focus and these parties responded with criticism of NSW for 'going it alone' with SP regulation, thereby abandoning the CoAG commitment to a nationally consistent regulatory framework. While such competition sometimes results in positive outcomes (e.g. SEDA and SEAV competition to be the first to introduce TP targets for housing that subsequently transferred to competition to raise benchmarks), my retrospective analysis of DIPNR's elitist approach to competition indicate that it created barriers to the national adoption of BASIX – an arguably superior tool to BCA.

Enrolment was omitted from DIPNR's configuration strategy because BASIX was developed under tight security to the point where briefing requests by mediator actants were denied or deferred. The consequences of this failure became apparent during mobilisation when criticism of BASIX reached its peak after it became mandatory less than two weeks after the final working version was released. This left industry actants unprepared and exposed to substantial risks in terms of costs and quality assured compliance options within the AHI's competitive tender system.

DIPNR's mobilisation strategy for BASIX was dependent on traditional AHI network dissemination of mandatory regulatory reforms. While the AHI network has performed this task effectively in relation to other regulatory reforms, the rationale underpinning those reforms has been more obvious and immediate (e.g. OH&S provisions, tie down and bracing responses to extreme weather events and termite protection) and therefore subjected to less criticism. As argued in Chapter 3 and 4, reasons for adopting SP reforms are far from obvious and the benefits from

those reforms are anything but immediate making them difficult to measure, cost and promote. Indeed, the most likely beneficiaries of BASIX are future generations and, as futurist Peter Ellyard observed: *future generations are unable to sue current generations for damages* (EAA ESD Conference 1996) thereby eliminating a compliance incentive that contributes to the black-boxing of other regulations.

Stalder summarised black-box status as...*any setting that, no matter how complex it is or how contested its history has been, is now so stable and certain that it can be treated as a fact where only the input and output counts (Stalder 1997).* BASIX has only recently achieved this status some four years after its introduction (although its 'settings' are still being contested by some experts). I suggest that this is attributable to a current lack of industry acceptance of the arguments supporting BASIX' required 'inputs' and its claimed 'outputs' for the reasons outlined above.

Summary

BASIX is an innovative change initiative that has yet to achieve its full potential. I suggest that this failure is substantially attributable to the failure (up until now) of the CA developing and implementing it to adequately negotiate the alignment of allies necessary to deliver that potential.

One such group of allies are other state governments. NSW 'going it alone' was seen as a weakness or problem by the mediator actants MBA and HIA. It presented them with an opportunity to use their strong political links to erode the power and effectiveness of BASIX under the guise of protecting housing affordability for consumers and representing their members' interest in minimising regulation.

While this latter justification might be indefensible to SP advocates, it nonetheless prevailed. DoP did not address or promote the potential for BASIX to provide a 'level playing field' upon which the AHI could provide housing products that 'enhance consumer lifestyles' without loss of competitive pricing. Many in industry attribute this DoP oversight to arrogance. I suggest that it demonstrated a lack of understanding in DoP at that time of the importance of broader change management strategies including consultation (alignment of allies) rather than reliance on the single actant, regulation using a mono directional application of power.

5.3.6 ABSA

The Association of Building Sustainability Assessors (ABSA) is a relatively new mediatory actant created by regulation that has enormous potential to contribute to the black-boxing of sustainable change. As an independent not-for-profit NGO managed by industry peak bodies to represent individual practitioners with high-level technical skills, ABSA also maintains close links with state and commonwealth government change agencies. (See Section 2.6.7 and Box 5-7 for detail).

This important actant (created by the SEDA network) now manages the accreditation and training of HERS assessors in Australia and New Zealand and, in partnership with DEWHA is working toward establishing a new AHI vocation, the Household Sustainability Assessor (via training and accreditation). The following brief ANT analyses of aspects of ABSA's network roles are included to demonstrate three important applications of ANT as an analytical tool.

The first example demonstrates how effective mediation is related to the number and strength of network links, not the power of the actant. CA recognition and empowerment of a passionate individual actor (Bernard Hockings) with high level networking skills initiated the 'snowballing' alignment of allies responsible for ABSA's creation and rapid rise as an influential macro mediator. The reciprocal view demonstrates how creative network configuration by a committed individual actor created a powerful new change actant in very short time, demonstrating the strength of weak ties in an actor network.

The second example demonstrates the potential for mismanagement or over-reliance on key actors by CAs to limit their effectiveness or destroy them. The AGO's recognition of ABSA as an effective vehicle through which to implement its particular change agendas became a significant threat to ABSA's growth, effectiveness (and indeed survival). I posit that the AGO failed to apply due diligence in assessing ABSA's financial and human resource capacity before overloading the fledgling organisation with contracts relating to 2nd generation HERS trialling and training delivery. The combined effect of under funding and inflexible contract management burnt out key ABSA actors and forced the management board to radically restrict organisational growth to avoid financial failure.

The final example demonstrates the importance CA consideration of the full range of network implications arising from change initiatives. While BASIX' strengths and shortcomings are argued elsewhere (Sections 3.2.6, 4.1.4 and 5.3.5 and Boxes 3-5, 3-14 and 4-4), DoP's failure to recognise the essential role of networks in creating socio-technological change is relevant again here. I suggest that DoP's initial introduction of the BASIX DIY (do it yourself) thermal performance assessment tool as a replacement for ABSA assessors was short-sighted. While innovative in its accessible internet-based format and the preferred assessment tool of some practitioners (including myself), DIY is a passive actant (unable to provide interactive advice). By comparison, ABSA assessors provide accurate, flexible assessment outcome via an interactive network of practitioners who also inform, educate and enrol clients in the mobilisation of sustainable reform agendas.

These examples demonstrate the usefulness of ANT in the design, implementation and evaluation (in this case – critique) of change strategies.

5.3.7 ANT analysis of additional strategies

Mandatory disclosure.

In ANT terms, Mandatory Disclosure (MD) of an energy or SP rating at point of lease or sale is likely to create linkages to the powerful wealth creation actant. I argue that due to the high assessment cost and small return in energy savings available to consumers who might use it to differentiate between existing houses on the market, these links are likely to be quite weak in mild climate zones or wealthier socio-economic groups. Indeed, consumer and marketing network reaction to the standalone introduction of such a program has potential to create negative political and media links. (See section 6.5.4 for analysis of MD implications in DoI terms).

For this reason, I argue that MD should be accompanied by a requirement for mandatory valuation of SP by lenders and property valuers to create additional, supportive links between SP and the powerful network of finance actants that is closely linked to most actant groups in the AHI network. I further argue that the strength of these links could be increased by MD of both an SP rating of the building and the actual household performance based on utility bills (e.g. NABERS), to allow market differentiation by marketers and consumers on the basis of potential for improved SP performance (and therefore increased property value) from responsible occupant behaviour as well as property improvements. While many argue that such disclosure would be 'unfair' to families and certain socio-economic groups (REIA 2006; SBE & Energy_Consultants 2005), I suggest that its omission is unfair to future generations.

In summary, I argue that mandatory disclosure of both actual utility bills (e.g. NABERS) and rating tool simulation (e.g. HERS) performance of all housing stock at point of lease or sale is the most effective regulatory actant through which to enrol new and existing home owners, investors and tenants in a macro network. This combination would align lenders, valuers and property marketers and mobilise them as mediators to improve the SP performance of all housing stock by improving capital value through both investment in SP home improvements and modified behaviour. Mandatory valuation of SP improvements combined with increasing utility costs would black-box these substantial social changes by creating multiple, permanent links to the powerful wealth creation paradigm through capital gain and reduced operating costs.

Measurement tools

Measurement tools have arguably driven the regulatory network because current regulations have been developed around the most accurate measurement tools available at the time of their inception. It has been stated that 'if we can measure it accurately, we can regulate it'. The question then arises- is this a useful strategy or does it sometimes limit the scope of regulation? Many suggest that the current regulatory focus on the thermal performance (TP) of the housing envelope flows

from NatHERS being one of the earliest regulatory tools available (Williamson, O'Shea & Menadue 2001).

As the housing affordability crisis grew, the often overstated cost of SP inclusions (Crouch 2005; HIA 2003a, 2003b, 2003d, 2005b; Osterhage 2005) or regulatory compliance (Tomkins 2004) was used (sometimes misleadingly) to argue against SP regulation and benchmark creep. While undoubtedly effective in driving change, I maintain that current 5–6 star TP focussed standards are indeed approaching the limit of cost effective carbon reduction return. Alternatively, flexible GGE performance based regulations (e.g. BASIX) encourage the AHI to develop innovative and cost effective solutions to the core problem – climate change (Reardon 2007; Williamson 2005) by broadening compliance options to include appliances and renewables.

ANT analysis suggests that, while the inclusion of high levels of SP performance in new housing was shown to be economically advantageous (Allens Consulting 2002) and remains so (DPIV 2008), initial affordability has stronger and more numerous AHI network linkages that SP agendas are yet to counter. While planned new regulatory mediation actants such as mandatory disclosure (MD) are likely to contribute to the alignment of such networks, their additional linkage to wealth creation through mandatory valuation and minimum pre-sale SP standards would enrol the lending, marketing and consumer networks and generate more effective or black-boxed outcomes. These arguments are expanded in Chapter 6.

Additionally, I postulate that the proposed application of HERS (a useful TP simulation tool to inform new housing design) as the metric for MD (Delorme 2005; NFEE 2007a; SBE & Energy_Consultants 2005) is inappropriate due to the cost of ratings and its limited capacity to generate cost-effective SP solutions for existing housing. While the declaration of a comparative rating is likely to enrol existing home consumers in the SP reform network by facilitating informed choices at point of lease or sale, its potential to is limited in terms of mobilising or black-boxing this enrolment by ensuring occupant behaviour change. I suggest that the additional declaration of a NABERS (or equivalent) rating based on actual consumption is essential to achieve this final and most important step. However, strong established linkages between HERS and other powerful mediators in the network most associated with MD rollout (DEWHA and ABSA) are dominating the problematisation and interressment processes as demonstrated in Boxes 5-9 and 5-10.

Box 5-9: Potential for existing network links to influence the selection of HERS as the Mandatory Disclosure assessment system.

This case study demonstrates the potential for pre-existing network linkages between key SP mediators to influence or limit the problematisation and interressment phases of MD development. Several such actants are involved in MD. Here I examine the roles of ABSA, DEWHA and the

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state and territory government members of the National Framework for Energy Efficiency (NFEE a CoAG body) in their pre-existing network links to the actant HERS. DEWHA (formerly AGO) committed significant federal funding to 2nd generation HERS tools for application in BCA's TP codes for new housing. I posit that this investment is a link that provides strong incentives for DEWHA to maximise HERS outcomes.

ABSA was created to administer and quality assure the application of 1st generation HERS assessment systems in the AHI and was therefore associated with the development, trialling and application of 2nd generation HERS tools. Accordingly, HERS is fundamental to ABSA's continued existence and its main source of network influence and funding. ABSA's position in the network as a bridging mediator between government and industry (see 2.6.7) made it a strategically important contributor to all four stages of configuration of the MD network. I suggest that these powerful network links pre-dispose ABSA to recommending the adoption HERS as the basis of the MD assessment system.

The NFEE is responsible for the problematisation of MD through its Buildings Implementation Committee, a group chaired by AGO (now DEWHA). At their January 2007 meeting, the findings of an AGO commissioned scoping study on MD (SBE & Energy_Consultants 2005) were presented for consensus agreement (NFEE 2007a). Recommendation 5 stated that: *The combined HERS/appliance assessment approach be adopted nationally (SBE & Energy_Consultants 2005)*. Minutes of the subsequent NFEE meeting in April 2007 (NFEE 2007b) confirm that many participating government representatives preferred the HERS approach to maintain consistency and build on their existing HERS skill bases. I suggest that this is at least partially attributable to the strong network links developed between DEWHA, HERS, NFEE and the state and territory governments involved in the rollout of 2nd generation HERS in the BCA. NSW's DoP was among few bodies suggesting the consideration of alternative metrics including BASIX or NABERS as an appropriate assessment tools (ibid).

While no subsequent action has been taken by the NFEE since the April 2007 meeting, I argue that despite its arguably superior potential, BASIX is unlikely to be selected owing to the network divisive actions of DoP during it BASIX interressment and mobilisation phases (which included the exclusion of ABSA and criticising the AGO's expenditure of taxpayer dollars on HERS).

This case study demonstrates how strong network alliances between the NFEE, DEWHA, HERS and ABSA appear likely to ensure the adoption of an arguably inferior measurement tool (HERS-based assessment) for MD.

The ANT strategic analysis in Box 5-9 demonstrates the capacity of strong, established networks to stabilise or 'black-box' the network to the point where new actors entering (in this case MD) are

obliged to accept the dominant paradigm (in this case, the HERS measurement tool) to the exclusion of alternatives. While this has been presented as a desirable outcome from network configuration in ANT terms, the above example demonstrates how such network analysis can also be used to identify potential barriers. Box 5-10 below further demonstrates this capacity by identifying barriers and lost opportunities occurring in current agendas as a result of failure by CAs to configure the network in a way that allowed them to work collaboratively towards common goals using shared resources,

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Box 5-10: Poorly configured CA networks: lost opportunity, duplication and diminished outcomes.

This case study reviews the current Green Loans (GL) and Mandatory Disclosure (MD) development process to identify missed opportunities and potential barriers in ANT network configuration terms. Through my AR role as a consultant to ABSA on the GL project, I observed that unreasonable development time constraints linked to political agendas have limited the problematisation phase. This has led to a failure to adequately align this important new actant with other complementary actants in the AHI sustainable change network. These complementary actants include MD, training initiatives, specialist existing home assessors and assessment tools, mandatory minimum SP standards for existing housing stock and mandatory valuation of SP (MV). As argued in 5.2.3, a coordinated approach to change mediation by CAs is essential to amplify the mobilisation influence of individual change actants in black-boxing the new sustainable housing paradigm.

For example, were the incentive actants GL and MV to be launched in tandem with the regulatory actant MD and indirectly linked (by announcement) to a proposal to introduce mandatory minimum pre-sale SP standards for existing housing stock, I assert that the change outcomes would be extensive and rapid. (See Sections 6.5.3, 5.5.4 and 6.5.5 for detailed prospective analysis). A simpler association opportunity that is also being ignored is the apparent synergies between GL and MD. I suggest that the assessment protocols and metrics for both programs could be configured to be complementary – if not identical. Further, the earlier launch of GL presents an opportunity to test MD options through trial interressment and enrolment that would streamline the mobilisation phase. While this is possible, it is currently not proposed.

In the GL program, an initial failure to define the problem solving objectives of the GL program has created confusion and barriers in the interressment phase. While not abandoned, the initial focus on provision of low or no interest finance to home owners for SP improvements has shifted to one of data collection and SP consultancy provision with only indirect linkages to the influential finance incentive actant. While DEWHA commissioned research into audience needs and market opportunities, this research will not be available until after the launch of the program by which time

400 Household Sustainability Assessors (HSA) will be trained, accredited and promoting their services to home owners.

This did not allow adequate definition of the role of HSA before training delivery eliminating the opportunity to create a new type of assessment actant with a different skill set to ABSA assessors. I suggest that HSA assessors require high-level communication skills focussing on consumer behaviour modification and specific knowledge relating to the limited range of options available for funding under the GL scheme. These options could be identified and explained in a report generated by the assessment tool. However, neither the assessment tool nor the schedule of funded inclusions was available during training development and delivery. This necessitated development of generalised training with decreased emphasis on the communication and engagement skills that would arguably lead to effective mediation roles by HSAs. Additionally, HSAs have received no formal training in the use of the assessment tool that is fundamental to their role.

I suggest that in ANT terms, these missed opportunities stem from inadequate problematisation and have manifested as barriers in the interressment and enrolment phases of GL. For example, the delayed delivery of the GL assessment tool and unnecessary duplication of NABERS is (at least) partially attributable to DEWHA's failure to interress and enrol DECC (the NABERS developer). While this process was commenced, it failed due (in part) to inadequate time frames for negotiation of IP rights and requests for incorporation of (arguably) unnecessary modifications to NABERS attributable to inadequate problematisation. Wasteful duplication of existing training for the GL program (which would have been eliminated by a BITS-like learning hierarchy) was compounded in this case by DEWHA's failure to align and enrol competitor-training actants (e.g. SV's Nationally Accredited Course in Home Sustainability Assessment – 21854 VIC and the South Australian Government's Energy Friends training course).

This case study demonstrates how an opportunity to create a new job category of Sustainability Assessors is likely to be compromised by competition between CAs (Commonwealth and State) and by over-reliance on existing skills, technologies and power bases, leading to a lost opportunity to create a new type of assessment actant with a different and complementary skill set to that of ABSA HERS assessors.

The above analysis demonstrates the capacity of ANT analysis to identify and explain problems and weaknesses in change agendas and suggests strategies to overcome them. While many of the problems in Box 5-10 can be attributed to the imposition of unreasonable timeframes by political actants, I contend that ANT-based strategic planning could have minimised or eliminated them by facilitating collusion between CAs to achieve the best outcomes rather than compromising them through competitive duplication of training, assessment tools and specialist SP practitioners.

The role of regulation

Regulation is arguably the most powerful and effective mediatory actant available to CAs. The purpose of this ANT analysis of regulation is to develop additional (triangulated) understandings of the arguments and strategic directions developed through DoI analysis. In other words, what additional insights into how regulations could be made more effective might ANT analysis yield? Regulation is a powerful change creation actant because it forces the creation of new network links that would otherwise not form between 'dormant' intermediaries (e.g. skills acquired by practitioners to ensure regulatory compliance are often applied 'above and beyond' mandated contexts as voluntary better or best practice). With sound management, these links ultimately spawn new mediator actants and networks with unforeseen socio-economic benefits. In other words, regulation enrols actors who would not normally engage in SP networks and, once mobilised in the network many of these actors assume mediatory roles as part of their BaU scenarios.

To create lasting change however, these new links and mediator actants require political support driven by consumer acceptance, which, in turn is driven by familiarity, affordability, acceptability and personal benefits. Without strong political commitment and backing, the implications of the mandated adoption of unfamiliar technological innovations can provide fertile ground for sceptics to grow their influence and power by generating opposition based on uncertainty and fear.

To date, the predominant CA focus on only new housing has limited the outcomes and has been perceived to be unfair by AHI lobbyists. I argue that a regulatory focus that encourages both retrofitting of existing housing stock and responsible behaviour by occupants would yield more cost effective, comprehensive outcomes. For example, mandatory disclosure of NABERS or equivalent rating at point of sale (and lease) has minimal compliance costs (and therefore affordability impacts), cannot be perceived to be singling out one market sector and can be influenced by (and therefore influences) both occupant behaviour (sociological) and building performance (technological) at minimal cost. Additionally, it empowers individuals and encourages participation in sustainable change, thereby creating a supportive political environment. Finally, mandating the incorporation of environmental performance into property valuations would deliver rewards for responsible behaviour and encourage retrofitting of low cost technological improvements by home owners.

Box 5-11: HIA and MBA arguments against BASIX on affordability issues.

While contradicting the Victorian Government's RIS findings (Allens_Consulting 2002; Victorian_Government 2005) about the economic benefits of mandatory thermal comfort provision in housing, the NSW government aligned with sceptic actants HIA and MBA (which DoP had failed to align) by limiting and watering down BASIX requirements. This was partially due

to an arguably poor choice by DIPNR to mandate the inclusion of rainwater tanks (a relatively high cost – low yield water demand management method) as part of a GGE and water use reduction regulation. Up to 80% of the cost of BASIX compliance is the water tank and pump system. BASIX' introduction coincided with a downturn in the economy with real estate prices flattening and a fall in housing construction activity. Arguments were mounted by HIA and MBA that BASIX was contributing adversely to this downturn through its impact on housing affordability (Crouch 2005; HIA 2003b, 2005b).

Housing affordability became a powerful competitor actant to sustainable change with stronger and more numerous links to government (e.g. government sensitivity to its contribution to unaffordability from tax double and triple dipping and poor planning decisions). Not surprisingly, the government took the simple, low cost option to be seen to be concerned about housing affordability by aligning with and conceding to sceptic lobbying. While the sceptics' affordability arguments were unfounded, change advocates found it difficult to counter the political 'spin' generated by worst-case scenario BASIX compliance costs that included rainwater tanks. Without rainwater tanks, BASIX compliance adds negligible additional cost to a home. Were the rainwater tank water demand option to have been replaced with a cost effective one (e.g. mandatory fitting of water efficient WCs and showers before sale), BASIX may well have escaped erosion by sceptics and been allowed to deliver cost effective GGE and water use reductions.

Conclusion: A sound regulatory initiative was weakened (at least temporarily) by successful sceptic lobbying based on the inclusion of a cost ineffective compliance requirement. ANT analysis identifies several ways this could have been avoided. These include: a thorough regulatory impact assessment during the problematisation stage to identify rainwater tanks as a high cost, low yield option; aligning HIA and MBA through better industry consultation during the interressment phase; allowing and addressing user feedback by running a trial mobilisation phase rather than commencing mobilisation after only limited interaction with the user network.

From an ANT perspective, regulation has potential to rapidly black-box sustainable change in the new housing sector by mandating the mobilisation phase of network configuration, locking in SP and allowing industry to return to its repetitive BaU application of standardised solutions. While this would appear to be a desirable short-term strategic outcome for a change agenda, I argue that it has potential to compromise medium and long-term outcomes because it provides little incentive for AHI practitioners to develop the high level skills that lead to innovation and reinvention – essential components of long-term sustainable built environment (See DoI arguments in Section 4.2.5). Such black-box outcomes contribute little to constructive growth in the AHI SP actor network allowing competitor networks (e.g. housing affordability) to develop stronger political links

thereby exposing SP actants to adverse reaction each time a new compliance measure, method or benchmark is introduced. The NSW experience with BASIX in Box 5-12 demonstrates this well.

Box 5-12: BASIX' failure to deliver benchmark creep comparable to other states.

While BASIX is arguably the best-equipped regulatory actant to allow SP innovation development to drive seamless benchmark creep while remaining 'black-boxed' to mainstream practitioners and consumers, it is yet to deliver to its full potential in this regard. I posit that this is (at least) partially attributable to DoP's failure to interress the specialist network of SP innovators needed to partner with them to develop and deliver such innovations (see earlier arguments in Section 5.3.5).

DoP's interressment approach alienated and divided this strong network (created predominantly by SEDA), causing some to become negatively aligned (e.g. ABSA) and strengthening network associations with competitor CAs and regulatory actants (DEWHA, BCA and HERS). Without this supportive network, DoP were unable to convince other states and territories to adopt BASIX leaving NSW isolated and out of pocket and BASIX vulnerable to the arguments of sceptics and critics (e.g. HIA and MBA). This translated into a weakening of political linkages to BASIX and its regulatory targets and allowed political competitors (e.g. housing affordability) to strengthen their links with the NSW government. The result is that NSW, once a national leader in AHI SP reform, is now isolated and falling behind other states in SP outcomes and its innovative regulatory actant will likely never achieve its full potential.

I suggest, that regulation must achieve a balance between providing cost effective, risk minimised, standardised solutions for the volume housing sector and encouraging innovation in the less cost sensitive and risk averse sector. Flexible, performance-based regulations with creeping benchmarks (e.g. BASIX) achieve this whereas BCA does not as demonstrated in Box 5-13.

Box 5-13: BCA's failure to encourage innovation.

AR observations and feedback from training attendees (GreenSmart and BDAA) confirm that, while House Energy Rating Software (HERS) is ideally suited as a design tool, its complexity and cost prevent 'in-house' HERS capacity in many design offices, where it could be used in 'non-rating mode' (ABSA 2005, Accurate Training Course) to analyse each building, identify problem areas and inform cost effective, project specific solutions.

The majority of HERS simulations are performed by ABSA assessors post-design to generate complex, user-unfriendly compliance oriented data. This limits learning outcomes for designers choosing this BCA compliance path, because they tend to minimise interaction with their ABSA assessors owing to cost, preferring instead to apply 'one size fits all' standardised solutions on the basis of previous experience and advice from their ABSA assessor, in order to avoid additional

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HERS assessment fees in the event that the design fails to comply. Additionally, while ABSA is working to correct this problem, many assessors have limited understanding of building thermal performance or poor communication skills. This often leads them to recommend simplistic, ineffective solutions that can be added easily to completed project documentation in the form of a note to 'get a project across the line'.

BCA's alternative compliance path, the deemed to satisfy (DTS) provisions also discourage innovation. Complex, prescriptive tables and charts encourage the use compliance solutions deemed to deliver assumed (non-verifiable) outcomes - often developed through a one off set of calculations then applied repetitiously, effectively black-boxing the learning outcomes and innovation paths for the majority of practitioners.

In contrast to BCA's innovation suppressing prescriptive approach, BASIX' flexible compliance paths facilitate the selection of application specific compliance options (in risk, cost and complexity) as shown in Box 5-14.

Box 5-14: BASIX' potential to 'black-box' SP development for the AHI mainstream while encouraging innovation and affordable benchmark creep.

Because BASIX facilitates the introduction, adoption and refinement of innovative new SP compliance solutions by innovative practitioners and consumers, less innovative actors can continue to apply standardised, tried and proven BaU solutions without having to change their practices or learn new skills on a regular basis. When innovative solutions are deemed to be commercially viable by the specialist network of SP innovators, regulatory bar creep in association with CA promotion (media coverage, design awards, display villages etc) of these new, cost effective innovations, encourages their uptake and application by mainstream practitioners at a pace that suits their market position and innovativeness, thereby guaranteeing steady market growth to deliver economies of scale and maintain affordability. (See section 6.3.3 for further analysis).

In summary, I argue that while the regulatory focus on new housing has enrolled and mobilised a powerful and diverse network and created significant social change, it is yet to reach its full potential to deliver outcomes (e.g. GGE reductions) and this is somewhat attributable to the unintended role of current regulations in limiting strong network linkages with innovation at both macro and micro level. Further, the change created by new building regulation is yet to be stabilised or black-boxed. In other words, AHI change outcomes from current regulations are open to challenge and erosion by non-aligned or competitor actants. I posit that this is at least partially attributable to a failure by CAs implementing new building change agendas to align the powerful marketing and finance network as argued earlier (see Sections 5.2.1, 6.5.4 and 6.5.5).

As an alternative strategy, I suggest below that the regulatory actant with greatest potential to create or strengthen these links and black-box change is mandatory disclosure and valuation of both real and simulated performance of all housing stock at point of lease or sale.

Other incentives

Subsidies, rebates and 'cliffs' (pre-announced subsidy reduction or withdrawal dates), are mediator actants commonly introduced by CAs during the interressment or enrolment phases of network configuration. These have been observed to have varying rates of success in later stages during AR. ANT analysis indicates that such incentive actants have limited application beyond those initial phases because finite funding constraints often necessitate their withdrawal before achieving 'black-box' status. Successful mobilisation strategies were observed in relation to low cost items (e.g. free light bulbs and AAA shower heads from NSW GGAP) where the practice became part of BaU before phased subsidy withdrawal. However, cost proved prohibitive with expensive or complex SP (e.g. photovoltaic arrays). While SEDA's use of 'cliffs' in its photovoltaic rebate program enjoyed some success in stimulating uptake by early adopters during mobilisation, its limited funding was exhausted well in advance of broad adoption by mainstream intermediaries.

This analysis suggests that such incentives are unlikely to be effective in black-boxing adoption of complex technologies when introduced as 'stand alone' enrolment strategies. Rather, they require complementary, mobilisation strategies that continue the enrolment phase of network configuration process through mobilisation to acceptance or 'obligatory passage point' where subsequent actors are obliged to accept them as a solution to the problem. For example, the current Commonwealth Solar Homes and Communities Plan's renewable energy rebate is an interressment and enrolment strategy that encourages widespread installation of household and community PV systems. However, its withdrawal before effective (and affordable) mobilisation strategies will arguably lead to an immediate drop in demand. Such mobilisation strategies include gross feed in tariffs such as those introduced in Germany in 2000 that doubled the amount of electricity generated from renewable sources (Gross 2007) and created demand for PV systems (EnergyMatters 2008).

I propose that such mobilisation strategies are an effective replacement for the 'one-off' grants because they encourage immediate uptake by consumers by creating certainty of return on initial investment and, will require no further subsidy post carbon trading when the real cost of renewable or low carbon infrastructure is passed on to consumers.

5.4 ANT Analytical conclusions

ANT analysis in Chapter 5 provides alternative (to DoI) insights into my AR observations by facilitating an analytical focus on the role of the AHI social system in creating sustainable change as

an interconnected network of actants. Deeper understandings of the dynamics of socio-technical change developed through ANT analysis identified additional network specific methods through which CAs might influence the change process. These methods are drawn from both the broad analysis of the AHI as an actor network in Section 5.2 (summarised in Section 5.4.1) and the strategic analysis of specific case studies in Section 5.3 (summarised in Section 5.4.2).

The technological components of AHI sustainable change were not specifically analysed in ANT because these were addressed effectively through DoI analysis in Chapters 3 and 4. Rather, ANT was applied to develop deeper insights into the sociological aspects sustainable change and addresses only the change creation network roles of technological actants in terms of:

- Socio-technical change as a political process;
- Society and technology as mutually shaping and changing;
- Society and technology as both local and global actants;
- Technology as an embodiment of particular social practices and values.

The analysis explores the role of CAs as mediation actants in configuring and aligning networks to command or influence behavioural change by the intermediaries in them by creating or strengthening both mediator hubs and individual mediator actants. This approach is not intended to imply a hierarchy. Rather, it indicates that CAs are the primary focus of my analysis.

5.4.1 Summary of ANT analysis of AHI actants and their network interactions

DoI analysis suggested that the network itself is a significant driver of sustainable change – especially the vanguard sector which invents, develops and ultimately commercialises the improved practices and technologies that drive minimum mandatory benchmark creep. ANT analysis confirmed this and identified strategies to increase its effectiveness during AR, through creating stronger links between ABEC's dual codes of practice in existing regulatory actants (see BASIX case studies), creating new specialist consultants to facilitate SP transfer between the codes (see ABSA case studies) and strengthening these actants through the alignment and enrolment of the powerful finance and marketing networks as incentive actants (See 5.3.7).

In other words, I suggest that while continuing to mandate minimum practice, CAs should cultivate an environment conducive to benchmark creep by supporting innovation-generating actants and strengthening the network links that commercialise their innovations and increase the relative advantage of those innovations to consumer intermediaries. I posit that these strategies would provide incentive for practitioners to develop the high level skills that lead to innovation and reinvention – essential components of the longer-term goal of a sustainable built environment.

From an ANT perspective, new housing regulation has black-boxed minimum standards of sustainable change by mandating the mobilisation phase of network configuration. However,

analysis also exposed risks in reliance on regulation alone to create change. During AR, the AHI actor network demonstrated its capacity to create substantial barriers to regulatory change and weaken its impact when the allegiance of key mediator actants is not negotiated through consultative enrolment (see BASIX case study). While allowing mainstream industry to return to its repetitious BaU application of standardised solutions, I argue that regulatory black-box outcomes do little to strengthen the AHI SP network. This has potential to allow competitor actants (e.g. housing affordability) to develop stronger political links thereby exposing SP actants to adverse reaction each time a new compliance measure, method or benchmark is introduced. BASIX allows this refinement process to be addressed by expert mediators while maintaining black-box BaU status for mainstream industry intermediaries.

The creation (or re-configuring) and careful management of network hubs was identified as a significant change creation opportunity arising from extensive, influential links to large numbers of intermediary AHI actants (e.g. HIA or ABSA). While the finance and marketing sector is arguably the most powerful and universally linked hub in the network, it remains unaligned with SP change networks. I argue that enrolling and aligning this group as a central hub in the next round of regulatory network re-configuration is essential. Analysis in Section 5.2.4 suggests that MD as a standalone reform is unlikely to enrol lending authorities in any significant way and DoI analysis in sections 6.3.6 and 6.5.4 confirms this. Both analytical approaches identify the need for strong supportive regulatory actants such as MV and increased utility prices to create strong links between SP performance and wealth creation in relation to capital gain and reduced operating costs for new housing, home improvements and rental returns from investment properties. Flow-on benefits from enrolling the finance sector would likely include: the enrolment of marketing agents; provision of SP home improvement incentives; linkages with proposed government subsidies for 'green' loans and visible corporate ethical leadership for industry.

While regulation has enrolled and mobilised a powerful network in the new housing sector, it has done little to align and enrol the larger, more powerful AHI network of existing home owners. This confirms DoI observations that consumers are an actor group whose potential to influence sustainable change in the AHI network remains untapped by CAs. Only limited attempts have been made to develop compatibilities between SP and the competing needs and interests of intermediaries in the network of existing home owners. This allows the powerful traditional wealth creation paradigm of interaction between consumers, investors, lending authorities and property marketers to dominate housing choices by consumers and creates significant barriers to change.

Additional network configuration strategies through which CA mediators can expand and strengthen their network influence include: empowering mediators in associated networks (e.g. OLs in each practitioner stream) to create and align new actors through interressment and enrolment

and strengthening the network influence of strategically important weak actants (e.g. voluntary best practice) by creating new allied actants (e.g. MD and MV). An important message from an ANT perspective is that it is not the characteristics or power of an individual actant in a network that creates change but rather, that interactive communication between all of these actants in the network creates change – often in response to one or more 'catalytic' or 'driver' actants (e.g. regulation).

5.4.2 Summary of Strategic Analysis of AR Cases Studies in ANT

In Section 5.3, ANT's effective network configuration strategies were applied as an analytical framework in which I identified and explained network related successes and problems observed in selected AR case studies. The alternative or additional perspectives generated through this approach confirmed and, in several cases, extended those generated through DoI analysis in Chapters 3 and 4. A useful finding in addition to the identification of network related causes of problems in change agendas was that ANT's capacity to uniquely frame the analytical discovery process also provided clear insights into to how they might be avoided or overcome. ANT provided an effective language through which to describe such findings and its simple, concise framework facilitated translating these findings into useful generalisations with potential for transfer to other applications including my prospective analysis in Chapter 6. These generalisations (and their sources) are briefly summarised below.

Generalisation 5.4.1: Change mediating actants are more powerful when their varied network influences are aligned through network configuration to create multiple interactive links. This was apparent in SEDA's network configuration where several separate networks (e.g. commercial and residential or design and construction AHI sectors) were linked to complementary mediation actants (e.g. specialist consultants, opinion leaders, HERS, ABGR and ESH) through mediation hubs such as Energy Smart Allies. Analysis of potential for MD, MV and GL to complement each other further supports this generalisation and underpins concluding recommendations in Chapter 6.

Generalisation 5.4.2: Thorough problematisation is essential to provide a sound foundation upon which to configure a change network. For example, I posit that the success of SEDA's voluntary sustainable change agenda in the AHI can be attributed to the implementation of a sound and thorough interressment process that drew strength and clarity from a clearly defined set of problems that required solving.

Generalisation 5.4.3: Discerning but inclusive interressment of supportive actants is a critical step that determines the type of alliances and their effectiveness in solving the problems and enrolling other actants. The strategic network alliances developed by SEDA during interressment snowballed throughout the industry in NSW – particularly in industry peak bodies. During the enrolment stage,

these alliances became an integral part of the negotiation process through which mutually beneficial roles were negotiated with peak bodies to mobilise the change agenda broadly. This mobilisation process encountered very few barriers.

Generalisation 5.4.4: Over-reliance on mandated change can inhibit network growth and participation by key mediator actants. For example, in contrast to the SEDA example in Generalisation 3, DIPNR's failure to maintain and develop the network alliances during its interressment and mobilisation of BASIX weakened the network and created a series of barriers to the BASIX rollout.

Generalisation 5.4.5: Sound interressment and enrolment processes often spawn new specialist mediator actants. For example, ABSA was created by SEDA during the interressment phase of BCA and was mobilised during the enrolment phase of 2nd generation HERS development. It now plays a much broader mediator role although, as demonstrated in 5.3.6, CAs should be careful not to overload such effective, specialist mediators.

Generalisation 5.4.6: Creating new network to facilitate collaboration and resource sharing between CAs would eliminate counter-productive competition between CAs and limit the associated resource duplication and inhibition of network growth. The negative impact of such competition was demonstrated in my analysis of the Green Loans case study.

Generalisation 5.4.7: Regulation is a powerful change creation actant that is yet to be applied to the existing housing sector. ANT analysis confirms DoI findings that the current regulatory focus on new housing is unbalanced and fails to engage all housing consumers resulting in weak, unreliable political linkages to SP change agendas. This identified an urgent need for additional strategies to address existing housing stock. While the proposed MD of an energy rating at point of lease or sale will go some way towards this, the ANT analysis summarised in Generalisation 1 leads me to assert that its isolated introduction will deliver only limited outcomes because it will create only weak links to powerful finance and marketing sector networks.

Generalisation 5.4.8: While contributing positively to change, existing network links can black-box change creations methodologies (especially regulatory tools) thereby excluding newer and more innovative actants. For example, the strong network links developed between DEWHA, ABSA, NFEE and other CoAG actants involved in the development and implementation of 2nd generation HERS appear likely to see HERS adopted as the metric for MD when other more appropriate metrics (e.g. NABERS) would arguably lead to better outcomes. The same network seems likely to continue to apply HERS as the primary national metric when BASIX is arguably a superior tool due to flexible compliance paths, appropriate GGE focus and unique capacity to facilitate ABEC's dual code approach.

Chapter 6   Next steps drawn from prospective analysis

In this chapter, I synthesise my retrospective DoI and ANT analysis of AR by applying both theoretical frameworks in a prospective context to develop concluding recommendations for my AR partners at two levels. Firstly, I consolidate the outcomes of my retrospective AR analysis by applying them prospectively to identify strategies with potential to increase the effectiveness of current AHI change agendas and inform their ongoing management (Sections 6.2 and 6.3). Secondly, I transfer these new housing focussed theoretical understandings of AHI sustainable change creation to identify additional strategies (Section 6.4) and adapt them to existing housing through a critique of currently proposed strategies.

6.1   Overview

In Chapters 3 and 4, action research change agendas were analysed reflectively within Diffusion of Innovations theory to develop deeper understandings of their role in creating sustainable change in the Australian housing industry during nine years of action research. In Chapter 5, I applied Actor Network Theory as an additional analytical method within the theory of DoI, in order to develop further insights into the role of socio-political interactions in sustainable change creation and to identify opportunities through which change agencies might increase their effectiveness through informed network configuration.

In this chapter, I examine tensions and synergies arising from and between DoI and ANT in a prospective analytical context, to explore alternative adoption scenarios with potential to accelerate SP adoption. These include the exploitation of opportunities observed during AR to overcome barriers and broaden the range of adopters targeted to include existing home owners. DoI and ANT proved to be complementary analytical frameworks. Agreements between the two confirmed my interpretation of AR phenomena while tensions between them yielded additional perspectives and strategies rather than analytical contradictions or disagreements. The delayed completion of this research (for health and personal reasons) created an additional opportunity to reflect on recent developments in SP change agendas and address them in this concluding analysis.

This prospective analysis is based on acceptance of the fundamental argument throughout the thesis that ABEC's dual codes of 'minimum mandated' and 'voluntary best' practice provide a sound platform for sustainable reform within the AHI. I address four areas of strategic focus through which the benchmarks in each code might be progressed and linked by enhancing the connections between them - described as 'silver threads' by ABEC CEO John Wells (Wells 1998).

Firstly, I re-visit communication, the most fundamental component of change creation from both diffusion and ANT perspectives. I give particular emphasis to its roles in providing opinion

leadership, skill development and ready access to current information about SP as they evolve through innovation and reinvention (Section 6.2). Secondly, I nominate critical SP goals, examine timeframes to achieve them and explore future strategies to improve the role of regulation to achieve those goals. These strategies include: improving existing metrics and regulatory frameworks; accelerating minimum benchmark creep in existing mandatory codes for new housing and substantial additions; encouraging 'fluidity' of adoption from minimum through better to best practice and expanding the regulatory focus to include consumers, financiers and the property marketing sector (Section 6.3). Next, I examine additional (to communication and regulation) strategies to accelerate the voluntary adoption of better and best practice and stimulate the SP refinement or reinvention it generates. These strategies include: skill and information provision, information networks, opinion leadership, risks and incentives and marketing strategies (Section 6.4). Finally, I identify important areas for future research through a brief exploration of likely SP gains arising from extending CA focus beyond new housing and major alterations to encourage the diffusion of SP in the existing housing sector to improve the performance of existing housing stock and modify the behaviour of its occupants (Section 6.5). Options considered fall in all three types of adoption decision, including optional (individual), collective (community or organisation) and authority (regulated), drawn from retrospective analysis of AR. In section 6.6, I summarise my prospective analytical findings in a set of recommendations to inform planning and managing change agendas.

6.2   Communication in future change agendas

Section 3.3.2 explained AR observations about the role and usefulness of types of communication in the diffusion of sustainable change in the AHI. Chapter 5 clarified and extended understandings of the role of the network in the diffusion process Here, I re-visit that analysis in a prospective context to identify opportunities to improve communication methods in existing change agendas and to inform the communication strategies of new ones.

6.2.1 Language as both barrier and opportunity

An important first step in designing new change agendas or refining existing ones is for CAs to recognise that different adopter groups have distinct language and information needs and to develop communication strategies that recognise and exploit this.

