UTS UNIVERSITY OF TECHNOLOGY SYDNEY

How Will Australian Superannuation Portfolios Reach Net Zero?

by Donna Lopata

Thesis submitted in fulfilment of the requirements for the degree of

Doctor of Philosophy

under the supervision of Professor Stuart White and Alison Atherton

University of Technology Sydney
Institute for Sustainable Futures

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Signed Certificate of Original Authorship

I, Donna Lopata declare that this thesis, is submitted in fulfilment of the requirements for the award of Doctorate in Philosophy, Sustainable Futures, in the Institute for Sustainable Futures at the University of Technology Sydney.

This thesis is wholly my own work unless otherwise referenced or acknowledged. In addition, I certify that all information sources and literature used are indicated in the thesis.

This document has not been submitted for qualifications at any other academic institution.

This research is supported by the Australian Government Research Training Program.

Signature: Production Note: Signature removed prior to publication.

Date: January 28, 2025

“Not everything that can be counted counts, and not everything that counts can be counted.”

(Cameron, 1967)

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Thesis Format Statement

This thesis is a ‘Conventional Thesis’ as described in the University of Technology Sydney’s Graduate Research Candidature Management, Thesis Preparation and Submission Procedures 2024 (Section 9.1.1).

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Note on Greenhouse Gas Conversion

Carbon Dioxide (CO_2) is used universally as a measure of equivalent Greenhouse Gas Emissions and an indicator of global warming. This thesis refers to carbon as an abbreviation for equivalent emissions of greenhouse gases (GHG), Methane, Nitrous Oxide, Hydrofluorocarbons, Perfluorocarbons and Sulphur Hexafluoride.

Acronyms and abbreviations

Term	Explanation
AASB	Australian Accounting Standards Board
ABS	Australian Bureau of Statistics
ACCU	Australian Carbon Credit Union
ACSI	Australian Council of Superannuation Investors
AICD	Australian Institute of Company Directors
ALP	Australian Labour Party
APRA	Australian Prudential Regulation Authority
ASFA	The Association of Superannuation Funds of Australia
ASFI	Australian Sustainable Finance Initiative
ASIC	Australian Securities and Investments Commission
ASX	Australian Securities Exchange
ATO	Australian Tax Office
AUM	Assets under Management
BFID	Best Financial Interests Duty
BIS	Bank for International Settlements
CA100+	Climate Action 100 +
CCUS	Carbon Capture, Utilisation and Storage Technology
CDP	Carbon Disclosure Project
CDR	Carbon Dioxide Removal
CERES	Coalition for Environmentally Responsible Economies
CFA	Chartered Financial Analyst
CFR	Australian Council of Financial Regulators

COP	Conference of the Parties (United Nations)
CPG	Prudential Practice Guide (APRA)
CSH	Critical Systems Heuristics
CSR	Corporate Social Responsibility
CVA	Climate Vulnerability Assessment (APRA)
Double Materiality	Double Materiality is the theoretical point where financial materiality and impact materiality converge.
EMDE	Emerging Markets and Developing Economies
ESG	Environmental, Social and Governance
ETS	Emission Trading Scheme
FASB	Financial Accounting Standards Board
FI	Financial Institution
FUM	Funds under Management
GDP	Gross Domestic Product
GFANZ	Glasgow Financial Alliance for Net Zero
GHG	Greenhouse Gas
GRI	Global Reporting Initiative
GSS+	Green, Social, Sustainability and Transition bonds
IAM	Integrated Assessment Models
IEA	International Energy Agency
IFRS	International Financial Reporting Standards
IGCC	Investor Group on Climate Change
IIGCC	The Institutional Investors Group on Climate Change
IOSCO	International Organisation of Securities Commissions

IPCC	Intergovernmental Panel on Climate Change
ISSB	International Sustainability Standards Board
KPI	Key Performance Indicator
LSEG	London Stock Exchange Group
LULUCF	Land Use, Land-Use Change and Forestry
MNC	Multinational Corporation
NDC	Nationally Determined Contributions
NET	Negative Emissions Technology
NGFS	Network for Greening the Financial System
NZAMI	Net Zero Asset Managers Initiative
NZAOA	Net zero Asset Owner Alliance
NZBA	Net zero Banking Alliance
OECD	Organisation for Economic Cooperation and Development
PAII	Paris-Aligned Investor Initiative
PCAF	Partnership for Carbon Accounting Financials
PRI	Principles for Responsible Investment
RBA	Reserve Bank of Australia
RCP	Representative Concentration Pathways
RIAA	Responsible Investment Association Australasia
SAA	Strategic Asset Allocation
SASB	Sustainability Accounting Standards Board
SBTi	Science-Based Targets Initiative
SDG	Sustainable Development Goals
SEC	The U.S. Securities and Exchange Commission

SFDR	Sustainable Finance Disclosure Regulation (EU)
SFT	Sustainable finance taxonomy
SIS Act	Superannuation Industry (Supervision) Act 1993
SLB, SLL	Sustainability-Linked Bond, Sustainability-Linked Loan
SMSF	Self-managed superannuation funds
SRI	Socially Responsible Investment
SSP	Shared Socio-economic Pathways
TCFD	Taskforce for Climate-related Financial Disclosure
TDR	Transdisciplinary research
TNFD	Taskforce for Nature-related Financial Disclosure
TPT	Transition Plan Taskforce (UK)
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
UTS	University of Technology Sydney
VCM	Voluntary Carbon Market
WEF	The World Economic Forum
YFYS	Your Future, Your Super Act 2020

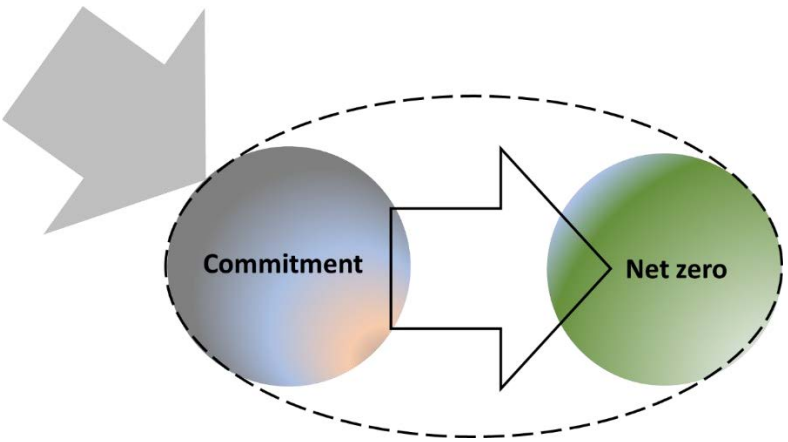
Abstract

Most of Australia's largest superannuation funds have committed to reaching net zero portfolios by 2050. Their ambition aims to protect beneficiary assets from financially material climate risk but is also critical for limiting the impacts of climate change. The context of Australia's 4.1 trillion AUD superannuation system adds further complexity to the immense challenge of decarbonising diversified global portfolios. This transdisciplinary research intends to support the superannuation sectors' transition to net zero.

Consistent with this theoretical framework, academic and industry knowledge was applied to systems thinking theory to analyse system assumptions and find leverage points for change. Interviews and thematic analysis showed that intent is the most critical leverage point in the system, affecting all facets of net zero implementation. The study also revealed a critical distinction between achieving net zero 'portfolio emissions' or net zero 'planetary emissions'. The thesis argues that the former approach does not fundamentally alter the current state or achieve long-term global sustainability, while the latter requires vast systemic change.

This research found that despite Australia's legislated net zero goal in accordance with the Paris Agreement, that intent has not been consistently applied to superannuation. Current sector legislation is acting as a barrier to implementation, and where sustainable finance policy has been introduced, it is fragmented and has an intermediate level of ambition. Under the current system conditions, most superannuation portfolios will not reach Paris-aligned net zero. By making this disjunction explicit, its implications for climate futures can be better understood at this imperative time of transition. The Australian Government must contextualise net zero intent for the superannuation sector in a way that takes a global view of beneficiaries and limits the impacts of climate change for a sustainable future.

Figure 1 How will Australian Superannuation Portfolios Reach Net Zero?



Chapter 1.

Thesis Introduction

I had just delivered a presentation on the catastrophic sea level rise and impending submersion of Tuvalu, a small Polynesian nation. With a population of just over 10,000, the country is expected to be the first nation of climate refugees, with all islands fully submerged by 2100. Tuvalu had already been experiencing severe climate impacts.

As I was leaving the lecture theatre, a young woman stopped me. She explained that she was Tuvaluan and thanked me for raising awareness of her country. In our brief exchange, she told me about her gratitude for being in Australia.

Her graciousness in the face of the devastation of her home and my shame that my nationality and typical Australian lifestyle made me complicit in its destruction was a formative moment and a motivation for my research.

Source: (SBS News, 2015)

1.1. The Research Case for Net Zero Australian Superannuation Portfolios

Warnings of the dire threat of climate change to humanity and the planet have amplified to the extent that unless adequate actions are taken this decade, the prospects for climate mitigation and adaptation will diminish (IPCC, 2022). The geographical features of Australia make the continent especially vulnerable to extreme weather events and have already caused temperatures to rise 1.5^{o}C above pre-industrial averages, with climate adaptation impossible for some parts of the country (Gergis, 2024). In the scenario where average global temperatures rose by 2^{o}C over pre-industrial times by 2100, the sea level would increase by at least 30 centimetres, and most of Australia's coastline would contract by 300 metres. Noting that most of Australia's population lives in coastal areas, the impacts of the inundation would be colossal (Gergis, 2024).

To stay within the less risky 1.5^{o}C limit set out in the Paris Agreement, global emissions will need to be reduced to net zero before about 2050 (IPCC, 2018). Net Zero targets have become the principal strategy for companies and countries to manage the risks of climate change (Net Zero Tracker, 2023). As at April 2024, more than 14,000 organisations globally, including 11,368 companies, 1,149 cities and 679 financial institutions organisations, have committed to a net-zero goal (UNFCCC, 2024b). In 2022, Australia legislated a national target to reach net zero by 2050 with a 43% reduction below 2005 emissions by 2030 (Commonwealth of Australia, 2022). Net zero commitments have achieved significant scale and as at August 2024, cover at least 88% of global emissions (Net Zero Tracker, 2024).

However, the concept of net zero in the Paris Agreement has been criticised for its over-simplicity with misleading temperature outcomes and ambiguous wording that allows entities to adapt their intended emissions pathway and timeframe to suit their specific requirements and limits their risk of failure (Fulton et al., 2020; Geden, 2016; Rogelj et al., 2021). Judgement and urgent research is required for a translation of net zero from the physical state where human-caused GHG emissions in the atmosphere, lithosphere and biosphere are balanced to stop global warming, to an entity-level pathway that addresses net zero timing, governance, scope and accountability (Fankhauser et al., 2022). The interdependence of climate systems with nature and biodiversity has been a topic of growing attention by policymakers and sustainable finance practitioners. Richardson et al. (2023) quantified and continued investigating the critical interconnections between nine biophysical and biochemical earth systems and processes in their planetary boundaries framework. They calculated that six of

nine boundaries have already breached the safe operating space for humanity. Their modelling showed an integral relationship between climate change and the biosphere. If deforestation co-occurs with CO_2 emissions increase, land temperature rise is higher, and further carbon is then released by lost vegetation and soils arising from forest cover losses. United Nations (2015b, p. 4) refer to the seventeen economic, social and environmental sustainable development goals as "*integrated and indivisible*." The doughnut framework by Raworth (2017) also identifies the social and ecological interactions for human wellbeing and planetary health. Whilst these relationships are recognised, these elements are typically disaggregated to assist action in practice and policymaking. Similarly, for pragmatic reasons, this research is limited to climate change. Consideration of nature and biodiversity by the finance sector is less established than climate change, with scale expected to improve with the recent launch of Taskforce on Nature-related Financial Disclosures in 2021 and the Global Biodiversity Framework adopted in December 2022 (TNFD, 2023; UNEP, 2022).