Moore (1999) identified a significant 'gap' (Figure 20) between the very different information and communication needs of categories of adopter (especially between innovators and early adopters and early adopters and the late majority). He reported IT diffusion studies in which he attributed the diffusion failure of promising technologies to a failure by innovators to communicate the advantages to later adopters in language and terms they understood and could relate to their own

context (see also Section 4.1.3). Moore theorised that, the more complex the innovation, the greater the communication gap between early innovators or adopters and later adopter groups (Moore 1999). Robinson discusses the role of this communication gap as a barrier to adopting sustainable innovations in communities targeted by CAs in his work as an advocate of sustainable change (Robinson 2000).
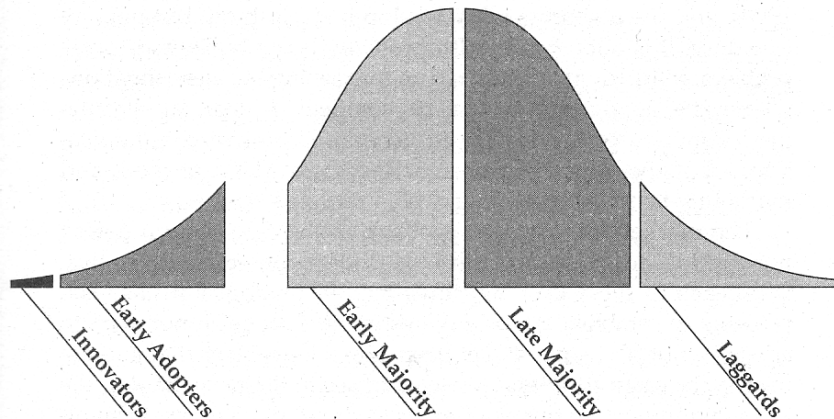
Figure 20: Moore's Gap (Source: Moore 1999)

AtKisson recognised Moore's gap around SP adoption through his advocacy of the role of 'knowledge transformers' to translate the technical SP knowledge created by researchers and early adopters into the mainstream application language of later adopter groups to facilitate its uptake and application (AtKisson 1999). (Section 2.5.2 and Box 4-15 describe my application of the knowledge transformer principle in *Your Home*.)

While Rogers (2003) disputes Moore's gap arguing that DoI's innovativeness-based adopter categories are a continuum (Rogers, 2003), my AR observations confirm that with SP diffusion in the AHI, Moore's gap is evident between innovator-early adopters and the early majority of practitioners. For example, during the writing of *Your Home*, some innovators on the Technical Steering Committee challenged the replacement of technical terms with common, audience friendly language despite recommendations to the contrary in project specific communications research (Penman 2000). Industry Steering Committee representatives insisted on it. An equally important but less defined gap (consistent with Rogers' continuum) was also observed between early and late majority adopters (For example see Box 3-26: Adjustment of GreenSmart and ABSA training in response to shifts in attendee innovativeness as SP diffusion progresses and, Box 3-27: The role of interaction between adopter groups in GreenSmart training delivery).

I suggest that while not directly attributable to the innovativeness of individual practitioners, both gaps arise from innovation-determined roles and interests of the market sector networks in which practitioners from each innovator category most commonly interact. Early adopters and innovators tend to network through interactions related to the development, application and review of new

251

technologies including e-group participation, SP specialised conference or CPD attendance and technical SP literature. They are driven by consumers with similar interests and needs. In contrast, the early and late majority tend to network through generalist trade expos, supplier information seminars and CPD attendance. This group tends to access information through trade publications, observing the work of others (copying) and by word-of-mouth (Penman 2000). Individual clients have less direct influence on their decision-making because their products are developed before being marketed.

My retrospective analysis indicates that the gap between early and late majority adopters is attributable more to affordability, risk management differences and network associations than to the innovativeness of practitioners. While this may well explain Rogers' disagreement with Moore's gap and confirm his continuum, further exploration of that argument is beyond the scope of this analysis. Consumer demand, budget and risk are important factors in either case. Each 'gap' or transition requires specific CA attention in addressing the particular language, information needs, skills and influence of each group in both regulation and resource provision (see Sections 6.3 and 6.4 for more detail). Additionally, the facilitation of greater interaction in and between their preferred networks is an important strategy to overcome Moore's gap. This requires that CAs target a variety of specific audiences and employ a range of media and communication methods that include: interpersonal communication; concise, audience specific information provision using diverse media (web sites, e-groups, trade journals, promotional brochures, DVDs and videos); audience specific CPD training and the integration of interactive compliance assistance in each regulatory tool.

In the sections below, I further explicate my retrospective analysis on opinion leadership, network influences and communication media in SP diffusion and its implications for the design of future change agendas and strategies.

6.2.2 The variable importance of interpersonal communication

The five stages of the (optional) DoI innovation decision process were discussed in Chapter 4. Here, I examine the variable effectiveness of interpersonal communication (IC) during the first three stages of that process (knowledge, persuasion and decision) according to adopter category. Diffusion scholars generally agree that these three stages account for the greatest variation between adopter categories in terms of the time taken to adopt an innovation (Rogers 2003, pp 214–215). Effective CA strategies can reduce this timeframe by applying different approaches for each category at each stage of decision (see Section 4.1.6).

While the majority of practitioners have progressed beyond these three decision stages because of the change agendas analysed through AR, their clients rarely have. Indeed, while home owners are arguably the most important group of adopters in the AHI, they are the least advanced in the

adoption decision process. Accordingly, this section prospectively addresses the use of IC by both practitioner and CAs targeting consumer groups to accelerate consumer adoption decisions.

In DoI terms, IC is a two-way, face-to-face process through which two or more individuals create and share information in order to achieve convergence (or divergence) in their understanding of an innovation (ibid). Other forms of communication include mass media, literature and interactive on-line media (commonly generated by CAs). Diffusion studies indicate that in a voluntary adoption context (currently consumers), mass media channels are more important as information sources for early adopters than they are for later adopters. Later adopters are more likely to be influenced by IC of the subjective evaluation of early adopter individuals from similar social backgrounds than they are by scientific data or CA promotional material (Rogers 1995; Rogers & Kincaid 1981).

The effectiveness of IC between practitioners and their clients in achieving convergent understandings of SP was consistently confirmed throughout AR by specialist SP practitioners and my own reflective practice. Common, favourable elements included 'word of mouth referrals' by earlier adopters of SP and, face-to-face testimonials about SP advantage from previous clients during site visits. While it could be argued that SP specialist practitioners attract clients who are favourably pre-disposed to SP, many practitioners reported scenarios in which sceptical clients were convinced to adopt through IC. Volume housing practitioners reported a very different experience that I suggest is partially attributable to their inability to achieve similar levels of face-to-face IC with their consumers.

Below, explore strategies to inform the effective application of IC by change agents and OLs to reduce the innovation decision period for consumers from various innovation categories. This analysis is drawn from earlier retrospective analysis. Figure 22 depicts Rogers' (2003) summation of diffusion research findings about the variable effectiveness of IC in the adopter groups at different stages of the innovation decision process in a diffusion study involving the adoption of a new weed spray by Iowa farmers. As demonstrated in subsequent prospective analysis, these generalisations fit the AHI housing context. It is important to note that, knowledge in DoI terms refers to awareness rather than technical detail and persuasion is exposure to opinion leadership from early adopter peers – not marketing or 'selling'.

By contextualising Figure22 below within the AHI SP diffusion process below, I demonstrate its importance in explaining variable success rates observed in change agendas targeting different audience groups and recommend strategies for effective application of IC in each of the DoI innovativeness-based adopter groups at appropriate stages of their adoption decision process.
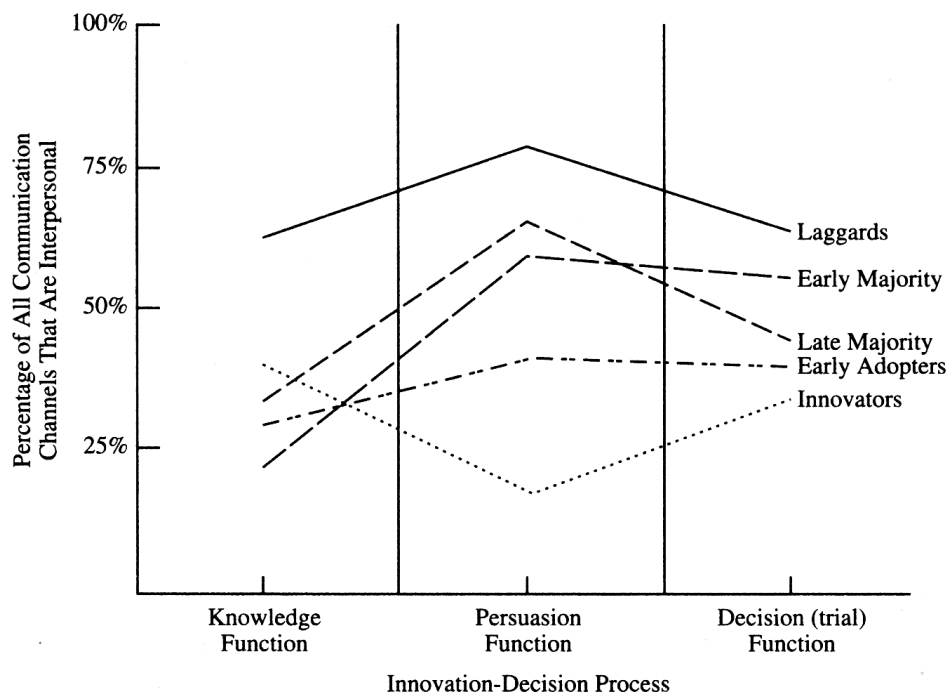
Figure 21: The relative importance of Interpersonal Communication Channels at stages of the Innovation-Decision Process (Source: Rogers 2003, p.212)

Innovators: Because this group develop the SP, their IC needs are high during the initial problematisation stage but drop substantially during the function phase because they are creating the solutions through their own research and innovation rather than hearing about them from other adopters. Their IC levels rise again at the decision stage, which (in their case) involves publication and promotion of their innovative practices or technologies. Currently, few feedback loops exist to capture this knowledge and communicate it to later majorities.

Early adopters: This group attend specialist conferences and CPD events through which they engage with informed innovator networks during the early stages of the innovation development cycle. Because of this, their knowledge stage often pre-empts the production of accessible, user-friendly information about SP. For this reason, this group rely on frequent, effective IC with expert innovators for much of their early knowledge and, while they tend to source much of their feasibility stage information through their own research during the persuasion stage, their IC levels remain high as they communicate their findings to innovators. Their commonly assumed role as OLs during this process tends to raise their IC levels the during decision stage. CAs should encourage this effective and timely form of opinion leadership.

Early and late majority: Interpersonal discussion of SP between these practitioners is limited during the knowledge stage due to a lack of OLs in their networks at that time. Their IC interactions peak during the persuasion stage and this commonly occurs between practitioners and SP company representatives at trade shows and expos. These groups frequently attend seminars

and CPD training during the decision phase and, because the early majority tend to be more thorough in their skill acquisition and enquiry, their IC levels remain higher (than late majority) during this phase. Because later majority adopters tend to apply much simpler SP post decision, their CPD needs are lower. That said, the promotion of successful strategies through case studies is an under-utilised but potentially important adoption driver for the early and late majorities.

Laggards: While not specifically framed within DoI, interviews with representatives from this group during communications research for *Your Home* indicated that they rarely access technical literature (Penman 2000). AR observations within industry peak bodies also suggest that they rarely attend conferences or CPD events. My reflective practice and AR observations confirm Rogers' generalisation that this group tend to network with less educated peers and most of their information is received interpersonally through homophilous conversations with other laggards or, in isolation through observation and uninformed interpretation of competitor projects through their own experiences (Rogers 2003 p. 284).

For this reason, they tend to receive conflicting or incorrect advice, which increases their scepticism and necessitates higher levels of IC throughout the adoption decision process – particularly as they approach persuasion. In the trialling phase, laggards often experience difficulty (due to low skill levels) and some (whom I categorise as sceptics in the post regulatory environment) take strong, negative OL stances. This suggests that CAs should focus IC strategies on early and late majority adopters at the persuasion stage (usually just pre-or post introduction of a new regulation or bar creep event). Effective media for this (as demonstrated by their role in the successful diffusion of other non SP innovations in the AHI) are trade expo stands, conferences and event specific CPD events (e.g. ABSA's introduction to BASIX courses – half day for late majority and laggards and full day for early majority).

Type and strategic application of IC in optional or collective adoption decisions

IC typologies are explained in Section 3.3.2 where their role in determining the effectiveness of diffusion related communication is examined in detail. In summary, a **polymorphic** OL is an individual who acts as an OL for diverse topics whereas a **monomorphic** OL leads opinion with single topic expertise (Rogers 2003 p 314). Additionally, the source of OL status is also important. **Homophilous** opinion leadership roles are typically, *earned and maintained by the individual's technical competence, social accessibility and conformity to the system's norms* whereas **heterophilous** OLs are often viewed by parties to IC as coming from outside the system norms (Rogers 2003, p. 27). Each combination of expertise and status has a valid application in IC but its effectiveness is very much dependent on: the context in which IC occurs; the subject being discussed; the stage of adoption decision of the other party and their innovativeness.

Next, I examine various types of IC and identify those with most potential to benefit SP diffusion in terms of both the stage of innovation decision they are likely to be most effective and, the type of adopter they are most likely to influence at each stage. It is intended that this analysis will inform the strategic planning of interventions by CAs in language and timing for effective communication of strategies to specific audiences.

Peer to peer (typically homophilous and polymorphic).
This form of IC is most effective at the persuasion and decision stages of adoption – especially among the early majority who network with both the informed innovators and the less informed early majority. In this context, early adopters are most likely to bridge Moore's gap or fulfill AtKisson's transformer role.

To maximise its effectiveness, CAs and trainers should focus on creating network links through which early adopters interact informally with later adopters on a peer to peer basis that de-emphasises expertise (heterophily) and emphasises the exchange of mutual application experience (homophily). This was observed during AR to be particularly effective in contextualising SP adoption in the diverse range of practices associated with the production of housing solutions. It may be less effective at the knowledge or awareness stages. Indeed, it was observed during AR to be misleading at the knowledge stage – particularly among later adopters where it has been observed to introduce or perpetuate myths (e.g. that double glazing eliminates solar gains or, that low voltage halogen lighting is low energy).

Peer to expert peer (typically heterophilic and polymorphic).

This form of IC is most powerful at knowledge decision persuasion stage and is effective in overcoming Moore's gap when it occurs between adopters from similar categories. A common example is the use of OL 'testimonials' to endorse diverse SP during the during persuasion and decision phases for early and late majority practitioners. For example, a regular presenter technique used in GreenSmart is, after introducing a particular SP, to ask the group 'has anyone used this practice or technology'. Frequently one or more practitioners will respond and tell their story. Practitioners who are at critical stages in their decision process will often continue the conversation during course breaks – creating effective learning outcomes.

Practitioner to client interaction (heterophilous and polymorphic)

Important SP diffusion roles include the critical IC role of practitioners as OLs in promoting and marketing the adoption of better and best practice to consumers during their persuasion and decision stages. My questionnaire data demonstrated that SP advocacy by practitioners is linked to their SP skill and confidence levels (see Appendix 2). Practitioners with higher skill levels reported greater confidence in advocating SP to clients and were therefore more successful as OLs in

encouraging them to adopt or incorporate better and best practice features. The reverse is also true. A problem commonly reported by specialist SP design practitioners is that builders with low SP skill levels often advise clients to omit better practice SP inclusions due to a lack of understanding of the benefits or perceived inability to deliver. For this reason, training and skill provision warrants higher priority by CAs than it currently receives.

In the sales and marketing sector, important skills include understanding the thermal comfort and lifestyle advantages of SP. Additionally, sales personnel should be aware that, while useful in reducing utility bills, SP inclusions will not eliminate them at today's prices. I argue that discussion of 'payback' periods should be replaced by discussion of environmental benefits and 'future proofing' against pending utility cost increases resulting from carbon trading and water shortages. In other words, SP should be marketed as a timely investment in reducing environmental impact with 'potential' future savings rather than an investment recouped within a finite period. Payback periods are not used to market any other housing features because, as is the case with SP, such a strategy would be seen to be highlighting irrelevant or negative aspects of the feature.

Reflective practice and AR observation confirm that practitioners working in the custom design sector have regular opportunities to engage their clients in adopting best practice. The custom design process is suited to this form of heterophilous opinion leadership because once committed, clients liaise with their practitioner over a 2 to 6 month design period during which they research recommendations at the persuasion stage which often lead to strong decisions to commit to best practice outcomes. For this reason, I advocate increased emphasis on interpersonal communication skills in practitioner CPD.

Manufacturer to practitioner

This type of IC occurs at two levels. Firstly, at conference, CPD or trade presentations, the supplier representative is perceived as heterophilous and monomorphic by homophilous polymorphic practitioners. Typically, barriers that arise from scepticism about the accuracy or impartiality of the information being provided are overcome through OL endorsement via their application in case studies. An important additional role recommended for CAs is the provision of peer review of manufacturer claims (e.g. the Austral – Think Brick research discussed earlier in Box 3-15). This type of IC was observed to be effective in bridging between the persuasion and decision stages. I argue that its effectiveness would be improved through CA introduction of a peer review or quality assurance framework with input from innovators and expert practitioners.

The second level includes the interactive face-to-face meetings that occur (usually in the practitioner's work place or, at a CPD event) when an SP supply company representative calls to explain the technical aspects and application of a product (often in response to a practitioner request). In this interaction, the practitioner assumes heterophilous, polymorphic status while the

representative is often homophilous and monomorphic (depending on background and skill) having been trained in the specific characteristics of the product but not necessarily its full range of applications. Important SP diffusion roles in this situation include interactive reinvention through problem solving, knowledge exchange, skill provision and technology diffusion. This level of personalised interaction between suppliers and early adopter practitioners encourages trialing and permanent adoption by other practitioners because these practitioners use their previous projects to market innovations to new clients and explain them to peers. This form of IC would arguably benefit from CA incentives or catalysts such as awards, endorsements or small research grants for peer reviewed, published outcomes.

Practitioner to manufacturer interaction

Typified by practitioners seeking specific information about new technologies and practices, this type of IC is effective among innovators and early adopters at the 'knowledge' and 'persuasion' stages (e.g. Austral and Think Brick tours of their Newcastle research facility for innovators and OLs). As well, it bridges the gap between 'persuasion' and 'decision to trial' phases with early and late majority practitioners. I assert that the potential of this common form of IC to enhance the reinvention feedback loop is under-utilised by manufacturers and that it would benefit from similar incentives to those described above.

Regulators and CAs to practitioners

In this context, heterophilous actors (in terms of authority and knowledge) seek to communicate their change objectives or pending regulatory reforms to polymorphic practitioners. Because the focus is often monomorphic (exclusively on the regulation rather than its implications in the BaU scenarios of its target audience), this communication often fails or, at best, is misinterpreted. I suggest that greater focus by CAs on the application context would help to overcome this barrier. This might include opportunities for IC between practitioners and regulators similar to that described in Box 6-1 below where practitioners requested face-to-face IC with CAs through which they were able to contextualise and, in some cases, re-shape the objectives by challenging their relevance in the workplace context.

Additionally, I argue that this form of IC between regulators and OLs is a critical pre-requisite to the effective introduction of new regulations that is often ignored by CAs (see criticism of DoP in relation to BASIX in Chapters 4 and 5). The ABCB's Industry Consultation Committees (e.g. ABCB 2004a, 2005; ABCB 2006b) demonstrate the effectiveness of such IC in engaging OLs in the regulatory development process, thus increasing the likelihood of supportive roles during rollout. This demonstrates the importance of this form of IC in ensuring acceptance and adoption of complex reform agendas by busy decision makers.

Box 6-1: Advice to Waste Boards on the value of homophilous communication.

The vast majority of AHI practitioners fall in the small to medium enterprise (SME) category (HIA 2005a; Murray 1999). In their investigation into the motivations of early adopters of business waste reduction plans for the monomorphic change agency NSW Waste Boards, researchers concluded that the extreme workloads of principals and managers, combined with the complexity of information relating to SP *means that small businesses must necessarily depend on face-to-face involvement by skilled advisers, rather than paper resources* and argued that this conclusion *has important implications for the design and resourcing of services for SMEs (Social_Change_Media & Forsyth_Communications 2000).*

A similar conclusion was also reached by Veritas Consultants in their 1999 study with major business associations. In discussions with major NSW industry associations about adopting waste plans by practitioners, Veritas found that participants *emphasised 'face-to-face' liaison and 'hands on' advice provision' as essential elements of a successful industry education program* and observed that most stakeholders saw the client CA (Regional Waste Boards) as *essentially isolated and 'not out there' with industry and business at senior management level. They strongly prefer face-to-face liaison as opposed to the dissemination of material (Veritas_Consultants 1999).*

As discussed in Box 3-6, the Waste Boards re-invented themselves as Resource NSW and went on to conduct a most successful change agenda based on this and other advice.

The importance of relevant working examples in association with IC

The importance of trialability in overcoming SP innovation related diffusion barriers was discussed in Section 3.2. Case studies (display homes, videos and printed documents) were identified as useful substitutes for 'actual' trialling. Here, I examine the use of case studies in the trialling process as an important form of IC (or a catalyst for it) because they allow the user to choose both the type of information exchanged (mono or polymorphic) and the time, place and participants in that exchange to eliminate heterophilic barriers. During AR, case studies commonly became the focus of discussions between practitioners or, between practitioners and their clients. Practitioners reported clients arriving in their offices with a range of SP case studies (often from YH) through which they communicated their needs to the practitioner or, to which they attributed their decision to adopt SP after seeing or experiencing best practice case studies. Consumer testimonials (e.g. the YH DVD or Technical Manual case studies) were often cited as motivational by the early adopter clients of custom design practitioners.

GreenSmart builder training attendees (especially those from early or late majority) consistently requested site visits to 'working examples' or addresses that they could visit post training where they could 'see, touch and feel' a best practice home. In this context, homophilous IC with fellow practitioners was observed to be a powerful opinion influence during BDAA tours. Additionally, to

overcome their risk aversion, these groups request costed examples to put real dollar values against the SP they are considering. This is lacking in most published case studies. YH avoided the inclusion of actual costs owing to its potential to prematurely date the printed media. This could easily be overcome through reference to a regularly updated website (See AR recommendations in Appendix 2) or, by declaring relative costs. While subscriber information sources (e.g. EcoSpecifier) are a viable alternative, these are rarely accessed by later adopters owing to cost and user expertise assumptions. An opportunity exists for CAs to sponsor the incorporation of free, later adopter specific information streams in these resources.

The above analysis demonstrates the importance of IC and the role of the AHI network in facilitating it across a wide range of adopters at critical stages of their innovation decision-making processes. In prospective analytical terms, it identifies important opportunities for consideration by CAs in the future development and refinement of their change strategies. While a change strategy that utilises each IC opportunity is unlikely, a CA checklist based on this analysis would ensure that rather than impairing network interaction, a proposed agenda capitalises on and enhances it.

The role of IC in authority adoption decisions

In Section 4.1.6, I analysed the adoption or innovation decision processes and adapted Rogers' five stage voluntary process to better address the AHI's mandatory SP adoption decision process. While the initial decision is mandated in this research context, effective diffusion depends on subsequent voluntary decisions to adopt better and best practice. Figure 22 below, is an expanded version of Figure 14 (Post decision stages of adoption by practitioners when the initial decision is mandated).
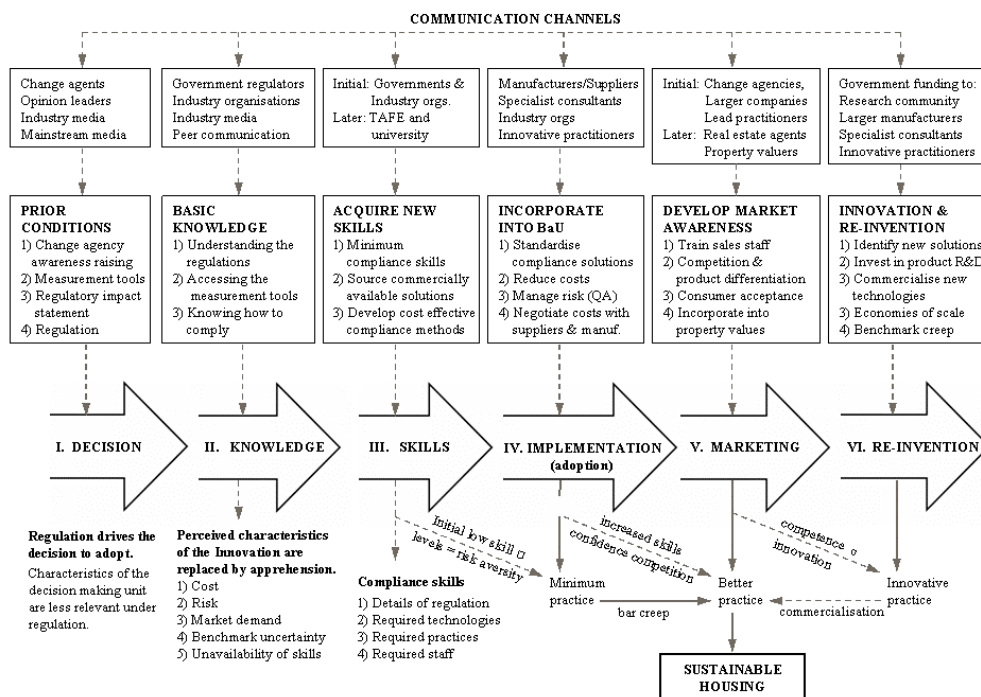
Figure 22: Communication channels interconnecting mandatory and voluntary adoption decisions.

A larger version of the above diagram can be found on page 366. The added boxes at the top of the diagram identify the industry actors most responsible for communicating information about SP innovations at each stage of implementation after the initial mandated decision and summarise the different types of information most commonly sought by adopters at each stage. The interdependence of mandated minimum and voluntary best practice is explained in detail in Section 4.1 and further illustrated through ANT in Chapter 5. Here, I include them as the basis of prospective analysis of the roles of communication in the sections below.

6.2.3 Opinion leadership and communication. Who influences who and how?

As argued throughout my retrospective analysis, opinion leadership ranks among the most important adoption drivers in this research context from both DoI and ANT perspectives. DoI provides a sound framework for analysis of the role of opinion leadership through interpersonal interaction but places less emphasis on the role of networks in facilitating opinion leadership to influence individual decisions by other actors. ANT facilitates a specific focus on networks as actants in their own right by examining their roles and influence on each other by channelling (and often amplifying) the collective views of individual actants – be they sociological or technological. Here I synthesise those different perspectives through prospective analysis of future OL roles.

In Chapter 4, I interpreted the increased non-mandated adoption intention rates (i.e. voluntary best practice) reported by questionnaire respondents in 2003 and 2004 as having been substantially driven by effective opinion leadership and change agency within SP specific networks such as HIA GreenSmart. These networks have clearly defined objectives to encourage homophilous communication between peers from similar adopter categories and, frameworks to facilitate the heterophilic communication of knowledge, skills and common language sets in those networks. In Figure 23 below, I identify both opportunities to expand and refine existing networks as well as network gaps that need to be filled by change agencies.

Figure 23 summarises the most common macro level opinion leadership channels in the AHI. Arrow weight indicates either strength or number of interactions (see Box 5-8: The strength of weak network links). Blue arrows indicate links influencing SP adoption and red arrows indicate links associated with the AHI's most powerful OLs, lenders, property valuers and realtors. These links exert a predominantly negative or counter SP adoption influence in most AHI network sectors. Additionally, they are more powerful (in number and strength of networks influenced) than the limited SP regulatory framework for new housing. In the following sections, I explore strategies to reverse this counter-productive (to SP adoption) trend. These include the strategic use of specific types of opinion leadership to overcome (or harness) problematic system norms and the development of communication networks through which that leadership can be effectively delivered.
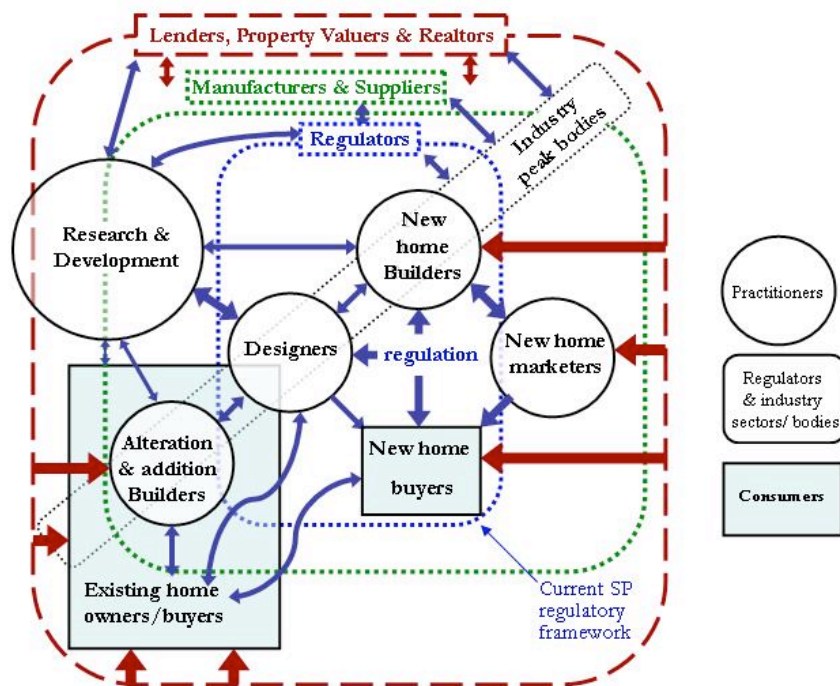
Figure 23: Current opinion leadership and interaction paths between AHI adopter groups, organisations and institutions.

Opinion leadership and system norms

DoI literature shows that system norms are an important barrier to more widespread SP innovation adoption by consumers. Norms define what is tolerable in a community or social system (Rogers 2003). Their influence ranges from acceptable community behaviours to established perceptions about housing. In their investigation of discrepancies in both type and level of adoption of family planning measures by individuals in Korean villages with similar backgrounds and circumstances, Rogers and Kinkaid (1981) attributed such discrepancies to 'system norms' or established behaviour patterns associated with individual villages (Rogers & Kincaid 1981).

During AR, system norms relating to consumer perceptions of desirable attributes in housing were observed to influence SP adoption variability between industry sectors (e.g. volume or custom built housing) and, regulatory jurisdictions (e.g. variable rollout of 5-star BCA provisions in each state or territory). The powerful, influence of lending authorities, property valuers and marketers contributes to the maintenance or perpetuation of established norms in the AHI. Their rationale is simply explained by the simple realtor aphorism: 'more buyers – higher prices'. Homes that conform to system norms are more appealing to the majority of buyers in the community who also conform to system norms. While growing slowly (Investa 2007), consumer demand for sustainable features by home buyers remains low according to market research (Haratsis 2003). On this basis, I assert that unless SP regulatory change agendas look to specifically target the lending and finance sector, its role in maintaining non-SP supportive system norms is likely to continue.

Engaging new and influential OLs

The lending, property valuation and marketing sector are arguably the most influential OLs in the AHI but they are yet to be fully engaged in SP change agendas. While new housing initiatives, water shortages, climate change awareness and pending carbon tax-related increases in energy price have alerted this sector to the likely influence of SP issues in the medium to long term, my AR observations suggest that their focus is short-term (5–10 years) a period corresponding to average ownership of a home in Australia and the average repayment period for a mortgage. *The average length of home ownership is 7-8 years, before buying another one.* (Ruthven, 2007 p. 5) I posit that the failure of CAs to develop interventions that engage this sector in SP advocacy in the short-term is a missed opportunity that has created, and continues to maintain, a substantial barrier to SP adoption within the industry.

Further, I contend that while mandatory disclosure (MD) of SP rating at point of lease or sale is likely to stimulate medium and long-term consideration of the role of SP in creating differential demand (and therefore value), for properties with superior SP inclusions, it is likely to receive little more than token attention by this sector in the short-term owing to its failure to deliver immediate dividends. While beyond the scope of this research to investigate in detail, a range of intervention strategies with potential to overcome this MD limitation including: mandatory valuation of SP features by property valuers; mandatory upgrading of existing housing stock to minimum SP performance standards before sale; short-term tax incentives and subsidised loans for SP upgrades to existing houses or achieving above minimum performance in new homes. These are explored further in relation to existing hosing stock in Section 6.5.

Consensus is growing among both climate change scientists and economists on the need for immediate GGE reductions (Garnaut 2008a; Lynas 2008; OECD 2008; Stern 2006; Worldwatch_Institute 2008) and the housing sector is arguably one of the best-placed sectors to deliver immediate, short-term GGE reductions. However, governments remain reticent to support strong initiatives aimed at the property finance and marketing sector due to (perceived) implications for housing affordability and unfair impact on lower socio-economic groups - regardless of their potential to deliver positive outcomes in both cases. I posit that the Commonwealth's proposed Green Loan scheme would be far more effective were it to be introduced in conjunction with mandatory pre-sale SP upgrade requirements and used to offset adverse outcomes for low budget households.

In Section 6.5, I argue that a policy to mandate cost-effective carbon reductions from the housing sector could be financed through the partial re-investment of revenues from the proposed Carbon Pollution Reduction Scheme (CPRS). I contend that such a short to medium term intervention has obvious potential to deliver triple bottom line benefits by addressing adverse socio-economic

outcomes from the current housing slump (superannuation losses, rental increases, housing shortages and un-affordability) while delivering timely and cost-effective GGE reductions.

The role of networks

In Chapter 5, I applied ANT to reflectively analyse the SP diffusion role of networks during AR. Additionally, ANT's capacity to inform the strategic planning of change agendas through network configuration was used to explain variable success rates between selected AR change agendas and identify opportunities to increase the effectiveness of future change strategies. Here, I draw on aspects of that analysis to inform my prospective analysis.

Rogers observes that, individual adopters have personal 'thresholds' of exposure to an innovation that vary according to their innovativeness. Less innovative individuals require exposure to higher numbers of adopters who are satisfied with the innovation before they too decide to adopt (Rogers 2003, pp 355-357). Organised network events facilitate opinion leadership interaction between a range of actants critical to the diffusion process and expose would-be adopters to unusually high levels of opinion leadership from a range of sources.

For example, Solar House Day and sustainability fairs (well configured network events) facilitate interaction between later adopters who might be at the knowledge or persuasion stages of their innovation decision process and early adopters whose homes (an important actant in ANT terms) are on display. Additional actants including technical experts such as designers and organisers are often present to provide strong, timely opinion leadership that is both homophilous (because of the setting) and heterophilic (due to their expertise). In these environments, sceptics and later adopters are often observed to be listening to conversations between OLs from their community and technical representatives from SP companies. While the IC that occurs between community leaders (early adopters) and suppliers is often heterophilic, the third party (later adopter) listening in receives homophilous confirmation of the worth of the innovation from the peer. In other words, mutiple levels of both heterophilic and IC occur simultaneously at such events. Individuals with high adoption thresholds are often exposed to adequate numbers of satisfied adopters in their own community network to decide to acquire more knowledge about the innovations. Exhibitors at such fairs cite high levels of enquiry and successful sales soon after as the reason for their continued attendance at such events.

Such networks are also effective in facilitating and reinforcing opinion leadership in the workplace. Rogers differentiates between individuals' adoption thresholds (discussed above), and attaining 'critical mass' in a system or organisation. Micro-level IC networks that operate within organisational or workplace environments can effectively accelerate the diffusion process when an OL within the system hierarchy adopts. Subsequent homophilous workplace discussions between

individuals of similar gender, belief system or rank lead to collective adoption decisions (Rogers 2003, pp 360-3362).

These examples demonstrate the critical role of networks in the diffusion process and underpin my prospective recommendation that CAs should apply ANT's four stages of network configuration (problematisation, interressment, enrolment and mobilisation) to the planning of new change agendas and the fine tuning of existing ones. It also demonstrates the complementary application of DoI and ANT as analytical frameworks.

The role of industry media

While recent progress is encouraging, the expanded use of industry media to diffuse SP remains an under-exploited option by CAs. The majority of current SP-related content in these publications amounts to advertorials by manufacturers and suppliers of SP technologies. While increasing, specialist journalistic input is limited owing to a lack of both funding and journalistic expertise in the field of SP in the built environment – especially in the consumer publications that Penman (2000) identified as a significant source of consumer 'research' during their new home decision-making process. DEWHA successfully 'incubated' the production of Sanctuary Magazine by the Alternative Technology Association and sales of HIA's GreenSmart Magazine continue to grow. However, these publications are rarely accessed by later adopters or, are seen as biased towards SP by this audience.

I observe that an opportunity exists for the provision by CAs of refereed articles to mainstream housing industry media that promote the medium and long-term benefits of better and best practice SP in housing and, to publish the regulatory targets nominated in Section 6.3.1 (all housing to be carbon neutral by 2020). An additional opportunity identified through AR activities with mainstream practitioners is the growing need for a journal or industry magazine that publishes new global SP research findings and reports on recent innovations in the language and style preferred by practitioners from each adopter group. In other words, there is a market for a current best practice magazine to supplement the *Your Home* Technical Manual. I argue that practitioner awareness of viable best practice SP solutions in other countries (e.g. 3M® paraffin phase change beads in plasterboard) has potential to create demand from larger scale Australian projects where economies of scale might well make the exercise viable- thereby accelerating the technology transfer process.

The role of E-groups

Rogers (1995) demonstrated that information from homophilous sources (close peers accessed through social or organisational networks) is more influential than information from heterophilic sources (media, government or academic sources). Several e-groups that address SP exist within designer networks (HDAA, BDAA and BDA NSW). I assert that these networks provide a much

needed, low cost conduit for timely (at point of application) skill and information delivery to practitioners where it is most useful (the workplace) and likely to be applied or recorded for later use. AR observations suggest that this valuable resource is under-utilised by CAs.

For example, E-groups facilitate an ideal combination of homophilous (practitioner to practitioner sharing their experiences in applying SP, both successes and failures) and heterophilic (expert opinion and advice from innovators) as demonstrated in Box 6-2 below. The accuracy and usefulness of advice provided through these networks depends on expert input and peer review. While a variety of such experts contribute to each of the above networks, this input is often inconsistent due to workload and commitments. I posit that formal arrangements to guarantee timely expert input and promote their use by more practitioners would increase their effectiveness.

Box 6-2: The HDAA E-group

The HDAA e-group was started by architect and SP advocate Frank Lowe among a small network of colleagues in Sydney in 2004 and has over 200 subscribers, most of whom are practicing architects. Apart from providing continual insights into the progress of SP awareness and understanding amongst designers, this group (and others) have exerted high levels of opinion leadership in the design sector and, while their contribution to change cannot be measured, I observe that it has been (and continues to be) substantial. The following transcripts from one Q&A session (HDAA 2008) are included to demonstrate the effectiveness of such groups in timeliness, usefulness, accuracy, homophilous language and strong, multiple sources of opinion leadership.

Question by Practitioner A (4.36 pm, 22 July 2008): I am filling out BASIX for a new dwelling- 4 levels etc. The dwelling has a large conditioned area over 300 sqm. I have passed the water and thermal comfort sections (although the windows are mainly double glazed).
1. The new dwelling BASIX energy section requires a photovoltaic energy panel system of 2.1 kW in spite of me putting all the best energy saving measures, does anyone know why this is?
2. Also can anyone tell me whether they think a simulation under ABSA may help this situation by lowering the heating and cooling loads and thus the need for the energy panels? Best wishes…

Response 1 by Practitioner B: (6:40pm 22 July 2008): In BASIX when you use DIY for thermal comfort the maximum heating and cooling load is passed onto the energy section, whereas if you get a simulation then the simulation heating and cooling loads are passed on – I think? Or maybe it is because DIY is conservative in relation to simulation and simulation can pick up some improvements that DIY does not?

In regard to the energy section: Do you have a large pool? Or worse a spa? They use energy

Please outline the rest of the energy commitments to enable a response.

Response 2 by Practitioner C (6.40 pm 22 July 2008): This is the least understood aspect of BASIX and the aspect that everyone who generally criticises it should be cheering. There may be issues such as B is pointing out, regarding the 'deemed' energy figures out of DIY method, but there is something much more important. The Thermal Comfort pass you obtained was for a 'cap' on the projected heating and cooling energy use per square meter of 'conditioned' space. Large house find passing this really easy, because compared to small houses, they have a smaller ratio between the exposed outside surfaces and the floor area. So far so good (for you), if a bit unfair to those designing smaller houses. And now comes the BASIX sting: When calculating likely energy use overall (the Energy Score), BASIX multiplies your handy thermal comfort 'pass' figures by the actual area of 'conditioned' space. Bad, Bad, Bad to have a really big house. And at over 300 square meters, you have a big house so you shouldn't be surprised that you don't project the required energy saving compared to state average consumption.

Personal bias: convince the client they don't need such a big house!

Unbiased advice: If you really have used double glazing, reduced the glazing areas, oriented the glazing well, shaded it, insulated intelligently, zoned the house properly with real doors, specified efficient plant, and foregone energy guzzlers like spas and pools, an ABSA simulation done by a competent assessor should reward you for your efforts, where DIY just can't. But don't expect miracles and be thankful BASIX doesn't yet ask the size of the plasma TV, or how many there are.

Response 3 by Practitioner D (10.36 am 23 July 2008): Why not simply put in the 2.1 KW photovoltaics? That seems like a good solution.

Response 3 by interstate Practitioner E (2.53 pm 23 July 2008): In the colonies we are surveilled less on the achieved energy efficiency of new buildings than elsewhere. I get to do those 'ratings' when the normal process doesn't deliver a minimum compliance outcome. A recent enquiry was for a 'mansion' ($2.5m by my eye) by a well regarded 'name' architect. The concrete bunker and stone construction meant it wouldn't rate. I suggested some things including 10kW PV (yes, it was that scale of energy guzzler). The client interestingly resisted the PV solution, and opted to re-design in different materials. Seems the PV might be a continuous reminder of how big an impost on the planet their habitat is.

Rogers observed that: *The more homophilous two [or more] individuals are, the more likely their communication will be effective. Individuals who depart from the homophily principle and attempt to communicate with others who are different often face the frustration of ineffective communication* (Rogers 2003, pp. 306-308). However, heterophilous communication is often required to effectively explain complex SP. The HDAA e-group medium overcomes this barrier by facilitating innovator practitioner responses to specific problems raised by others in the homophilous practitioner language of mutual problem solving. Heterophilic peer input to the above case study from practitioners B and C was affirmed in homophilous language by practitioners D and E - leading to its recognition and acceptance by less innovative group members who may have doubted the relevance of its heterophilic source to their ircumstance. Rogers notes the value of such communication in diffusion terms through the

observation that such …*heterophilous communication has a special informational potential…[and] even though it may only occur rarely…[such] network links often connect two cliques…via interpersonal links…called 'bridges' [which] are especially important in conveying information about innovations…* (Rogers 2003, pp. 306-308).

The HDAA group (and to a lesser extent, the BDAA e-groups) create an environment in which this 'special informational potential' to connect such cliques in relation to SP has been achieved. The late Frank Lowe (HDAA founder) argued that the e-group works because it links practitioners from similar (homophilous) backgrounds, most of who knew and trusted each other through other social networks. HDAA was created by Lowe as a communication and mutual problem-solving network for architectural practitioners in Sydney's north east. 'Outsider' input to this group is only accepted after contributions are validated by long-term members over time. I define acceptance as uninhibited responses to postings by a range of members leading to subsequent discussion.

While I advocate the establishment of similar groups by CAs to create effective, low cost SP diffusion networks, the viability of a 'one size fits all' super e-group is questionable. The HDAA experience suggests that such e-groups would ideally: be formed as an additional communication medium in existing social and professional networks; remain small and localised to maintain homogeneity and; welcome polymorphic discussion of a range of issues – not just SP. Attempts by BDAA and BDA NSW to limit the discussion on such groups weakened the subscriber base.

One network that would particularly benefit from the establishment of such an e-group is the HIA GreenSmart Professionals group (evidenced by strong support for the concept by a substantial majority of attendees at GreenSmart training). In a publicly accessed group, 'Wiki style' peer review of 'expert' comments and submissions would quality assure the information provided without creating a heterophilic barrier to less confident or competent practitioners whose questions and comments often generate the most useful discussion on HDAA and BDAA e-groups. Additionally, information streaming (e.g. clear rules for category headings for email filter systems) to facilitate efficient information management is essential in such polymorphic networks.

6.2.4 Summary of the prospective role of communication

As arguably the most critical element of innovation diffusion, the communication strategies adopted by CAs require rigorous planning and design in terms of media type, content and delivery mode. The following generalisations summarise the prospective analysis above and include key recommendations drawn from it.

Generalisation 6.2.1: Language and content used to explain the merits of SP should be carefully designed to avoid Moore's gap because the needs, interests and applications of potential adopters vary according to their innovativeness based adopter category.

Generalisation 6.2.2: Opinion leadership is a particularly important component of SP diffusion that should be specifically addressed through structured training and skill development for OLs.

In selecting and grooming OLs, CAs should broaden their focus to include the housing finance, valuation and marketing sectors and, maintain awareness of whether the role context is homophilous or heterophilous to maximise and exploit the strengths of each communication type.

Generalisation 6.2.3: Interpersonal Communication is an important component of the innovation decision process for every adopter. However, individual adopter IC needs (and therefore its effectiveness) varies according to both their innovativeness and stage of decision.

Ideally, communication strategies should address both these variables through the use of specific language, communicators, media and messages. Alternatively, appropriate media (e.g. publication, trainer, conference presenter, network or interactive IT forum) should be chosen and messages and language appropriate for each variable should be included if audience streaming is not viable.

Generalisation 6.2.4: Communication strategies should be planned to address the stages of innovation decision in distinct streams where viable – particularly if the agenda is targeting later adopters or those with limited understanding of SP (e.g. consumers).

Generalisation 6.2.5: Initial information overload adds to perceptions of complexity and can generate negative adoption decisions within these later adopter groups.

SP related information provision should be staged to match the innovation decision process: i) provide simple initial awareness of the advantages and benefits of SP; ii) provide opportunities for exposure to opinion leadership through IC with early adopter peers in homophilous environments such as community events for consumers or trade events and e-groups for practitioners (the less innovative the adopter, the more such interactions are required); iii) ensure that well designed, accessible additional information is available to individual adopters (e.g. hotlines, web sites and display homes) when sought during their variable, individual adoption decision process.

Generalisation 6.2.6: Individual adopters undertake different innovation decision processes and their IC needs vary according to: stage of decision (e.g. knowledge, persuasion or decision); role (e.g. designer, builder, marketer, lender or consumer) and innovativeness level (e.g. early or late adopter and sceptic).

A variety of role specific IC interaction opportunities were examined and their likely relevance to each adopter category explained. These included homophilous and heterophilous sources for both consumers and practitioners (e.g. supplier representatives and expert peers for practitioners and sales staff, lending authorities and practitioners for consumers).

Generalisation 6.2.7: Homophilous networks are an important component of diffusion because they provide opportunities for opinion leadership and information exchange to occur.

While CA provision of support and resources for such networks is a cost effective diffusion strategy, the temptation to create large and impersonal (heterophilic) networks should be avoided.

6.3   The future role of regulation

Several important questions were raised in Chapters 3 and 4 on the relative merits of BASIX and BCA as mandatory minimum compliance regulatory frameworks in DoI terms. Additional questions relating to their role in configuring and enhancing SP supportive networks were raised through ANT analysis in Chapter 5. Here, I draw on understandings developed in both those retrospective analytical frameworks to examine their capacity to meet the requirements of likely future scenarios. I commence by briefly summarising my findings on their strengths and weaknesses through a prospective critique of their likely role in an increasingly regulated SP future.

Firstly, I argued for the importance of setting short, medium and long-term targets and measuring AHI progress towards them to more directly engage the AHI in sustainable reform and provide clear direction to inform forward planning and encourage innovation development. I then critiqued the potential of current measurement systems (HERS, BASIX, NABERS, MEPS etc.) and the regulatory frameworks in which they are administered (predominantly BCA or BASIX) to drive SP adoption rates beyond current minimum practice to the levels of best practice required to meet increasingly urgent GGE reduction targets. While all the impact categories examined throughout the research remain important, the most urgent short-term problem, climate change has become my principal focus in this prospective context.

In a prospective context below, I argue that the first step in that process must be to set sustainable built environment targets and publicise them widely. The second step is to refine our metrics and regulatory frameworks to ensure that every opportunity to meet those targets innovatively and cost effectively is recognised and incentivised. The third step is to facilitate the development and diffusion of the skills and technologies required to deliver genuine solutions within the AHI. Finally, I argue that building owners and users should be aware of these targets and provided with incentives to contribute to their delivery by demanding best practice SP performance in their new homes, upgrading their existing homes to meet new standards and, changing their behaviour to ensure that these SP improvements deliver impact reductions – especially GGE.

6.3.1   Goals, timeframes, metrics and regulation

In Chapter 2, I argued that goal setting should be a fundamental component of any change agenda. While pending carbon trading and GGE reduction targets are likely to provide overarching societal

goals relating to climate change, specific goals are yet to be set within AHI change agendas. My earlier DoI and ANT analysis demonstrated how the absence of such goals inhibits both innovation development and regulatory bar creep, leading me to argue that short, medium and long-term future targets would send clear messages to industry to inform forward planning, stimulate innovation development and accelerate skill acquisition across all sectors.

The publication of urgent research findings about the need to act rapidly to mitigate critical climate change (IPCC 2007b; Lynas 2008; OECD 2008; Worldwatch_Institute 2008) suggests that the regulatory focus should move from the focus of energy efficiency to the specific and urgent problem of GGE reduction as BASIX already does. While the success of longer term supply side initiatives to reduce the carbon intensity of energy sources (DCC 2008; Garnaut 2008a, 2008b) may necessitate a shift back to a demand reduction focus to offset carbon costs, sceptics (Angel 2008; James 2007) argue that this is unlikely to occur in a timeframe that averts critical climate change.

Next, I outline and argue for the need for stringent targets and finally, I suggest improvements that might be required to existing regulatory frameworks to ensure that they are met.

The setting of ultimate and interim goals within clearly defined timeframes was argued earlier to be essential to facilitate forward planning for innovators, manufacturers, suppliers, practitioners and home owners. An arguably more important imperative for such targets is to send a clear and unequivocal message to financiers, marketers and home owners that SP performance will become a fundamental component of property values and investment strategies within a finite time frame (See 6.5.5). I argue that setting stringent targets is defensible from an economic and political perspective in terms of the need for households to reduce energy use to offset increasing energy prices resulting from carbon trading. Additionally, a range of experts and authorities including Garnaut, Stern and the Victorian Government (Garnaut 2008b, pp. 1-5, 27-31, 249-267; Stern 2006; Victorian_Government 2005) have predicted significant economic opportunities for early adopters of climate change mitigation and penalties for later adopters.

The viability of achieving a 60 per cent reduction in GGE by 2050 was recognised by Australian Business Roundtable on Climate Change (BRCC) who argued that such a target could be achieved *while maintaining strong economic growth* and noted that *with early action, the economic impact by 2020 would be modest (BRCC 2006, p. 16).* The housing sector has had the capacity to achieve carbon neutral and carbon positive outcomes from freestanding, new homes for a modest cost for several decades. This is also achievable in both multi-residential and existing housing stock – albeit at increased cost in some cases dependent on climate zone, construction type and existing condition (Reardon et al. 2008, pp. 11-14 & Case Studies). Recent advances in SP have reduced those costs even further and,

given sufficient incentive (e.g. stringent targets and change supportive strategies argued throughout this thesis), innovation is likely to continue and accelerate this trend.

Increasing home energy consumption is a significant and avoidable contributor to Australia's GGE. In 1998, the housing sector accounted for 11.5% of total Australian energy consumption and 17% of its energy related GGE (GWA 1998) and, while not expressed in national percentage terms in the 2008 study (DEWHA 2008b), household consumption is estimated to have increased by approximately 25% between 1990 and 2008 and its GGE intensity has also increased during this period. In the face of dire predictions regarding the likelihood and consequences of climate change documented in Chapter 2 including (Brown 2008; CIE 2007; IPCC 2007b; Levine 2007; Lynas 2008; OECD 2008; Worldwatch_Institute 2008), I argue that stringent GGE reduction targets should be implemented in the housing sector because they:

- are capable of delivering immediate GGE reductions;
- can be achieved easily (by comparison to other industries) and;
- are justifiable in terms of offsetting carbon trading induced increases in energy costs.

Additionally, the AHI is among the most regulated industries and its existing regulatory frameworks have the capacity to deliver the most immediate and cost-effective contribution to climate change of any industry.

Whilst unlikely to be implemented due to the availability of more cost effective strategies that are beyond the scope of this research, the following stringent (but currently achievable) targets are included to indicate the significance of the housing sector's potential contribution to climate change mitigation.

- all new housing could become carbon neutral by 2020 via a methodology that adopts BASIX like targets (i.e. a % reduction in GGE) that commit to annual GGE reduction benchmark creep of 5% starting with 45% in 2009 (a 5% increase on current levels) followed by a further 5% every 2 years thereafter until 2020;
- a carbon neutral target for existing housing stock by 2030 starting with a 20% reduction (off a current assumed base of zero) at point of lease or sale (based on NABERS or equivalent rating) starting in 2010 and increasing by 4% per annum thereafter.
- continued introduction of additional incentives (e.g. adequate gross renewable energy grid feed in tariffs, low interest loans or partial rebates and recognition and promotion of achievement) to encourage the achievement of carbon positive status where viable.

Strategies include the installation of micro renewable generation (e.g. rooftop photovoltaics) but only after all other cost effective demand reduction improvements related to envelope and appliance efficiency had been made. As a *worst case scenario*, a grid connected photovoltaic array of

between 1 and 3 kW$_{peak}$ capacity (depending on climate, energy source, occupant numbers and efficiency) might be required at a cost between $10,000 and $30,000 at 2008 prices.

These indicative targets are based on the assumptions that: i) the number of occupied households follows predicted trends (DEWHA 2008b) equating to an average 7.5 million between 2010 and 2030; ii) MEPS standards for appliance efficiency continue to increase and; iii) economies of scale maintain or reduce current installation costs. While detailed costing is beyond the scope of this research, the targets and costs are based on outcomes already achieved by my own and other SP specialist practices using currently available technologies and practices.

The cost of achieving such targets for the majority of households could be amortised over the 25 year lifespan of an average housing loan and repaid through reduced energy bills in a post carbon trading environment and returns from the renewable energy feed in tariffs being introduced by state and territory governments. However, because the time gap between initial investment and return presents a substantial barrier (ASBEC 2008; CIE 2007), I suggest that a government contribution in the form of a grant or low interest loan would be required to cover the initial installation cost for a household with average consumption (DEWHA 2008b) and that households consuming above average be required to make up the difference or reduce their consumption.

Such a strategy could be funded through the recoverable investment of less than 10% of estimated annual Carbon Tax revenue over 20 years to be repaid by householders from energy savings. It would deliver an approximate 10% permanent reduction in total Australian GGE by 2020 and a further 10% by 2030 with no further investment required. It would require no additional grid infrastructure and would postpone the need for new power stations until viable low carbon alternatives are developed. Alternatively, were the government contribution to take the form of a grant, the cost is well within Garnaut's recommendation that 50% of carbon tax revenues be allocated to households and 30% invested in renewables (Garnaut 20008b). Lesser targets could obviously also be achieved at lower cost (and outcome).

ASBEC suggest an alternative approach in which a combination of 'green depreciation', public funding and tradable 'White Certificates' issued in return for verified improvements in energy efficiency would be used to offset the initial cost of such improvements (ASBEC 2008). As argued in Chapter 2, analysis by CIE (CIE 2007), ASBEC estimate that this scheme would save 60 Mt of equivalent (CO_2-e) per annum and that this would reduce the cost of CPRS by approximately 14% over a similar timeframe to that discussed above by applying similar (although less stringent) targets. ASBEC claim that this scheme would *save the economy around $38 billion by 2050 reducing the economic adjustment costs foreshadowed in the CPRS Green Paper* (ASBEC 2008, p. vii).

Regardless of the final target or scheme selected, the housing sector is a low cost, immediately achievable source of GGE reductions that remains under-utilised. Until a mandatory target is nominated, the AHI (and particularly the marketing and finance sector) have little incentive to apply better and best practice and development of the practitioner skill base required to deliver high level outcomes remains effectively stalled. Indeed, as Pears (2008) argues, CPRS may well have an adverse effect on voluntary GGE efficiencies in the absence of such a scheme (Pears 2008). Accordingly, I argue that stringent GGE reduction targets for all housing are required as a matter of urgency.

6.3.2 Next steps. Regulation 2010 to 2020.

Here, I explore strategies through which current AHI regulations relating to SP might be adapted to better address the opportunities and barriers identified through retrospective DoI and ANT analysis in Chapters 3, 4 and 5.

I contend that as the accuracy and sophistication of our SP measurement tools increases, so too will the complexity of regulations and skill levels required to adequately comply with them – especially if those regulations continue to apply a prescriptive approach like that used in BCA. At the current national 5-star standard, the use of HERS in warmer climates has already reached the limits of prescriptive approaches. To achieve higher star ratings, a designer or assessor must choose between an envelope designed to maximise the efficiency of mechanical cooling (a 'conditioned' dwelling) or, to maximise the more cost and GGE effective passive cooling aspects (a 'free running' dwelling). Subsequent retrofitting of air-conditioning in a free running home leads to a massively inefficient outcome and a conditioned home is virtually unliveable in summer without air-conditioning in some climate zones. In other words, the problem can only be adequately resolved for one or other set of occupant lifestyle preferences. Should an occupant with different preferences occupy the home (this is virtually inevitable in the 40-50 year life span of a home), the energy use and GGE outcomes of good design can be reversed.

While this dilemma is limited to climates where the predominant requirement is for cooling energy use, I argue that it is indicative of a challenge facing regulatory evolution- the need to regulate or manage user behaviour. The feasibility or usefulness of regulations that require a designer or assessor to make assumptions about the thermal comfort needs of future occupants is questionable. An alternative approach might be to regulate the installation of all mechanical heating or cooling systems and to make approval conditional on the dwelling meeting minimum thermal performance standards that ensure its efficient use (See Boxes 3-9 and 3-10).

The best outcomes are currently achieved through a compromise requiring high-level design skills to identify appropriate solutions early in the design process. This highlights the need for substantial

increases in practitioner skill levels. ABSA argue that skilled assessors will overcome the problem of practitioner skill deficiencies and many early and late majority practitioners are already utilising this option (AR observation during training delivery). While this is arguably inevitable for most practitioners in the medium term, I argue that its short-term effect is to limit the acquisition of skills required to develop well-resolved preliminary designs before incurring the cost of specialist ABSA consultant input (as they do with other BaU consultant input). This often causes SP consultant input to be viewed as an afterthought rather than an integral component of the design from the earliest stages.

An emerging problem, associated with the delegation of expert thermal design input to ABSA assessors (encouraged by BCA complexity) is additional compliance costs arising from the use of inefficient or ineffective solutions to overcome poor design. This diverts budget away from more efficient or appropriate SP inclusions, compromises outcomes and creates barriers to affordable regulatory bar creep as a flow-on from SP advances. BASIX offers a viable solution to this problem through its flexible, performance-based regulatory focus on reduced GGE and interactive help levels – especially in thermal performance (See Box 3-14: BASIX DIY as a design and trialling tool).

BASIX' focus on relevant target (GGE reductions and water consumption) through flexible compliance paths and its capacity to accurately position each project on the minimum to best practice performance continuum are also effective in addressing this problem. However, while DoI and ANT analysis demonstrated BASIX' capacity to provide a sound base model for a regulatory framework, its failure to engage the AHI network in its development and implementation (as discussed in Chapter 5), created barriers that need to be overcome by future regulatory frameworks. The ABCB's regulatory development framework provides a sound base model from which to implement the network configuration strategies identified in Chapter 5 and is the only body capable of delivering a nationally consistent SP regulatory framework. However, as argued in Chapters 4 and 5, its onerous, consultative process needs refinement and its expensive, inflexible paper-based format restricts the regulatory development and benchmark creep processes. By comparison, BASIX' accessible, low cost, easily updated web-based format provides a viable alternative.

In summary, I argue that future new home and major renovation regulations will benefit from the inclusion of many of the positive aspects of BASIX examined above and should move away from the prescriptive approaches of BCA. More importantly however, I argue that an additional regulatory focus on post occupancy performance should be introduced as a matter of great urgency and, as argued in Section 6.5.3, the proposed framework for Mandatory Disclosure does not go far enough. I explore further options to extend the focus and influence of CAs in the existing housing sector in Section 6.5.

6.3.3   Regulations that address both ABEC codes and encourage SP transfer

In this section, I explore strategies through which CAs might drive the adoption of better (and then) best practice beyond critical mass. While the direct effect of regulation in eliminating worst practice and raising minimum standards is well understood, its indirect role network influence has received less attention from CAs and arguably, remains under-utilised. As depicted in Figure 15: The combined effect of minimum benchmark creep and voluntary best practice adoption (p 161), and argued in Section 4.1.6, incremental progress in both codes of practice is critical to accelerating SP adoption. Equally critical are strong communication or network linkages between the codes (see ANT analysis in Section 5.3.6).

Currently, few formal or structured linkages exist between ABEC's dual codes of practice. While they occur informally through various industry media, BASIX is arguably the only regulatory tool to include structured links whereby later adopters seeking alternative or more cost effective and site specific solutions for a particular context or application are exposed to better and best practice solutions offered as part of its flexible compliance paths. BCA DTS compliance paths arguably have the opposite effect. Complex, prescriptive formulae to achieve DTS through BCA do not encourage designers to trial alternative options. See Box 5-13: BCA's failure to encourage innovation. Indeed, they encourage 'shortcuts' or transfer of generic solutions that are often ineffective or inefficient because they are not site specific (See Box 6-3: Avoidance of HERS assessment as a compliance path by WA designers)

Box 6-3: Avoidance of HERS assessment as a compliance path by WA designers

In WA, the most recent state to adopt 5-star benchmarks in BCA (Queensland pending June 2008), many designers are opting to use the cumbersome Deemed to Comply provisions in BCA rather than HERS ratings. In my AR consultant role working with designers in WA on SP best practice projects, it became apparent that their understanding of the complex interactive relationship of thermal performance variables was limited and many felt threatened by having their buildings rated by an ABSA assessor – preferring instead, the tedious but in-house path of DTS compliance (BCA 2006). While in each case, the projects were approved, the designers had gained little or no understanding about the building's thermal performance and were unable to identify viable, cost effective ways to improve it

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By comparison, with a simple click and then 'calculate', BASIX quickly indicates the performance outcomes achievable from a broad range of compliance options based on specific climate and site details. During AR, training attendees reported how a promising result from an exploratory 'click' in BASIX often encouraged the designer to research the feasibility (mostly of cost and availability) of recently introduced, innovative compliance options. Additionally, BASIX' web-based format and expert review panel (through which innovative solutions can be submitted) encourages this 'cross

pollination' of best and minimum practice solutions between innovators and later adopters (see also section 6.3.4). Industry training developed by ABSA and delivered by industry peak bodies advises practitioners of any risk associated with the options offered by BASIX – something that should arguably have been provided by its developers.

I recommend that future regulatory codes should incorporate and enhance these aspects of BASIX by providing more detailed 'how to' information, cost and risk implications and linkages to case study examples. Again, these options could be easily achieved at relatively low cost through a web-based format similar to BASIX. For this reason, I also strongly recommend the discontinuation of the BCA paper-based approach to regulatory documentation.

DoI and ANT analysis of AR indicated that an associated and under-utilised outcome from mandated minimum standards is their role in introducing practitioners with little SP interest or knowledge to SP-related networks. Acquiring new skills to achieve minimum compliance requires that practitioners engage with new networks, through which they are exposed to SP opinion leadership which has potential to encourage the pursuit of better and best practice. For example, on two separate occasions, regional builders who had never considered adopting SP before attending GreenSmart training (in response to BASIX) subsequently became ABSA assessors and assumed powerful OL roles in their local networks. Similar outcomes occurred in the BDA network during SEDA's ESH program.

While the above examples are encouraging, the full potential of mandatory minimum compliance in triggering better and best practice adoption remains largely untapped because practitioners who are not motivated to join specific networks such as ABSA have few alternative support networks. HIA attempted to establish a GreenSmart network through which trainees could network regularly and attend SP trade nights or CPD events but while effective, it proved unprofitable and was discontinued. I assert that a specific CA focus on developing and enhancing such networks in partnership with industry peak bodies is an important opportunity with potential to drive increased levels of better and best practice adoption by a range of adopters through exposure to opinion leadership and innovation.

The above examples further demonstrate the potential for 'fluidity of innovativeness' discussed in sections 3.3.3 and 4.1.6. Fluidity of innovativeness challenges the DoI assumption that adopter innovativeness is attributable to personality and social circumstance and suggests that, in the case of AHI practitioners, it is often determined by workplace constraints. This indicates that a greater emphasis on strategies to encourage adopting innovative solutions by traditionally conservative industry sectors is warranted in the future development or modification of regulatory tools. In Section 6.3.4 below, I examine strategies that while specific to each adopter category, also encourage adopting innovative SP by later adopters.

6.3.4 Flexible regulatory compliance paths

Here I explore regulatory strategies to minimise adverse outcomes related to Moore's gap and limitations arising from the 'one size fits all' approach commonly applied by regulators. Regulations are usually developed by innovators in collaboration and consultation with early adopters. This process often leads to criticism and compliance avoidance by later majorities and sceptics because the recommended (or mandated) compliance strategies are often too complex or expensive to apply in low cost or high volume housing.

Flexible regulatory frameworks that offer a range of compliance paths that include varying levels of innovation provide an ideal solution to this problem - providing that the risks and costs associated with the various options and paths are communicated to the practitioner to inform choice during the compliance decision-making process (i.e. as the submission is being prepared). While BASIX offers flexible compliance options, its interactive advice features remain under-utilised by practitioners and would benefit from increased feedback and interaction facilities for later adopters (e.g. testimonials from practitioners who have trialled new solutions and peer reviewed advice for those considering them).

Figure 24 (a portion of the Innovation Development Cycle diagram explained in Section 5.2.4), depicts the interactions and roles of adopter groups around regulation.
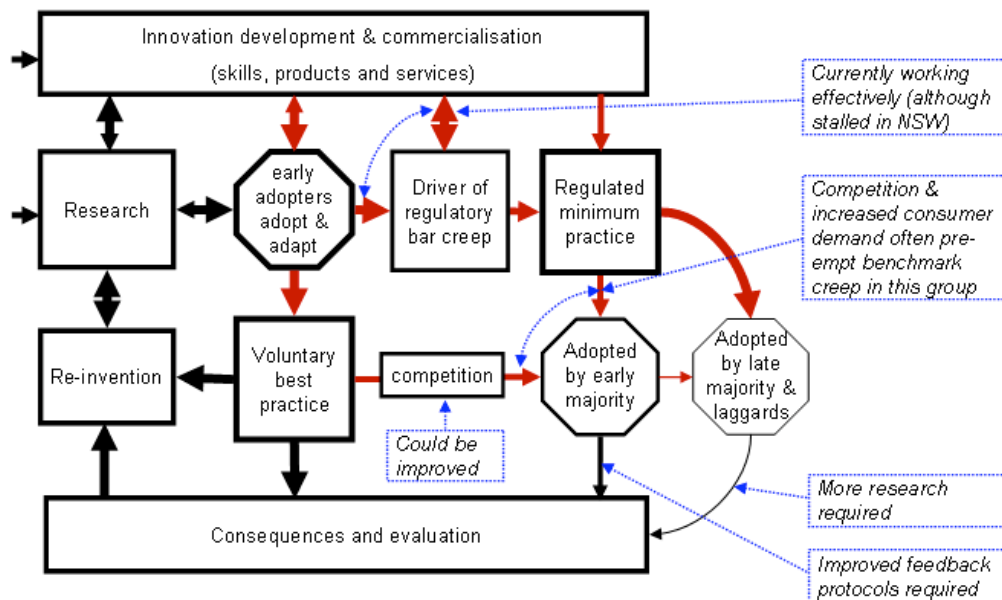
Figure 24: Adopter group interaction around regulation.

In Figure 24, the red arrows represent innovation decision influences whereas the black arrows represent innovation development interactions. Arrow weights indicate my assessment of their relative importance in influencing better and best practice. While current regulations address the interactions depicted by red arrows reasonably well, those interactions depicted by black arrows are

not well understood or exploited by CAs in current regulations. Consequently, these interactions are the predominant focus of my prospective analysis below where I examine the role of each adopter group in relation to better and best practice adoption in response to regulation and recommend strategies to increase it.

Early adopters

As mentioned earlier, prescriptive minimum standards can have adverse outcomes by limiting advantages arising from innovation – sometimes reducing innovativeness in this group to the lowest common denominator by removing (or failing to address) innovation incentives. While BCA achieves limited flexibility in thermal performance compliance through its use of HERS, I argue that BASIX' capacity to assess mandatory minimum compliance via flexible, performance-based paths while also measuring better and best practice is preferable because it encourages competition and exploration. Both regulatory frameworks would benefit from improved feedback linkages with early adopters.

My earlier retrospective AR analysis identified a broad range of innovative SP solutions and positive diffusion benefits arising from innovation and reinvention by early adopters through their pursuit of best practice. This highlights the need for CAs to support such innovation and encourage its diffusion in later adopter groups. While BASIX is well suited to this task and provides an ideal base model for other regulatory regimes (e.g. BCA), this potential remains under-utilised. I advocate the incorporation of strategies in BASIX and BCA to encourage the adoption of BASIX + X% solutions such as those applied in Nelson's Ridge (See Section 3.2.5 and Box 3-2) where X is a voluntary commitment to better practice that was used to market differentiate on the basis of SP.

As noted in Section 3.2.5 in relation to Nelson's Ridge estate, the effectiveness of such a strategy depends on: well informed and motivated sales staff (in SP terms); targeting appropriate markets (i.e. prestigious rather than low cost housing estates) and the promotion of the lifestyle benefits of superior SP performance rather than cost savings. Such marketing strategies risk being prematurely outdated by SP benchmark creep (as was the case at Nelson's Ridge) leading me to suggest that demand for better and best practice SP performance would be much greater were they to be linked to the additional strategies of mandatory disclosure, minimum pre-sale performance standards and mandatory valuation of SP discussed later.

Early adopters are typically involved in the development and implementation of measurement systems and compliance verification protocols (e.g. ABSA assessors are predominantly designers and builders from this group). Effective OL profiles include national and international leaders in innovation. The information and CPD needs of this group are distinctly different to those of later adopter groups. Current and recent AR observations confirm that their skill and information needs

are being met by ABSA as part of its CPD and quality assurance protocols for assessor members. I address training and information provision in detail in Section 6.4.3.

While network links between early adopters and later majorities exist (see Figure 23), I contend that they are under-utilised and that potential dividends from CA investment in strengthening them are significant. In particular, their role in the innovation development and reinvention processes should be recognised and monitored to justify arguments for more regular bar creep. CAs tend to delegate this task to researchers whose innovation focus rarely extends to the early majority where the re-invention and refinement of SP leads to cost-effective application opportunities for later adopters.

Early majority

While this group often operate in a more cost and risk constrained market sector than early adopters, their capacity to demonstrate market leadership through SP-based product differentiation is an important factor driving their adoption of better practice. Competition flowing from the promotion of best practice by competitors is a driver that would benefit from greater CA focus. In that sense, BASIX provides an ideal benchmarking system whereby these adopters can measure the performance outcome of a variety of SP innovations and where appropriate, market them to their more innovative consumers under their market differentiation strategy. This 'staged' adoption of better practice facilitates trialling and market testing of innovations prior to incorporation of the most cost-effective as standard practice throughout the whole product range. This practice is not encouraged or promoted by DoP. I assert that this oversight partially explains why NSW has fallen behind other states and territories in benchmark creep and delivered SP outcomes – despite having an effective regulatory and benchmarking framework.

Training and information provided to early majority practitioners should address the risk and QA aspects of innovative SP. It should also facilitate interaction with researchers and manufacturers to commercialise the most viable innovations emerging from their refinement and reinvention in association with innovators and early adopters. Moore's gap was observed to be prevalent among practitioners from this group – evidenced by overwhelmingly positive feedback on the *Your Home* technical Manual by early majority training attendees. I maintain that greater use of plain language by regulators, CAs and OLs in explaining and advocating SP reform would overcome this barrier

OL profiles found to be most successful within this group were competitors who had (successfully) adopted better practice. While open networking between such competitors is atypical, publication of detailed reviews of award winning projects was observed to communicate powerful opinion leadership to the point of driving competitors to invest in SP training for their entire staff as demonstrated in Box 6-4 below.

Box 6-4: Opinion leadership and competition driving demand for training.

Under the leadership of CEO John Sidoti, CPG Property Group (Clarendon Apartments, Clarendon Homes and Bellevale Homes) provided customised, 'in house' GreenSmart training to the majority of its executives, designers and project managers. Clarendon Homes and Clarendon Apartments who specialise in volume housing at the luxury end of the market subsequently won GreenSmart awards for a range of projects. Bellevale Homes, a less prestigious subsidiary of the Clarendon group, adopted fewer SP than Clarendon but were the recipients of a Resource NSW best practice resource recovery and recycling award.

The publicity flowing from this opinion leadership by CPG generated a 'chain reaction' in the volume housing sector. HIA were able to convince near competitor Allam Homes to invest in similar 'whole office' training and later adopter Masterton Homes followed suit a few months later. Other smaller early adopter competitors sent key staff to GreenSmart courses during this period. This provides an important example of the role of competition in driving the sequence of skill acquisition, trialling and then adoption described by Rogers in his innovation decision stages (Figure 13: Five stages of the Innovation Decision Process).

Late majority

For this group, minimum mandated targets with 'deemed to comply' provisions were observed to be the most effective change strategy during AR and this was explained through retrospective analysis in Chapter 4. In prospective terms, I advocate the tailoring of regulatory compliance paths to include simple, cost-effective solutions for this group (e.g. BASIX' deemed to comply thermal performance path for the most common, single storey, low cost project homes). Regulatory agendas (such as BASIX) would benefit from the incorporation of additional information (or links to it) about low-cost, low-risk, quality assured solutions as they become available. Such links would ideally include case study examples of successful applications of the SP in competitor projects typical in this sector.

Skill and information needs. AR observations during training delivery led me to conclude that this group respond best to applying Rogers 'critical mass' strategy (wherein it is stated that adoption is inevitable and that critical mass is imminent) combined with demonstration of straightforward, standard solutions, where to get them, what risk is involved and their cost.

Effective OL profiles include low budget competitors who have gained market or cost advantages from careful selection of simple, effective SP compliance strategies. Additionally, testimonials or personal accounts from fellow practitioners who have found innovative ways around cumbersome aspects of regulatory requirements are effective in opinion leadership.

Laggards

Minimum mandated standards are ideally suited to laggards. While this group may or may not benefit from the additional strategies recommended above for the more innovative adopter categories, an important consideration for laggards is the inclusion of simple, accessible, low-cost compliance paths based on BaU practices. In addition to minimising compliance costs for this most cost sensitive and risk averse adopter group, the potential for laggards to become sceptics is minimised through clear explanation of such compliance options (see Section 3.3.3).

Summary

The above prospective analysis of existing regulatory frameworks identified a range of measures specific to each adopter category with potential to minimise opposition to benchmark creep while increasing better and best practice adoption and demonstrating its viability. The following generalisations summarise key findings and strategies through which to implement them.

Generalisation 6.3.1: The regulatory compliance process is a critical stage in the innovation decision process during which practitioners are more likely to consider innovative solutions.

Regulators should recognise that practitioners are more likely to trial those solutions when the regulatory tool provides information and interactive feedback on the implications and outcomes of adoption during the process of selecting a compliance path. That information should be designed to be appropriate for later adopters (early adopters generally source information elsewhere) and include case study examples of application in typical later adopter projects.

Generalisation 6.3.2: Later adopters play an important role in the regulatory development process by refining and commercialising SP innovations and providing opinion leadership to less innovative adopters.

CA incorporation of formal feedback opportunities during the process of compliance path selection would monitor later adopter experiences, needs and contributions and facilitate their incorporation into regulatory tools thereby improving their effectiveness and relevance to facilitate more rapid benchmark creep.

Generalisation 6.3.3: Provision of recent, peer reviewed information about SP innovations and, case study examples of their application endorsed by later adopters within regulatory tools is likely to reduce risk and cost aversion amongst later adopters.

This would ideally be provided through links to a national databases (e.g. EcoSpecifier), technical guides (e.g. *Your Home*) and case studies accessed directly from within a national, internet-based regulatory compliance tool during the compliance decision process. The information should be presented in easily understood language.

6.3.5 Adoption incentives and non-adoption consequences

In this section, I examine future roles for incentives and consequence in driving the adoption of better practice by practitioners. Retrospective DoI analysis of AR indicated that incentives and consequences applied during the early stages of change agendas were effective in raising awareness and compliance-related skill acquisition. Incentives were also observed to be useful in encouraging voluntary adoption of better practice and associated skill acquisition by leading developers, designers and builders. Long-term benefits arising from the continued provision of incentives were also observed in relation to best practice award and recognition incentives.

Penalties

The observed use of ineffective SP compliance solutions in combination with poor installation practices and occasional avoidance suggest that an increased focus on more effective SP compliance certification and non-compliance consequences is required to ensure that current benchmarks deliver to their fullest potential.

Current low stringency levels for BASIX and BCA certification in conjunction with the difficulty and cost of post construction assessment continue to make SP adoption a low priority for many designers, builders and consumers. My earlier analysis suggests that current levels of partial or non-compliance by the late majority or laggard sectors of the AHI are substantially attributable to the absence of penalties for non-adoption. Further, that analysis indicated the effectiveness of non-compliance penalties in ensuring improved outcomes from SP change agendas. Accordingly, I recommend that adoption incentives and non-adoption consequences (including risk) for practitioners, certifiers and consumers be made an integral part of all change agendas whether mandatory or voluntary. Box 6-5 below demonstrates the effectiveness of penalties in driving rigorous implementation of SP regulations during the early phases of mandatory adoption. This approach led to the expeditious incorporation of one SP regulation (sediment control) into BaU scenarios – particularly by later adopters.

Box 6-5: The role of non-compliance penalties in 'fast tracking' sediment control to BaU.

In early 2000, local governments throughout Australia introduced a range of sediment control requirements for construction zones in response to dire research warnings on potential ecological impacts from sedimentation of waterways (ANZECC & ARMCANZ 2000; Sabolch 1999) and predictions of more extreme weather events as an outcome of global warming (IPCC 2001). Despite active promotion by councils (including providing installation guidelines with building approvals), uptake and compliance levels remained low and breaches of installed control systems continued until heavy fines (firstly by Brisbane and Gold Coast City Councils).

MBA and HIA received a flood of enquiries from builders that resulted in provision of sediment control training and information to members and insistence on the inclusion of a fact sheet on sediment control in YH by MBA and HIA Industry Steering Committee representatives (Rieck 2000; Wilson 2000). As a GreenSmart trainer in NSW, sediment control was a major component of the course during 2002-3 but, by 2004, attendees reported that installation and maintenance of sediment controls had become part of BaU and it was subsequently dropped from the course.

The above case study demonstrates the effectiveness of non-compliance penalties in eliminating worst practice or avoidance. In that case, the results of non-compliance were obvious and the source of the breach was generally easily identified. This is often not the case with other SP. For example, the assessment of mandatory minimum thermal performance compliance requires a sound understanding of TP and specialised skills and knowledge of the variable performance of various types of glazing, shading and insulation in climate zone and site specific conditions.

For this reason, certification of mandatory SP compliance is, at best lacking in rigour and at worst, non-existent. This is partially attributable to a low SP skill base among local government and private certifiers and the fact that SP compliance certification is 'just one more task' being added to the workload of already overstretched local government certifiers. I suggest that this should be overcome through delegation of the SP certification role to specialist trained and certified assessors (e.g. ABSA) along with the capacity to impose (or recommend) penalties or stop work orders for non-compliance.

Incentives

Penalties do little to encourage the adoption of more effective minimum compliance options and even less to encourage the adoption of better and best practice by later adopters. I posit that incentive strategies are essential in this regard

Some regulatory incentives observed to be effective during AR include: fast tracked development consent for applications embodying better or best practice (adopted by some Sydney councils during the voluntary phase of SEDA's ESH policy); best practice awards and the associated marketing and promotion of winners (as conducted by all industry peak bodies); making 'champions' of leading companies and practitioners (see OLs) and promoting their successes as case studies in mainstream industry media. Finally, the availability of CRC research grants for practitioner-manufacturer partnerships to explore innovative application of new or leading edge technologies would encourage the development and commercialisation of improved SP. While the range of practitioner incentives with potential for application is extensive, most currently focus on best practice and have limited effect in driving adoption of affordable, low risk better practice by later adopters owing to perceptions of un-affordability.

Best practice promotion needs little CA support in resource terms due to funding and promotion by suppliers, manufacturers, leading practitioners and their clients although, I argue that it would benefit greatly from CA input to the planning, organisation and initiation stages (ANT network configuration). Once mobilisation is achieved, achieving 'black-box' status is arguably inevitable with effective innovations due to their relative advantage for adopters.

A more important consideration for CAs when developing an incentive system is to target the specific adopter group in which they most want to generate or permanently establish change. For example, promotional incentives to incorporate the high cost or risk technologies and practices integral to best practice and inspire adoption by innovative practitioners and their consumers are common. However, strategies that incentivise the commercialisation of those technologies and the development of more effective practices to offset cost and loss of competitiveness for later adopters are rare. In their responses to my 2004 questionnaires, both architects and building design practitioner groups (polled separately) nominated the cost of SP as the biggest barrier to their voluntary adoption of innovative SP (see Appendix 2 p. 361).

Accordingly, I advocate a shift in CA focus to incentive strategies that address early and late majority adopters because adopting even modest levels of better (than mandated minimum) practice by these groups yields significant dividends owing to the volume of housing they produce. This requires an additional focus on promotion of the benefits of better practice rather than the almost exclusive current focus on best practice. In Chapter 3, I identified the lack of relative advantage associated with SP adoption as an adoption barrier that should be addressed by CAs. As argued in Chapter 3, this is easier said than done. While mandatory disclosure of an SP rating at point of lease or sale is likely to offset this to some extent in the medium term, its potential effectiveness is unknown – particularly its effect on the new housing sector. This aspect of incentives and consequences is addressed as part of my prospective analysis of the role of consumer incentives in Section 6.5.