This research examines the net zero commitments and actions of Australian superannuation funds. The Australian superannuation sector is significant in relation to the net zero transition due to the immense size of its assets, the privileged position of superannuation funds at the top of the investment chain, their diversified global portfolios with high exposure to Australia's materials-heavy market, its regulated design, long-horizon objective, and representation of the majority of Australia's population. Whilst a rich and growing body of research intersects finance, climate and net zero, the PhD candidate is unaware of any academic research specifically focused on the transition of the Australian superannuation sector to net zero. Addressing this research gap at this imperative time of transition is critical. This study aims to provide knowledge that will support policy and practice to transition to net zero superannuation portfolios, a research approach that "*is more important now than ever before, given the significant societal disruptions by pandemics, climate change, and technology"* (Bansal & Sharma, 2022).

This thesis finds that as at May 2024, twenty Australian superannuation funds had a net zero by 2050 commitment. Together, they manage 1.679 Trillion AUD, representing over 60% of all APRA-regulated funds. Their ambition is vital for protecting member savings from financially material climate risk and, more critically, limiting the impacts of climate change. The net zero commitment made by those funds is voluntary. However, they occurred consecutively to several noteworthy legal and regulatory developments in Australia. Much of this progress happened during this PhD study, supporting and elevating the issue but also posing a challenge to the currency of the research.

Australia's superannuation is the seventh largest pension plan globally as measured as a percentage of GDP (OECD, 2023b). Legislative superannuation in Australia was established in 1992 to facilitate retirement funding and to ease the national welfare burden (Australian Government Productivity Commission, 2018). The importance of superannuation to the Australian economy is rising in the context of a growing elderly dependency ratio (Australian Bureau of Statistics, 2018). On introduction, Superannuation Guarantee contributions were set at three percent of earnings, by July 2025, these are legislated to reach twelve percent. It is anticipated that as the superannuation system continues to mature, it will progressively fund a more significant proportion of retirement savings (Australian Government, 2020). With few exceptions, legislation since July 2024 requires employers to contribute 11.5% of each employee (member) salary to a superannuation fund, which can be accessed after the member reaches 'preservation' age and retires. Most superannuation funds are held in industry, retail and public sector superannuation funds where investment professionals pool and manage member contributions. These are regulated by the Australian Prudential Regulation Authority (APRA), which oversees trustees and ensures that the best financial interests of superannuation members are met. As at March 2024, 23 million Australian superannuation accounts totalling 2.69 trillion AUD were managed by APRA-regulated funds (APRA, 2024c) representing a high proportion of Australia's population of almost 27 million people as at December 2023 (ABS, 2024). Superannuation members include both those in accumulation phase as well as pension phase. A twenty-year-old superannuation member in 2025 is unlikely to retire and access their savings until after 2070.

In 2016, Senior Counsel Noel Hutley and Sebastian Hartford-David issued a legal opinion that company directors who failed to consider climate change risks could be liable for breaching their duty of care in the future (Hutley & Hartford-Davis, 2016). In 2018, superannuation member Mark McVeigh filed a case against REST Superannuation. McVeigh, who will not be eligible for retirement income until 2060, alleged that the fund's trustee failed to act in his best interests by not properly considering climate change risks in their fund investments. The case was settled in favour of McVeigh in November 2020, setting a precedent for the fiduciary duty of pension funds globally (Equity Generation Lawyers, 2020). The Federal Court ordered REST to amend and provide evidence of their revised climate change, sustainability and stress test policies, undertake TCFD and PRI consideration and develop a risk management strategy. By 2019, Hutley and Hartford Davis issued a supplementary opinion stating the "*profound and accelerating shift in the way that Australian regulators, firms and the public perceive climate risk*", indicating an increasing exposure of individual directors to liability for failure to consider

climate change risks (Hutley & Hartford-Davis, 2019). Their view at that time also commented on the regulatory endorsement of TCFD recommendations by the RBA, ASIC, APRA, and the ASX Corporate Governance Council. By 2021, Hutley and Hartford Davis issued a revised opinion. They noted further pressure for climate action and a view that climate risk consideration and disclosure were no longer sufficient (Hutley & Hartford-Davis, 2021). The Australian legal expectation, they said, is now for companies to take positive steps to manage climate risks by developing a well-documented net zero strategy, and where targets are announced, they need to be backed with the genuine intention to deliver them. Their opinion also warned companies that there was an acute litigation risk if their net zero commitments were found to be misleading.

Later that year, APRA issued guidance on Climate Change Financial Risks in CPG229, cautioning trustees to identify the financially-material risks posed by climate change in compliance with existing prudential standards (APRA, 2021b). In 2023, APRA (2023a, 2023b) updated their Prudential Standard and Guidance on Investment Governance SPS530 to create a formal link to CPG229 and regulate the need for board-approved risk analysis, stress testing and asset valuation that considers financially material climate risk. Additionally, a series of policy actions have recently been announced and are currently under development by the Federal Government to support sustainable investment in Australia (Chalmers, 2023a). In the Sustainable Finance Strategy Roadmap, the Australian Treasurer notes, "*The Roadmap is all about mobilising the significant private capital required to achieve net zero, modernising our financial markets and maximising the economic opportunities associated with energy, climate and sustainability goals*" (Australian Government, 2024k). Mandatory climate-related financial disclosure for the largest Australian financial institutions and companies will commence in January 2025. Included in the suite of planned reforms is the intention to deliver net zero transition plan guidance by the end of 2025. Although these actions are positive steps towards net zero superannuation portfolios, this research revealed a critical distinction between achieving net zero 'portfolio emissions' or net zero 'planetary emissions'. The thesis argues that the former approach does not fundamentally alter the present state or achieve long-horizon sustainability. The latter approach requires vast systemic transformation and legislative change, including finance for climate solutions in 'uninvestable' economies. By making those boundary judgements explicit, the research enables an understanding of how Australian superannuation portfolios intend to reach net zero so that their impact on climate futures can be better defined, measured and implemented.