Other barriers that would benefit from incentive provision identified during AR include consumer demand and practitioner skill development – particularly amongst consultants (e.g. engineers). Architects, (whose design practices employ more staff than building designers) also ranked a lack of skilled personnel as a significant barrier. Builders responded with slightly different rankings. 43 per cent of builder respondents (HIA GreenSmart questionnaire, 2005) deemed lack awareness among consultants to be the most critical barrier and more than 35 per cent ranked the availability of cost effective technology, consumer demand and availability of skilled staff as also being very important. Additionally, a significant proportion of builder respondents nominated lack of designer skills and conflicting local, state and federal government regulations as being important barriers.

While significant progress has been made in addressing many of these barriers since 2004-5, feedback from training attendees during 2006 and 2007 confirmed that lack of consumer demand and the availability of skilled staff remain the most significant barriers. Accordingly, I address prospective strategies to deal with each in greater detail in subsequent sections. Section 6.4.3 addresses skill provision. In 6.5.2 I examine a range of strategies (including regulation) to increase consumer demand and, in Section 6.5, I review additional strategies to address existing housing stock and consumer behaviour. Practitioners also regularly challenged the usefulness of new housing SP regulation in the absence of strategies to encourage consumers to use them more efficiently. In the next section, I examine regulatory strategies with potential to improve consumer behaviour in Section 6.3.6.

6.3.6 Regulation as a driver of more efficient consumer behaviours

Here, I critique the current AHI regulatory focus on designers and builders of new homes and propose additional strategies with potential to exert ore influence on consumer behaviour. As argued earlier, new housing accounts for less than 2% of total Australian housing stock in any given year. Additionally, early indications are that energy efficiency measures in new housing contribute little to reductions in household energy use owing to the *rebound effect* wherein *as a result of the application of energy efficient technology, the level of service provided increases* (Pears 2004). Pears cites the examples of households raising thermostat settings because heating costs have been reduced through improved thermal performance or taking longer showers because efficient showerheads reduce the likelihood of running out of hot water (ibid). This was confirmed by limited research into the performance of 5-star HERS rated homes (Williamson 2005). Although, as Pears (2004) observed, *often, the energy saving action is blamed for changes that simply reflect underlying trends anyway.* These trends include increasing house size and consumer demand for higher levels of comfort or amenity.

Accordingly, I recommend a shift in change agenda focus from fine-tuning new housing to improving the baseline performance of existing housing stock. I posit that while the continuation of regulatory bar creep in the new housing sector is essential to offset the rebound effect, more substantial and cost effective environmental gains are achievable through an additional focus on existing housing stock and particularly, the behaviour of its users (including new home owners). Existing home owners and occupiers are the most numerous and potentially largeswt contributors to reductions in housing-related environmental impacts. However, they are also the most disparate in character (in age and income) are often less knowledgeable in SP terms due to the prevalence of powerful social norms and language barriers in long established communities (Salt 2003) and are typically more cost-sensitive than new home buyers due to age and income. I contend that because change is more difficult to regulate in this sector (especially behaviour), regulatory strategies have been ignored by CAs to date. Below, I examine ways to overcome several of these barriers.

Reflective analysis of AR in DoI and ANT identified several potentially effective areas of focus for regulations with potential to influence the operation, maintenance and upgrading of existing housing stock. These include: providing consumer adoption incentives and non-adoption consequences (additional to the practitioner strategies addressed in 6.3.5 above); the linkage of SP to property value and regulatory engagement of the most powerful housing sector OL, the finance, investment and property marketing sector. Additional regulatory strategies that incorporate these drivers of consumer engagement are outlined and argued below. The influence of current regulations is summarised in Figure 11 (Page 160). That figure is further expanded in Figures 25, 26 and 27 below, where the potential influence of additional strategies that engage key OLs and market sectors is addressed.

The extent of regulatory influence under existing frameworks is indicated by the blue, dotted elipse in Figure 25, while the arrows represent additional network influences. The hollow arrows indicate the direct influence of BCA and BASIX on practitioner sectors while the red arrows indicate additional indirect competing network influences from and between other network sectors. Arrow weight is indicative of the strength of those network influences. The red, outer square indicates the extent of the AHI network and specifically, the scope of influence of lenders, property valuers and marketers – arguably the most powerful, network influence in the AHI. Current regulation does not influence this sector.

Manufacturers and suppliers are an additional sector with considerable influence over practitioners and their consumers that, while affected by AHI regulation, are not directly influenced by it. New home marketers are depicted as an AHI practitioner group because they are involved in the production of new housing whereas real estate agents are not. Of particular importance in this context is the existing home owner or purchaser group because existing regulation has limited influence on it while it is dominated by other sectors – particularly financiers and marketers.

While indicative only, Figure 25 (below) demonstrates the limited influence of current regulation on the existing housing sector while indicating the scope, number and strength of competing influences that dominate decision-making about SP adoption in the housing sector. Figure 26 below indicates the likely additional influence of mandatory disclosure of an energy and water rating at point of sale in the proposed scope. The outer purple square in Figure 27 indicates the potential additional influence of mandatory of both *rated* and *actual* performance (e.g. a NABERS rating) at point of sale and lease. The important difference between figures 26 and 27 is their potential to influence user behaviour in addition to driving investment decisions and demand for housing with superior SP performance.
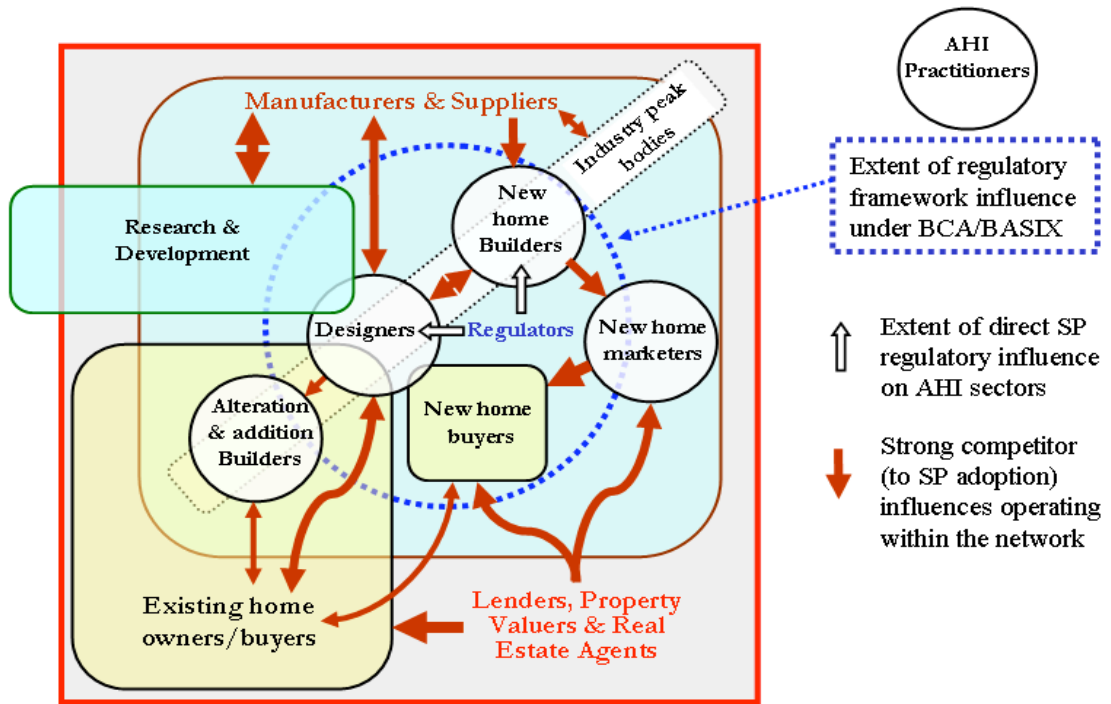
Figure 25: The influence of current regulations and competing AHI network influences.

In Figure 26 below, the outer, red, dotted square indicates the likely scope of influence of proposed mandatory disclosure of water and energy ratings at point of sale (and later lease) on OLs. The text surrounding that square indicates the likely impact on each industry sector in the AHI network and the number and weight of arrows indicate the likely focus and strength of that response.
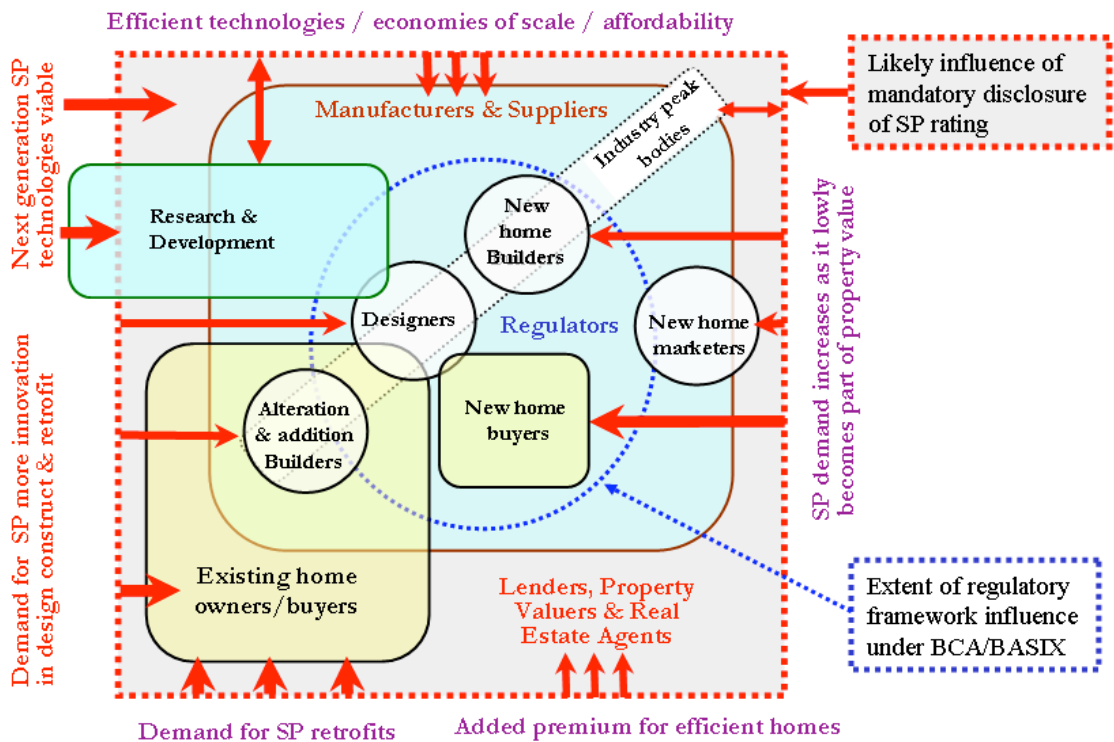
Figure 26 Likely additional influence of mandatory disclosure of water and energy rating.

By constrast, in Figure 27 below, the red dotted mandatory disclosure of 'rating only' square in Figure 26 is shown as solid and an additional (purple) dotted square has been added to scope the likely additional influence of mandatory disclosure of 'actual' energy and water consumption (e.g. NABERS) at point of lease or sale – particlarly on occupant behaviour. The additional (to rating only disclosure) benefits are sumarised in the surrounding text. The most important of these are:

- direct influence on consumer behaviour through raising awareness of inefficient lifestyle and providing both incentives for effcent behaviour and consequences for inefficiency;
- the (indirect) association of actual consumption with property value is likely to engage the finance and marketing sector in SP advocacy to increase property value;
- the creation of broad new direct and indirect SP linkages throughout the AHI network.

Whilst currently politically unpallatable, such a strategy would benefit from association with increased utility costs which are a likely outcome from the currently proposed Carbon Pollution Reduction Scheme. Mandatory public disclosure of actual consumption is also currently unlikely to receive political approval. However, I assert that voluntary disclosure should be encouraged (particularly by low energy use households) to encourage consumer consideration of the undeclared but likely additional operating costs for a lower rated home at point of lease or sale. Additionally, the relative household GGE emissions currently included on energy bills by several energy suppliers could be mandated as a first step to 'privately' raise consumer awareness.
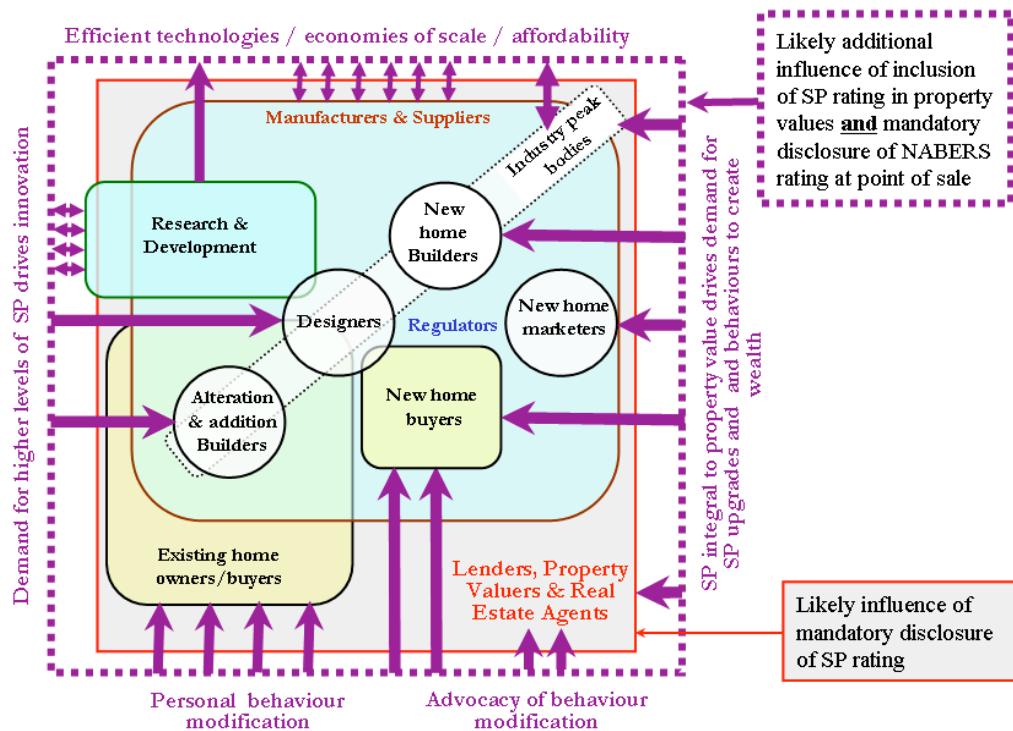
Figure 27: Likely influence of mandatory valuation of SP performance and disclosure of 'actual' energy and water consumption (in addition to water and energy ratings).

The above recommendations relate to the regulatory component of consumer demand interventions and should not be seen as 'stand alone' solutions. They are interdependent with those outlined in Section 6.5. One such important intervention is the mandatory valuation of SP. I observe that property valuers (and banks and property marketers) are currently not recognising the implications of carbon trading for future energy prices and household budgets in their valuations. This suggests the need for an additional regulatory strategy to ensure consistent valuation of sustainable home inclusions and improvements and guarantee their linkage to capital gain and wealth creation. The concept of mandatory valuation of SP is further addressed in section 6.5.6.

6.3.7 Summary

The following recommendations summarise my prospective analysis of the future role of regulation and recommended modifications or refinements to ensure maximum effectiveness.

1. Short medium and long-term targets should be nominated for all impact categories and progress toward them monitored and reported.

2. A nationally consistent regulatory framework and appropriate measurement tools should be developed and implemented for both new and existing buildings.

3. Prescriptive, paper-based minimum standard regulatory frameworks (e.g. BCA) should be replaced by web-based tools (e.g. BASIX) to facilitate:
    *   measurement of better and best practice in addition to minimum compliance thereby encouraging innovation and market competition;
    *   the provision of flexible compliance paths to encourage innovation and technology transfer between industry sectors;
    *   capacity for immediate update as new SP become available;
    *   seamless benchmark creep;
    *   interactive help and case study examples at point of decision;
    *   a 'click' to calculate function to facilitate selection of effective compliance options;

4. The certification and monitoring of compliance should be tightened through an extensive network of trained, licensed certifiers and assessors.

5. Inadequacies in current assessment tools that encourage and reward inefficient or ineffective strategy selection should be eliminated.

6. Improved, interactive feedback and consultation channels should be provided for users of regulatory tools to engage practitioners in their refinement.

7. Flexible compliance solutions should be developed to address the needs of each practitioner adopter category while encouraging 'fluidity' of innovativeness (trialling of more advanced options) when warranted in a specific project.

8. The current singular new housing focus of regulation should be expanded to include regulations that stimulate consumer demand by engaging lenders and marketers in the SP diffusion process and make SP an integral component of property value or wealth creation.

9. Better and best practice should be encouraged, recognised and rewarded;

10. The cost of SP improvements should be offset as a barrier to better and best practice through the publication of irrevocable commitments to implement regulatory targets and measures that reflect current understandings of the dire implications of irreversible climate change.

11. Industry consultation processes associated with regulatory development should be refined to encourage network participation while applying the precautionary principal to limit the right of vested interests to delay the regulatory development process through protests based on metrics and product or technology biases. Such issues should be addressed through regulatory exceptions pending research or development of new or alternative solutions as required.

6.4   Additional strategies

The need for innovation, refinement and commercialisation of SP creates another important challenge for CAs. While the need for constant reinvention of SP was identified through DoI analysis as a short-term diffusion barrier, its essential role in creating more efficient and effective medium to long-term outcomes necessitates specific attention by CAs.

In the above sections, I examined future roles for communication (6.2), regulation (6.3) in driving the adoption of better practice. Here I explore additional prospective strategies identified during retrospective DoI and ANT analysis as having potential to drive better practice adoption to critical mass in later adopter categories (in addition to innovators and early adopters). I investigate a range of motivational triggers that were identified as appropriate for application in each adopter category and suggest appropriate emphasis for each. These include: competition; recognition and reward of excellence; training, skill and information provision. The application of a mix of strategies was also recommended by Shipworth (2000) whose extensive review of home energy conservation triggers found that: different strategies will motivate different households; diverse strategies might motivate the same person in different ways and, a combination of strategies can result in change actions becoming accepted and expected (Shipworth 2000, p. 137).

6.4.1 Competition as a best practice adoption driver

Here I examine the future role of competition among early adopters and its influence down the adoption line via diverse networks. Specifically, I explore ways to increase both 'competition' between actants and, the networks through which it influences individuals and organisations. The role of awards programs (e.g. GreenSmart, BDAA, RAIA, MBA) in creating competition incentives and promoting their outcomes has been examined in detail throughout the retrospective analytical sections of the thesis. A recurring finding from that DoI and ANT analysis of competition in various contexts was that the later adopters (especially late majority) saw awards as having limited relevance in their market sector. HIA have gone some way towards correcting this bias through additional categories specific to later adopters (e.g. display home and project home of the year). In my AR role as a judge of HIA GreenSmart Awards, I observed that these categories quickly attracted among the highest entrant numbers of any category and were often the most strongly contested of all categories with significant numbers of innovative, best practice entries. I suggest that an opportunity exists for CAs to incentivise competition further by sponsoring additional cost limited categories where the judging criteria are cost-effective, high levels of SP performance benchmarked in standard industry tools (e.g. BASIX).

Awards sponsorship (a low cost – high profile strategy) could be complemented with prizes that include high profile marketing in consumer media (in addition to their current publication in industry media). Marketing could include professionally written and photographed advertorial promoting the low cost, lifestyle enhancing features of winning entries. I posit that such strategies would incentivise cost-effective SP innovation development. Currently, designers and builders of low cost housing report that they do not enter awards because of perceptions that they are unable to compete with higher budget projects. This barrier to cost-effective innovation development and the pursuit of better and best practice by late majority practitioners could be overcome at relatively low cost through the above recommendations.

An additional strategy with potential to encourage competition and SP-based market differentiation by later adopters is Mandatory Disclosure (MD). However, MD is primarily aimed at existing housing stock rather than new housing. With current mandated minimum SP standards in new housing, MD will provide little incentive for the new housing sector (particularly later adopters) to adopt better practice. This suggests the need for a specific MD strategy for new housing. For example, for BASIX or BCA compliant housing, MD might include a NABERS rating to link superior performance (including user efficiency) to marketing. I expand this argument further in Section 6.5.4 where I explore the need for MD to include declaration of 'actual' performance in the form of energy and water consumption on a per occupant capita basis.

Recognition and reward of excellence is an effective innovation driver. A primary diffusion benefit from recognition and promotion of projects incorporating SP excellence is to demonstrate that SP is achievable and, that such projects are viable and marketable. While the custom designed high budget projects typically entered in the past by innovators and early adopters were seen by many practitioners working in the mainstream or volume housing market as elitist, that profile is changing as volume housing companies embrace SP and develop innovative, cost effective solutions and begin to market differentiate on the basis of SP performance.

An opportunity exists for CAs to encourage additional mainstream actors to enter such awards and promote their success to competitors. Further, the promotion of projects in mainstream consumer media is a low cost opportunity through which CAs could create an environment supportive of excellence in SP by stimulating consumer demand and creating competitive advantage.

The potential for recognition to encourage entrants to engage in false or over-stated claims about SP achievements ('greenwash') to gain market advantage should be monitored. Sponsoring CAs should set strict judging criteria and ensure that judging panels are credentialed in SP. Less rigorous judging tends to encourage a focus on visible, low cost SP features. For example, in the Victorian EcoHomes project (Hes 2004), visible features such as solar HWS and rainwater tanks were the preferred point scoring option for builders over concealed options such as insulation and PVC free plumbing. A further risk associated with such SP promotion at the low cost end of the market is that OLs could fail - sending a negative message to an already risk averse industry.

6.4.2   Marketing strategies to increase consumer demand

Here I prospectively analyse potential benefits arising from a broadening of CA focus from design and construction practitioners to include sales and marketing practitioners. The latter group is more closely linked to and influenced by lenders and property valuers – a group that, as previously argued is among the most powerful decision-making influences in the AHI. I contend that together, these two groups have substantially more influence on consumers than design or building practitioners.

AHI businesses and practitioners have limited promotional budgets and have demonstrated reluctance to risk them attempting to achieve market differentiation in the untested (in terms of consumer demand) area of sustainable performance. When urged to market on SP principles during training, early and late majority adopters invariably responded along the lines of 'you create the consumer demand and we'll build them'.

A strategy with potential to overcome this problem was developed during AR training and consultancy with Clarendon Residential Group. This major project home company developed a high level 'SP package' and offered it on a similar basis to their luxury pack for a set additional cost.

While demand was poor at the time (2004), the 'SP package' concept was subsequently adopted by several volume home builders (See Sections 3.2.5, 3.2.6 and Box 3-2 BASIX application in Nelson's Ridge GreenSmart Village 3-2). As argued earlier, low demand for these SP packages was attributed (in part) to a lack of SP knowledge and motivation among sales staff. It was suggested that provision of SP training to sales staff would at least partially overcome this barrier. (See also section 6.3.2 for the role of regulation in addressing this problem).

Clarendon Residential Group were the first company to deliver SP training to sales staff using the *Your Home* Buyers Guide in 2007. Evaluation of that training reported positive outcomes. Staff indicated that they found the guide to be useful in a proactive way with some clients and left the course feeling confident in their capacity to use the guide to explain and market SP inclusions to clients. Staff expressed a need for access to backup technical information on issues raised in the guide to appear technically competent in front of clients. Some staff felt that the guide placed too much information in the hands of their clients but most saw it as a marketing advantage for Clarendon (T_Issues_Consultancy 2008).

In addition to SP training for marketers, I postulate that the promotion of events and display villages where homes with both minimum and best practice SP are marketed (as occurs in many marketing strategies that include luxury and performance models) would facilitate market differentiation based on SP. While this strategy might strengthen consumer perceptions that SP belong at the luxury end of the market, perceptions could be turned to advantage by sales staff trained in the marketing of low cost SP 'upgrade packages' on the basis of affordable luxury. This sales method has been demonstrated to be very effective in the automotive sector and I claim that it is equally relevant in housing because it would ensure that the unseen performance benefits of SP were promoted in each case.

GreenSmart builders and other innovators frequently report that the promotion of their well designed 'free running' products in display villages is problematic because their competitors run heating or cooling at very high thermostat settings to make a subliminal thermal comfort impression on consumers. A strategy to overcome this and 'level the playing field' in marketing terms might involve mandating the declaration of energy use in display homes and marketing materials (e.g. 'this display home is air-conditioned and is unlikely to achieve similar levels of comfort in 'free running mode') or, mandate the prominent display of 24 hour smart metering in display homes.

Prospective ANT analysis leads me to recommend a further strategy that involves a network of partnerships between volume housing actors and CAs to promote the unseen benefits of SP to consumers. DoI analysis identified opinion leadership by the volume housing sector as an effective change creation strategy that is currently under-utilised by CAs. I suggest that celebrity advocacy of

the thermal comfort, lifestyle benefits and low running costs of best practice SP homes (often owned by pro-environment celebrities) could exert significant influence on consumer opinion in today's carbon aware environment.

6.4.3 Information and skill provision as a best practice adoption driver

Retrospective DoI analysis in Chapter 4 indicated that high skill levels are critical to both the innovation decision process (Section 4.1.7) and the innovation development process (Section 4.2.5). AR observation and analysis throughout my retrospective analysis demonstrated that skill acquisition also encourages practitioners to adopt opinion leadership roles and participate in competition and market differentiation based on SP (Section 4.1.7). Clearly, skill development is a fundamental component of effective change. Opportunities to improve skill delivery identified through retrospective analysis include:

- improving skill delivery processes including provision of alternative learning paths and motivations and, addressing the specific needs of adopter groups and industry sectors (Sections 3.3.3 and 4.1.7);
- providing post training support networks including skill exchange and SP problem solving e-groups (Sections 5.2.3 and 6.2.3);
- developing specialised or advanced training and delivering it within an accredited SP skill hierarchy similar to that outlined in the BITS proposal (Giffard & Reardon 2003) to accredit and quality assure the various types of SP consultant as new AHI vocations (Sections 2.6.4 and 4.1.7).
- providing appropriate skill and information for each adopter category (i.e. innovators, early adopters, early majority and late majority (Section 3.3.3);
- promoting opportunities arising from skill and information exchange between customised innovation specialists and the volume sector who refine (simplify) and commercialise SP innovations (Section 4.2.5).

Further opportunities are examined through the prospective analysis below.

Improving skill delivery by meeting complexity and diversity in SP skill needs

While Section 4.2.5 identified the provision of a diverse range of skills as a driver of innovation development, Section 3.2.3 identified problems for RTOs (Registered Training Organisations) and course developers arising from the need for constant updating of course content and training materials to reflect those developments. Additionally, divergent skill and knowledge levels among practitioner attendees make it difficult to tailor training to specific audience needs. This highlights the need for a fresh approach to training development similar to that proposed in BITS (Giffard & Reardon 2003) that includes a formal structure through which prior learning can be recognised and

built upon. The need to move from generalist training to specialist courses within an overarching skill hierarchy has now become urgent.

In that hierarchy, introductory level training should be recognised as a fundamental first stage. The requirement for non-technical, entry level information to contextualise SP through introductory level training remains important because new practitioners who have not been exposed to SP concepts during tertiary training or CPD will continue to enter the field for the foreseeable future. These new practitioners include (but are not limited to): home energy auditors; sales staff and real estate agents; lenders and property valuers; product specifiers, quantity surveyors, estimators and purchasing officers.

However, because the majority of design and building practitioners (including architects, engineers, planners and developers) have already received introductory level training or, in the case of recent graduates, have received it during tertiary education, there is a growing need for delivery of specialist skills to keep pace with advances in SP and resultant regulatory benchmark creep. Innovation development and reinvention continue to deliver new, advanced practices and technologies and growing consumer awareness is driving demand for sophisticated applications in some industry sectors. Emerging specialist skills include: advanced thermal performance consultants; specialist design and building practitioners for sustainable retrofit, alteration or addition in response to mandatory disclosure; low energy lighting designers; low GGE heating specialists (e.g. heat recovery, solar hydronic or geothermal heat pump) to name but a few.

My AR observations of current ad-hoc responses by industry and CAs to meeting training demand are wasteful due to duplication of introductory level training and ineffective due to a lack of advanced or specialised training or formal assessment. Proprietary ownership of training also limits access by some practitioners. Current and recent AR observations confirm that advanced skill and information needs are not being met (except by ABSA as part of its CPD and quality assurance protocols for assessor members). Practitioners attending generalised training (e.g. GreenSmart) for a second time to refresh their skill and information levels report difficulty accessing skills, training and information appropriate to their needs through refresher or advanced courses

I suggest that, in the absence of a BITS like program, an effective interim solution to this problem is for CAs to partner with ABSA in promoting the availability of 'advanced' training and support information (e.g. updates) through ABSA and providing incentives (e.g. subsidised training) for non-members to attend. Much of ABSA's member training is funded through annual licence and membership fees. Because of this, fewer non ABSA member practitioners are attending ABSA training and this has potential to limit important network interaction between the innovative practitioners who develop new solutions and the assessors whose role includes validating, value adding and advocating their adoption by less innovative clients from later adopter groups.

What types of training and skills are required?

In Chapters 2, 4 and 5, I identified discontinuation of SP-related curriculum content skills in most tertiary education for AHI practitioners during the mid 1980s (ABEC 2002; Baggs & Cole 1997) as a substantial barrier to SP adoption. While this deficit is currently being corrected by Universities and TAFEs, I suggest that current high levels of demand for introductory CPD training will continue in the medium term until the SP skill shortage among practitioners from later adopter categories is met and recent graduates become established in the AHI workforce. As this occurs, the current trend in demand for more specialised CPD training by early adopters is also likely to increase in line with SP diffusion. Further, as the later majorities begin to apply higher levels of SP in response to regulatory bar-creep and consumer demand, training in specialist volume housing solutions will also be in high demand.

The following prospective recommendations summarise the priority specialist training needs of AHI practitioners. They are drawn from AR observations of current industry needs and course limitations, trainee feedback during existing courses, specific training requests by practitioners and reflective practice observations and notes made while developing and delivering a range of continuing professional development (CPD) training to each of the main practitioner groups.

1) Advanced thermal performance design skills for each major climate zone (i.e. heating, cooling and mixed climates) including: appropriate construction systems; glazing and shading design; thermal mass calculations and design; insulation design, specification and installation – particularly reflective foil insulation which is not well understood.

2) Practitioner (not ABSA assessor) skills in using HERS as a design (not rating) tool;

3) Advanced thermal performance solutions for the volume housing sector including: quality assured, commercialised technologies and practices (e.g. glazing and insulation standards; thermal mass; cross ventilation; zoning design) and, the role of the volume housing sector in innovation development.

4) Advanced appliance selection – particularly innovative heating, cooling and HWS technologies (e.g. ground or water source heat pump, co-generation, solar-hydronic, fans and de-humidifiers).

5) Compliance certification skills for building inspectors and private certifiers;

6) SP communication and marketing skills for all practitioners who have direct consumer contact (i.e. design, construction, assessment and marketing) with particular emphasis on sales staff.

7) Cost effective carbon neutral and positive housing solutions.

8) SP Refresher courses to update practitioners on innovation development trends.

The above summary is indicative of needs observed during AR and is not claimed to be comprehensive. I strongly advocate further research to identify and prioritise all SP competencies required by built environment practitioners. Further, I assert that their incorporation within an ANTA recognised hierarchy that structures their development and delivery as recognised qualifications towards a new industry vocation *sustainability consultant* should become a high priority CA objective. As recommended by Giffard and Reardon (2003), this qualification should be attainable by completing a range of role specific accredited CPD modules and/or university and TAFE courses.

The role of networks in reinforcing learning outcomes

Training has both interpersonal and network components and both need to be addressed in training design and post training support to ensure the most effective outcomes in terms of ongoing behaviour change. Reflective practice combined with DoI and ANT analysis of AR confirmed that such interaction between participants is a critical component of training. Box 3-27 examined the role of interaction between attendees from different adopter groups during GreenSmart training within DoI. ANT analysis in Section 5.2.4 explored the role of training and skill provision as a driver of SP network formation and opinion leadership and Section 5.3.4 identified HIA's failure to fully develop a post-training support network for GreenSmart professionals as a mobilisation barrier. In Section 6.2.2, I discussed the importance of interpersonal communication between peer and expert peer in reinforcing learning outcomes and described the various AHI network links through which this occurs for each adopter category and practitioner type.

The outcome of this analysis is agreement between ANT and DoI that networks are essential to reinforce learning outcomes in a post training environment. Accordingly, I recommend that CAs and RTOs delivering SP training make the formation and support of such networks a central component of their overall skill delivery package.

Summary

Retrospective analysis of AR identified the role of skill and information provision to AHI practitioners as a significant driver of SP adoption and confirmed its importance as a driver of better and best practice as change agendas mature - especially regulation and benchmark creep. Additionally, it highlighted the need for refinement and customisation of training and skill delivery to suit the varied needs of practitioners with differing levels of skill development, workplace application and consumer demand. My prospective analysis suggests that practitioner skill and information needs will become specialised as SP diffusion progresses in the AHI.

Further, the interdependence of skill provision and best practice adoption identified through both retrospective and prospective analysis suggests that developmental evolution of training courses should exceed practitioner demand from each adopter category rather than simply meeting it. In other words, training should lead opinion and demand rather than responding to it. Such a strategy has potential to encourage the increased levels of innovation required to cost-effectively meet the ultimate sustainable housing targets nominated in Chapter 2 (zero net lifecycle environmental emissions and zero net lifecycle environmental depletions). The immediate focus should be on GGE reductions to maximise the AHI's significant potential to deliver short and medium term contribution to climate change mitigation until longer-term supply side options become viable.

6.5   *Existing housing stock and user behaviour*

In Section 6.3.6, I critiqued the new housing focus of CAs and argued that existing home owners are the most numerous and potentially the biggest AHI contributors to reductions in SP-related environmental emissions and depletions. While the role of existing housing and consumer behaviour is beyond the core focus of this research (i.e. new housing and the practitioners responsible for it), the existing housing sector and its owners, renovators, financiers and marketers are inextricably linked to the new housing sector. Additionally, the existing housing sector and the behaviour of users of both new and existing housing has emerged as the most important 'next step' in providing meaningful outcomes from sustainable change in the housing sector and provide the greatest potential for significant short-term reductions in GGE and water use.

Recent exponential increases in climate change onset (IPCC 2007b) and the associated need for more immediate and effective responses that arose during the currency of this research necessitated this shift in focus from AHI practitioners to AHI consumers. While beyond the initial focus of my research, my AR roles now include participation in the development and implementation of programs to address existing housing and consumer behaviour due of their potential to deliver immediate GGE reductions. In those roles, I have observed that the current urgency being applied to policy development in this field is already creating duplication between state, commonwealth and NGO CAs. This has potential to lessen the effectiveness of change agendas through poorly designed and targeted strategies that overlook important lessons learned from previous experience (evidenced by the two Garnaut strategies critiqued below), thereby generating confusion and disempowerment among consumers. The following sections seek to re-visit those lessons in the current context of the Green Loans and Mandatory Disclosure policies to identify and recommend additional strategies drawn from DoI and ANT analysis during this research.

Garnaut (2008) suggests two strategies to create incentives for home owners to improve household energy efficiency. The first involves subsidising third parties to provide advice or install low-emission options in homes. The second involves creating obligations or incentives to encourage third parties such as energy retailers to deliver energy efficiency improvements from households and businesses (Garnaut 2008a, p. 412). I would suggest that many additional (and arguably more viable) strategies have already been identified throughout this research and indeed already implemented by AR partners. Additional strategies are addressed in Sections 6.5.4 and 6.5.5 below.

Garnaut acknowledges the limitations of these strategies through his observation that cost is likely to limit the number of audits and subsidised installations able to be delivered. Accordingly, he recommends that schemes should focus on low-income households. He also observes that because schemes rely heavily on household adoption decisions, they tend to favour informed individuals who are already motivated to save energy adverse distributional impacts would occur. Additionally, while recognising their potential to affect both household behaviour and building efficiency, he recognises the difficulty of estimating the actual outcomes that might be delivered by 'obligations or incentives' approaches (ibid). These observations are consistent with my research findings and suggest that Garnaut's doubts about their effectiveness as incentives for home owners are well founded. The question then remains, what strategies might provide incentives for home-owners?

6.5.1 Communication channels and strategies for consumers or householders

In this section, I review the communication strategies applied in consumer change agendas in terms of the scope of their audience focus and the methodologies that underpin them through a brief review of change creation literature. My earlier prospective analysis addressed the roles of: regulation (6.3.1 and 6.3.2); voluntary codes of best practice (6.3.3); information and skill provision and network building for practitioners (6.4.3) within the analytical frameworks of DoI and ANT. However, strategies that target consumer audiences have been largely overlooked because they fell outside the focus of existing AHI change agendas. This critique briefly examines useful ANT and DoI strategies through which to address the needs of those audiences in a prospective context.

In current consumer change agendas, many CAs have relied heavily on providing information to change behaviour. Indeed, consumers were an important component of the *Your Home* audience. While information provision initiatives might meet the needs of early adopters who are already motivated to change, my research indicates that they have lesser impact on later adopters. Rogers notes that excessive communication about innovations can cause information overload among later adopters whereby an adopter (or OL) is unable to select the most relevant messages for their context (Rogers 2003, p367). The vast range of information being circulated by CAs on the need to adopt more sustainable behaviours clearly fits within this scenario. I suggest that in some cases, such approaches have contributed to adoption breakdown - a problem noted in the statements:

Behaviors, of course, must be supported by knowledge and attitudes. But, research in the field of environmental education and in commercial marketing (Hines, Hungerford & Tomera 1987 in Monroe, Day & Grieser 2000) *has shown that there is no cause-and-effect progression from knowledge to attitude to behaviour as educators have long believed* (Monroe & Day 2000, p. 3).

Clearly, alternative strategies are needed. In her analysis of change creation methodologies in household energy efficiency, Shipworth (2000) recommended the use of a range of strategies in addition to information provision which- she noted 'sometimes motivates'. These strategies include: financial savings; subsidies and rebates; linking attitudes and actions; tapping into social and cultural influences (particularly social norms) and market transformation strategies including labelling, MEPS, regulation and pricing (Shipworth 2000).

In his paper 'How to make a theory of change', Robinson used story analysis to explore the experiences of 93 adults who had adopted personal lifestyle changes related to SP during the previous 12 months (Robinson 2006a). His analysis of the findings led him to suggest the following seven propositions about the voluntary adoption of new behaviours by individuals:

> *1) Individual voluntary changes result from personal dissatisfaction or frustration driven by dissonance between a person's self-image and life's arrows.*
>
> *2) The triggers for change are usually social interactions with family, workmates and friends.*
>
> *3) People need confidence in their ability to change (self-efficacy).*
>
> *4) Many changes are stimulated by major life events or breaks in routine.*
>
> *5) Beliefs about the change – such as reasons, causes and effects, costs and benefits, and consequences- tend to have a rationalising role rather than a triggering role (i.e. they allow people to justify the change to themselves and others).*
>
> *6) Sustained behaviours depend on supportive people, products, services or infrastructure that makes the new behaviours convenient.*
>
> *7) Sustained behaviours are those that provide sustained satisfactions, (including unexpected satisfactions).*

Based on these propositions, Robinson (2006b) proposed a psychological model of voluntary change with four elements: predisposing factors (dissatisfactions), enabling factors (rationalisations, self-efficacy, and convenience), triggering factors (social interactions) and satisfying factors. An effective application of these principles can be found in *Enabling EcoAction: A handbook for anyone working with the public on conservation* (Robinson & Glanznig 2003).

The above models have much in common with GreenCom's 'four strands' approach to the communication of environmental change messages. This advocates: i) applying aspects of community-based Social Marketing (McKenzie-Mohr & Smith 1999) to *encourage new (healthier, more environmentally friendly) behaviours in groups of people* ; ii) specific environmental communication strategies to reach target audiences; iii) Environmental Education as a process to *prepare citizens to*

prevent and solve environmental problems and; iv) the need to facilitate public participation in solutions as a basic tenet of all strategies to enhance their effectiveness in changing policy or making it more effective (Monroe & Day 2000).

Social marketing applies commercial marketing tools to change human behaviour. In their examination of the applicability of marketing concepts to social causes and social change, Kotler and Zaltman defined social marketing as...*the design, implementation, and control of programs calculated to influence the acceptability of social ideas and involving considerations of product planning, pricing, communications and marketing research (Kotler & Zaltman 1971).* They concluded that, while a marketing planning approach does not guarantee achieving social objectives, it provides a bridging mechanism through which behavioural science can be applied to socially useful behaviour change initiatives.

By drawing on theories or change creation methodologies outside those applied throughout this research, the above approaches identify useful, additional communication strategies through which existing households might be better engaged by CAs. While effective and inexpensive to implement, communication strategies require careful design and planning such as those outlined by Robinson in his 13 steps to good practice in communicating sustainability (Robinson 2002).

AR observations confirm that poor planning (often attributable to inadequate resource allocation during the development phase) frequently leads to their omission. For example, I contend that the current approach to developing the Commonwealth's 'Green Loans' program by CA DEWHA is likely to overlook many opportunities to incorporate important consumer engagement strategies owing to inadequate program development timelines attributable (in part) to political demands for expeditious delivery of the program. (This agenda is addressed in Section 6.5.4).

Robinson criticises CA use of education as a universal panacea of public policy and outlines seven steps to social change (Robinson 2007) drawn from Social Marketing theory to guide designing behaviour change programs. In this model, education is but one of several important components. Figure 28 summarises those seven steps for designing voluntary change projects. Figure 29 shows Robinson's analogous depiction of them as 'seven doors to change' in which the educator is depicted as a 'door opener' to several components of a process of change rather than its application as a single step solution to the implementation of public policy intended to create change often assumed by CAs (Robinson 1999, 2007).

Figure 28: Seven Steps to social change (Source: Robinson 1999).
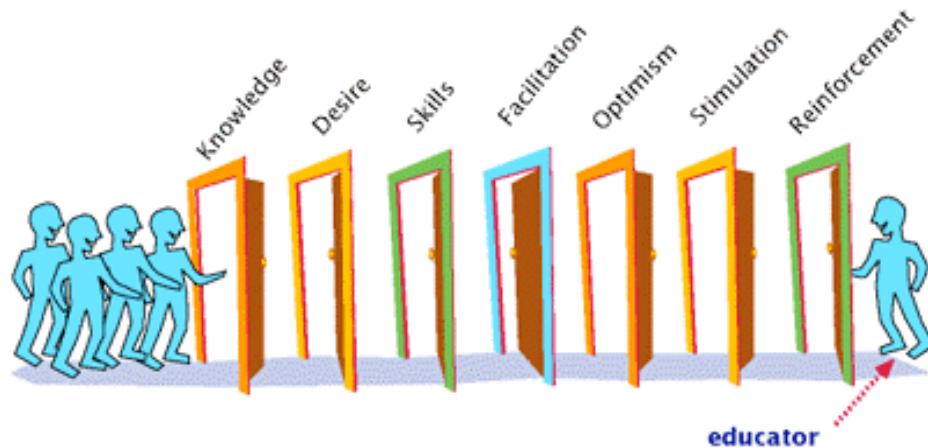
Figure 29: The Seven Doors to Social Change (Source: Robinson 1999)

Robinson (1999) positions the above approaches in and DoI theory as diffusion strategies through his observation that: …*in order to voluntarily adopt a behaviour, recipients of a change message must: perceive it to be beneficial; see it as compatible with their needs and values; find it easy to understand or adopt; be able to trial it and most importantly, feel that that the results of the trial or adoption are viewed positively by their peers* (Robinson 1999). In other words, DoI, Social Marketing and the other strategies outlined above are complementary change-creation methodologies with potential to value add those identified through DoI and ANT analysis of AR – especially in the voluntary adoption of SP by consumers.

In the next section, I apply insights developed through DoI and ANT analysis prospectively to identify strategies with potential to drive consumer demand, This analysis is informed by the brief overview of complementary consumer communication strategies and theories outlined above.

6.5.2   Strategies to achieve critical mass in consumer demand for SP

Rogers outlines four strategies for reaching critical mass for interactive innovations such as SP. (Rogers 2003, p. 361). The first involves targeting respected individuals in the social system hierarchy to adopt and become champions of the technology. While this strategy has been applied successfully in the AHI practitioner sector, its potential in other sectors (e.g. finance, marketing and real estate) remains untested. Such applications are examined in Sections 6.5.4 and 6.5.5.

The second strategy involves shaping individuals perceptions about the innovation by implying that its adoption is inevitable or that critical mass has or is about to occur. Again, this strategy was applied successfully in the practitioner sector during AR. While recent tipping points in awareness of climate change and water shortages have primed the community for a message, CAs are yet to link this awareness and expectation with specific solutions or innovations adopted in response. I suggest that the proposed mandatory disclosure and Green Loans initiatives addressed in Section 6.5.3 have potential to achieve this – although I also contend that current reluctance on the part of

CAs to target personal behaviour through mandatory disclosure of actual energy and water consumption will amount to an important missed opportunity should it persist.

Rogers' third strategy recommends introduction of the innovation to *intact groups in the system whose members are likely to be more innovative (ibid)*. While the targeting of architects and building designers by CAs throughout the entire AR journey has demonstrated the enormous potential of this approach, it is yet to be applied within the broader community. I examine strategies with potential to address this through Mandatory Disclosure and Mandatory Valuation (Sections 6.5.4 and 6.5.5).

In his final strategy, Rogers recommends that incentives *should be provided to early adopters – at least until critical mass has been achieved (ibid)*. This strategy has also been applied to a range of SP including lighting, showerheads, solar HWS and photovoltaic arrays. While some experts argue that the recent means testing of photovoltaic subsidies amounted to the withdrawal of the incentive from those most likely to adopt them well before adoption reached critical mass, I suggest that subsequent over-subscription of the scheme by lower income earners indicates that indeed, critical mass had occurred and that the subsidy was a successful diffusion strategy. Alternative strategies such as 'feed in tariffs' are discussed in Section 6.5.6 along with other innovations that might be addressed through the Green Loans program.

6.5.3 Green loans

During its 2007 election campaign, the Rudd government announced that it would introduce a 'green loans' program to provide financial assistance to householders who choose to improve their homes by adding sustainable technologies and features. In a Ministerial press release, Minister Garrett announced that:

> *Low-interest Green Loans of up to $10,000 will be made available to home owners specifically for the installation of solar, water and energy efficient products in their homes.*

> *Each household will be required to pay back the loan at the maximum rate of two percent of their annual gross income, with a minimum of $300 to be repaid each year.*

> *Under this program, households will be provided with a Green Renovation Pack and receive a household sustainability assessment report. The report will contain information on green home improvements, estimates of how much money could be saved by households implementing the ideas in the report and details of the benefits these changes will have for our environment* (Garrett 2008).

The program is due for delivery in 2009. It has potential to include many of the DoI elements common to successful diffusion studies in the DoI literature. Additionally, it has potential to embody several of the specific strategies identified in Section 6.5.2 above as likely to stimulate consumer demand for SP among consumers. However, opportunities to realise this potential are

now very limited due to its fast tracked introduction, limited scoping and failure to call for submissions and expert input such as those in the prospective analysis below (my offer to submit recommendations was declined by DEWHA).

Observations during current AR involvement in aspects of the program's development suggest that its objectives have shifted during the development phase. While details of the subsidised loan component are yet to be announced, current indications (November 2008) are that the Green Loan component is to receive a lower priority and that the principal focus will be the delivery of Home Sustainability Assessments and the collection of data about the SP status of Australian Housing. A rapidly developed course to train and licence Home Sustainability Assessors (HSAs) was launched in December 2008 and has currently trained over 400 assessors. It is intended that this course be upgraded to a nationally accredited HSA qualification during 2009.

The following prospective analysis of the program within the DoI and ANT leads me to suggest that its effectiveness will be determined by the communications strategies applied during implementation. Assessment by appropriately skilled and licensed HSAs provides an opportunity to engage home-owners in the SP adoption process through the interpersonal communication (IC) channels discussed in Section 6.2.2). However, as argued in Section 6.5.1, that communication should be planned using sound 'change creation' methodologies similar to those summarised by Robinson in his '7 doors' approach (Robinson 2007).

Prospective DoI analysis of the program as it is proposed suggests that local opinion leadership opportunities through community-based interaction between Green Loan or HSA adopters and potential adopters is an important aspect of the package that is currently missing. A simple solution might include the training and resourcing HSA assessors to launch programs in their own communities via community events such as fairs, festivals, school events. I suggest that the effectiveness of this strategy would be further increased through the targeted recruitment of homophilous HSA assessors with similar backgrounds to their intended clients (e.g. local 'mums and dads' seeking part time employment).

Additionally, my DoI analysis indicates that HSA assessors would be more effective if trained to recognise and respond to varying levels of innovativeness and stages of adoption decision among their clients with appropriate IC strategies. For example, innovative households may require their assessor to open Robinson's (2007) doors 7 and 8: stimulation (encouragement to pursue better practice) and reinforcement (recognition of the steps they have already taken) whereas early majority adopters might require doors 3, 4 and 5: skills, facilitation and optimism. Later adopters will need to have doors 1 to 5 opened by their assessor: knowledge (I know I should); desire (I want to); skills and facilitation (I can and its easy with a green loan) and optimism (its worthwhile).

While my AR role in the training development team confirms that these skills have been incorporated into assessor training (Robinson was engaged as a consultant), training developers identified the need for these skills to be further developed and reinforced by assessors in the workplace as part of an mentoring program. However, the proposed 'one size fits all' time allocation for assessment does not allow for this level of customised approach and may compromise outcomes. Further, the absence of a follow-up or 'reinforcement' visit by the assessor is likely to deliver much lower adoption of the advice provided by the assessor (see earlier arguments in Sections 6.5.1 and 6.5.2).

Finally, from an ANT perspective, I argue that restrictive development timeframes for the Green Loans program have limited DEWHA's capacity to adequately address the important problematisation stage of network configuration (evidenced by frequent shifts in scope and emphasis during development). This has placed limitations on the interressment phase (evidenced by withdrawal of support by key actants including State Government CAs with similar or competing programs that could be complementary and led to a failure by DEWHA to enrol appropriate measurement tools such as NABERS and existing training and skill bases in industry peak bodies. The result is arguably weaker network configuration with much duplication of important actants that will likely experience resistance or competition from non-aligned (duplicated) actants during the mobilisation phase. The target audience (householders) are likely to be confused by being asked to choose between a competing and duplicitous range of options.

My prospective ANT analysis suggests that the Green Loans- HSA program would benefit from declaration of a 6-month pilot phase by DEWHA during early 2009 during and after which problematisation should be completed and interressment re-commenced, expanded and completed. This would facilitate the development of strong network linkages between Green Loans, HSA and other complementary new actants including: Mandatory Disclosure; Mandatory valuation; the Carbon Pollution Reduction Scheme in addition to pending supply side actants including increased energy costs.

My ANT analysis leads me to conclude that, were these powerful individual actants to be linked through a well branded and understood, cohesive household change creation network, their combined change creation potential would achieve expeditious and cost-effective 'black-box' status whereby householders simply accept a new paradigm of need and value in household sustainable performance. I argue that the current approach, disparate application of the individual actants (reflected in the proposed time-frame for the isolated mobilisation of the Green Loans and HSA program during January 2009) will, at best see it under-achieve and at worst, ensure its eventual failure.

6.5.4 Mandatory disclosure

As discussed in Section 6.3.6, the lack of relative advantage associated with SP adoption is a significant adoption barrier that must be addressed as a matter of urgency if SP adoption by householders is to become mainstream. While mandatory disclosure (MD) of an SP rating at point of lease or sale is likely to offset this to some extent in the medium term, its potential effectiveness depends on a range of variables being examined by CAs (including DCC and DEWHA) as part of the Commonwealth's investigation of energy efficiency strategies intended to complement the carbon trading-related recommendations in its Green Paper (DCC 2008). Specifically, this investigation is examining: what might be declared, how it might be measured and how or stringently that information might be linked to strategies likely to create relative advantage such as property values and energy bills. In the following sections, I review the current direction of this enquiry and contrast them with my own research findings that identify the two most important aspects to be addressed as: the types of information declared and their linkage to incentives and consequences (i.e. risk and reward).

The state of play

The Commonwealth is preparing its White Paper that will inform Australia's Carbon Pollution Reduction Scheme (CPRS) response as a follow-on from the preliminary Green Paper (DCC 2008) and the Garnaut Reports (Garnaut 2008a, 2008b). The Commonwealth intends introducing a range of 'complementary measures' to the CPRS scheme that address demand side or efficiency measures. In his submission relating to these complementary measures, Pears (2008) points out the likelihood of *perverse and adverse* impacts of the CPRS on *voluntary abatement by households and businesses not liable parties* under the CPRS (Pears 2008). While Pears suggests a range of practical measures to overcome these impacts that include rewarding voluntary abatement efforts that go beyond what is 'reasonably expected' under CPRS. I contend that simple, performance-based MD along the lines proposed in my summary below would provide a effective, low cost method to achieve this in the case of householders.

However, MD assessment systems are currently being developed by DEWHA and early indications are that they will involve a complex, assessment intensive system based partly on HERS assessment. This approach is partially based on earlier research by DEWHA on MD through the National Framework for Energy Efficiency (NFEE) that saw two reports commissioned. The first was an international study of similar schemes in other countries (Delorme 2005) which indicated that few schemes were operational but several were planned for the UK, Europe and Canada. NFEE then commissioned a scoping study by SBE and Energy Consultants to identify appropriate measurement tools for MD application in Australia (SBE & Energy_Consultants 2005). This report recommended adopting HERS modelling as the basis for MD based on the ACT experience with

First Rate (known as ACTHERS) that had achieved significant success in the six years of its operation. At their meeting in April 2007, the NFEE building group discussed further options and opinion varied between state and territory government representatives. While several states preferred a HERS approach, others commented that it was too energy and thermal performance-focused and that appliances needed to be addressed. At time of writing, no further reports on NFEE progress in MD were available.

Garnaut's position on MD

In his Report to the Commonwealth on options for the CPRS (Garnaut 2008a), Garnaut supports the expansion of mandatory disclosure:

> *…ensuring that both parties in a transaction have access to sufficient information will generally be the most effective way to address information asymmetry. Disclosure schemes, such as energy efficiency ratings, complement an emissions trading scheme as they assist individuals to act on the price signal… disclosure schemes will be far more effective if they are mandatory, as sellers are only likely to apply voluntary labels to high-performing products, leaving consumers unable to select among average and poorly performing products* (Productivity Commission 2005 in Garnaut 2008).

While these statements are consistent with my research findings, subsequent statements are not.

Garnaut suggests that *The disclosure mechanism should be designed to show the running costs of the good, use familiar language (such as payback periods), and should be located at the point of sale, as for public information programs* (2008). As argued throughout this research, financial savings and payback periods are an ineffective SP marketing strategy because they create a consumer expectation that sustainable improvements should pay for themselves while simultaneously demonstrating that the financial savings are so low as to be insignificant for many households. This strategy continues to portray SP as an optional 'value add' rather than an intrinsic component of a home in 2008 and beyond as it should (and needs to) become. For example, payback and financial savings are never used to market extra bedrooms, spa baths, expensive finishes or excessive size in homes and yet these features are accepted as important components of property value and market differentiation.

Garnaut goes on to state that: *Mandatory disclosure should be applied to goods where it is cost effective to do so. This will be determined largely by the administrative cost of the scheme, its accuracy and the potential savings to consumers* (Garnaut 2008a, pp. 412-413). I strongly disagree with this statement. As argued in Section 6.3.6, a more important role for mandatory disclosure is its capacity to incorporate SP into property values and the associated wealth creation potential, thereby adding genuine (but less quantified) incentive for consumer adoption in a similar way to many other recognised but unquantifiable components of property value (e.g. views, status, aesthetics and neighbourhood amenity). The important distinction here is that in the latter scenario, incentives arise from the linkage of energy

308

performance to property value rather than actual energy bill savings. In this sense, the accuracy of the scheme is less critical but its linkage to additional interventions such as MV are essential (See Section 6.5.5 below).

Garnaut (2008a) cites economic modelling by DEWHA based on the ACT experience with mandatory disclosure of HERS rating at point of sale linking star ratings to average increases in capital value (DEWHA 2007) and suggests that a national scheme *could be useful (Garnaut 2008a)*. While similar results might be assumed in climates where winter thermal discomfort and the associated heating costs are equally significant, I suggest that they are less likely to occur in the majority of more benign Australian climates. This supports my argument that the linkage of mandatory disclosure to property value rather than actual energy savings is a more viable strategy. In that context, thermal comfort becomes the incentive rather than financial savings.

Finally, my research findings support Garnaut's (2008a) recommendation that a national mandatory disclosure scheme should be imposed at both point of sale and lease. His concerns about the cost and accuracy of the assessment are well founded based on the ACT model that relies on HERS modeling. I posit that expensive and rigorous modeling is of limited benefit in assessing existing households to identify cost-effective retrofit or upgrade strategies. HERS is a pre-construction rating tool for new housing. It addresses the complex interaction of a range of design elements for thermal performance. While these components can be simply and cost-effectively improved at design stage, they are difficult and expensive to address in a post-occupancy one.

As an alternative, I advocate the adoption of a simpler, more holistic rating tool such as NABERS (or the new tool being developed for the Green Loans – HSA scheme). Such tools have several advantages over HERS in the existing home assessment context. Firstly, they address three critical elements that contribute to household energy performance: thermal performance, appliances and occupant behaviour. HERS simulation addresses only thermal performance (although Accurate is being modified to examine appliances). Secondly, output from NABERS style tools can be adjusted to identify and recommend cost-effective rectification strategies for a range of SP indicators (e.g. water, waste and transport) specific to each household.

For example, a HERS simulation might identify that additional thermal mass, reduced window area on one or more elevations or the use of a different glazing type would improve thermal performance. While simple to accommodate at design stage in a new home (and cost-effective over expected lifespan), such recommendations are expensive and difficult (if not impossible) to implement in existing homes. On the other hand, shading, curtains, insulation and user behaviour modification are simpler, more cost-effective solutions likely to be recommended by NABERS and more likely to be adopted by existing households. HERS does not address these.

Finally, assessment costs are much lower and the methodology much simpler and more accessible with NABERS style tools than the expensive and relatively 'black-box' HERS tools. In its current from, NABERS is a user-friendly program that allows individual households to benchmark their own performance against other households of similar size in similar climates using real energy and water bills. This accessibility is an important component of change creation that, if linked to mandatory disclosure and mandatory valuation, would empower households to improve the sustainable performance of their homes and have this reflected in their property value.

Summary and recommendations

While the declaration of some type of standardised rating that benchmarks likely levels of sustainability performance that a tenant or purchaser might expect from the home under various occupation scenarios is essential to facilitate consumer influence through market choice, such ratings address only part of the problem. I argue (on the basis of earlier analysis) that such a declaration is unlikely to influence the behaviour of the occupants once they have moved in unless it is linked to additional incentives and consequences. While increased utilities costs resulting from carbon trading and water shortages are likely to deliver significant incentives to low and average income households, they are less likely to provide sufficient incentive for wealthier households.

For all households, and particularly affluent households, the mandatory linkage of SP performance to property values would add an irresistible incentive – its role in capital gain and wealth creation. The role of mandatory valuation of sustainable performance to achieve this linkage is addressed in Section 6.5.5 below.

I recommend an alternative or additional approach to provision of incentives and consequences. It involves the setting of minimum performance levels for MD and mandating that they be declared at point of lease and met prior to sale. The scheme would be announced with clearly defined short, medium and long-term targets that would coincide with pre-scheduled bar creep. Such a scheme would immediately add value to higher performing housing and send a clear message to the market that SP is now an integral part of property value and encourage home-owners to plan SP upgrades. This scheme would require flexible compliance paths such as those outlined below or subsidies and exemptions to offset costs and barriers for low-income households. Alternatively, CAs could fund the cost of minimum upgrades and either recover it from sale proceeds or fund it from environmental levies such as carbon permits or taxes as suggested by Garnaut (2008b) and Pears (2008). While likely to be viewed as extreme by many in the AHI, I assert that such interventions are required urgently if we are to achieve likely Australian climate pollution reduction targets in a timely and cost effective manner.

Additionally, as argued in Section 6.3.6, I recommend that the declaration of 'actual' water and energy consumption (as required by a NABERS rating) in addition to rated or simulated performance (as required by BASIX and BCA) is essential to maximise MD outcomes because it is a simple, cost effective way to influence the personal behaviours that most affect sustainable outcomes. Figure 27 in Section 6.3.6 (p 288) depicts the additional range of AHI network influences likely to arise from this approach. These include a direct influence on consumer behaviour by raising awareness of inefficient lifestyle and providing both incentives to improve efficency and consequences for continued inefficiency. Additionally, the (indirect) association of actual consumption with property value is likely to engage the finance and marketing sector in behaviour-related SP advocacy as part of their duty of care advice to maintain or increase property value.

The impact on low-income households could also be offset by adopting an extremely simple methodology based on actual resource consumption. Were MD regulations to adopt a flexible, performance-based regulatory focus that simply specified acceptable GGE and water consumption per household or per person living in that household, responsibility for meeting, maintaining or improving the SP performance would transfer from owner to owner. This would facilitate high levels of flexibility by allowing users to choose from the full range of options to meet compliance benchmarks including: efficient behaviour, appliance upgrades or envelope modification and would effectively shift responsibility for compliance to the market rather than industry and regulators.

Finally, I contend that the effectiveness of mandatory disclosure will be limited unless it adopts a simple, accessible and flexible methodology and is linked to risks and rewards such as those outlined above.

6.5.5 Mandatory valuation of SP as a potential adoption driver

In the AHI, it is agreed that residential property ownership in Australia is primarily an investment or wealth creation exercise and that 'liveability' qualities are a secondary consideration (Haratsis 2003; Investa 2007). However, Australian residential property is regarded (2008) by international credit agencies as 'overpriced' and the market corrections predicted by many analysts in recent years are occurring. In addition to the US sub-prime mortgage crisis, additional factors identified by property market analysts as likely maintain this correction are: a likely slowing of population growth rates, an aging Australian population decreasing demand and ultimately driving it downwards; decreasing family and occupant numbers per dwelling; changing lifestyles and; housing becoming unaffordable for future generations (Salt 2003).

Predicted outcomes are: a shift in priority and motivation from home ownership to the flexibility in housing choices provided by rental housing; communal ownership and maintenance of 'lifestyle

enhancing' features such as gymnasiums and pools through body corporate strata or community title; a shift in current housing demand from detached dwellings to medium and high density dwellings in more socially desirable locations that reduce travel times to work and recreation and facilitate social interaction more compatible with current lifestyles (ibid). While a detailed analysis of these trends is beyond the scope of this research, analysis of their probable outcomes identifies significant opportunities and threats to the diffusion of SP in the AHI.

As argued throughout this research (through retrospective DoI analysis in Section 4.3.3; ANT analysis in Sections 5.2.2, 5.2.3, 5.2.4; prospective DoI analysis in Sections 6.2.3 and 6.3.4 and as demonstrated by Figure 27, the linking of sustainability performance to the value of property has potential to become a significant SP adoption driver. While preliminary investigations into this opportunity have been commenced by both Commonwealth and State government CAs, little progress is yet to be made towards a decision to introduce it – even at trial level. I suggest that this might be attributable to perceptions by CAs that such an initiative would be opposed by the peak bodies representing property valuers such as the Australian Property Institute.

However, a key global peak body for property valuers, the Royal Institute of Chartered Surveyors (RICS) has adopted a far more proactive approach. In the following paragraphs, I examine research by RICS presented at the SB08 Conference in Melbourne predicting the inevitability of Chartered Surveyors becoming a green profession in the near future (Dixon et al. 2007).

The RICS survey found that while members regard sustainability as *relevant to their work* (Australia recorded the highest score in this regard), key barriers such as *lack of knowledge and lack of expertise* are limiting their application of sustainability measurement tools. The report found that key drivers for adopting SP by practitioners in this sector are 'reactive' (i.e. legal compliance and responsibility) rather than proactive or competitive. A perceived gap in coverage of economic and social issues in sustainability tools was also cited as a barrier (ibid).

RICS research also identified a 'divide' among practitioners between what it described as *leaders and followers* and ranked commercial and residential property valuers as followers. Indeed RICS members whose businesses focussed on residential property and valuation ranked at the lower end of responses in both perceived relevance of SP issues to their work and instructions received from clients about SP. This was attributed to lack of knowledge and expertise, a lack of flexibility in existing tools and the absence of a comprehensive and common standard or benchmark. That said, Australia was ranked highest in global leadership of engagement with SP and its associated tools and 12% of Australasian respondents reported that the commercial SP rating tools ABGR and GreenStar *very useful* (ibid). No reference was made to residential rating tools. The proposed solution was for RICS to provide greater guidance to its members on SP including a range of CPD training. RICS have introduced new mandatory competencies for membership which include:

> *Level One: Demonstrate knowledge and understanding of why and how sustainability seeks to balance economic, environmental and social objectives at global, national and local levels in the context of land, property and the built environment*
>
> *Level Two: Provide evidence of practical application of sustainability appropriate to your area of practice and, of awareness of the circumstances in which specialist advice is necessary.*
>
> *Level Three: Provide evidence of reasoned advice given to clients and others on the policy, law and best practice of sustainability in your area of practice* (Dixon et al. 2007).

This encouraging research leads me to recommend that CAs engage with RICS in Australia to explore potential partnerships aimed at progressing the integration of SP into property valuation in the housing sector.

In summary, I maintain that the non-adoption of mandatory valuation of SP in housing recommended above is likely to become a significant barrier to further SP diffusion in the housing sector as the property marketing sector attempts to recover from the adverse market trends outlined above. I assert that a failure to adequately link SP to property value at this time will result in its continued omission from the 'wish list' of housing purchasers and ensure its continued neglect by housing marketers and lenders.

6.5.6 Supply vs. demand side focus.

Are change agencies focussing on the most effective strategies to deliver meaningful outcomes – especially on climate change mitigation? Current research findings (including those recorded throughout this thesis) suggest that, in many instances, they are not. In the following paragraphs, I prospectively analyse two important areas with potential to deliver cost effective GGE abatement not (fully) addressed in CA strategies.

Firstly, while the predominant focus to date (on regulating designers, builders and consumers of new housing) has led to a suite of world class measurement and regulation tools, I suggest that genuine delivered outcomes from their application are, at best over-estimated (Pears 2004) and at worst, unverified (Productivity_Commission 2005; Williamson 2005). Secondly, (and importantly in this research context), additional strategies are required to encourage the substantial level of energy efficiency investment in the building sector required to ensure that this sector is able to maximise its potentially significant, relatively low cost contributions to national abatement targets.

This suggests the need for formal evaluation strategies (possibly adapted from those used in Health Promotions and Education field to evaluate the effectiveness of similarly unquantifiable change outcomes) to validate current change agendas or, inform policy decisions to shift focus.

While current Commonwealth focus on supply side options through carbon pricing or trading initiatives through its Carbon Pollution Reduction Scheme (CPRS) will potentially address the supply side imbalance, additional strategies are required to ensure that the housing sector is able to deliver its (arguably) critical contributions to national demand side abatement targets. These contributions include:

- cost-effective short and medium term GGE reductions;
- public awareness, engagement and empowerment in climate change mitigation;
- limiting increases in peak demand (and reducing demand for additional coal fired power stations) until carbon trading initiatives make cleaner supply options viable.
- offsetting or mitigating carbon costs on socio-economic sectors least able to afford them.

Research commissioned by the Australian Sustainable built Environment Council (ASBEC) argues that *CPRS alone will not be the lowest cost way of reducing* [GG] *emissions (ASBEC 2008).* Modelling by the Centre for International Economics (commissioned by ASBEC's Climate Change Task Group) *indicates that encouraging substantial investment in energy efficiency in the building sector would make the job of the CPRS easier…The building sector can and should play a role in achieving the deep GHG reductions…(ibid).*

ASBEC advocate the adoption of complementary measures (ibid) to the CPRS to encourage achievement of the full energy efficiency potential from construction sector demand which CIE estimates to be responsible for 23% of Australia's total greenhouse gas emissions are a result of energy demand in the building sector (CIE 2007). *The building sector's contribution to GHG emissions is mainly driven by its end use of, or demand for, electricity. This is a key difference from many other sectors where the main issue is emissions from the supply of energy (ibid).*

CIE estimate that the building sector as a whole could reduce its share of GHG emissions by 30-35 per cent while accommodating growth in the number of buildings by 2050 and that this could be achieved using current technology to significantly reduce the energy needed by residential and commercial buildings to perform the same services (ibid). However, they identify split incentives and slow returns on investment as a major barrier to widespread adoption and suggest that additional energy efficiency investments by the building sector could be generated by a supporting policy environment coupled with a broad-based GHG abatement target (ibid). They suggest that such a strategy *can reduce the costs of GHG abatement (cost per tonne of abatement) for all sectors by nearly 14 per cent by 2050 (ibid).*

CIE's findings reflect many of the prospective recommendations detailed in this Chapter drawn from 10 years of AR in the field. I have quoted them verbatim below as final support for the arguments and recommendations contained in this thesis.

Adopting energy efficiency strategies requires upfront investment by businesses and households to become more energy efficient.

The benefits, or payback of these investments, are gradual, accruing over the medium to long term, as savings on energy bills.

The building sector will need some additional incentives to overcome the impediments to change. These need to address a range of issues, such as the need to spur behavioural change, particularly to encourage adoption, and to offset the required upfront, direct capital expenditures.

Essentially, there is a need to encourage the rebuilding of our current building stock to upgrade the energy efficiency of assets in buildings to deliver a more sustainable outcome.

The pay-off from investing in the energy efficiency potential of the building sector would flow through the entire economy by reducing the cost that others would face to achieve their reduction in GHG emissions. (CIE 2007)

6.6 Conclusion

This research commenced in 1998 at a time when the implications of building-related impacts on the biosphere had been 'problematised' in ANT terms and 'interressment' by both government and NGO change agencies had commenced. At that time, the urgency of the problems was not fully understood. The need for urgency (particularly on climate change) became apparent during the 10-year research period as 100-year time frames for change were reduced to 50 years and less.

The body of this thesis (Chapters 3, 4 and 5) applied an Action Research (AR) methodology to explore the interressment, enrolment and mobilisation phases of several pre-2006 change agendas to develop a base level of understanding about sustainable change creation in the AHI from a DoI and ANT perspective (see Chapter 5 for detailed explanation the ANT terms used above). Change initiatives examined through AR during that research phase often assumed a greater 'luxury of time' than that which eventuated. Some related research findings were classified as temporary knowledge (Gibbons 1994) after analysis within DoI and ANT drew useful knowledge and insights that were then applied (through AR) to new or emerging strategies in response to new research findings and associated shifts in socio-political awareness and prioritisation.

In this chapter, I have applied the knowledge created through retrospective AR analysis in a prospective context to identify and recommend additional strategies with potential to respond with appropriate urgency to our current understandings of these problems. This final phase has included a specific focus on the most urgent problem, the aversion of critical climate change in the understanding that successful strategies developed in response to climate change will be applied to other built environment-related biospheric threats through other change agendas. In other words, prospective analysis in Chapters 5 and 6 has generated project specific recommendations that have

also been expressed as generalisations for application in subsequent AHI SP change agendas and with potential for adaptation to other change processes.

My research concludes that no single solution is available to create the socio-cultural paradigm shifts required across all sectors of the AHI (both new and existing). Rather, a diverse range of solutions ranging from slight shifts in emphasis to increase the effectiveness of existing AR change agendas through to new initiatives and focuses are required to transform the AHI into a clean, green industry that delivers its maximum contribution to sustainable futures. Specific new strategies for future change management were identified and the associated recommendations are summarised under key research outcome headings below.

1) Innovation decision strategies

- Broaden the current new housing focus to include existing housing stock (Section 6.5)
- Introduce mandatory assessment, disclosure and valuation of the SP performance of all housing to link it to wealth creation and property value (Sections 6.3.6, 6.5.4 and 6.5.5).
- Apply additional adoption incentives and non-adoption consequences such as mandatory minimum sustainable housing performance standards to be met prior to lease or sale and, the linking of these standards to well publicised short, medium and long term targets to be achieved through regular benchmark creep (6.5.2, 6.5.3, 6.5.4 and 6.5.5).

Influencing practitioner decisions to adopt better and best practice:

- Announce an increasingly stringent range of SP benchmarks and measure progress toward them to encourage investment in innovation and SP development while sending a clear message to industry that high standards of SP standards are an integral component of future housing (Section 6.3.1);
- Refine existing regulations and metrics to provide the flexible compliance paths that were demonstrated to encourage innovation development and facilitate cost-effective minimum benchmark creep (Section 6.3);
- Reward adopters of better and best practice through recognition and promotion and increase the consequences arising from minimal or non-compliance by introducing more stringent SP assessment and certification protocols (Section 6.3);
- Monitor the real performance of change agendas, regulatory regimes, innovations and practices (in terms of delivered outcomes)to add credibility to their claims and satisfy sceptics (Section 6.3.2 and 6.3.6);
- Develop new ways to offset the additional cost and loss of competitiveness for practitioners who adopt voluntary best practice SP (Sections 6.3.3, 6.3.2, 6.3.5 and 6.3.6);

New home consumers

- Accelerate cost effective SP regulatory benchmark creep by stimulating the transfer and commercialisation of innovation development within the volume housing sector (Sections 5.4, 6.2.3 and 6.3.3).

- Promote both the lifestyle advantages and future wealth creation potential of sustainable new homes and increase regulatory compliance stringency to ensure that AHI housing solutions deliver on consumer expectations (Section 6.5.4).

- Introduce incentives and penalties to encourage efficient user behaviour including the installation of 'user pays' differential metering and (at least) voluntary declaration of actual consumption at point of sale (Section 6.5.4).

Existing home consumers

- Shift the focus of SP consumer marketing benefits for the environment and future generations to potential increases in property value (post MD and MV) and future savings in operating costs due to imminent increases in resource costs (Section 6.5.1);

- Adapt the various practitioner and new home owner adoption decision incentives proposed throughout the research to the existing housing sector (Section 6.5).

Engaging financiers, valuers and marketing agents

- Provide incentives (including regulation) to the property marketing industry to shift sceptical attitudes to SP and impart the knowledge and skills required by this sector to encourage SP-based competition through the use of SP to differentiate products and add capital value (Sections 6.2.3, 6.3.6, 6.4.1, 6.4.2, 6.5.1 and 6.5.2);

- Engage the housing valuation, lending and marketing sector as powerful OLs in the AHI to accelerate the SP diffusion process by creating adoption incentives and leadership (Sections 6.3.6, 6.5.4 and 6.5.5)

2) Innovation development strategies

- Encourage innovative new technological solutions while reducing costs and commercialising viable existing technologies through strategies to accelerate SP research, development and reinvention processes (Sections 4.2.4, 6.2.3, 6.3.3 and 6.4.1);

- Cross pollinate practices and solutions developed by early and late adopters and between the custom designed innovative and the volume housing sectors (Sections 4.2.3 and 6.3)

- Invest in development and subsidised delivery of specialist training for practitioners in recognition of the cost of acquiring SP skills, knowledge and information (databases and resources) and keeping them up to date in a rapidly evolving field (Section 4.2.5 and 6.4.3).

- Provide flexible regulatory compliance paths to accommodate variable levels of innovation (cost sensitivity and risk aversion) among practitioners and consumers while encouraging best practice innovation by early adopters (Section 6.3.4);
- Place greater emphasis on training development and delivery including: recognising, registering and rewarding skill acquisition by practitioners to accelerate and streamline the integration of complex SP methods into BaU compatible practices (Section 6.4.3);

3) Communication strategies

- Apply differing approaches to communication to address the innovativeness of intended audiences, their stage in deciding to adopt SP and their role in the AHI (Section 6.2);

- Expose would-be adopters to effective opinion leadership through interpersonal communication from both homophilic and heterophilic sources depending on their innovativeness and stage of adoption decision (See Sections 6.2.2 and 6.2.3)

4) Network configuration strategies

The outcomes of ANT analysis are summarised in a set of generalisations in Section 5.4.2. These demonstrate that ANT's network configuration strategies (problematisation, interressment, enrolment and mobilisation) provide an effective intervention planning and management framework for CAs. Case study analysis frequently identified change barriers arising from inadequate problematisation (scoping initiatives to identify problems, objectives and solutions) or interressment (identifying synergies with supportive actants and aligning them with the initiative. These omissions were often attributable to demands for political expediency. Thorough problematisation and interressment were observed to be the hallmark of successful change agendas that typically enjoyed barrier free enrolment and effective, permanent (black box) mobilisation phases. Specific network alignment strategies recommended include:

- Engaging the powerful wealth creation mediator actants (financiers and realtors) in the AHI sustainable change network (see innovation decision strategies above);
- Developing post training problem solving support networks including e-groups and developing information exchange networks;
- Strengthening the role of change mediating actants by aligning them through network configuration to create multiple interactive links that amplify their varied individual network influences;
- Provide voluntary best practice change initiatives in addition to regulation to encourage network growth and increased participation amongst innovative mediator actants.
- Provide support and encouragement of new specialist mediator actants (e.g. ABSA) that are typically created by the network during the interressment and mobilisation phases of other

318

change agendas because their unique 'fit' within the network often facilitates the adoption of much broader mediator roles;

- Create a new network to facilitate collaboration and resource sharing between CAs;
- Engage all households in the change process (not just new home owners) by regulating SP upgrades to existing homes to strengthen political and finance sector linkages to SP change networks;

Closing reflection

While the level of sustainable change that has occurred within the AHI during my research timeframe is encouraging, the magnitude of the problems it sought to resolve has increased exponentially – particularly in relation to climate change mitigation and water management. Accordingly, the implementation and effective management of change strategies has assumed new levels of urgency. I assert that this increased threat to sustainable futures (and the probability of continued increases) provides ample justification for immediate introduction of the most stringent responses recommended on the basis of this research.

Chapter 7   Conclusions and Contributions

7.1.1 Introduction

In Chapter 1, I proposed that this thesis makes significant contributions on both practical and theoretical levels and outlined them (Section 1.9.1, p. 50) within the *"three outcome spaces associated with TD research"* conceptualised by Mitchell and Willetts (2008) in their analysis of the *'consequential outcomes'* experienced by doctoral students engaging in transdisciplinary (TD) research (Mitchell & Willetts 2008 in preparation). Those TD outcome spaces were defined as:

1) *the situation or problem space which may be a sector, a situation, a societal issue or problem or an aspect of practice in some domain;*

2) *peer reviewed, academic knowledge in the more conventional sense (see updated definition below) and*

3) *transformational change in the researcher, and mutual (perhaps transformational) learning by stakeholders involved in, or influenced by the research (ibid).*
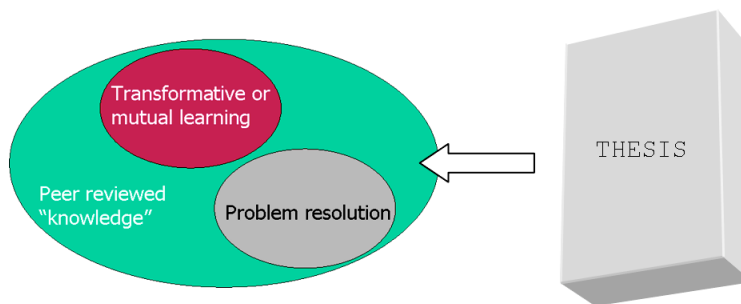
Figure 30: A summary of the relationships between the three outcome spaces in TD research (Source: Mitchell and Willetts, 2008; p. 12).

Three key characteristics of TD research identified by Wickson, Carew & Russell (2006) in their analysis of what differentiates TD research from multi or inter-disciplinary approaches are: *a problem focus; an evolving methodology and collaboration* (Wickson, Carew & Russell 2006, pp. 2, 6-12). They also identified three challenges faced by TD researchers as *integration, reflection and paradox (ibid)*. In the sections below, I explore these characteristics and the challenges and opportunities arising from them in the context of my TD research in keeping with Mitchell and Willetts' (2008) statement that *…it is incumbent on…TD students to be forceful, explicit and clear about the nature and extent of their contribution in terms of additions and/or shifts to knowledge and practice in broad terms* (ibid p. 19). This incumbency arises because TD research typically generates different types of outcomes and contributions to those of traditional disciplinary based research, which may not be valued unless made explicit.

At a practical contribution level, such TD related differences are inherent to my problem focussed, collaborative and evolving AR methodology. While this methodology was ideally suited to my research context, the making of explicit claims about the nature and extent of specific contributions

arising from it is problematic. Whilst I assert that my AR approach facilitated multiple, ongoing, practical contributions to important change agendas at many levels, the very nature of this methodology dictates that these contributions were made in collaboration with other highly skilled AHI sustainable change network actors.

In theoretical terms, the unique nature and extent of my contributions is distinguished through interactive application of Reflective Practice, DoI and ANT to draw new knowledge and meaning from the practical AR outcomes achieved during the research. This innovative approach evolved in response to the need for my research to make contributions at several levels including: i) timely problem solving within CA partner change creation programs; ii) simultaneous development of deeper understandings of AHI change processes to inform future management and; iii) the presentation of these findings in a format that facilitates their adaptation or transfer to other research contexts. I further define each type of contribution in the following paragraphs.

Firstly, my DoI and ANT analysis of AHI sustainable change during AR informed the practical contributions that were ongoing throughout the research. For example, such analysis underpinned original contributions to: audience specific language and content in YH; deeper understandings of (and therefore emphasis on) the role of network actants (e.g. HIA, BDAA and ABSA) within evolving AR change agendas and; the recognition of differing information, skill and regulatory compliance needs of the various DoI adopter groups that informed my AR contributions to the development of training and regulation. In this way, my AR methodology proved ideally suited to my AR role by allowing me to contribute as a change agent, reflective practitioner and opinion leader while conducting longer term research to gain deeper understandings of the field.