1.2. Transdisciplinary Research for Impact

This thesis aims to demonstrate the research rigour and capability for admittance into a doctorate and contribute knowledge that supports policy and practice to reach net zero superannuation portfolios for a sustainable future. These dual objectives are aligned with the UTS Higher Degree Research Capability Framework, where impact and engagement with real-world problems are identified as an important research outcome alongside traditional disciplinary knowledge (UTS, 2023). Research "*to solve the acute and stubborn economic, social, health, climate and environmental challenges facing Australia"* is also highlighted as an objective in the Australian Universities Accord (Australian Government, 2024d) and (Australian Research Council, 2019). In order to fulfil these aims, this thesis applies the theoretical framework of transdisciplinary research (TDR).

TDR, also referred to as knowledge co-creation and closely linked to systems thinking methods, is impact-focused research. TDR applies research to deliver tangible outcomes to improve complex societal problems (Willetts & Mitchell, 2017). TDR is distinguished by its theoretical perspective that to achieve that impact, research must depart from traditional academic boundaries and instead integrate knowledge from multiple disciplines and beyond academia to industry practice (Adams, 2010; Adams & Larrinaga, 2019; Bammer, 2013; Fam et al., 2017; Hirsch Hadorn et al., 2008; Sharma & Bansal, 2020). Early sustainability practitioners recognised the importance of a systems thinking approach to addressing the emerging environmental problems with the, then recently established, UNEP (1975) noting that *"the ultimate self-interest of all nations is inevitably merged in the inescapable web of interdependences. An integrated co-operative approach is needed."* TDR, systems thinking and purposive research have solid applicability to and history of use in research on sustainability, given its complexity (Adams, 2010; Bammer, 2013; Bernstein, 2015; Fam et al., 2017; Hirsch Hadorn et al., 2008; Jackson, 2019a; Lawrence et al., 2022). This research is aligned with the belief that TDR is the most effective methodology to create positive change towards sustainable futures (Reidy, Willett & Mitchell in Fam et al., 2017, pp. 94, 123).

TDR emphasises the validity of all forms of knowledge in order to engage with diverse stakeholders (Fam et al., 2017). Further, TDR is pragmatic towards epistemological perspectives rather prioritising the methods that can be used to deliver outcomes for improvement (Jackson, 2019a; Willetts & Mitchell, 2017). Despite its pluralistic approach, TDR is aligned with constructionism (Reynolds & Holwell, 2020) and the belief that knowledge is based on our individual interpretation of the objects we experience within the world (Crotty,

1998). Core to TDR is the recognition that actors have differing values and views on desirable outcomes, and they intuitively set boundaries when determining which aspects of a problem are relevant based on their assumptions. These judgements must be understood to challenge normative goals and achieve effective impact (Lawrence et al., 2022; Reynolds & Holwell, 2020). Therefore, a process of reflexivity on self-belief and the boundary of the problem to be explored is essential in understanding different actor perspectives, including those of the researcher (Bammer, 2013; Jackson, 2019b; Ulrich & Reynolds, 2010). This process of reflexivity is consistent with the re-evaluated role of the researcher in qualitative research, whose biases should be revealed, unlike the impartial and detached observations prioritised by an objectivist epistemology (Paltridge & Starfield, 2019).

TDR also requires awareness of distinct knowledge traditions beyond academia. Whilst academic research privileges rigour and defensible knowledge according to disciplinary conventions, industry prioritises context-relevant information that can be applied strategically by a team or organisation (Sharma & Bansal, 2020). Sharma and Bansal (2020) explore the challenges of bridging academic and industry knowledge traditions in projects and find that meaningful co-creation of knowledge benefits from a 'process ontology' view of incompleteness where outcomes are not restricted to the span of a single project meeting and the mutual learning process is explained in the continuous context of past and future events.

Willetts and Mitchell (2017) explain how the use of TDR in a PhD thesis raises a distinct set of examination considerations and propose criteria to assess the research rigour and measurable impact within the limited resources and time available to a sole student in a TDR PhD. A discussion on the application of these criterion to this research can be found in Chapter 3 Theoretical foundations and research framework.

1.3. Key Thesis Argument and Research Questions

The overarching research question in this thesis is,

'How will Australian superannuation portfolios reach net zero?'

A central finding in the analysis of interviews with industry participants was a critical distinction between achieving net zero 'portfolio emissions' or net zero 'planetary emissions'. The thesis argues that the former approach does not fundamentally alter the status quo or achieve long-horizon sustainability and can be more readily achieved by 2050. Whereas the latter approach requires vast systemic and legislative change, including finance for climate solutions in 'uninvestable' economies. Some research participants questioned whether a

planetary emissions commitment could realistically be achieved. However, the existential importance of this goal justifies the pursuit of this ambition and research.

The first sub-question in this thesis then is,

'How are actors interpreting net zero superannuation portfolios?'

As this distinction is critical to climate futures, portfolio and planetary emissions are considered in relation to the IPCC-derived Shared Socio-economic Pathways (SSPs) that portray alternative socio-economic climate narratives describing human lifestyle and development, policies, technology and environment (O'Neill et al., 2017). By making boundary judgements explicit, the research enables an understanding of how Australian superannuation portfolios intend to reach net zero so that their impact on climate futures can be better defined, measured and implemented at this imperative time of transition.

In order to understand the progress and challenges in implementing net zero portfolios, the thesis secondly investigates,

'How are superannuation funds implementing their net zero commitments?'

Net zero actions were considered from the perspective of a cross-section of superannuation funds as well as an analysis of the industry. The research examined how net zero commitments were being internalised through governance and skills, the net zero decisions they had implemented and their use of influence in stewardship practices and policy advocacy. The research found the interpretation of net zero to be a strong factor in the level of net zero implementation that had been achieved.

A further research finding, however, was that despite Australia's legislated net zero goal, that intent had not been applied to superannuation and was acting as a barrier to the sectors' transition.

This is addressed in the third sub-question in the thesis,

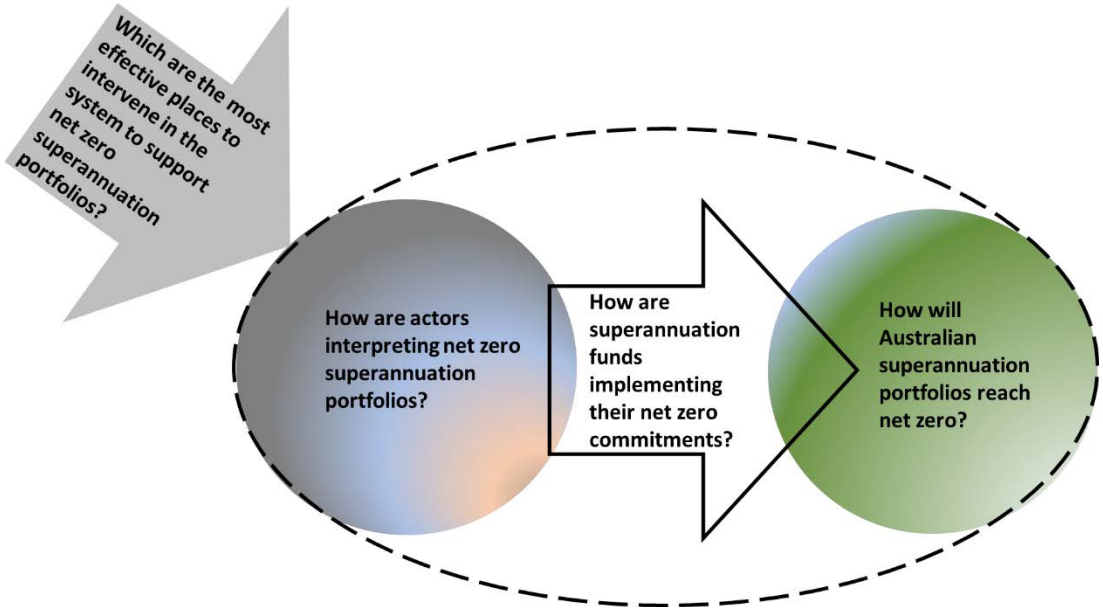
'Which are the most effective places to intervene in the system to support net zero superannuation portfolios?'

Using Meadows (1999) Systems dynamics framework, this study found the intent of the Australian Government within the APRA-regulated superannuation system to be the most powerful lever to enable portfolios to reach net zero. Interest groups are well-positioned to continue bridging the gap between government, superannuation funds, and members and

lobbying for action to reach net zero superannuation portfolios. Unless a specific net zero intent relating to superannuation funds is provided by the Australian Government, the level of ambition expected of a fund's net zero commitment will remain unclear, and barriers to the system design and dynamics will prevail. The expression of net zero intent is a function of net zero interpretation and ambition across all actors in the system.

The research questions are shown diagrammatically as a transition process where interpretation reveals the intent of the system and informs the extent to which it can be implemented.

Figure 2 Research Questions



1.4. Chapter Overview

The overarching research question, 'How will Australian superannuation portfolios reach net zero?' will be explored over five chapters.

Chapter 2 synthesises existing literature relating to net zero superannuation portfolios and demonstrates the need for further research. This chapter provides the foundation for this research and weaves knowledge across disciplines and industries. Given the emphasis on policy and practice and the nascence of this topic, grey literature, including policy documents, submissions to government consultations and industry reports, is an essential component of existing knowledge.

Chapter 3 outlines the transdisciplinary theoretical framework and systems thinking methodology used to examine the thesis research questions. The discussion refers to the prior

use of transdisciplinary research in aligned studies and justifies the suitability of TDR and the selected systems thinking methods to the research topic.

Chapter 4 addresses the research sub-questions 'How are actors interpreting net zero superannuation portfolios?' and 'How are superannuation funds implementing their net zero commitments?' and 'Which are the most effective places to intervene in the system to support net zero superannuation portfolios?' This analysis applies CSH by Ulrich (1994) and the Places to intervene in a system framework by Meadows (1999).

Chapter 5 concludes the analysis of the research sub-questions to answer the overarching thesis question, 'How will Australian superannuation portfolios reach net zero?' Given the TDR orientation of this research, these conclusions are also adapted to share the implications of the thesis for policy and practice. The outputs in this chapter are also intended as a future transdisciplinary research agenda for this topic and should be seen as an 'incomplete' step in the process of supporting the superannuation sectors' transition to net zero (Sharma & Bansal, 2020).

This chapter identified the scale and influence of net zero superannuation portfolios and their potential for immense socio-environmental benefit. It outlined the imperative for the superannuation sector's transition to net zero, given its long-term mandate and duty to beneficiaries. The discussion affirmed the suitability of a transdisciplinary research approach in addressing this complex goal within the race to limit the effects of climate change.

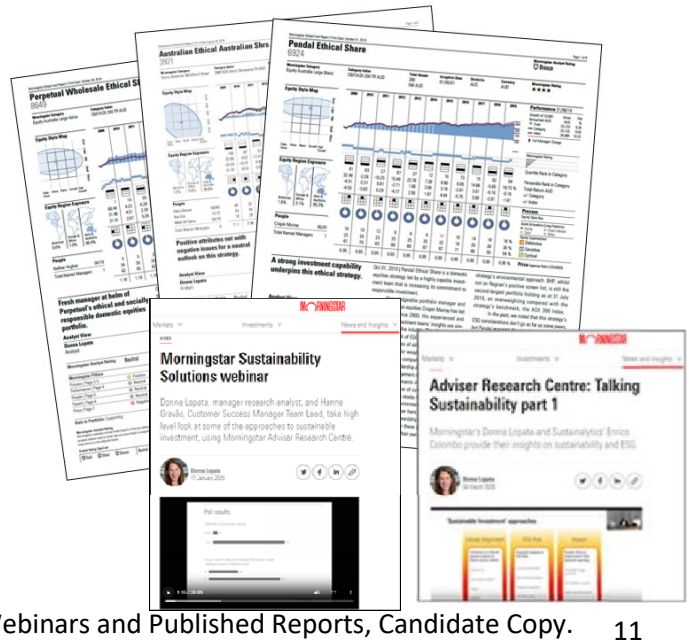
Chapter 2.