Secondly, while yet to be fully implemented, early indications suggest that the prospective recommendations in Chapter 6 will be (at least) partially applied by CAs and are likely to accelerate or consolidate change. For example, my recent contributions to industry consultation committees drawn from prospective analysis have included advocacy of: the adoption of the flexible, performance based regulatory compliance paths in next generation BCA; a shift in CA focus from new to existing housing stock; the accelerated introduction of mandatory disclosure by CAs to engage existing home owners and realtors; the engagement of the finance and marketing sectors by linking mandatory disclosure and valuation of SP to minimum pre-sale/lease SP performance; an expansion of training focus to include marketers, valuers and lending authorities and, the development of a skill hierarchy through which to deliver SP skills to all AHI practitioners (not just designers and builders) more effectively.

I contend that such ongoing reporting and feedback of research findings to partners in an AR context constitutes a type of Gibbons (1994) mode 2 publication equivalent (in contribution terms)

to mode 1 (ibid) peer reviewed publications. This further demonstrates the appropriateness of an AR methodology for change focussed research in a rapidly developing field.

Finally, I assert that my strategic recommendations to CAs in relation to their ongoing management and acceleration of sustainable change constitute an original contribution to both my AHI research context and, more broadly in terms of theoretical approaches to change creation and management theory. This contribution arises explicitly from my original use of ANT's network configuration strategies (Sections 5.3 and 5.4.2) to expand DoI's prospective analytical capacity in Chapter 6. My application of this original knowledge to update recommendations relating to change initiatives that progressed during the latter stages of the research ensured that the research remains relevant and timely and (e.g. Green Loans, Mandatory Disclosure and Valuation - Sections 6.4 and 6.5). I posit that this application demonstrates the effectiveness of these theoretical contributions and indicates their potential for adaptive transfer to other change creation and management contexts.

In the following sections, I further explore these contributions within the three TD research outcome spaces summarised in Figure 30 (Mitchell & Willetts 2008) and Mitchell's (2009) revised definition of outcome space 2 summarised in Figure 31.
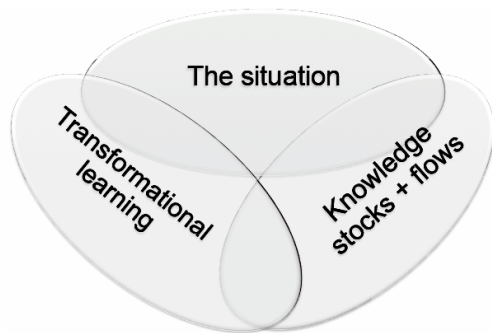
Figure 31: Three transdisciplinary outcome spaces (Source: Mitchell 2009).

Outcome Space 2: *Peer reviewed, academic knowledge in the more conventional sense* (Mitchell and Willetts 2008) was re-defined by Mitchell (2009) as: *Shifts in knowledge stocks and flows.* This revised definition aligns better with my industry focussed contributions (See section 7.1.3).

7.1.2 Outcome space one: the situation or problem space

In this research, practice based contributions that fall within Outcome Space 1 include publications, presentations and contributions to sustainable change made through AR. These were outlined in Chapter 1 (Section 1.9.1), documented in Chapter 2, expanded through the case studies used to illustrate my DoI and ANT analysis of AR in Chapters 3, 4 and 5 and finally, informed the prospective recommendations drawn from that analysis to inform future change in Chapter 6.

I assert that these research actions have made substantial original contributions to Mitchell & Willetts' (2008) *problem space* of sustainable change creation within the AHI *sector* to increase its

contribution to resolution of the *societal issue or problem* of maintaining sustainable futures by changing AHI *practices* (ibid). These contributions are also consistent with Wickson et al.'s (2006) TD research definition in that the *problem focus* embodied in my research was addressed through an *evolving* [AR] *methodology* that relied on *collaboration* with CAs, industry peak bodies and practitioners. My contributions to this outcome space also encountered the challenges *integration, reflection and paradox* (ibid) which I explain further below.

Issues of *integration* in TD research can relate either to integration across epistemologies and disciplines or integration across societal perspectives or viewpoints. Both types of integration issue arose regularly throughout my research. I first addressed issues of epistemological integration in Section 1.2 and concluded in section 1.2.3 that, while my research is framed within a predominantly social constructivist epistemological stance, an objectivist stance was adopted where appropriate during the Action Research (AR) phases to integrate with CA and industry positions. This had important implications for the methodology and methods applied and deemed valid by my varied audience groups. It also influenced my selection of analytical frameworks and methods (see Section 1.4). Contributions arising from epistemological integration are further addressed in Section 7.1.2.

The challenge of integration across both disciplines and industry viewpoints became particularly evident at several levels including the development of strategies to:

- overcome Moore's Gap (section 6.2.1; Moore 1999) between innovators and later majorities (e.g. the transfer of SP innovations between adopter groups in sections 4.2.4, 5.2.3 and 5.3.7);
- integrate complex SP within the BaU scenario of the cost-sensitive, risk-averse volume housing sector (Sections 4.1.5, 5.2.3 and 6.2 – 6.4) and;
- overcome lack of SP relative advantage in for consumers (Sections 3.2.7, 5.3.7 and 6.4.2).

Indeed, the prospective analytical solutions to these integration challenges presented in Chapter 6 arguably account for the majority of my contributions within outcome space one.

High levels of integration and collaboration were required during production of the *Your Home* suite of materials (Reardon et al. 2001a; Reardon et al. 2001b). These constitute a primary theoretical contribution embodied within a practical contribution. The YH publications were rigorously peer reviewed by technical advisors, industry and community advisors and CA partners. I and my fellow authors integrated a broad range of disparate and occasionally conflicting knowledge within succinct, accessible, audience specific information sources. The publication, now in its 4th edition continues to be widely accepted and used throughout the AHI as both a reference and a training resource (see Section 2.5.2).

The challenge of *reflection* was integral to my methodology through both reflective practice in relation to AR roles and iterative reflection during each of the AR cycles to explain observations and reconcile them within my chosen analytical frameworks. The methodological use of reflective

practice is addressed in Section 1.8.2 and its application is documented in Section 2.2.2. Iterative reflection on AR observations is an integral part of my analysis, often preceded by statements such as: *AR observations indicated, identified or confirmed*…or, embodied in the case studies that illustrate analytical arguments.

The *paradox* of resolving the imminent and urgent issues of sustainability confronting society through processes of incremental change within the AHI provided a significant challenge to me and many of my CA and SP innovator AR partners. This paradoxical dilemma is typical of social change related research such as sustainability (AtKisson 1999) and Health Promotion (WHO 1986) where, regardless of the scale or imminence of a threat, change occurs slowly or incrementally in the initial stages. I found two core tenets in my analytical frameworks to be most useful in addressing this paradox: DoI's concept of diffusion strategies working towards *critical mass* (around 15% adoption) whereupon change drives itself (Rogers 2003) and ANT's network configuration strategies that strive for *black-box* status where new actors entering the network are obliged to accept the change paradigm without challenge *(Bryce & Yasukawa 2004; Stalder 1997).*

Below, I address outcome spaces 2 and 3 and expand my responses to the above TD challenges.

7.1.3 Outcome space two: Theoretical and Knowledge Contributions

Contributions to this outcome space were outlined in Chapter 1 and defined as socially constructed and transdisciplinary (TD). They are re-visited here in terms of their embodiment within the thesis. Specifically, I examine contributions to the body of theoretical knowledge relating to my adaptive application of theories and analytical frameworks (DoI and ANT), methodology (Action Research) and methods (Reflective Practice, Iterative Reflection and Questionnaires) used to collect and analyse various types of data and position them within socially constructed knowledge through a transdisciplinary approach. Mitchell and Willetts (2008) observe that this type of contribution challenges traditional constructions of knowledge:

[Supervisors']…main concern with 'knowledge' was that it may be interpreted in a narrow Mode 1 sense (Gibbons et al, 1994) by some examiners. The idea of what counts as knowledge, and indeed, what counts as substantial or original, changes and is dependent on the disciplinary and epistemological stance of the individual [examiner]. Supervisors were clear that 'knowledge' should be broadly interpreted, and should include impact (Mitchell & Willetts 2008 in preparation, p. 17). See Section 1.2.2 for detailed analysis of Gibbons'(1994) knowledge modes in the context of this research.

Outcome space 2: *Peer reviewed, academic knowledge in the more conventional sense* (Mitchell and Willetts 2008) was recently re-defined by Mitchell (2009) as *shifts in knowledge stocks and flows (ibid).* Knowledge stocks shift when knowledge is presented in a format that facilitates its communication to audiences beyond those involved in the situation, sector or discipline that created it. For

instance, knowledge flows occur when ideas from one discipline or industry sector are introduced into another to change or inform it (Willetts 2009, personal communication).

This expanded definition recognises that *what we know or believe to be true differs radically between disciplines* and addresses the need to *talk across different ways of knowing, different forms of truth* that include *world views*, varied *epistemologies* and *values espoused* by scholars (Mitchell 2009). It does this by recognising *other ways of knowing* such as *experience based knowledge and personal understandings* (ibid). These types of knowledge align with Gibbons' (1994) Mode 2 and are typical of TD research - as distinct from conventional Mode 1 disciplinary approaches to knowledge creation.

In my research context, Mitchell's (2009) *ways of knowing* and *ways of being* recognise original knowledge contributions drawn from: reflective practice in relation to professional experience as an SP specialist practitioner within the AHI (see Section 2.2.2); change contributions arising from AR application of my analytical findings (e.g. the diffusion theory contributions to YH in Appendix 2); opinion leadership based on experience drawn from knowledge and understandings (e.g. principal authorship of the Your Home suite of materials and the numerous change focussed industry presentations and publications listed in Section 1.9.1; p. 50). Below, I briefly address additional Outcome Space Two contributions in terms of shifts in knowledge stocks and flows in the areas of analytical framework and methodology.

Analytical Framework

I posit that my adaptation of diffusion theory to this change focussed TD research context through the original use of ANT to expand DoI's analytical and strategic planning capacity constitutes an original contribution to knowledge stocks (see Sections 1.6 and 5.3). The flow of new insights from this unique combination of analytical frameworks generated original contributions in both theoretical and practical (change creation) terms. These included recognition of the diffusion limiting characteristics of SP innovations (in DoI terms) and my application of ANT's network configuration strategies to identify ways to overcome them.

Other knowledge flow contributions include deeper understandings of the interactive, interdependent change creation roles of key network actants. These were generated through application of ANT to expand the analytical capacity of DoI's processes of innovation decision and innovation development. I posit that in this unique combination, ANT and DoI informed each other to create new understandings of the processes of socio-technological change. My documentation of this, in the form of this thesis, constitutes a knowledge '*stock*' that makes it available now for adaptation and application in unrelated change creation fields

An additional contribution to knowledge stocks regarding sustainable change creation is recognition of the need for higher levels of re-invention or innovation development (than those currently addressed by the DoI literature) in the diffusion of sustainable practices within the AHI and other

social systems. Strategies to convert this potential diffusion barrier into a change creation opportunity drawn from both DoI and ANT (Sections 3.2, 4.2, 5.2 and 6.4) constitute a further contribution. DoI and ANT provided a diverse and complimentary range of insights into the complex processes of sustainable change creation. These complementary contrasts are graphically summarised in Figure 6 (p. 39) where DoI's main stages of the Innovation Development Process aligned with Callon's four stages of configuring an actant network (Callon 1986). (adapted from Rogers' (2003) six stages).

Useful contrasts between these two analytical approaches are highlighted in my use of DoI to explain and develop deeper understandings of the stages of an individual's decision to adopt change in combination with ANT's complementary capacity to map and re-configure the broader network influences that underpin it. For example, DoI's innovativeness based adopter categories provided a powerful framework for understanding and predicting the varying motivations and needs of individuals during the decision processes preceding change adoption. ANT's network configuration capacity proved effective in identifying strategies through which to target the delivery of resources to meet the specific needs of each DoI adopter category. ANT analysis of the network's role in triggering each DoI decision type (optional, collective or authority) identified further opportunities for CAs to fine-tune their interventions to ensure more effective use of each within a continuum of strategies defined by ABEC's dual codes of practice.

DoI's *opinion leaders* and ANT's *mediator actants* demonstrate a further complimentary contrast. DoI analysis identified and explained the variable effectiveness of opinion leadership at different stages of the Innovation Decision Process according to the individual innovativeness of the adopter (summarised in Figure 21, p. 254). ANT analysis provided deeper understandings and identified the networks commonly accessed by each adopter type thereby identifying opportunities to increase the effectiveness of mediation and opinion leadership at appropriate stages of the decision process.

These new understandings were also applied to other interventions and change triggers through prospective analysis in Chapter 6. For example, strategies were recommended through which CAs might adapt their interventions to address significant differences identified between DoI adopter category needs in relation to skill and information provision, regulatory compliance paths and the selection or advocacy of appropriate SP solutions and strategies.

Presentation of these various theoretical innovations based on my AR context in this thesis constitutes knowledge 'stocks' that can be usefully applied in future change-oriented research and the theoretical evolution of DoI and ANT.

Methodology

My extended use of AR to research a common theme (sustainable change creation) within an atypically broad range of (often) unrelated or competing AR case studies constitutes an additional knowledge 'stock'. These arose from innovative analytical integration of a diverse range of findings through *retrospective* analysis within DoI and ANT (Chapters 3, 4 and 5). Integration methods applied include the use of boxed case studies to introduce AR observational data to ground and illustrate my analytical arguments. Additionally, triangulated perspectives drawn from analysis of reflective AR practice within DoI and ANT were effective in explaining and validating my AR observations and positioning them within broader theoretical understandings of change creation through a series of generalisations (Sections 3.3.3, 4.4.4, 5.4.2, 6.2.4 and 6.3.4). These generalisations contribute at two levels.

Firstly, they capture retrospective analytical findings to inform prospective analysis of their change creation potential when applied within current and future AHI sustainable change agendas (Chapter 6). Secondly, they present knowledge created through this research in a format that is accessible to audiences beyond those involved in its production thereby increasing the potential for transfer adaptation and application in other contexts.

Summary

My theoretical contributions to outcome space two reflect an innovative interpretation, adaptation and application of methodological (AR change creation captured through reflective practice) and analytical (ANT supplementing DoI) processes within an overarching TD approach to socio-technological sustainable change creation within the AHI. I posit that my contributions to knowledge stocks within my research field have potential to flow to the development of effective theoretical responses to the increasingly complex research demands associated with sustainable futures in socio-technological change contexts beyond the focus of this research.

7.1.4 Outcome space three: transformation in myself and other stakeholders

Each contribution to this outcome space draw reflectively on one or more of Wickson et.al's (2006) central tenets of TD research: a situation or problem focus; an evolving methodology and broad collaboration. In her presentation on Upscaling Sustainability, Mitchell (2009) posed three questions that help frame this reflection: *What was it that transformed you? How might you make space for plurality? How would what you do change if you set out to create transformational learning, to add to knowledge stocks and flows, to improve a situation that matters?(ibid)* Rather than setting out to answer them, I use these questions to set the context for this closing reflection.

Personal transformation

Here, I reflect on transformational change experienced during my doctoral research journey. A decade ago, I embarked upon a research journey to investigate sustainable change creation in the housing sector on the basis of my previous knowledge and experience as a technological solution focussed, positivist design and construction practitioner. This initial approach was very much situation or problem focussed and, whilst that focus remained a core tenet of my research, it expanded during the doctoral journey to incorporate other ways of knowing, understanding and solving the same set of problems.

Chapter 2 documents the cyclical AR processes through which increasingly deep and insightful research questions were developed and investigated. This process transformed my elementary, practice based observations and change advocacy motivations into theoretically informed objectives that assimilate knowledge from a range of disciplines within effective sustainable change strategies for each AHI sector and practitioner type.

My ongoing AR practitioner roles in producing, applying and testing the various publications and presentations listed in Section 1.9.1 and then refining them through reflective practice (Sections 2.2.2 and 2.5.3) created transformational change in me as a researcher, practitioner and opinion leader. Increased skill and knowledge levels and deeper understandings of opinion leadership roles have improved my effectiveness as an author, trainer and presenter. I suggest that, had my action research (AR) methodology not allowed me to continue to develop as a reflective practitioner and change agent during this time, my transformation, learning outcomes and contributions would undoubtedly have diminished and made completion of the journey less likely.

Transformation in other stakeholders

A significant sustainable transformation occurred across the entire AHI during the time-frame of this research (see Sections 4.4.1 and 5.3.4). As stated earlier, attribution of any specific part of that change to this research is neither useful nor relevant. Rather, I suggest it can be reasonably assumed that this research contributed to that transformation at several levels. Further, I posit that those contributions to both the AHI sustainable change agenda and broader change contexts are likely to continue or increase as selected recommendations and strategies from Chapter 6 are applied, adapted and refined by CAs to meet evolving needs.

Transformations most closely associated with my research occurred amongst practitioners who participated in the various CPD training and information provision AR activities through BDAA, ABSA and HIA GreenSmart. Demonstrated transformational learning occurred amongst practitioners who attended these events and subsequently applied the knowledge and skills in their workplaces to achieve competitive advantage, meet regulatory compliance or satisfy consumer

demand. These include BDAA colleagues and HIA GreenSmart Professionals (see Sections 3.3.2, 3.3.3, 4.3.1 and 4.3.2). Unfortunately, no further evaluation of the effectiveness of these actions has been conducted (see Section 7..5 below).

Mitchell's (2009) question: *How would what you do change if you set out to create transformational learning, to add to knowledge stocks and flows, to improve a situation that matters?* is particularly relevant here. My response to that question in this context was embodied in the BITS proposal where I set out to create a transformational learning hierarchy within which skills and learning outcomes could be assessed and measured within a formal but flexible protocol. It was intended that this would lead to recognised qualifications that would in turn be linked to professional accreditation and licensing with associated codes of practice for professional practice.

I posit that had it succeeded, BITS would have ensured that transformational learning continued to add to sustainable knowledge stocks within the AHI for the foreseeable future. It would also have provided a mechanism through which to monitor, manage and quality assure outcomes. I reflect that the failure of the BITS program is the most significant lost opportunity associated with my research. For that reason, it warrants further consideration here to highlight a significant theoretical contribution from this research that occurs largely through omission or failure.

In other AR case studies, my feedback of research data and analytical findings to CA and industry peak body partners was seen to influence their delivery and refinement of change agendas to varying extents. The most significant influence occurred in association with three projects: the production and ongoing development of *Your Home*; the development and delivery of HIA's GreenSmart training and the range of CPD and motivational initiatives conducted through BDAA.

Each of these projects involved extensive collaboration between: multiple government departments; suppliers and manufacturers; industry peak bodies and individual practitioners. As argued in Chapter 5, this level of collaboration delivers superior outcomes because it creates multiple communication pathways and maintains or expands network links. While these three projects benefited from sound network configuration, this occurred through circumstance rather than by design. In this research context, the benefits of sound network configuration were identified through reflective analysis of AR well after opportunities for sound problematisation and interressment had passed.

I suggest that BITS failed due to inadequate network configuration from the outset. BITS was managed by a single CA rather than the CA joint ventures that characterised YH, GreenSmart and BDAA case studies. This limited input to the interressment phase of its network configuration and resulted in a failure to negotiate political linkages. Ultimately, at the mobilisation phase, the network broke down when funding was withdrawn and industry peak bodies withdrew because they were

asked to promote introductory level training that duplicated their commercially viable courses. BITS was always intended to offer advanced or specialised training – not duplicate existing courses. I posit that, had I and my partner CA applied sound ANT network configuration strategies from the outset of the BITS project, the outcomes would have been very different.

By demonstrating the value of ANT's network configuration strategies in planning and implementing change objectives, the BITS failure highlights an important research contribution.

Summary

Reflective self assessment of my transformation during this research journey indicates that I have emerged as a transdisciplinary, reflective practitioner, opinion leader and advocate of sustainable change whose epistemological approach has shifted from positivist to social constructivist. An important component of this transformation is new understandings of the processes of knowledge creation and the strengths, weaknesses and useful application or interpretation of different types of knowledge.

Such transformation provides more than adequate personal justification for the (part time) devotion of almost one third of my working career to this project. That said, it is definitely time to move on and apply those new understandings and critical thinking skills to addressing the increasingly urgent and complex problems facing humanity. In that regard, whilst my research has contributed to a less dramatic transformational change in other AHI practitioners, I suggest that it nonetheless amounts to a significant contribution to hope in relation to the achievement of sustainable futures.

Questions about whether the change that has occurred within the AHI and throughout broader society during the period of my research might mitigate the more extreme consequences of climate change can unfortunately only be answered by future generations. I am proud to have been a participant in that change process and look forward to continuing to contribute - hopefully more effectively as the challenges inevitably become more urgent.

7.1.5 Further research

This final section has two parts. Firstly, I examine high priority information and knowledge gaps to identify ongoing research needs. Secondly, I briefly identify aspects of my research with potential for adaptive application by other scholars.

Information and knowledge gaps

In addition to the ongoing need for SP innovation development (for which catalyst strategies are proposed by this research), I posit that AHI sustainable change has now progressed to the point where it would benefit from rigorous evaluation of the effectiveness of current change strategies.

This would either validate the ongoing investment of resources and effort or, identify alternative strategies with potential to be more effective.

Specifically, I have suggested that a shift in CA focus from new housing (and the practitioners responsible for it) to existing housing (and particularly the engagement of those who profit from it) is required as a matter of urgency. However, limited research into practical, cost-effective strategies to improve the SP performance of existing housing stock and likely environmental dividends arising from it continues to present a barrier to such initiatives. The currently proposed Home Sustainability Assessment agenda has potential to fill this gap although its linkage to (currently) weak Green Loan incentives is likely to limit outcomes. I suggest that additional research is required to fully explore the role of the new vocation of sustainability assessor to maximise its contribution to current and future change agendas.

Additionally, the current lack of evaluation of outcomes from new housing change agendas continues to provide fertile ground for the arguments of sceptics (e.g. Williamson 2005; HIA 2005a and 2005b). Whilst Pears (2004, 2005 and 2007) and Isaacs (2005c) have addressed these issues in submissions to various enquiries, more rigorous research to confirm and expand their opinions is urgently required to overcome this barrier or shift CA focus to more productive (in SP terms) strategies. Whilst data collected through BASIX is providing some insights into likely gains from new housing regulation, this should be expanded to national level through provision of similar data collection facilities within BCA relating to other states and climate zones. Data collection potential from the Home Sustainability Assessment program is critical in relation to existing housing stock. I advocate that this data be made accessible to researchers and, where possible within privacy limitations, correlated to recently constructed housing that was subject to mandatory energy and sustainability regulations. I posit that such correlation will deliver important research outcomes.

Finally, as argued strenuously throughout this research, a structured learning hierarchy through which to deliver skills to AHI practitioners from every profession (i.e. design, construction, planning, financing, marketing and valuing) is required as a matter of great urgency.

Transferable research outcomes

Analytical frameworks: The innovative combination of DoI and ANT applied for the first time in this thesis provided a highly effective framework within which to analyse and explain sustainable change and, to develop strategic responses to barriers and opportunities identified. For this reason, I suggest that it could be adapted and applied with similar effect in other change related research – particularly where that research involves complex socio-technological change.

Generalisations: The contributions to knowledge stocks from analysis in Chapters 3, 4, 5 and 6 are presented as generalisations to encourage a flow of that knowledge to other fields through interpretation, adaptation and application by scholars in other research fields.

Closing comment.

My heartfelt thanks to all those who have participated in, contributed to or simply tolerated me during this marathon commitment - which just happened to coincide with the most intense and eventful period of my life. In surviving one of those events – a brush with death – awareness of the temporariness of my tenure on this planet intensified. Strangely, this provided great comfort and led to my decision to devote the rest of my life to the hedonistic pursuit of those things that make being a human tolerable: love, sharing, creativity, caring, laughter, music, spirituality, thought and eventually, death - to make space for another to enjoy the privileges this amazing planet provides.

All of this I can achieve while minimising my footprint and that of my fellow humans so there is something left for future generations. Being a human is not all bad I guess.

Best get on with it then I suppose.

Thank you all.

Appendix 1: Industry Questionnaires.

The following paper provides an overview of my AR questionnaires. It was presented to the AGO in July 2004 to indicate the availability of research findings relevant to their ongoing development of the Your Home suite of materials as part of my AR interaction with that partner change agency.

See Appendix 2 for an example of an AR feedback presentation based on data collected through this and other questionnaires. While they remain an important component of my research contributions, these findings are not presented in detail throughout the main body of the thesis. because they were classified as Mode 2 or temporary knowledge (Gibbons et al. 1994). That classification does not diminish their importance. It indicates that the data analysis was highly relevant at a specific stage of my AR within the AHI sustainable change process (pre-regulation) and, that their ongoing contribution occurred through retrospective analysis of that change which yielded deeper and more permanent insights into how and why that change occurred (or not).

BDAA ESD Questionnaire. Aims, objectives and methods

Overview

This paper sets out the aims and objectives of industry questionnaires conducted as part of my Action Research PhD in Sustainable Futures. It has been prepared at the request of the Australian Greenhouse Office. Its purpose is to identify synergies between BDAA's proposed membership survey and the AGO's planned building industry research. Both organisations need to develop deeper understanding of the current wave of sustainable change sweeping the industry. They have two common focuses:

- evaluating the roles (past, present and future) of the *Your Home* suite of materials (YH) in that change process (recognising that YH does not work in isolation but rather, as an important component of a suite of reform agendas working in partnership).
- developing insights into triggers for, and rates of, adoption of sustainable change in the Australian Building industry upon which to plan effective development and delivery of additional resources.

Background

The YH materials have now been in circulation for over two years. The significant volume of these materials already dispersed in the target audience groups and the continuing demand for more would tend to indicate that the *Your Home* program has been successful. Yet no real evaluation has yet been conducted. During the lifespan of the YH materials, we have witnessed a significant acceleration in uptake of sustainable reforms across the industry. While it would be reasonable to assume that YH played an important role in this phenomena, we have a very limited understanding

of the magnitude and detail of that role and its interaction with other change agendas. This is a limiting factor in planning the next steps for the YH project.

YH was designed to fill an information gap observed in three main audience groups: designers, builders and their consumers. It recognised that the unavailability of clear, practical, non-technical information about sustainable housing options was a significant barrier to their adoption (Penman 2000; Penman & Reardon 2000) The YH developers recognised the importance of these specific audience groups in the sustainable decision-making process and sought to produce a set of materials that would not only meet their information needs, but would also enhance their interaction and facilitate decision-making in favour of sustainable options.

Anecdotal reports suggests that the materials have been successful in achieving those goals but many questions remain: How effective are they? What aspects could be improved? Are they as relevant three years on? What else is needed to make them effective? How well have they penetrated their market? Have they only been adopted and used by those already disposed towards sustainable options? How can their uptake and use by a broader audience be facilitated? How do they interface with other sustainable change agendas?

With the imminent release of the *Your Home* Interactive DVD, additional fact sheets and an updated version of the Technical Manual, BDAA are of the opinion that a national membership survey would be both timely and useful. research would inform the development and planning of our next round of Continuing Professional Development (CPD) based on the *Your Home* materials. The survey is designed to provide additional useful feedback for the AGO on market penetration, modes of use and need for additional or supplementary materials

It has been suggested by many parties to the sustainable reform agenda in industry (researchers, TAFE, industry peak bodies and government agencies) and the author, that the single greatest challenge looming for the ARBI is the building of a sustainable skill base among practicing industry professionals that will enable them to deliver sustainable housing solutions in line with growing consumer demand and increasing regulatory requirements (see BITS proposal for detail). In order to plan for the most effective development and delivery of resources (both existing and new), an understanding of the following understandings are required:

- weaknesses and strengths of the existing YH materials;
- changes in audience information needs since the original communications research and information design for YH was undertaken;
- changes in audience awareness of sustainability issues since 2000;
- the current rate of change and likely future rates of change.

The proposed research will address each of these issues.

Methodology

1) What do we know already (existing, relevant research)

RMIT survey. A recent poll by RMIT has yielded useful information about attitudes, knowledge and needs of developer and builder groups (mostly in Victoria). It is the intention of the writer to access this data and compare/link it at the data interpretation phase of this questionnaire.

ABEC survey. Research into sustainability in education was recently undertaken by ABEC and the Institute for Sustainable Futures, UTS for the AGO. Useful insights from that research will be used to inform the data analysis phase of this research.

RAIA survey. The author is aware of some research conducted by the RAIA but to date, has been unable to gain access to it. It would be useful for the AGO to access this research if possible before data analysis from this survey.

Your Home **Communications Research.** The original communications research upon which the YH materials were developed was conducted by Prof R Penman in September 2000. While Penman's methodology was different to that used in this research, her conclusions will be subjectively compared to this research to identify possible shifts in audience needs and characteristics over time.

2) What else do we need to know?

About the *Your Home* materials.

We need to know more than just user numbers and market penetration.
- Have the needs of the audience groups changed since the YH materials were developed?
- What are those changes and how can the YH project respond to them?
- What motivates current users?
- How do their motivations differ from non-users?
- Are the motivations transferable or are different approaches required to increase market penetration in other sectors?
- What are the characteristics of these sectors?
- What motivates them and how can YH trigger these motivations?
- What actual change has, is or might occur:
    o from the YH project;
    o from other initiatives and;
    o from the combined influence of YH and other initiatives.
- What additional strategies might increase uptake and use of YH materials?

About uptake and adoption trends

Sampling sophisticated enough to yield meaningful statistical predictions about likely uptake trends is beyond the scope of this poll. However, the writer is analysing the spread of sustainability throughout the building industry in the widely accepted theory of Diffusion of Innovations (DoI). This theory observes certain consistent characteristics about the spread of a given innovation (in this case sustainability) in a given social unit (in this case – the building industry).

While not precise, DoI theory allows certain general observations and predictions to be made about likely adoption patterns for sustainability in the industry under diverse conditions. For this reason, respondents to this poll will be asked to position themselves in the adopter categories defined by DoI theory in past, present and future scenarios. This will allow useful conclusions to be drawn about likely adoption patterns by analytical comparison to other diffusion studies.

3) Who should we ask?

The target audience for YH is designers, builders and consumers (their clients). This survey is intended for Building Designers who are representative of a wide range of the design profession but not all of it. Architects are a distinctly separate group with access to a different information set. While the YH materials meet the needs of many architects, anecdotal evidence suggests that adoption rates for the YH materials among architects are lower than among building designers. This questionnaire does not propose including the architect group. However, it is possible that a random sample of architects could be covered by telephone poll to give an indication of differences between the two groups.

Builders are the other main audience group for YH. The writer is aware of the concurrent HIA survey of builders and strongly suggests that these two surveys be coordinated and cross referenced. This would ideally involve including around 25% of questions common to both groups.

It is proposed that consumers be covered by questioning the building industry professionals in each organisation about the role of YH in their interaction with their clients. While a poll of consumers to test their needs would be useful, general market penetration of YH is low, making the required sample size too large and beyond the scope of this research. It is strongly recommended that a purpose designed consumer research exercise be undertaken by others.

4) Data collection

Two data collection methods will be employed.

Questionnaire.

A national poll of BDAA members (1,100 in total) was distributed via the BDAA national magazine as an insert in January 2004. The magazine will include an article by the writer related to subjects

being investigated in the questionnaire. While the focus was on practicing building designers, other non building designers were also be encouraged to complete the questionnaire. The distribution (2,200) of the magazine included manufacturers, suppliers and consultants to the building design profession. Responses from non-designers were treated separately to those of practicing designers.

Responses to the questionnaire were by fax, post or, respondents had the option of completing an electronic version hosted on the BDAA website.

Follow up phone interviews

Analysis of the previous BDAA poll indicated a skew in the sample caused by voluntary response. It was concluded that the majority of responses were received from pro ESD designers and that the poll did not accurately reflect the views of the whole membership – especially those who are not proactive in the ESD field. Accordingly, a random sample of approximately 50 designers nationally were contacted by telephone post questionnaire and interviewed to:

> 1) develop a profile for the non-respondent category to inform the analysis phase and;

> 2) gather additional data, comment and detail to confirm or deny assumptions from data analysis and clarify ambiguous results.

5) Analysis

Numeric data were analysed using simple statistical methods to create data sets suitable for quantitative analysis. Additional qualitative analysis was used to support predictive conclusions. Qualitative analysis was conducted in the established theoretical framework of Diffusion of Innovations. This analysis supported useful, indicative conclusions in addition to quantitative analytical methods.

What will the research outcomes be?

Insights into:
- use by and usefulness of the YH materials to Building Designers and their clients
- useful changes/additions to the materials to make them effective in this group
- how and why change is occurring
- what might trigger that change
- how different sectors of the target audience are affected by different change triggers
- how and why individuals in each group adopt change at different stages,
- some general predictions about likely future rates of adoption.

BDAA 2001 Questionnaire, BDAA 2004 Questionnaire, BDAA phone Poll.

The following pro-forma was used during a random telephone poll of BDAA members to identify any biases or skews in questionnaire data. It includes the main questions asked in internet and mail-out questionnaires and is provided as an indication of the types of questions and data collected through the various questionnaires listed above.

Telephone poll

I am ringing on behalf of BDA Environment Director, Chris Reardon with a few simple follow-up questions related to the BDAA ESD questionnaire circulated to members In February this year. The purpose of this telephone poll is to ensure that the findings of that questionnaire are representative of the views of the whole BDAA membership.

Your practice has been chosen at random for this telephone poll and any responses given will remain anonymous under the UTS code of human research ethics. The questions will only take a few minutes to answer. Would the principal designer in this practice or a senior decision maker be prepared to help by taking a few minutes to talk to me?

❑ yes ❑ no

If no, ask why? *(try to find out if it is because they are not interested in ESD or think it is a waste of time)*
    ❑ Not available..
    ❑ Not interested...
    ❑ Too busy..
    ❑ Ring back at another time?..

If yes:

Your response will remain anonymous according to the UTS code of human research ethics. Please do not answer any question if you are not comfortable to do so. The aggregated outcomes of this research will be used to inform the development of ESD training and regulation by governments in partnership with industry bodies through the PhD research of Chris Reardon.

Do you agree to proceed?

    ❑ yes..
    ❑ no...

1) Do you understand what the term ESD means?

    ❑ yes..
    ❑ no...

    If no, read the following:

        ESD is short for ecologically sustainable development. The term is used in this research to describe ways of designing buildings that will reduce their environmental impact on the ecological systems that support all life – including humans. This includes: energy efficiency, water consumption, waste water treatment, waste management, materials use and species extinction.

Do you now understand what the term ESD means?

If no:. Thanks for your time. Sorry to bother you.

If yes:

2) Did you or someone in your office fill in and return the ESD questionnaire circulated earlier this year.
    ❑ yes...
    ❑ no..

3) On a scale of 1 to 5 with 1 being the lowest and 5 the highest, how important is ESD in your work or business?

1	2	3	4	5

If the respondent filled in and returned the questionnaire, read the following.
    Unless there is something else you would like to add, I thank you for your time.
    Your responses have already been recorded from your original survey response.
    The results will be published in Designers Brief later this year.

If they did not fill in the questionnaire:

4) We would like to know why you didn't return the questionnaire so that we can better gauge how representative the questionnaire is of views of the whole membership. Please answer yes or no to the following statements

    You received the questionnaire?
    ❑ yes...
    ❑ no..
    You thought the questionnaire was only for ESD experts?
    ❑ yes...
    ❑ no..
    You are not interested in ESD or it is not relevant in your work?
    ❑ yes...
    ❑ no..
    You wanted to respond but were unable to?
    ❑ yes...
    ❑ no..

5) What age group do you belong to?
    ❑ Under 20...
    ❑ 20–29..
    ❑ 30-39..
    ❑ 40-49...
    ❑ 50-59..
    ❑ 60-69 ………...
    ❑ 70 & over..

6) Do you have a copy of the *Your Home* materials in your office?
    Consumer Magazine & CD ROM ❑.no..
                          ❑ yes..
                          ❑ yes, multiple copies................................

    Technical Manual   ❑ no..
                          ❑ yes..
                          ❑ yes, multiple copies................................

7) What year did you first become aware of ESD, energy efficiency or sustainability?

1970s	1980s	1990	1995	1996	1997	1998	1999	2000	2001	2002	2003	20...?

8) When did or might you first decide to trial ESD principles in a project:

1970s	1980s	1990	1995	1996	1997	1998	1999	2000	2001	2002	2003	20...?

9) When did or might you first decide to use ESD principles in all your projects:

1970s	1980s	1990	1995	1996	1997	1998	1999	2000	2001	2002	2003	20...?

10) The next set of questions are about how confident you feel in being able to address various ESD considerations in a project. On a scale of 1 to 5 with 1 being lowest and 5 being highest, how confident do you feel about being able to design the following ESD requirements into a project?

Consideration	1	2	3	4	5
Low energy consumption					
Low greenhouse gas emissions					
Energy-efficient building envelope					
Energy-efficient appliances					
Greenhouse efficient energy sources					
Natural ventilation (cross, stack etc.)					
Reduced water consumption					
On site wastewater treatment					
Soil loss and sediment controls					
Aesthetic/visual impact					
Indoor air quality/out gassing mats					
Greenhouse friendly transport					
Reduced biodiversity impact					
Recycling construction waste					
Operational waste recycling facilities					
Social/cultural impact of development					
Economic impact/cost of change					

That completes this poll. Thank you for your time. The results of the survey will be published in

Designers Brief later this year and on the BDAA website

Appendix 2: Example of feedback of AR data to stakeholders

Data collected through Questionnaires during the early phases of research was analysed and the results fed back to CA partners through ongoing AR. Whilst these contributions shaped many change agendas during AR, they became less important as those change agendas progressed and were referred to throughout the thesis as Mode 2 (Gibbons et al. 1994) or temporary knowledge. Several feedback channels were used including: submissions to government committees and consultation forums, publications in industry journals (e.g. BDAA Designers Brief); conference presentations (e.g. MBA, HIA, BDAA); industry seminars and manufacturer/supplier liaison.

The following example is provided as an indication of the level and content of temporary knowledge contributions through AR feedback. It is a PowerPoint presentation by the author to the *Your Home* Industry and Technical Committees prior to update and publication of Edition 3. It includes summarised analysis of industry practitioner questionnaires and other AR findings on the use and usefulness of the YH Technical Manual in practitioner stakeholder groups. This AR feedback shaped the next two editions of the YH TM; informed ATA Motus research into consumer audience needs (ATA_MOTUS 2004) that led to the replacement of the YH Consumer Guide with Sanctum Magazine and, laid the groundwork for the production of both the New Home Buyer's guide and the Renovator's guide (CoA 2007, 2008b).

Overview

- What has changed since YH was launched?
- Where are we now?
- Diffusion of Innovations analysis
  - Adoption rates
  - Adopter categories
  - Information needs for each category
- How does Your Home currently fit?
  - Comments & data from users
- What changes should we consider?
  - Stratification of technical information levels?
  - Streaming of detailed information to specialist needs?
  - Single or multiple media
  - Appropriate dissemination methods

What has changed since 2000?

- ESD adoption rates are accelerating rapidly
- New and more stringent regulations
- Improved measurement tools
- Demand has increased for:
  - a larger & more sophisticated skill base
  - training to deliver those skills
  - more detailed technical information
  - improved methods, materials and solutions
  - access to latest product information
- As we progress, designer roles, skill & information needs will become even more demanding
- Can Your Home be updated to accommodate these needs without losing its intended audience?

Where are we now?

- o Change is occurring exponentially
- o We need to manage this carefully because:
  - o Many "concepts" are not yet adequately tested or refined
  - o Regulation could exceed ability to deliver viable solutions creating a "loss of confidence".
  - o Early adopters (opinion leaders) could fail sending a negative message to the rest of industry
  - o Consumer demand may outstrip industry's capacity to supply leading to "green wash", disappointment and loss of interest
- o Hypothesis: Main barrier = lack of skills in industry
  - o Min 7 year lag for TAFE; 10 years for universities
  - o urgent need for industry CPD to bridge gap

Is it too early to stimulate consumer demand?

Diffusion of Innovations

A quick overview

- o New ideas (innovations) are adopted by a society or industry by a process of diffusion .
- o Adoption usually follows an "s" shaped curve.
- o Rates of adoption vary depending on:
  - o the relative advantages of the innovation (cost/benefit)
  - o their compatibility with current norms (BAU)
  - o their complexity (ESD is an evolving science)
  - o their trialability (risk in a risk averse industry)
  - o potential for would be adopters to observe them

The role of Your Home in DoI

o Your Home is an important tool in diffusing the innovations associated with sustainability within the residential building industry

o Its main role is to "transform" highly technical information and concepts into understandable, implementable actions

o Its audience was designers, builders and consumers

o YH was never intended to be a highly technical text– yet the demands for technical content grow

o So how should we adapt it to best meet current information needs?