A Review of Knowledge Relating to Net Zero Australian Superannuation Portfolios

I have a diverse career background. In my first career stage, I worked as an interior designer for architecture firms on commercial, hospitality, and residential projects. During my training in the early 2000s, sustainable design practices were becoming more common. I studied passive energy principles and life cycle analysis, and the term 'net zero' was first used in the context of sustainability and its application to design. I was also fortunate to intern at the Centre for Design at RMIT University, where I assisted with research on the embodied energy of construction materials.

Those sustainability principles were formative for the subsequent years of my career. Fifteen years later, I retrained and entered the finance sector, and saw that sustainable investment was still widely shunned by institutional investors in Australia. My interest in covering the ethical and ESG-focused funds in my research role at Morningstar was uncontested by the more experienced analysts in the team, who mostly viewed sustainable finance with derision.

However, my role exposed me to the growing range of sustainable finance products and tools being developed in the industry. As I continued to interview investment managers and deliver presentations to financial advisors, it was clear that a cultural shift was underway, but there was a research gap.



Source: Selection of Webinars and Published Reports, Candidate Copy.

2.1. Australian Superannuation-Orientated Net Zero Literature

I began my research by systematically searching the Scopus database using the keywords "superannuation" AND "net zero", but no specifically focused peer-reviewed literature was found. I expanded the search terms to include "superannuation" AND ["carbon risk" or "climate change" or "climate crisis" or "global warming" or "decarbonisation" or "carbon emission" or "stranded asset"], which revealed several connected articles. This section discusses the existing literature focused on the topic in the context of Australian superannuation.

Climate risk as a fiduciary duty for Australian superannuation

Kliponen (2021) takes a legal perspective on the clear fiduciary duty of superannuation trustees to protect portfolios from climate risks, arguing that litigation will increase over the failure of trustees to respond sufficiently to financially material climate risks. Barker et al. (2016) asserts that the Superannuation trustees' duty of care may not be met unless climate change governance is adequately addressed. The same author contributed to a climate governance guide issued by the Australian Institute of Company Directors (Barker & Turner, 2021) and a chapter in a climate governance handbook (Mulholland et al., 2020). Donald et al. (2014) extends beyond consideration of financially material climate risk and explores the legal ability of superannuation funds to participate in impact investment, where environmental and social returns are emphasised alongside financial yield. The research pre-dates the 2020 YFYS Act, where the word 'financial' was added and its focus made explicit in Best Financial Interests' Duty. As with the more recent report findings of Freshfields Bruckhaus Deringer (2021)Australian legislation restricts superannuation funds from impact investment, which is not supported by a clear financial justification. Core to the reason for these different legal positions is the distinction between financial materiality and impact materiality; these are reviewed in 2.5.2 .

Short-termism in Australian superannuation

The horizon for materiality is closely linked to discourse on short-termism in finance. Drew (2009) argues that despite their long-horizon mandates and universal ownership, Australian superannuation funds are a source of short-term pressures within the finance system where missed or negative corporate earnings trigger stock turnover, lowered bonuses and career consequences for managers and board members, and lowered incentives for investment managers. Therefore, Drew proposes a series of transformative but significant changes to industry practice to remedy short-termism in superannuation. That study is part of a body of literature revealing the many ways that immediate financial outcomes are prioritised in

business and finance sector processes and practices, obstructing the value-creating investment needed to achieve net zero portfolios (Carney, 2016; Louche et al., 2019). The implications of entrenched short-termism in conventional finance sector processes such as brief stock holding, quarterly reporting, short-term benchmarking and performance incentives are issues that are addressed in 2.6.

Sustainable Development Goals and Socially Responsible Investment in Australian Superannuation

Moore and Sciulli (2022) explore the reporting practices of the top twenty superannuation funds in relation to sustainable development goals (SDG) to assess whether there is sufficient recognition and evidence of SDG-aligned investment. They found that only some SDGs, including Climate action and affordable and clean energy, have been adequately disclosed. In contrast, the SDGs that typically apply to EMDE were not included, suggesting that the superannuation funds had decided not to prioritise them. A further article, written two decades ago by Van der Laan and Lansbury (2004), followed the introduction of product disclosure rules requiring funds to advise "*the extent to which environmental, social, ethical and labour-relations considerations were taken into account in the selection, retention and realisation of investments.*" The article noted the challenges of renewable energy investments to meet the investment criteria of superannuation funds but also questioned the appropriateness of fossil fuel investment, including in SRI-labelled funds. The debates and incongruencies of tools for change, including climate-related reporting and labelling, are investigated in 2.7. Climate solutions investment and fossil fuel phase-out are also pertinent topics in this research and are found in 4.3.

Australian Superannuation Member engagement and interest in the environment

Another related article by De Zwaan et al. (2015) analyse why such a low proportion of superannuation members select the ESG choice funds offered by their superannuation funds. They found that about two-thirds of surveyed members were interested in investments that considered the environment, but 70% did not know if their fund considered the environment, and many were unsure whether ESG investing would help the environment. The research also found that almost a third of members did not know what fund option their savings were in, indicating a high level of disengagement that may be a significant factor in the low uptake of ESG choice funds. Member engagement and attitudes to climate-focused investment is an area that is worthy of future research to support the superannuation sectors' transition to net zero.

Existing scholarly articles introduced in this section provide helpful insight into the Australian superannuation sectors' context in the transition to net zero. Firstly, the knowledge showed

the climate-related conundrum for superannuation trustees. They must address the legal risk of climate inaction alongside the regulatory constraints on climate-focused decisions due to best financial interests' duty. Secondly, the literature identified the value-dilutive presence of short-termism in Australian superannuation practice. Thirdly, misleading reporting and labelling of superannuation investments and challenges in renewable energy investment were raised. Finally, the effect of member disengagement from superannuation on portfolio climate outcomes is also raised. The relatively small amount of peer-reviewed literature also indicates the limited academic attention centred on the Australian superannuation sectors' transition to net zero.

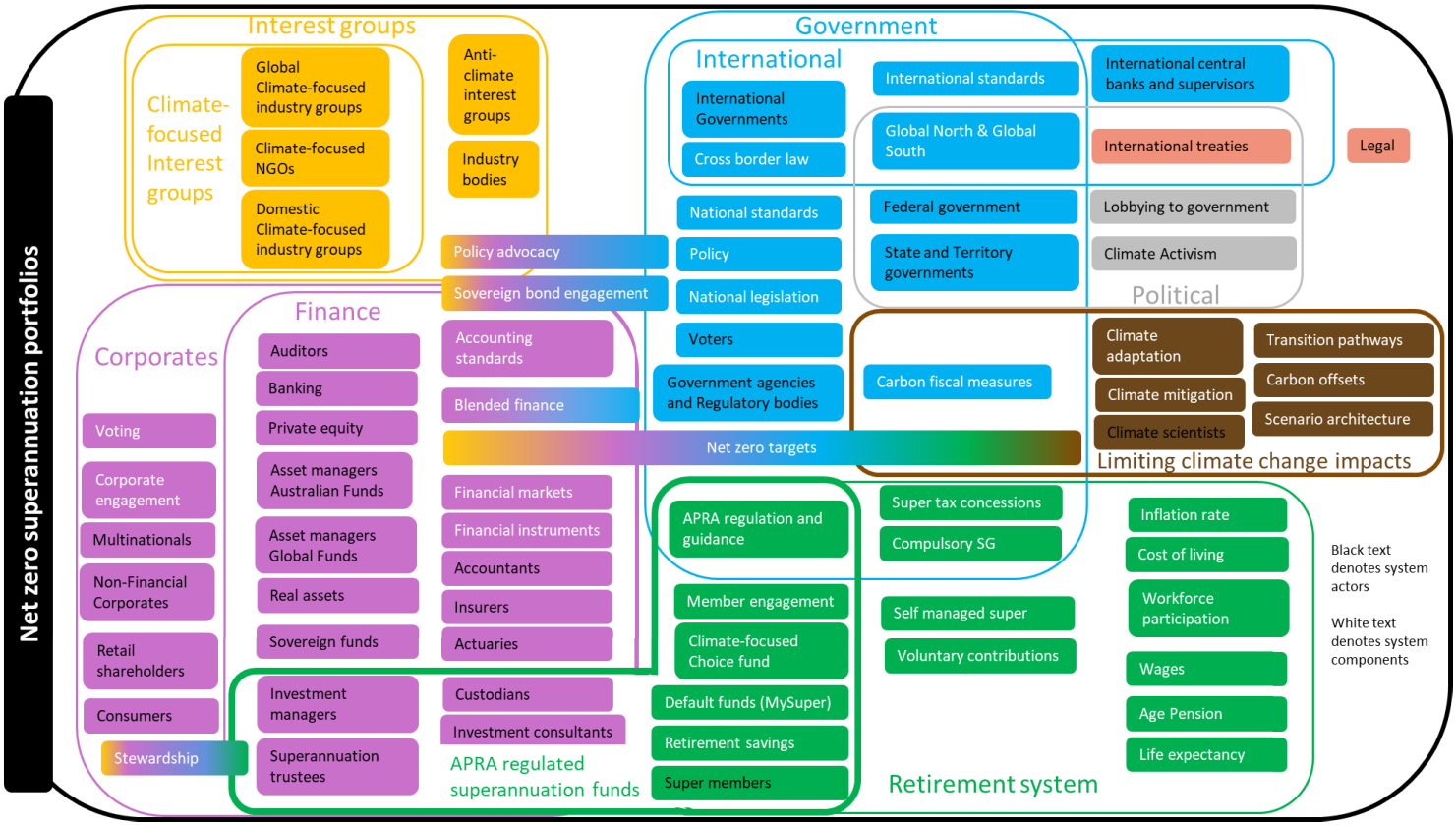
2.2. A Broader Scope for Knowledge Relating to Net Zero Superannuation Portfolios

Looking beyond the knowledge that is directly focused on the Australian superannuation sector, the next stage in my literature review situates the thesis topic within sustainable finance. It shows the intersection of the research with multiple systems, such as the political, environmental, financial and retirement systems. This narrative literature review has been conducted in a way that is consistent with a TDR approach. My judgement on the inclusion of knowledge has been explicitly mapped for transparency and critique. Wide realms of research from multiple disciplines are synthesised alongside industry and policy knowledge. In showing the breadth of knowledge related to the superannuation sectors' transition to net zero, this section also reveals the gravity and resonance of the topic.

2.2.1. Context Diagram for Net Zero Superannuation Portfolios

I have identified the scope of content I consider to be relevant to net zero superannuation portfolios in a context diagram, Figure 3. The stakeholders are shown in black text, the components are shown in white, and the interacting sub-systems are colour-coded. Context diagrams (also known as systems maps) are a systems-thinking tool used to reveal judgements on the boundary of knowledge and the sub-systems that are deemed applicable to the research. These decisions will, therefore, impact the research findings. It is essential to acknowledge that the boundaries of a systems map have been determined by the researcher and will be distinct based on individual interpretation (Abson et al., 2017; Sebastian & Riedy, 2023). The use of context diagrams in TDR is also discussed in section 3.3.