How innovations diffuse

Stages of adoption:

Awareness - the individual is exposed to the innovation but lacks complete information about it

Interest - the individual becomes interested in the new idea and seeks additional information about it

Evaluation - individual mentally applies the innovation to his present and anticipated future situation, and then decides whether or not to try it

Trial - the individual makes full use of the innovation

Adoption - the individual decides to continue the full use of the innovation

Awareness → Interest → Evaluation → Trial → Adoption
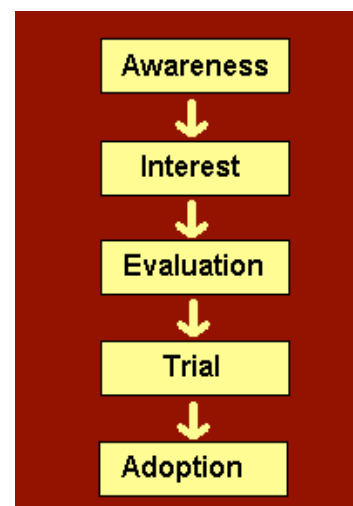
Rogers, E. 1995

Adopter categories

- o **Innovators**
  - typically researchers, designers, governments and regulators who recognise problems, invent solutions and/or develop policies to drive their diffusion
- o **Early adopters**
  - typically leading design practitioners and their clients working (at least partially) in less cost sensitive, risk averse sectors of industry who develop solutions, demonstrate achievability, drive competition and deliver working examples
- o **Early majority**
  - more mainstream operators seeking a competitive advantage. (e.g.. GreenSmart builders). Drive the commercialisation of solutions and often set the pace for regulatory reform
- o **Late majority**
  - typically engaged by a combination of competition and regulation
- o **Skeptics & Laggards**
  - mostly forced in by regulation. Can undermine early adoption
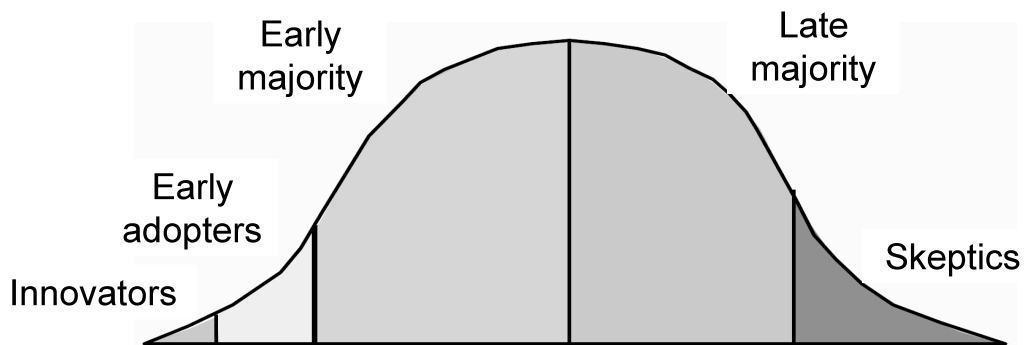
A typical profile of the various categories of adopter (based on innovativeness) as an innovation (sustainability) is diffused within a society

Information needs vary according to adopter category

o Innovators generally have higher levels of prior knowledge and require more technical information – mostly beyond the scope of YH.

o Until recently, YH met the information needs of all other adopter categories reasonably well

o As the innovations diffuse, the information needs of earlier adopters become more sophisticated

o The needs of novices are also changing

o Later adopter groups are generally risk averse and cost sensitive. They require information about cost effective, practical, commercially available solutions.

o Meeting the changing needs of each group within one document could lessen its effectiveness
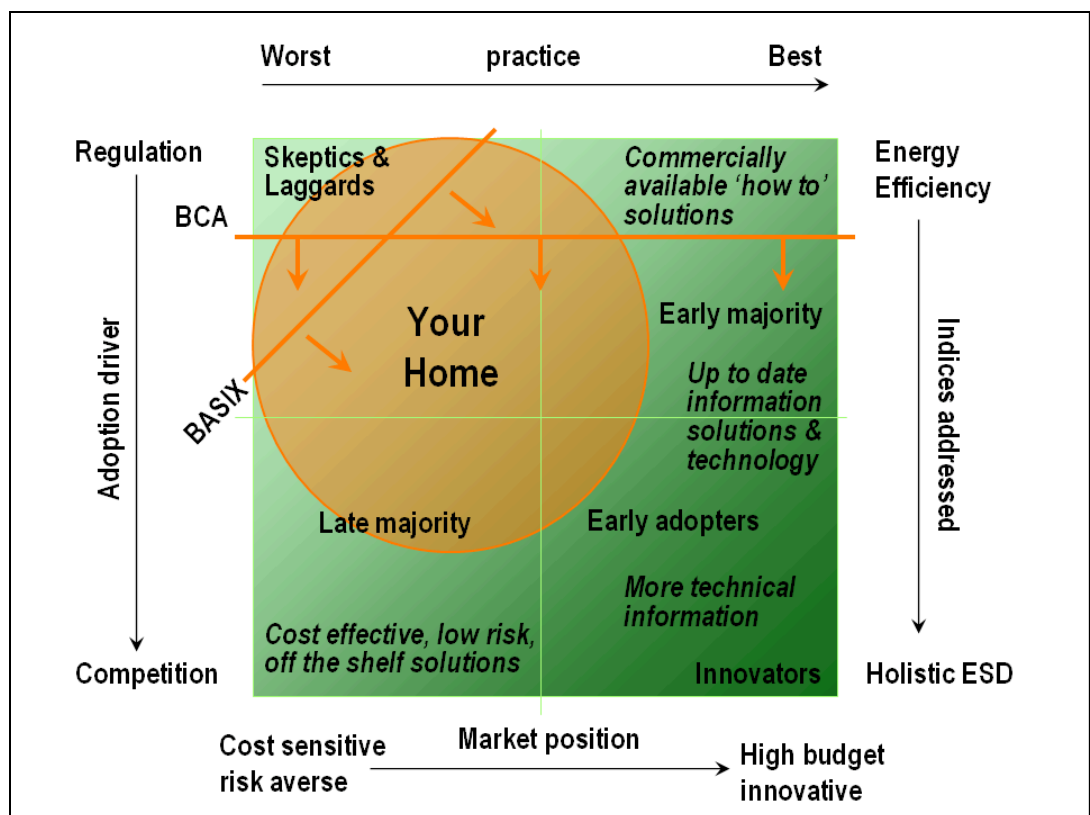
These slides examine the categories of actors we are communicating with as defined earlier by diffusion theory. Sustainable (or green) performance improves as we approach the bottom right corner where the innovative, high budget people are found.

The indices on left/right top bottom indicate the strongest drivers for each group. While these influences apply across the whole quadrant, their effect is strongest on the group immediately adjacent and diminishes as we approach the other side – where that influence predominates. I hope that made sense?

You can see the effect of current regulatory agendas in orange. The arrows indicate the direction of bar creep. BASIX is diagonal because it addresses more indices than the horizontal energy efficiency-focused BCA.

The circle in the top left approximates the current coverage of YH. When first released in 2000, the coverage addressed a much greater proportion of user needs. Sustainable change is occurring and we need to adjust YH in response.

The italicised text in each quadrant is a summary of the information needs of each group of practitioners according to my recent surveys.

What does research within the BDAA audience group tell us?

Adoption curves generated by plotting cumulative totals of BDAA RAIA & HIA samples adopting ESD & EE principles
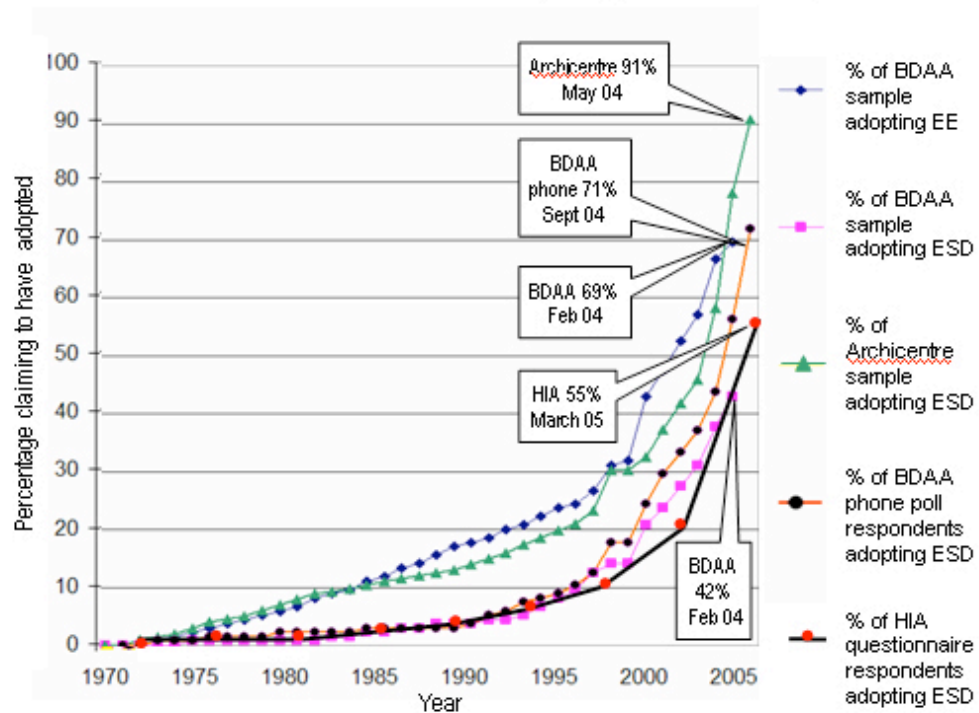
Characteristics of the subject group

- o Building Designers are:
  - o an accessible, modest sized national industry group,
  - o representative of a diverse range of skills and roles.
  - o a median group between builders and design professionals
  - o strongly client focused providing good access to consumers
  - o overly representative of the "ESD early adopter" category
  - o strongly committed to sustainability as an organisation
  - o have strong linkages to all major industry groups
  - o flexible and responsive to learning and change.

- o Sample size: 1300 practicing members nationally
- o 135 responses received (≥ 10% response rate)

The graphs above depict the cumulative total of respondent's declarations regarding the date of their decision to adopt sustainable practices in three separate questionnaires and a phone poll conducted through my AR.

They form adoption curves that follow a very similar trajectory. These curves are atypical in diffusion terms because they are yet to show an inflection point. I posit that this is due to the introduction (or planned introduction) of mandatory standards in BCA from 2004.

Conclusion : In diffusion terms, we are making good progress on decisions to adopt some level of sustainable practice. The important questions now become, how might we accelerate the adoption of best practice and; how rapidly can existing benchmarks creep towards better practice.

Notes:

Respondent understandings of ESD vary significantly.
Respondent definition of 'applying in all projects' often means 'every project that they can' not every project.
Only some aspects of ESD are addressed – rarely all.
The accuracy of respondent recollection of dates and events is only approximate.

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Change is occurring rapidly.
What should the next steps be?

- o Define ultimate goals required to ensure social, economic and ecological sustainability
- o Agree appropriate, achievable targets & timeframes
- o Coordinate the agendas of regulators and change agencies to encourage, mandate and measure progress.
- o Map the knowledge and skills required by each industry player to achieve these goals and timeframes (BITS)
- o Develop the resources required to deliver knowledge and skills through CPD, TAFE and University
- o Build collaborative networks within industry to deliver and manage this complex and ongoing process of change
- o Explain and market the benefits to consumers

</div>

In light of that information, perhaps we should pause for a minute and re-visit the fundamentals before proceeding….

We need to set comprehensive targets. Irish joke: If I was going to there – I wouldn't be starting from here.

My suggestion:

Zero net lifecycle environmental emissions.

Zero net lifecycle environmental depletions.

NABERS (was?) and BASIX are describing and measuring progress towards these e.g.. BASIX can measure 100% + GGE scores to allow embodied energy payback The BCA needs to develop similar facilities – not just minimum targets with no future direction.

My thesis addresses these but they are beyond the scope of today

This is occurring – albeit slowly. Communication and collaboration between departments and levels of government needs to be improved

We are just starting this process. BITS – or something similar is needed urgently to maximise effective use of scant resources and eliminate duplication. The old building industry adage: Do it once, do it right

Today's discussion of *Your Home* is an important part of this

This aspect is progressing well but needs formal planning and management

This is probably the last step. Stimulating consumer demand too early may expose the single greatest barrier – a lack of skills in industry.

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**Building Designer use of
and comments on the Your
Home materials**

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Your Home distribution by State

The average Technical Manual possession by practitioners is approximately 55%.
Consumer magazine holdings are slightly higher.
Almost all these Technical Manuals were distributed during a CPD seminar series in 2001.

Average respondents in possession of Tech Manual is 60%. 800 members attended the first and only training seminar series and were presented with a Tech Manual.
60% of membership = 810.

Clearly, very few manuals have been distributed to BDAA members since.

After respondent skew correction, the average Tech Manual ownership by practitioners is approximately 50%. Job half done!

How often do you use the Your Home materials?

Consumer Magazine: 19 never   71 occasionally   14 frequently   3 all the time

Technical Manual 21 never   48 occasionally   31 frequently   3 all the time

Your Home Website 58 never   34 occasionally   6 frequently   0 all the time

Rank the usefulness of each.

Consumer Magazine: 12 no use 18 rarely   50 occasional   15 regular   10 essential

Technical Manual: 12 no use   8 rarely   27 occasional   24 regular   26 essential

Your Home Website 32 no use 24 rarely   26 occasional   8 regular   4 essential

How do you use them?

83 own info   82 inform clients   18 training staff   13 inform consultants   2 other

Rank the information provided in the Your Home Technical Manual

Range of topics covered

| | too much |
| about right |
| sometimes insufficient |
| not enough |

Adequate explanation of each topic

| too much |
| about right |
| sometimes insufficient |
| not enough |

Level of technical content

| too much |
| about right |
| sometimes insufficient |
| not enough |

Level of practical "how to" information provided on topics covered

| too much |
| about right |
| sometimes insufficient |
| not enough |

Ease of navigation / ability to find the information you need

| too much |
| about right |
| sometimes insufficient |
| not enough |

What are the most useful aspects of the Your Home materials in your practice?

31 Very useful for informing clients
21 A useful ESD reference
 7 Easy to understand
 7 Passive design information
 6 Motivates me to apply ESD
 6 Reinforces my knowledge/skills
 5 Explains broader ESD principles
 4 Good level of information
 3 Composting WC information
 3 Informing staff
 3 References and links
 3 Insulation practices

2 Case studies
2 Information on water use
1 Orientation & site analysis
1 Materials use
1 Energy use
1 Statistical information
1 Heating/cooling information
1 Information on responses in other regions/climates
1 A good filing system for additional information

What might improve the Your Home materials?

Additional information requested

22   More "how to" information (technical, specific, detailed)

19   Products / technical specification (suppliers, contacts, comparative performance).

17   Case studies: (12 just more; 3 more "mainstream"; 2 more tropical).

13   Regular updates (latest products, techniques, regulations)

5   Comparative tables for materials & construction system performance (comparative tables)

What might improve the Your Home materials?

Additional information

2   More references (technical information, materials, supplier web sites)

2   Update insulation information (bulk / RFI)

2   More detail on grey water systems

2   More state regulation specific information

1   More detail on embodied energy

1   More detail on thermal lag in envelope performance

1   Explain NatHERS within passive design fact sheets

Conclusions

o Your Home currently provides a useful broad base of quality information but it is starting to date

o The volume already is proving daunting to novices

o As practitioners become more expert, their information needs become more specialised and application specific

o Different types of supplementary information are required:
  o more recent/up to date and more technical
  o commercially available, regulation specific solutions
  o up to date sources of cost effective products & services

o Can Your Home effectively meet all these needs?

Where are the content gaps?

Apart from those already identified by the AGO
o New Housing
  o Heating / cooling & GGE (expand existing fact sheet)
o Existing housing (new fact sheets?)
  o consumers (owners & investors)
  o NABERS - property marketing and valuation
  o Alterations & additions (regulation & metrics)
o Multi residential (separate text?)
o Materials selection (EcoSpecifier?)
o Lifecycle approaches (EcoSpecifier?)
o Commercial buildings (separate text)

What <u>types</u> of information are required for each adopter category?

Note:

The following observations are drawn from my action research roles as

- Builder & Building Designer
- CPD develop/delivery for BDAA
- Author of some of Your home & participant in original communications research
- HIA GreenSmart trainer/course developer in NSW (2 years)
- Course developer/lecturer at CQU in Built Environment
- Regular presenter at community ESD seminars
- Guest lecturer at UTS, Archicentre & other industry forums
- Industry conference speaker

My action research has included documenting responses to presentation variations with these diverse audience groups – seeing what works and what doesn't and linking this to the position of the audience on the adoption curve

This is an overview of those findings. For the detail, read my PhD.

Information strata

- o **Attitudes**
  moral & ethical judgments about what we need to do
- o **Knowledge**
  why and how we should act on those judgments
- o **Skills**
  how we implement those actions
- o **Depending on who/where we are in industry, varying degrees of each are required.**
- o **Can a single information source achieve this adequately?**

Attitudes are predominantly motivational

To experts, they are seen as preaching
To novices, they provide reason, motivation & incentive
They are very useful sales tools
E.g. baby boomers in developed world
80% resources consumed by 20% population,
inter and intra generational equity; Brundtland definition,

Knowledge

The environmental impact of the built environment industry
how ecosystems work / ecological footprint,
global warming / Kyoto,
Importance of biodiversity /

Skills

How we implement SP in our housing stock effectively and efficiently.
Innovative design requires comprehensive understanding of technologies and practices
Quality assured specification and implementation requires comprehensive knowledge of:
who makes it,
how much it costs,
what its limitations are,
all the tricks of the trade for getting it in place,
making sure it works
and keeps working for the life of the building.

Information streams

o Comprehensive & highly technical knowledge
   Engineers, leading ESD designers, assessors & ESD consultants

o Detailed conceptual understanding, sound "how to" knowledge and
   access to specialist knowledge/advice to inform innovative solution
   development/implementation
   Design professionals, specialist builders, planners & certifiers

o Sound conceptual understanding and knowledge of how/where to
   find solutions (by others)
   Developers, volume builders, managers, consumers & draftspeople,.

o General conceptual overview combined with specialised application
   skills.
   Sales staff, project managers, trades (e.g.. plumbers), financiers, valuers

I suggest four distinct information streams. *Your Home* can't really address the first but, with
thoughtful amendments and delivery in the right training forum, it can address most of the others –
with a little help from other resources like EcoSpecifier and newly formed e-groups

What information and training do BDAA members need

High confidence levels

Application	Mean deviation	response strength
GGE efficient energy sources	0.09	+7%
On site wastewater treatment	0.14	+8%
Soil loss & sedimentation control	0.07	+8%
Reduced water consumption	0.49	+47%
Energy efficient appliances	0.48	+59%
Low energy consumption	0.58	+61%
Energy efficient envelope	1.0	+82%
Natural ventilation	1.03	+82%
Aesthetic/visual impact	1.09	+92%

Low confidence levels

Application	Mean deviation	response strength
Reducing biodiversity impacts	-0.55	-53%
Low greenhouse transport	0.03	-51%
Indoor air quality	- 0.4	-42%
Designing convenient recycling facilities	-0.38	-41%
Recycling / resource recovery	-0.26	-27%
Economic impact/cost of change	-0.12	-14%
Reducing Greenhouse Gas Emissions	0.01	-7%
Social/cultural impacts	0.02	-4%

Q. Rank your confidence level in being able to address the following ESD (SP) considerations in a project?

Confidence levels by state.

Chart categories (left axis):
Low energy use
Low GGE
EE envelope
EE appliances
GGE energy
Nat ventilation
Water DSM
WW treatment
Soil loss
Aesthetic/visual
Indoor air qual
GGE / transport
Biodiversity
Waste min
Recycling facilities
Social/cultural
Economic / LCC

Legend:
■ NSW
■ VIC
□ QLD
□ Other
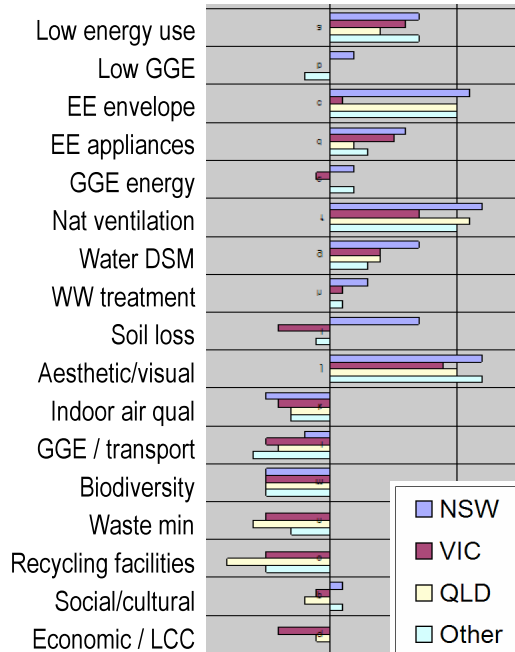
Conclusions

o Confidence levels on Energy efficient envelope & natural ventilation are high

o In Victoria, mandatory 4 – 5 star requirements have tested skills and lowered confidence

o NSW excels in this field due to length of exposure to SEDA ESH 3.5 star policy.

o Other states have probably dropped since BCA introduction

o GGE reductions and GG efficient energy source skills need attention

o Low confidence levels of concern are:
  o indoor air quality;
  o waste minimisation
  o recycling facilities (except for NSW)

o Low confidence is evident in fields not directly within respondent control or state focus

Understanding levels are higher in states where ESD agendas have been operating longest (Victoria & NSW).Confidence levels drop when compliance becomes mandatory (e.g.. mandatory 4-star energy ratings in Victoria)

NSW has had mandatory energy ratings (Energy Smart Homes) for longer.

Confidence levels have adjusted

GGE reductions and GG efficient energy sources need some attention

Soil loss and sedimentation control are good in NSW, bad in Victoria (not mandated) and poor in Qld where they are most strongly mandated. This leads me to suggest that practitioners overestimate their skill levels until forced to apply them under mandatory regulations.

Negative confidence levels are notable on indoor air quality, transport (beyond influence/scope), Biodiversity (same for most of us). waste minimisation and recycling – (except for NSW where Resource NSW has run a very successful change agenda).

A lack of confidence in socio-cultural aspects in Victoria and Qld (what can I say?)

Economic / Life Cycle Costing – especially Victoria – probably from real experience with mandatory 5 star.

Your Home users record higher confidence levels.

Conclusions

o Whilst these differences are unable to be directly attributed to YH use. Note that Victorian YH users have much higher confidence than average.

o Practitioners with specific ESD expertise or interest have probably participated in YH related training or discovered YH through their own research.

o Confidence levels build through experience over time.

o Most practitioners received a copy of YH when they attended the first and only YH specific CPD in 2001

o Higher confidence levels would be expected amongst these practitioners.

o Notwithstanding the above, YH is used by and useful to, practitioners working with ESD

Note that Victorian YH users have much greater confidence in envelope efficiency than the combined sample including non-users

BDAA priority for CPD training

Priority	Subject	Mean deviation	response strength
1.	New rating tools (BCA, HERS, NABERS, BASIX)	1.13,	90%
2.	Marketing sustainable design	1.13,	88%
3.	Water sensitive urban design	0.94,	84%
4.	Waste water treatment & recycling	0.98,	83%
5.	Environmentally preferred materials selection	0.85,	80%
6.	Cost management and Life Cycle Costing	0.84,	80%
7.	Generalist ESD courses	1.04,	79%
8.	Specialist – passive solar design	0.79,	71%
9.	Social & cultural aspects of sustainable design	0.76,	70%
10.	BCA Minimum Energy Code	0.66,	57%
11.	Waste minimisation & recycling	0.48,	52%
12.	Specification of efficient appliances	0.45,	51%
13.	Soil loss and sedimentation control	0.34,	40%

This slide gives a clear indication of where CPD training should focus

Actions to create demand for SP

	Action	Mean deviation	response strength
1.	Disclose energy rating at point of lease or sale (e.g.. First Rate disclosure in ACT)	1.5,	83%
2.	Mandatory ESD design performance (BCA, BASIX)	1.5,	83%
3.	Mandatory ESD operational performance (NABERS)	1.4,	80%
4.	Mandatory valuation of energy features	1.4,	71%
5.	Combining ESD & energy	1.3,	72%
6.	Mandatory valuation of ESD features	1.3,	70%
7.	Lifestyle TV	1.16,	66%
8.	Increase water cost	1.25,	62%
9.	Increase energy cost	1.23,	58%

Drivers of adoption

Rank the importance of the following factors in driving the adoption of ESD (0 to 5)
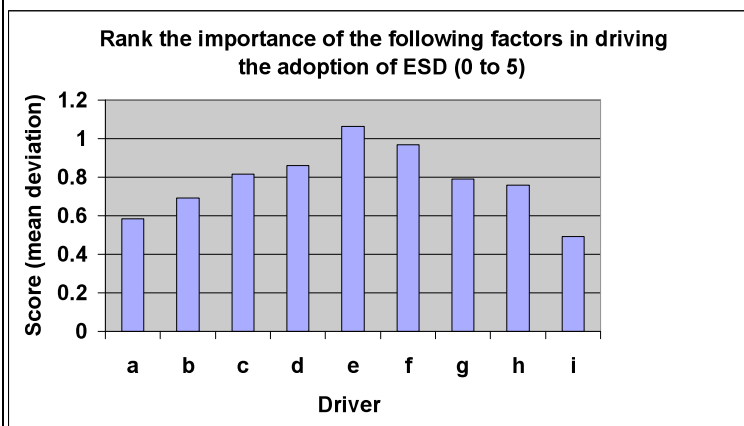
...reasing the industry skill base
...cal government regulation
...te government regulation
...deral government regulation
...proving technology availability
...nt – consumer demand
...areness amongst consultants
...dership by developers
...ilability of skilled staff

Here, technology availability is seen by practitioners as the biggest driver followed by consumer demand. Quote from a practitioner: *if they make it and certify it, we'll use it.*

Barriers to adoption

In your opinion, how important are the following as barriers to the adoption of ESD?

Score (mean deviation)

Nominated barrier

Legend
a) Local government regulation
b) Availability of skilled staff
c) State government regulation
d) Federal government regulation
e) Inadequate skill base
f) Awareness amongst consultants
g) Technology availability
h) Leadership by developers
i) Client – consumer demand
j) Cost

j) Cost and i) consumer demand are seen as the biggest barriers followed by h).

We have seen substantial improvement in Opinion Leadership roles by developers in NSW, VIC and WA this year.

g) Technology availability is also seen as a problem. This is reinforced anecdotally by feedback from GreenSmart attendees and designer interviews. However, the problem is quickly becoming one of awareness rather than absence of resources.

YH partnerships with manufacturers and suppliers are potentially useful in this regard – provided that they are inclusive- not exclusive. Current AGO practice of allowing certain manufacturers to sponsor (and write) fact sheets outside the peer review process of this committee are (my opinion) seriously weakening the credibility of the YH materials (Cite Austral Bricks, Insulation Solutions and AGGA/Pilkingtons)

Inadequate skill base and consultant awareness are the next most important after varying levels of emphasis on regulator levels.

Note that Commonwealth regulation (or lack of it) is seen as the biggest regulatory barrier.

This perceived skill base deficit is predominantly personal as most are sole traders.

Staff availability is low because most are sole practitioners

Barriers to adoption
Comparing BDAA to Archicentre sample
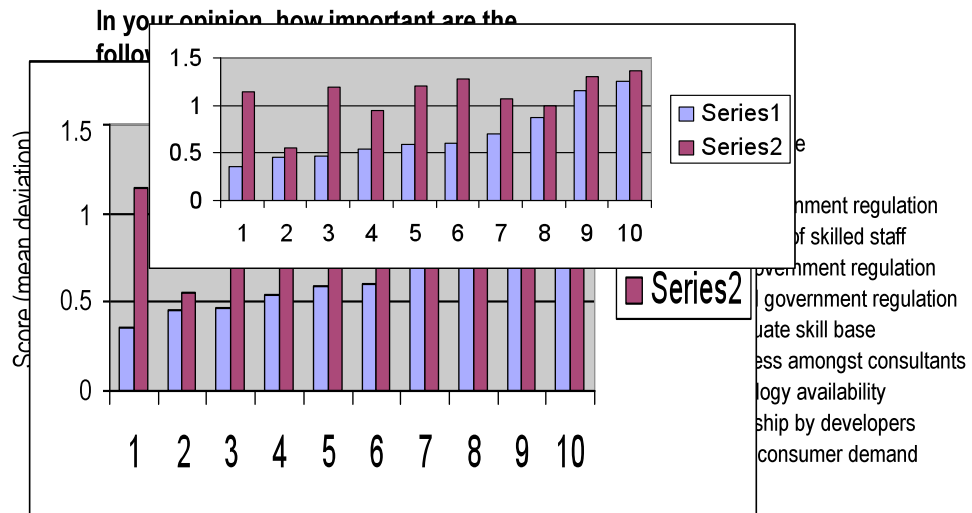
Significant variations between architects and building designer responses to this question beg further investigation. Certainly market position and budget have some influence. Additionally, architects are far more likely to use consultants (which explains why architects rank this among the highest barriers) to provide quality assured professional advice whereas BDs are likely to use in-house solutions.

Staff availability is low because most designers are sole practitioners. This is an important consideration when designing information and training resources for this group. Time out of the office is often a bigger consideration than cost – although both are critical.

Additionally, In-house references and resources need to be low cost and accessible. Very few single practitioner offices that can afford expensive resources like EDG which (I argue) was developed with large practices in mind but is an equally important resource for small practices.

Conclusions

o The survey provides a reasonable picture of the attitudes of the subject group towards applying ESD (SP) and Energy Efficiency in their work and their feedback/suggestions for the YH materials.

o With more knowledge/skill and the advent of improved benchmarking tools, it is reasonable to assume that the "soft" adoption intentions recorded will translate into solid gains.

o Your Home is seen as a very useful tool by those BDAA practitioners who have it.

o As skill levels increase, so do demands for more detailed information and training. Let's discuss them

Discussion

o **What changes should we consider?**
   o Stratification of technical information levels?
   o Streaming of detailed information to specialist needs?
   o Single or multiple media?
   o Appropriate dissemination methods?

Communication channels (boxes):

- Change agents
- Opinion leaders
- Industry media
- Mainstream media

- Government regulators
- Industry organisations
- Industry media
- Peer communication

- Initial: Governments & Industry orgs.
- Later: TAFE and university

- Manufacturers/Suppliers
- Specialist consultants
- Industry orgs
- Innovative practitioners

- Initial: Change agencies, Larger companies, Lead practitioners, Real estate agents
- Later: Property valuers

- Government funding to:
- Research community
- Larger manufacturers
- Specialist consultants
- Innovative practitioners

PRIOR CONDITIONS
1) Change agency awareness raising
2) Measurement tools
3) Regulatory impact statement
4) Regulation

BASIC KNOWLEDGE
1) Understanding the regulations
2) Accessing the measurement tools
3) Knowing how to comply

ACQUIRE NEW SKILLS
1) Minimum compliance skills
2) Source commercially available solutions
3) Develop cost effective compliance methods

INCORPORATE INTO BaU
1) Standardise compliance solutions
2) Reduce costs
3) Manage risk (QA)
4) Negotiate costs with suppliers & manuf.

DEVELOP MARKET AWARENESS
1) Train sales staff
2) Competition & product differentiation
3) Consumer acceptance
4) Incorporate into property values

INNOVATION & RE-INVENTION
1) Identify new solutions
2) Invest in product R&D
3) Commercialise new technologies
3) Economies of scale
4) Benchmark creep

Stages (arrows):
I. DECISION
II. KNOWLEDGE
III. SKILLS
IV. IMPLEMENTATION (adoption)
V. MARKETING
VI. RE-INVENTION

Regulation drives the decision to adopt.
Characteristics of the decision making unit are less relevant under regulation.

Perceived characteristics of the Innovation are replaced by apprehension.
1) Cost
2) Risk
3) Market demand
4) Benchmark uncertainty
5) Unavailability of skills

Compliance skills
1) Details of regulation
2) Required technologies
3) Required practices
4) Required staff

Diagonal labels: Initial low skill levels = risk aversity; increased skills confidence competition; competence o innovation

Minimum practice — Better practice — Innovative practice
bar creep — commercialisation

SUSTAINABLE HOUSING

Larger scale copy/repeat of Figure 22 from p 261.

365

Bibliography

ABCB 2004a, *Housing Technical Committee Meeting No 7*, Australian Building Codes Board, Canberra.

ABCB 2004b, *Revised Energy Efficiency Provisions for Class 1 and 10 Buildings in BCA Volume 2 (Housing Provisions)*, Australian Building Codes Board, Canberra.

ABCB 2005, *Energy Efficiency BCA, Volume 2. Draft Regulation Impact Statement; Proposal for enhanced requirements for houses*, Australian Building Codes Board, Canberra.

ABCB 2006a, *Building Code of Australia 2006. Class 1 and Class 10 Buildings: Housing Provisions, Volume Two*, CanPrint Communications, Canberra.

ABCB 2006b, *Energy Efficiency BCA, Volume 2. Regulation Impact Statement; Proposal for enhanced requirements for houses*, Australian Building Codes Board, Canberra.

ABEC 2002, *Study of Education, Training and Continuing Professional Development in Energy Efficiency and Greenhouse related issues*, AGO, Canberra.

Abrahamson, E.R., L. 1997, 'Social network effects on the extent of innovation diffusion: A computer simulation.' *Organization Science,*, vol. 8, pp. 289-309.

ABSA 2005, *Letter to Director General, DoP NSW by Dick Clarke, ABSA President*, Sydney.

AGO 1999, *Scoping Study of Minimum Energy performance Requirements for incorporation into the Building Code of Australia*, Australian Greenhouse Office; Commonwealth of Australia, Canberra.

AGO 2000, *Impact of Minimum Energy Performance Requirements for Class 1 Buildings in Victoria*, Australian Greenhouse Office, Commonwealth of Australia, Canberra.

Alcamo, J. & Bennett, E.M. 2003, *Ecosystems and human well-being: a framework for assessment*, ISLAND PRESS (The Center for Resource Economics). Washington, DC.

Allam_Homes 2004, 'GreenSmart traing (company specific).' unpublished, Housing Industry Association.

Allens_Consulting 2002, *Cost-Benefit Analysis of New Housing Energy Performance Regulation: Impact of Proposed Regulations* Sustainable Energy Authority of Victoria & Building Commission, Melbourne.

Alley, R.B., Mayewski, P.A., Sowers1, T., Stuiver, M., Taylor, K.C. & Clark, P.U. 1997, 'Holocene climatic instability: A prominent, widespread event 8200 yr ago', *Geology*, vol. 25, no. 6 June 1997, pp. 483-486.

Angel, J. 2008, *Light Green Start to Emissions Trading*, Media Release, Total Environment Centre, <http://www.tec.org.au/index.php?option=com_content&task=view&id=684&Itemid=203>.

ANTA 1999, *Resources for theTraining Package for Assessment and Workplace Training BSZ98: Learner's Pack*, Australian National Training Authority, Melbourne.

ANZECC & ARMCANZ 2000, *Australian and New Zealand Guidelines for Fresh and Marine Water Quality*, A&NZ Environment and Conservation Council & Agriculture and Resource Management Council of A&NZ, Canberra.

Argyris, C., Putnam, R. & MacLain-Smith, D. 1982, *Action Science: Concepts, Methods and Skills for Research and Intervention*, Jossey-Bass, San Francisco.

Argyris, C. & Schön, D.A. 1974, *Theory in practice : increasing professional effectiveness*, Jossey-Bass Publishers, San Francisco.

ASBEC 2008, *The Second Plank - Building a Low Carbon Economy with Energy Efficient Buildings*, Australian Built Environment Council, http://www.asbec.asn.au/research.

ATA_MOTUS 2004, *Your Home Consumer Guide Communications Effectiveness Study findings & Communications Strategy* Alternative Technology Association, Melbourne.

AtKisson, A. 1999, *Believing Cassandra, An optimist looks at a pessimist's world*, 1st edn, Scribe Publications Pty Ltd, Melbourne.

Austral 2006, *The Role of Thermal Mass in Energy Efficient House Design*, *Background Paper:*, Austral Bricks, Sydney.

Baggs, D. & Cole, G. 1997, 'Survey of ESD coverage in Built Environment Design Schools in Australia ', unpublished, Ecological Architect Association.

Ballinger, J.A., Prasad, D., K & Rudder, D. 1992, *Energy Efficient Australian Housing, 2nd Edition*, National Solar Architecture Research Unit, University of NSW, AGPS, Canberra

BBC 2006, *Howard rejects emission targets*, <http://news.bbc.co.uk/1/hi/world/asia-pacific/4797339.stm>.

BDAA 2008, *Who we are*, http://www.bdaa.com.au/about.html Accessed Feb 2008.

Beagle, D. 2001, 'The Sociotechnical Networks of Scholarly Communication', *portal: Libraries and the Academy*, vol. 1, no. 4, pp. 421-443 The Johns Hopkins University Press

Berry, M. 1999, 'Unravelling the "Australian Housing Solution": the Post-War Years ', *Housing, Theory and Society*, vol. Vol16 No3/October 20, no. 3, pp. 106-123.

Bishop, R.A. 2003, *The History of Bubonic Plague*, *University of Texas Health Science Center*, Graduate School of Biomedical Sciences, Houston.

Blanchon, P. & Shaw, J. 1995 'Reef drowning during the last deglaciation: Evidence for catastrophic sea-level rise and ice-sheet collapse', *Geology*, vol. 23, no. 1, pp. 4-8.

Boudourides, M. 2001, 'The politics of Technological innovations: network approaches', Paper, International Summer Academy on Technological Studies Deutschlandsberg, Austria.

Boyer, E.L. 1997, *Scholarship reconsidered : priorities of the professoriate*, 1st edn, Jossey-Bass Publishers, San Francisco.

Bragança, L., Mateus, R. & Koukkari, H. 2007, 'Perspectives of building sustainability assessment ', paper presented to the *Portugal SB07. Sustainable Construction, Materials and Practices - Challenge of the Industry for the New Millennium*, Lisbon, August 2007.

Braxton, J.M., Luckey, W. & Helland, P. 2002, *Institutionalizing a broader view of scholarship through Boyer's four domains*, Jossey-Bass, New Jersey.

BRCC 2006, *The Business Case for Early Action*, Australian Business Roundtable on Climate Change, www.businessroundtable.com.au viewed 27-22-08.

Brown, L.R. 2008, *Plan B 3.0: Mobilizing to Save Civilization, Third Edition*, vol. New York, WW Norton.

Bruce, A., Lyall, C., Tait, J. & Williams, R. 2004, 'Interdisciplinary Integration in Europe: The case of the fifth framework programme', *Futures* vol. 36, no. 4 pp. 457-470.

Bryce, P., Johnston, S. & Yasukawa, K. 2002a, *Implementing a program in sustainability for engineers at University of Technology, Sydney: A story of intersecting agendas*, University of Technology Sydney, Broadway NSW Australia.

Bryce, P., Johnston, S. & Yasukawa, K. 2002b, 'Implementing a program in sustainability for engineers at UTS: A story of intersecting agendas', unpublished, University of Technology Sydney.

Bryce, P. & Yasukawa, K. 2004, 'Actor Network Theory: some ideas for conducting research for positive socio-technical change.' personal communication, 24 November, 2004, Sydney.

Callendar, G.S. 1938, 'The artificial production of CO_2 and its influence on temperature', *Q. J. R. Meteorological Society*

no. 64, pp. 223-240.

Callon, M. 1986, 'Some elements of a sociology of translation: Domestication of the scallops and fishermen of St Brieuc Bay.' in J. Law (ed.), *Power, Action and Belief: A new sociology of knowledge?*, Routledge & Kegan Paul, London, pp. 184-208.

Callon, M. 1991, 'Techno-economic networks and irreversibility', in J. Law (ed.), *A Sociology of Monsters: essays on power, technology, and domination*, Routledge, London, pp. 132-161.

Callon, M. & Law, J. 1982a, 'On interests and their transformation: enrollment and counter-enrollment', *Social Studies of Science*, vol. 12, pp. 615-625.

Callon, M. & Law, J. 1982b, 'On interests and their transformation: enrollment and counter-enrollment', *Social Studies of Science, pp.*, vol. 12, pp. 615-625.

Carew, A. 2004, 'Reflective and Post-normal Engineering: Models of sustainable engineering practice and their implications for undergraduate teaching and learning', PhD thesis, University of Sydney.

Chalmers, A.F. 1999, *What is this thing called science?*, 3rd edn, University of Queensland Press, St Lucia, Qld.

Chappells, H. & Shove, E. 2003, 'The Environment and the Home', paper presented to the *Environment and Human Behaviour Seminar*, Policy Studies Institute, London, 23rd June 2003.

Checkland, P. & Holwell, S. 1997, 'Action Research: Its Nature and Validity', *Systemic Practice and Action Research*, vol. 11, no. 1, pp. 9-21.

Cherry, N. 1998, *Action Research: a pathway to action, knowledge and learning*, RMIT University, Melbourne.

CIE 2007, *Capitalising on the building sector's potential to lessen the costs of a broad based GHG emissions cut*, Prepared for: ASBEC Climate Change Task Group by Centre for International Economics Canberra.

City_of_Subiaco 2004, 'Subiaco Sustainable Demonstration Home', *Website:* , viewed 17th June 2007 <http://www.subiacosustainable.com.au/>.

Clarendon_Homes 2007, 'Thermal Performance Building Sustainability Seminar feedback.' unpublished, Building Designers Association of Australia.

Clarke, D. 2006a, 'The importance of being Accurate:The role and importance of thermal modelling in reducing energy consumption in Australian Buildings', *The ABSAlute discourse series*.

Clarke, R.J. 2006b, 'Panning controls and sustainability: PlanFirst's potential seen through a case study of Pittwater', Masters thesis, University of Technology Sydney.

CoA 2004, *Your Home Interactive DVD*, DVD, Commonwealth of Australia, Canberra.

CoA 2007, *Your Home Buyer's Guide: A step by step guide to buying a new home*, Commonwealth of Australia, Canberra.

CoA 2008a, *Your Home Buyer's Guide: A step-by-step guide to buying a new home*, Commonwealth of Australia, Canberra.

CoA 2008b, *Your Home Renovator's Guide: An independent guide to improving your home*, Commonwealth of Australia, Canberra.

Cole G, M. 2007, *BASIX Standards* e-mail, HDAA e-group April 27 2007.

Commonwealth_of_Australia 1991, *National Housing Strategy : a framework for reform*, Australian Govt. Pub. Service, Canberra.

Commonwealth_of_Australia 1992, *The National Greenhouse Response Strategy*, Australian Greenhouse Office, Canberra.

Commonwealth_of_Australia 1998, *National Greenhouse Strategy: Strategic Framework for Advancing Australia's Greenhouse Response*, Australian Greenhouse Office, Canberra.

Crawford, R.B., Jenkins, H.K. & Murray-Prior, H. 1999, 'Ensuring rigour from a single researcher study.' *Ensuring rigour from a single researcher study. Paper: Curtin University of Technology.*

Crotty, M. 1998, *The foundations of social research : meaning and perspective in the research process / Michael Crotty.*, Allen & Unwin,, St Leonards, N.S.W. :.

Crouch, E. 2005, *Sustainability making for unaffordability*, HIA Response to Sustainable Cities Report, On Line Opinion: http://www.onlineopinion.com.au/view.asp?article=196 Accessed 2 Jan 08.

Crouch, E. 2006, *Red Tape Restricts Water Flow*, On Line Opinion: http://www.onlineopinion.com.au/view.asp?article=5174 Viewed 3 Jan 08.

CSIRO 2005, 'Distributed Energy and Demand Side Management', *CSIRO Energy Technology http://www.det.csiro.au/science/de_s/de_dsm.htm*, viewed 20-02-09.

Day, B.A. & Monroe, M.C. (eds) 2000, *Environmental Education & Communication for a Sustainable World; Handbook for International Practitioners*, GreenCom, US Academy for Educational Development, Washinton DC.

DCC 2008, *Carbon Pollution Reduction Scheme: Green Paper: Summary*, Department of Climate Change, Canberra.

Delorme, L. 2005, *A Study into International Directions for the Mandatory Disclosure of Energy Performance of Buildings*, Faber Maunsell - AECOM for Australian Greenhouse Office, National Framework for Energy Efficiency website http://www.nfee.gov.au Accessed March 2007.

Denzin, N.K. & Lincoln, Y.S. 2005, *The SAGE handbook of qualitative research*, 3rd edn, Sage Publications, Thousand Oaks.

DET_&_SEDO_WA 2007, *Bunbury ecoHOME*, West Australian Department of Education and Training; Sustainable Energy Development Office., viewed 17th June 2008 <http://bunburyecohome.com/>.

DEWHA 2007, *Modelling the Relationship of Energy Efficiency Attributes to House Price: The case of detached houses sold in the Australian Capital Territory in 2005 and 2006. A statistical consultancy report by the ABS*, Department of the Environment, Water, Heritage and the Arts, Canberra.

DEWHA 2008a, *Confirmation of circulation, sales figures and website access for the suite of YH materials*, e-mail to Chris Reardon 8th July 2008 *Lucinda Wheadon*, Department of the Environment, Water, Heritage and the Arts, Canberra.

DEWHA 2008b, *Energy Use in the Australian Residential Sector 1986 - 2020*, Department of the Environment, Water, Heritage and the Arts, Commonwealth of Australia, Canberra.

Diamond, J. 2005a, *Collapse: How Societies Choose to Fail or Succeed*, Viking, New York.

Diamond, J.M. 2005b, *Guns, germs, and steel : the fates of human societies (2nd edition)*, Norton, New York.

Dick, R. 1990, *Rigour without numbers: the potential of dialectical processes as qualitative research tools*, Interchange, Chapel Hill, Qld.

Dick, R. 1992, *You want to do an action research thesis?*, Interchange document, University of Queensland.

Dick, R. 1999, *Sources of rigour in action research: Addressing the issues of trustworthiness and credibility.*

Diesendorf, M. & Hamilton, C. (eds) 1997, *Human ecology, human economy : ideas for an ecologically sustainable future*, Allen & Unwin, St Leonards, N.S.W.

Diesendorf, M. & Hamilton, C. (eds) 1997, *Human ecology, human economy : ideas for an ecologically sustainable future*, Allen & Unwin, St Leonards, N.S.W.

Dixon, T., Colantonio, A., Shiers, D., Gallimore, P., Reed, R., Wilkinson, S. & Keeping, M. 2007, *A green Profession? RICS members and the sustainability agenda*, Research Report by, Oxford Brookes University, University of Melbourne & Georgia State University for the Royal Institute of Charetered Surveyors, Oxford.

do Nascimento, D.E. 2000, 'The Nature of the Networks of Innovation and Technological Information Diffusion in a Region in the Initial Stages of Industrial Development', viewed 17th December 2008 <http://in3.dem.ist.utl.pt/downloads/cur2000/papers/S26p02.pdf >.

DoP_NSW 2003, *Benchmarking BASIX*, viewed 15th June 2007 <http://basix.nsw.gov.au/information/resources.jsp>.

DPIV 2008, *Proposed Victorian Energy Efficiency Target Regulations 2008: Regulatory Impact Statement*, Department of Primary Industries, Melbourne.

Dupuy, D. 1997, 'Technological Change and Environmental Policy: The Diffusion of Environmental Technology', *Growth and Change*, vol. 28, no. Winter 1997, pp. 49-66.

Durfee, M. 1999, 'Diffusion of Pollution Prevention Policy', *The Annals of the American Academy of Political and Social Science*, vol. 566, no. 1, pp. 108-119 (112).

Easton, G. 1992, 'Industrial networks: a review', in B. Axelsson & G. Easton (eds), *Industrial Networks - A new View of Reality*, Routledge, London

Eckstein, D. 2006, *Personal communication during GreenSmart Design Award judging,*.

Ehrlich, P.R. & Ehrlich, A.H. 1972, *Population, resources, environment : issues in human ecology*, 2nd edn, W.H. Freeman, San Francisco.

Ellyard, P. 1996, *Keynote Presentation.Ecological Architects Association Inaugural ESD Conference.* Darling Harbour.

Energy_SA 2003, *Energy Friends Home Energy Auditing Course*, Government of South Australia, viewed 2-11-2008 <http://www.energy.sa.gov.au/government_programs/energy_friends>.

EnergyMatters 2008, *Feed-in tariff for grid-connected solar systems*, http://www.energymatters.com.au/government-rebates/feedintariff.php viewed 19th Dec 2008.

Flannery, T. 2007, *Presentation to National Press Club, 18th July*, ABC Television, Canberra.

Foster, K.P. 1998, 'Gardens of Eden: Flora and Fauna in the Ancient Near East', in, *Transformations of Middle Eastern Natural Environments: Legacies and Lessons*, New Haven, Yale University, pp. 320-329.

Foucault, M. 1972, *The archaeology of knowledge*, Tavistock Publications, London.

Foucault, M. 1989, *The archaeology of knowledge*, Routledge, London ; New York.

Fuller, S. 2002, *Social epistemology*, 2nd edn, Indiana University Press, Bloomington.

Garnaut, R. 2008a, *Garnaut Climate Change Review: Final Report*, Cambridge University Press, Port Melbourne.

Garnaut, R. 2008b, *Garnaut Climate Change Review: Interim Report to the Commonwealth, State and Territory Governments of Australia*, Comonwealth of Australia, Canberra.

Garnaut, R. 2008c, *Garnaut Climate Change Review: Interim Report to the Commonwealth, State and Territory Governments of Australia*, Garnaut Climate Change Review, http://www.garnautreview.org.au/CA25734E0016A131/pages/draft-report.

Garrett, P. 2008, *Green Loans for Aussie Homes*, Media Release: ENV02 13th May 2008, The Hon Peter Garrett MP, Minister for the Environment, Heritage and the Arts, Commonwealth of Australia, Canberra.

Gately, D. 1984, 'A Ten-Year Retrospective: OPEC and the World Oil Market', *Journal of Economic Literature, American Economic Association*, vol. 22, no. 3, pp. 1100-1114.

Geoghegan, W.H. 1994, 'Whatever happened to instructional technology?' *22nd Annual Conference of the International Business Schools Computing Association*, Baltimore, Maryland.

Gibbons, M., Limoges, C., Nowotny, H., Schwartzman, S., Scott, P. & Trow, M. 1994, *The new production of knowledge: the dynamics of science and research in contemporary societies*, Sage, London.

Giffard, S. & Reardon, C. 2003, *Building Industry Training in Sustainability: Working Paper*, Australian Greenhouse Office, Canberra.

Glassick, C.E., Huber, M.T. & Maeroff, G.I. 1997, 'Scholarship Assessed', *Paper given at 5th AAHE Conference on Faculty, Roles and Rewards, Sandiego California, Jan 18 1997*.

Gore, A. & Guggenheim, D. 2006, *An Inconvenient Truth*, Movie, L. Bender, S. Burns & L. Lennard, US, May 2006.

Government_of_Victoria 2002, *Regulatory Information Bulletin: Energy Efficiency Standards for New Residential Building*, Building Commission Victoria, Melbourne.

Gross, M. 2007, 'Germany goes for solar', *Current Biology*, vol. 17, no. 16, pp. R616 - R617.

GWA 1998, *Household Energy Use in Australia: End Uses, Greenhouse Gas Emissions and Energy Efficiency Program Coverage*, George Wilkenfeld & Associates, Sydney.

Hammes, D. & Wills, D. 2005, 'Black Gold: The End of Bretton Woods and the Oil-Price Shocks of the 1970s', *The Independent Review*, vol. IX, no. 4, pp. 501-511.

Haratsis, B. 2003, 'Presentation by Macroplan CEO ', paper presented to the *HIA Planning Conference*, Burswood Perth.

Hardi, P. & Zdan, T.J. 1997 *Assessing sustainable development* International Institute for Sustainable Developmen, Winnipeg, Manitoba.

Hawe, P., Degeling, D. & Hall, J. 1994, *Evaluating Health Promotion* MacLennan & Petty, Melbourne.

HDAA 2008, *E-group discussion re BASIX*, http://mailman.listserve.com/listmanager/listinfo/hdaa, viewed July 2008.

Healy, K. 2003a, *Theoretical Foundations of Research*, Workshop summary, Institute for Sustainable Futures, UTS, Unpublished.

Healy, S. 2003b, 'Epistemological pluralism and the 'politics of choice', *Futures*, vol. 35, pp. 689-701.

Herschell, R.M. 1999, 'Some Principles for 'Quality Control' in Qualitative Research a Phenomenographic Treatise', *Paper: Christian Heritage College*.

HIA 2003a, *HIA Submission to the Productivity Commission Inquiry into First Home Ownership*, Housing Industry Association, Canberra.

HIA 2003b, 'Loud and Clear: HIA's Message on Affordability', *http//www.buildingonline.com.au*, vol. November 2003.

HIA 2003c, *Restoring Housing Affordability - the housing industry's perspective*, Housing Industry Association, Canberra.

HIA 2003d, *Restoring Housing Affordability - the housing industry's perspective*, Housing Industry Association, Canberra.

HIA 2005a, 'In a knot over red tape', *http//www.buildingonline.com.au*, vol. March 2005, viewed 3 Jan 08.

HIA 2005b, 'Sustainability minus affordability', *http//www.buildingonline.com.au*, viewed 3 Jan 08.

HIA_GreenSmart 2003-7, 'GreenSmart training. Attendee feedback.' unpublished, Housing Industry Association.

Hines, J.M., Hungerford, H.R. & Tomera, A.N. 1987, 'Analysis and synthesis of research on responsible environmental behavior: A meta analysis', *The Journal of Environmental Education*, vol. 18, no. 2, pp. 1-8.

Hirsch, R.L., Bezdek, R. & Wendling, R. 2005, *Peaking of World Oil Production: Impacts, Mitigation & Risk Management*, US Department of Energy, National Energy Technology Laboratory, www.netl.doe.gov/publications/others/pdf/Oil_Peaking_NETL.pdf accessed 04/08.

Hockings, B. 2006a, *BASIX DIY Discussion Paper (unpublished)*, Association of Building Sustainability Assessors, Sydney.

Hockings, B. 2006b, *Update on Accurate trial in North Queensland, email to Reardon 5th February*.

Holmesglen_TAFE 2007, *Home Sustainability Assessment Course: 21854 VIC*, Sustainability_Victoria.

Horlick-Jones, T. & Sime, J. 2004, 'Living on the border: knowledge, risk and transdiciplinarity', *Futures*, vol. 36, pp. 342–456.

Hubbert, M.K. 1956, 'Nuclear Energy and the Fossil Fuels: Publication No. 95, Shell Development Company', paper presented to the *American Petroleum Institute*, San Antonio, Texas, June 1956.

Hurley, J. & Horne, R. 2007, *Review and Analysis of Tools for the Implementation and Assessment of Sustainable Urban Development*, RMIT University, Melbourne Unpublished paper viewed 11-01-08 at http://www.cfd.rmit.edu.au/programs/sustainable_built_environments/.

IISD 1998, *The Bellagio Principals*, International Institute for Sustainable Development, Bellagio.

Investa 2007, *Sustainability Report*, http://www.investasustainability.com.au/reports/2007/sustainability/Approach/ (accessed 26/10/07).

IPCC 1990, *Climate Change: The IPCC Scientific Assessment*, JT Houghton, GJ Jenkins, JJ Ephraums; Cambridge University Press, Cambridge.

IPCC 2001, *Climate Change 2001: The scientific Basis*, Intergovernmental Panel on Climate Change, Cambridge University Press, UK.

IPCC 2007a, *Summary for Policy Makers, In: Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [B. Metz, O.R. Davidson; P.R. Bosch, R. Dave, L.A. Meyer (eds)]*, Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA. .

IPCC 2007b, 'Summary for Policy Makers in Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change ', in B. Metz, O.R. Davidson, P.R. Bosch, R. Dave & L.A. Meyer (eds) Cambridge University Press, Cambridge, UK & New York, USA.

Isaacs, T. 2005a, *Accurate: 2nd Generation Nationwide House Energy Rating Software*, The Royal Australian Institute of Architects.

Isaacs, T. 2005b, *Comments on the BASIX DIY Rating Tool, ABSA submission to DoP Nov 2005*, Melbourne.

Isaacs, T. 2005c, *Evidence in support of policies to improve building fabric performance, A report prepared for: The Insulation Council of Australia and New Zealand,The Business Council for Sustainable Energy and The Australian Glass and Glazing Association*, Melbourne.

James, J. 2007, *The proof of climate change and the inevitability of 2 degrees C*, Climate Crisis Coalition, http://www.planetextinction.com viewed Sept 07.

James_Hardie 2007, *The Smarter Green Book: Designing and building sustainably with James Hardie*, James Hardie, Sydney.

Johnson, L. & Milne, G. 2008, *Green Loan Household Sustainability Assessor Training - Scoping Study*, The Association of Building Sustainability Assessors Inc (for DEWHA), Sydney.

Johnston, L. 2003, *Submission: NSW Standing Committee on Public Works Energy Consumption in Residential Building*, RAIA, Sydney.

Jones, C.D., Cox, P.M. & Huntingford, C. 2006, 'Climate-carbon cycle feedbacks under stabilization: uncertainty and observational constraints', *Tellus B*, vol. 58, no. 5, pp. 603 - 613.

Katz, E. & Lazarsfeld, P.F. 1955, *Personal influence: The part played by people in the flow of mass communications.*, Free Press, New York.

Keeling, C. 1970 'Is carbon dioxide from fossil fuel changing man's environment', *Proc. Am. Philos. Soc (not accessed)*.

Keeling, C.D., Bacastow, R.B., Bainbridge, A.E., Ekdahl, C.A., Guenther, P.R. & Waterman, L.S. 1976, 'Atmospheric carbon dioxide variations at Mauna Loa Observatory, Hawaii', *Tellus*, vol. 28, pp. 538-551.

Kemmis, S. & McTaggart, R. 1988, *The Action research planner*, 3rd ed. edn, Deakin University, [Waurn Ponds, Vic.].

Kline, S.J. 1995, *Conceptual foundations for multidisciplinary thinking*, Stanford University Press, Stanford, Calif.

Klupfel, E.J., Pfeiffer, W.C. & Filson, G.C. 2003, 'Thought for Fuelling Change: A Review of Three Models for Understanding Environmentally Significant Transitions', *The Environmentalist*, vol. 23, no. 1 / March, 2003, pp. 29-38.

Kordjamshidi, M., King, S. & Prasad, D. 2005, 'Towards the development of a Home Rating Scheme for free running buildings ', paper presented to the *Destination Renewable, ANZSES Solar Energy Conference*, Melbourne, Australia

Kotler, P. & Zaltman, G. 1971, 'Social marketing: an approach to planned social change', *Journal of Marketing*, vol. 35, no. 3, pp. 3-12.

Kuhn, T.S. 1970, *The structure of scientific revolutions,*, University of Chicago Press, Chicago.

Langston, C. 1996., *Environmental economics series / edited and compiled by Craig Langston.*, Construction Economics Unit, Faculty of Design, Architecture and Building, University of Technology, Sydney for Seminar Series on Environmental Economics,, Broadway, N.S.W. :.

Latour, B. 1992, 'The Sociology of a Few Mundane Artifacts', in W. Bijker & J. Law (eds), *Shaping Technology/Building Society: Studies in Sociotechnological Change*, The MIT Press, Cambridge, MA.

Lawrence, R.J. & Després, C. 2004, 'Futures of Transdisciplinarity', *Futures* vol. 36, no. 4 pp. 397-405.

Lee, T. 2005, *Critique of BASIX DIY Function: , A report prepared by Energy Partners for ABSA*, Canberra.

Levine, M. 2007, 'Residential and commercial buildings', in IPCC (ed.), *Climate Change 2007: Mitigation. Contribution of Working Group III to Fourth Assessment Report*, Cambridge Press, New York.

Lovelock, J. 2006, *"The Revenge of Gaia: Earth's Climate Crisis and the Fate of Humanity"*, Basic Books, New York.

Lynas, M. 2008, *Six Degrees: Our Future on a Hotter Planet*, National Geographic Society.

Lyotard, J.F. 1984, *The postmodern condition : a report on knowledge*, University of Minnesota Press, Minneapolis.

Machlup, F. 1980, *Knowledge and knowledge production*, Princeton University Press, Princeton ; Guildford.

Mahajan, V. c1985, *Models for innovation diffusion / Vijay Mahajan, Robert A. Peterson*, Sage Publications,, Beverly Hills :.

Masterton_Homes 2005, 'GreenSmart traing (company specific).' unpublished, Housing Industry Association.

McGrath, C. & Zell, D. 2001, 'The future of innovation diffusion research and its implications for management: A conversation with Everett Rogers', *Journal of Management Inquiry; Thousand Oaks*, vol. 10, no. 4, p. 386.

McKenzie-Mohr, D. & Smith, W. 1999, *Fostering Sustainable Behaviour: An Introduction to Community Based Social Marketing*, New Society Publishers, B.C. Canada.

McRight, A.M. & Dunlap, R.E. 2003, 'Defeating Kyoto: The Conservative Movement's Impact on US Climate Change Policy', *Social Problems*, vol. 50, no. 3, pp. 348-373.

McTaggart, R. 1991, *Action research: a short modern history.*, Deakin University, Geelong, Vic.

Meadows, D.H. 1972, *The limits to growth : a report for the Club of Rome's project on the predicament of mankind*, Earth Island, Lond.

Meadows, D.H., Meadows, D.L. & Randers, J. 1992, *Beyond the limits : global collapse or a sustainable future*, Earthscan Publications, London.

Midgley, D.F. 1986, *A meta-analysis of the diffusion of innovations literature / David F. Midgley*, Australian Graduate School of Management, University of N.S.W.,, Kensington :.

Mitchell, C., McGee, C. & Carew, A. 2002, *Training in the Building and Construction Industry: Stage II: Final Report for Australian Building Energy Council*, Institute for Sustainable Futures, UTS, Sydney.

Mitchell, C., Reardon, C., McGee, C. & Hawke, G. 2002, *Survey of Education, Training and Continuing Professional Development in Energy Efficiency and Greenhouse-related Issues for Australian Building Industry Practitioners, Report for the Australian Building Energy Council*, Institute for Sustainable Futures, UTS, Sydney.

Mitchell, C., Turner, A. & White, S. 2005, 'DES 27: Sustainable Water Use – Efficient then Effective', in, *Environment Design Guide*, Australian Council of Built Environment Design Professions, Melbourne.

Mitchell, C. & Willetts, J. 2008 in preparation, 'Quality criteria for inter and trans-disciplinary research', in M. Davies & M. Devlin (eds), *Interdisciplinary Higher Education: Theory and Practice*, Unpublished.

Mithraratne, N., Vale, B. & Vale, R. 2007, *Sustainable Living: The Role Of Whole Life Costs And Values*, Elsevier Science & Technology (United Kingdom).

Monroe, M. & Day, B. 2000, *Environmental Education and Communication for a Sustainable World: Handbook for internationa practitioners*, Academy for Educational Development, GreenCom, Washington, DC.

Moore, G.A. 1999, *Crossing the chasm : marketing and selling high-tech products to mainstream customers*, Rev. edn, HarperBusiness, New York.

Moore, R. & Reardon, C. 1997, *BDAA Environment Policy*, Building Designers Association of NSW Inc, http://www.bdansw.com.au/page/esd_policy.html.

Murray, J. 1999, *Submission by Master Builders Australia to the Productivity Commission Study into Improving the Future Performance of Buildings*, MBA, Melbourne.

NAFI 2005, 'Environment Minister backs timber as envronmentally friendly and energy efficient building product.' *Media Release http://www.nafi.com.au/media/view.php3?id=351*, viewed 3 Jan 08.

NFEE 2007a, *Areas of Focus: Residential Buildings*, National Framework for Energy Efficiency, http://www.nfee.gov.au/buildings.jsp?xcid=123 viewed 17th December 2008.

NFEE 2007b, *Minutes of NFEE Building_Group Meeting 2 April 2007 Chair: Stephen Berry*, AGO, Canberra.

NSW_DoP 2003, *Benchmarking BASIX*, viewed 15th June 2007 <http://basix.nsw.gov.au/information/resources.jsp>.

NSW_Parliament 1995, *Sustainable Energy Development Act 1995 - Section 4 (Repealed 2004)*, Australasian Legal Information Institute, viewed 26th Sept 2006 <http://www.austlii.edu.au/au/legis/nsw/repealed_act/seda1995321/s4.html>.

OECD 2008, 'OECD Environmental Outlook to 2030', viewed 23 April 2008 < www.oecd.org/environment/outlookto2030>.

Osterhage, P. 2005, *Master Builders Queensland Response to RD 2004-02-Energy Efficiency for Houses and RIS 2005-02-RIS*, MBA Queensland, Brisbane.

Pearce, F. 2007, *With Speed and Violence: Why Scientists Fear Tipping Points in Climate Change* Beacon Press Boston.

Pears, A. 2004, 'Energy Efficiency - Its potential: Some Perspectives and Experiences', paper presented to the *International Energy Agency Energy Efficiency Workshop*, Paris. April 2004

Pears, A. 2005, *BASIX DIY technical review, email advice to ABSA on 6th November*, Melbourne.

Pears, A. 2007, *Residential Sector Energy Efficiency Scenario - Background, framework and rationales.*

Pears, A. 2008, *Submission to Commonwealth Government on Carbon Pollution Reduction Green Paper*, http://www.climatechange.gov.au/greenpaper/consultation/submissions.html viewed 25-11-08.

Penman, R. 2000, *Communications Report. Design for Good Living Project*, Communicating Matters & Institute for Sustainable Futures, UTS, Canberra.

Penman, R. & Reardon, C. 2000, *Design for Good Living: A communication plan to meet the information needs of clients, designers and builders.*, Communicating matters & the Institute for Sustainable Futures, UTS, Canberra.

Pezzoli, K. 1997, 'Sustainable development literature: a transdisciplinary bibliography', *Journal of Environmental Planning & Managemen*, vol. 40, no. 5, pp. 575-601.

Pope, J., Annandale, D. & Morrison-Saunders, A. 2004, 'Conceptualising sustainability assessment', *Environmental Impact Assessment Review*, vol. 24 pp. 595-616.

Productivity_Commission 2005, *The Private Cost Effectiveness of Improving Energy Efficiency*, Report no. 36, Canberra.

Putnam, R.D. 1993, *Making democracy work: civic traditions in Modern Italy.*, Princeton University Press, Princeton, New Jersey.

Reardon, C. 2001, *BLAR11045 Built Environment 1: An introduction to the environmental impact of the built environment*, Undergraduate course, Central Queensland University, Faculty of Engineering and Physical Systems, Rockhampton.

Reardon, C. 2002, *Submission to SEDA-Strathfield Council Solar Power Forum*, SEDA NSW and Strathfield Council, Closed forum; Sydney.

Reardon, C. 2003, *Jerrabomberra GreenSmart Village - greenwash?*, e-mail to W. Gersbach, HIA. August 19.

Reardon, C. 2004a, *Diffusing sustainable innovations within the Building Industry: 3 years on, where does Your Home fit?*, Powerpoint presentation to the Your Home Steering Committee, September 2004, Australian Greenhouse Office, National Library, Canberra.

Reardon, C. 2004b, *Testimony to: Inquiry on Sustainable Communities*, Transcript of the Canberra Committee Meeting, Environment and Natural Resources Committee, Victoria. 27 October 2004, Melbourne, pp. 44-52.

Reardon, C. 2007, 'Towards Sustainable Housing: So much progress - so far to go - so little time. How might we accelerate sustainable change?' paper presented to the *2nd Australian International Green Build & Renewable Energy Exhibition and Conference*, Australian Technology Park, Everly

Reardon, C. & Clarke, D. 2003a, *NSW Standing Committee on Public Works: Inquiry into Energy Consumption in Residential Buildings, Testimony recorded in Report of Proceedings, 25 August 2003*, NSW Legislative Assembly, Sydney, pp. 9-15.

Reardon, C. & Clarke, D. 2003b, *Submission to NSW Standing Committee on Public Works: Inquiry into Peak Electricity Demand, BDA NSW Environment Working Group*, Sydney.

Reardon, C., McGee, C., White, S. & Shackel, S. 2001a, *Your Home Technical Manual*, 1st edn, Commonwealth of Australia, Canberra.

Reardon, C., McGee, C., White, S. & Shackel, S. 2005, *Your Home Technical Manual*, 3rd edn, Commonwealth of Australia, Canberra.

Reardon, C., McGee, C., White, S., Shackel, S. & Slapp, B. 2001b, *Your Home Consumer Guide*, 1st edn, Commonwealth of Australia, Canberra.

Reardon, C., Milne, G., McGee, C. & Dowton, P. 2008, *Your Home Technical Manual*, 4th edn, Commonwealth of Australia, Canberra.

Reardon, C. & Penman, R. 2000, *Communications Action Plan.   Design for Good Living Project*, Institute for Sustainable Futures, UTS, Sydney.

REIA 2006, *REIA Comments on Mandatory Disclosure Study, Submission to the AGO*, Real Estate Institute of Australia, Canberra.

Rieck, T. 2000, *Statement to Your Home Industry Steering Committee meeting*, Housing Industry Association, Canberra.

RMIT 2001, 'Greening the Building Life Cycle: http://buildlca.rmit.edu.au/', viewed March 2009.

Robèrt, K.-H., Schmidt-Bleek, B., Aloisi De Larderel, J., Basile, G., Jansen, J.L., Kuehr, R., Price Thomas, P., Suzuki, M., Hawken, P. & Wackernagel, M. 2002, 'Strategic sustainable development -- selection, design and synergies of applied tools', *Journal of Cleaner Production*, vol. 10, no. 3, pp. 197-214.

Robinson, L. 1999, 'Learning from Social Marketing', paper presented to the *Australian Association of Environmental Education Conference*, Sydney, January 1999.

Robinson, L. 2000, 'Notes on the Diffusion of Innovations theory', viewed 11th May 2007 <http://www.enabling-change.com.au/Summary_Diffusion_Theory.pdf>.

Robinson, L. 2002, 'Communicating Sustainability Checklist: 13 steps to good practice', *Adapted from: Education for life; Guidelines for Biodiversity Education; UK council for Environmental Education, 1997. http://www.enablingchange.com.au/ Viewed 27/08/08.*

Robinson, L. 2006a, 'How to make a theory of change: Introducing a collaborative method for designing solutions to complex social and environmental problems', unpublished, http://www.enablingchange.com.au/ Viewed 27/08/08.

Robinson, L. 2006b, 'The voluntary adoption of new practices', unpublished, http://www.enablingchange.com.au/ Viewed 27/08/08.

Robinson, L. 2007, *A Seven Step Social Marketing Approach*, http://www.comminit.com/en/node/206586 Viewed 20/10/08.

Robinson, L. & Glanznig, A. 2003, *Enabling EcoAction: A handbook for anyone working with the public on conservation*, Humane Society International, WWF Australia and World Conservation Union Australia, Sydney.

Rogers, E.M. 1983, *Diffusion of innovations.*, 3rd ed. edn, Free Press ; Collier Macmillan,, New York : London :.

Rogers, E.M. 1995, *Diffusion of innovations*, 4th edn, Free Press, New York.

Rogers, E.M. 2003, *Diffusion of innovations*, 5th edn, Free Press, New York., NY.

Rogers, E.M. & Kincaid, L.D. 1981, *Communication Networks: Toward a New Paradigm for Research*, New York: Free Press.

Rootman, I., Goodstadt, M., Potvin, L. & Springett, J. 2001, *A framework for health promotion evaluation*, Centre for Health Promotion, University of Toronto, Canada.

Ruthman, P. 2007 *Home ownership versus leasing.* Industry Newsletter *www.ibisworld.com.au/sunrise/homeownershipleasing.pdf* Accesssed May 2009 p. 5.

Ryan, B. & Gross, N. 1943, 'The diffusion of hybrid seed corn in two Iowa communities', *Rural Sociology*, vol. 8, pp. 15-24.

Sabolch, M. 1999, *Report into Soil Erosion and Sediment Control Costs in Residential Urban Development*, Department of Land and Water Conservation (DLWC) Sydney.

Salner, M. 1999, 'Self deception in qualitative research: Validity issues', *Paper: University of Illinois, Springfield.*

Salt, B. 2003, *The big shift : welcome to the third Australian culture : the Bernard Salt report*, 2nd edn, Hardie Grant Books, South Yarra, Vic.

SBE & Energy_Consultants 2005, *A Study into the potential for a National Mandatory Disclosure Requirement of Energy Efficiency in Residential Dwellings:Issues Paper*, Prepared for the Australian Greenhouse Office, Canberra.

SBE & Hansen 2007, *Sustainability Assessment in the Planning Process - Investigation Report* Victorian Local Sustainability Accord Project: Municipalities of Port Philip, Darebin and Moreland, Melbourne.

Scambos, T.A., Bohlander, J.A., Shuman, C.A. & Skvarca, P. 2004, 'Glacier acceleration and thinning after ice shelf collapse in the Larsen B embayment, Antarctica', *Geophysical Research Letters*, vol. 31, 22 September 2004.

Schneider, S. & Lane, J. 2005, 'An Overview of "Dangerous" Climate Change', Stanford University, Stanford, California.

Schön, D.A. 1983, *The reflective practitioner : how professionals think in action*, Basic Books, New York.

SEDA 1998, *Energy Smart Allies Directory*, NSW Government, viewed 3/11/ 2006 <http://www.energysmartallies.com/esa/>.

SEDA 2004, *Annual Report*, Sustainable Energy Development Authority, NSW, Sydney.

Selman, P. & Wragg, A. 1999, 'Local Sustainability Planning: From Interest-driven Networks to Vision Driven Super-networks', *Planning Practice & Research*, vol. 14, no. 3, pp. 329-340.

Shipworth, M. 2000, *Motivating Home Energy Action: A handbook of what works*, Australian Greenhouse Office, Canberra.

Shojai, S. & Katz, B. 1992, *The Oil Market in the 1980's: A Decade of Decline* Praeger/Greenwood.

Sibley, J., Hes, D. & Martin, F. 2003, 'A triple Helix Approach: An interdisciplinary approach to research into sustainability in outer suburban housing estates.' paper presented to the *Methodologies in Housing Research Conference –*, Stockholm September 2003

Smythe, A. & Holian, R. 1999, 'The credibility of the researcher who does research in their own organisation', *Paper presented at Association of Qualitative Research Conference: 'Issues of Rigour in Qualitative Research',*, Melbourne, July 6-10 1999.

Social_Change_Media & Forsyth_Communications 2000, *Who are the green hats? An investigation into the motivations of early adopters of business waste reduction practices*, Northern Sydney Waste Board, Sydney.

Soebarto, V.I. 2000, 'A Low-Energy House and a Low Rating: What is the Problem ', paper presented to the *34th Conference of the Australia and New Zealand Architectural Science Association*, Adelaide.

SSRS 1976, 'The impact of environment and lifestyle on human health:' *National Symposium. ANU 2nd to 4th september 1976*, eds M. Diesendorf & B. Furnass, Society for Social Responsibility in Science (ACT), Canberra.

Stalder, F. 1997, *Actor-Network-Theory and Communication Networks: Toward Convergence*, Faculty of Information Studies, University of Toronto, viewed 15 April 2005 <http://felix.openflows.org/html/Network_Theory.html>.

Stalder, F. 2004, *The Dynamics of Actor-Networks and Neighbouring Theories*, nettime, viewed April 17 2004 <http://www.fis.utoronto.ca/~stalder>.

Stern, N.H. 2006, *Stern review on the economics of climate change.*, HM Treasury, London.

Strathern, M. 1999, 'What Is Intellectual Property After?' in J. Law & J. Hassard (eds), *Actor Network Theory and After*, Blackwell Oxford, UK, p. 161.

Sugo, H.O., Page, A.W. & Moghtaderi, B. 2004, 'A comparative Study of the Thermal Performance of Cavity and Brick Veneer Construction', paper presented to the *Proceedings of the 13th International Brick and Block Masonry Conference*, Amsterdam, Holland.

Sugo, H.O., Page, A.W. & Moghtaderi, B. 2006, 'The Study of Heat Flows in Masonry Walls in a Thermal Test Building Incorporating a Window', paper presented to the *Canadian Masonry Symposium, June 8-12, 2005*, Banff, Alberta.

Suri, H. 1999, 'The process of synthesising qualitative research: a case study.' *Paper: presented at "Issues of Rigour in Qualitative Research" Annual Conference of the Association for Qualitative Research,Melbourne, 6-10 July, 1999.*

Szokolay, S. 1992, 'An energy rating system for houses', in, *Energy-efficient Ratings and Standards for new houses*, Queensland Energy Information Centre Department of Resource Industries, Brisbane.

T_Issues_Consultancy 2008, *Your Home- Buyer's Guide Staff Training Workshops: Evaluation Report (unpublished).* Clarendon Residential Group, Sydney.

Tarde, G. 1903, *The laws of Imitation*, Holt, New York.

Tennent, S. 2002, *What Drives Housing?*, in ABS (ed.), *1301.0 - Year Book Australia*, Canberra.

Thomas, P.C. & Thomas, L. 2000, 'A Study of an Energy Consumption Index Normalized for Area in House Energy Rating Schemes ', paper presented to the *SOLAR 2000, 38th Annual conference of Australian and New Zealand Solar Energy Society*, Brisbane.

Thompson-Klein, J. 2004, 'Prospects for Transdisciplinarity', *Futures* vol. 36, no. 4 pp. 515-526.

Thoning, K. & Tans, P. 2000, 'Atmospheric CO2 records from sites in the NOAA/CMDL continuous monitoring network', in, *Trends: A Compendium of Data on Global Change*, Carbon Dioxide Information Analysis Center, Oak Ridge National Laboratory, U.S. Department of Energy, Oak Ridge, Tennessee, U.S.A.

Tomkins, K. 2004, *HIA Issues of Concern regarding BASIX*, *Submission to NSW Department of Planning* by Housing Industry Association, Sydney.

Totaro, P. 2003, 'Carr pleges super environment body', *Sydney Morning Herald, March 21.*

UN 1992 -a, *Agenda 21: Rio Declaration on Environment and Development (The Earth Summit)*, United Nations www.un.org/esa/sustdev/agenda21.htm.

UN 1992 -b, *Uniterd Nations Framework Convention on Climate Change*, www.unfcc.int.

UN 1997, *The Kyoto Protocol to the United Nations Framework Convention on Climate Change*, www.unfcc.int.

UNEP 1992 *United Nations Conference on Environment and Development*, *The "Rio Declaration"*, UNEP, Rio de Janiero.

Vale, R. & Vale, B. 1975, *The Autonomous House. Design and Planning for Self Sufficiency.*, 1977 edn, Thames & Hudson, London.

Valente, T.W. 1995, *Network models of the diffusion of innovations*, Hampton Press,, Cresskill, N.J. :.

Vaughan, D.G. & Spouge, J.R. 2002, 'Risk Estimation of Collapse of the West Antarctic Ice Sheet', *Climatic Change*, vol. 52, no. 1-2 January 2001, pp. 65-91.

Veritas_Consultants 1999, *A Review of Commercial & Industrial Waste Minimisation Strategy*, for the Southern Sydney Waste Board, Sydney. Nov 1999.

Victorian_Government 2005, *5 Star Results Strong - Low Cost for High Returns*, *Media Release*, Ministers for Environment and Planning, Melbourne.

VicUrban 2004a, *2004 VicUrban Annual Report,*, VicUrban, Melbourne.

VicUrban 2004b, *VicUrban EcoSelector*, Sustainability assessment tool, *Online: http://www.vicurban.com/innovations/041024_ecoselector_aurora.pdf*, Melboune.

Waisbord, S. 2001, 'Family tree of theories, methodologies and strategies in development communication', Report for the Rockerfeller Foundation.

Waisbord, S. 2001., 'Family tree of theories, methodologies and strategies in development communication', Report for the Rockerfeller Foundation.

Walker, G. 2003, 'Leading the way: Sustainability - the big picture', *Housing*, vol. November 2004, pp. 12-15.

Watson, S. & Hyde, R. 2001, 'Household Energy Rating: Questioning the Current Direction', *eprint.uq.edu.au/archive/00003139/01/ISES_2001.pdf Viewed 2 N0v 2007*, Department of Architecture, University of Queensland, Brisbane.

WCED 1987, *Our Common Future*, *The Brundtland Report*, World Commission on Environment and Development, Oxford University Press, New York.

Wejnert, B. 2002, 'Integrating Models of Diffusion of nnovations: A Conceptual Framework.' *Annual Review of Sociology*, vol. 28, no. 1, p. 297.

Wells, J. 1998, 'Industry presentation by ABEC CEO', unpublished.

Wheeler, T. 2002, *Issues raised by the Royal Australian Institute of Architects*, *Chapter Four - NatHERS; 4.3 Problems. Standing Committee on Public Works Report on Government Energy Reduction Targets*, no 52/8, NSW_Parliament, Sydney, pp. 96-98.

WHO 1986, 'Ottawa Charter for Health Promotion', *First International Conference on Health Promotion, 17–21 November*, Ottawa, Canada, <http://www.euro.who.int/AboutWHO/Policy/20010827_2>.

Wickson, F., Carew, A.L. & Russell, A.W. 2006, 'Transdisciplinary research: characteristics, quandaries and quality ', *Futures*, vol. 38, no. 9, pp. 1046-1059.

Willetts, J. & Mitchell, C. 2006, 'Learning to be a "Transdisciplinary" Sustainability Researcher: A Community of Practice Approach', paper presented to the *12th ANZSYS conference - Sustaining our social and natural capital*, Katoomba, NSW Australia, 3rd-6th December, 2006.

Williamson, T. 2005, *Energy-Efficiency Standards in Residential Buildings: A Plea for Evidence-Based Policy Making*, *Submission 28 to Productivity Commission Public Enquiry into Energy Efficiency*, School of Architecture, Landscape Architecture & Urban Design, University of Adelaide, Adelaide.

Williamson, T.J. 2000, 'A Critical Review of Home Energy Rating in Australia ', paper presented to the *34th Conference of the Australia and New Zealand Architectural Science Association*, Adelaide.

Williamson, T.J., O'Shea, S. & Menadue, V. 2001, *NatHERS: Science and Non-Science*, School of Architecture, Landscape Architecture & Urban Design The University of Adelaide.

Wilson, D. 2000, *Statement to Your Home Industry Steering Committee meeting*, Master Builders Association, Canberra.

Winter, R. 1987, *Action-research and the nature of social inquiry professional innovation and educational work.*, Avebury, Aldershot, England.

Woodroffe, C. 1994, 'Sea level ', *Progress in Physical Geography*, vol. 18, no. 4, pp. 436-451.

Worldwatch_Institute 2008, *State of the world 2008: Towards a sustainable global economy*, The Worldwatch Institute, Washington DC.

Zammit, M. 2006, 'Managng Peak Load Demand', *Energy Response, Melbourne. Power Transmission & Distribution, Issue 1*, pp. 30- 31

Zuber-Skerritt, O. 1992, *Action Research in Higher Education: Examples and Reflections*, Kogan Page, London