Figure 3 Net Zero Superannuation Portfolios Context Diagram



The colour-coded interacting sub-systems are:

a) the Australian retirement system, shown in green
b) the government, political and legal system, shown in blue
c) the corporate system, including the finance sector, shown in violet
d) the interest group system, shown in gold
e) the climate science system, shown in brown

The key research area and the main field in which this research is situated is sustainable finance. Sustainable finance resides within the corporate system and the finance discipline but intersects with all other sub-systems. Individuals play multiple roles across several sub-systems, such as superannuation members in the Australian retirement system, voters in the Australian political system, consumers in the business sector, and so on. Each of these sub-systems is also independently complex.

There is precedent in using systems maps to understand the superannuation sector. Donald et al. (2016) provide an example of systems mapping to explore the complexity of the superannuation system and understand the level of systemic risk that could occur in the event

of a local shock. They found that whilst the legal structures connecting actors are important, the high concentration of asset consultants and investment custodians servicing the largest superannuation funds increases systemic risk. Noting that the superannuation industry has become more concentrated since the time of their study, systemic risk would be expected to have increased. In the context of this thesis, their research should be considered for financially material climate risk, which poses the threat of both local and systemic shocks and a risk to financial stability (APRA & RBA, 2021, {NGFS Central Bank and Supervisors Network for Greening the Financial System, 2023 #7389)}. Another example of systems thinking applied to the superannuation system is the dedicated systems dynamics 'Mapping team' that existed in the ATO from 2000 until 2002 when policy priorities changed. Haslett and Sarah (2006) present the *High-Level Core Map of the Superannuation System* that was developed alongside close to forty other causal loop diagrams to position the department for involvement in policy reform and showed the suitability of systems methods for policy design given the system's complexity.

2.2.2. Narrative Literature Review Method

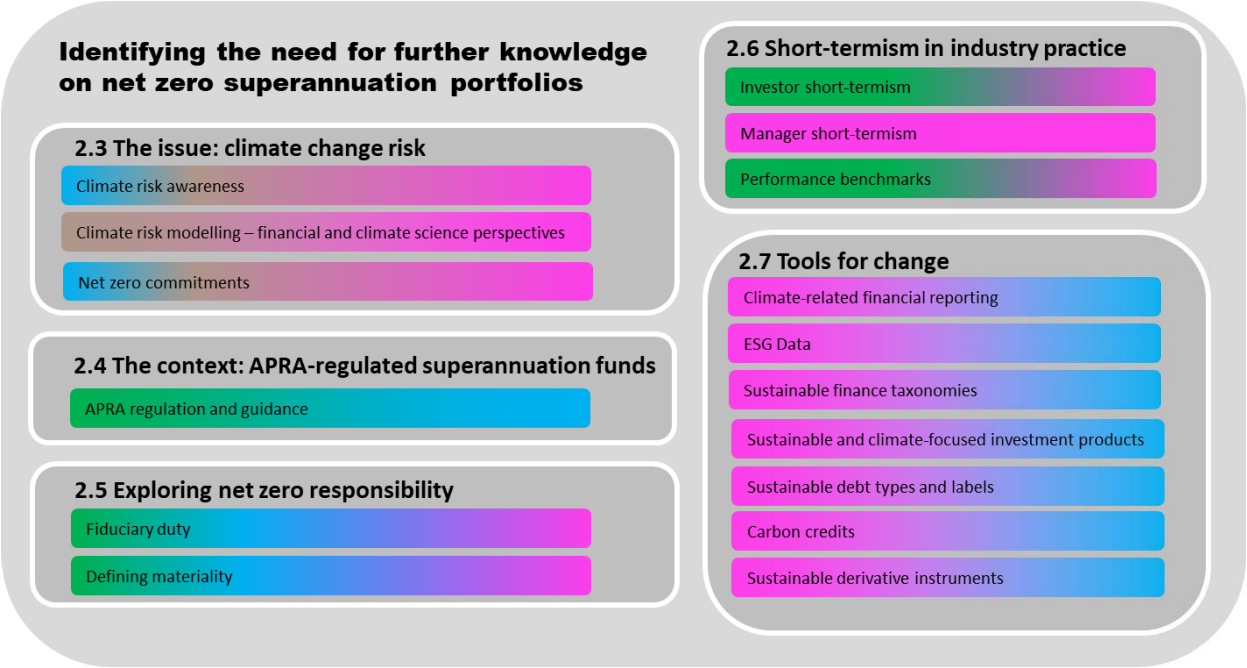
Narrative literature reviews are a research tool for synthesising and evaluating many views on a topic (Snyder, 2019). They usually begin by locating an issue, showing its position alongside existing literature and identifying areas where research is lacking to refine research questions and provide a rationale for further study (Efron & Ravid, 2019). The review is not exhaustive and instead relies on a narrative progression to situate the topic, synthesise existing knowledge, clarify the research questions and demonstrate the research need. Whilst critics of narrative literature reviews argue that there is a risk that a bias in knowledge selection can cause inaccuracy, a creative approach that combines a range of perspectives is often needed in the review of an emerging topic (Snyder, 2019), as is the case for net zero superannuation portfolios.

The review of existing knowledge presented in sections 2.3 – 2.7 spans the extensive context diagram shown in Figure 3 and explores knowledge in five successive parts;

- The issue: climate risk,
- The context: APRA-regulated superannuation
- Net zero-related responsibility in superannuation
- Short-termism in industry practice
- Tools for change

These are shown diagrammatically in Figure 4, with colour coding corresponding to the context diagram.

Figure 4 Situating and Synthesising Net Zero Knowledge



A challenge in conducting this research has been the speed and volume of sustainable finance knowledge currently being produced, especially in grey literature. However, the inclusion of grey literature in an evolving research area is critical, as it has more succinct publishing requirements and is, therefore, more current (Alfred, 2020). In defining the boundary of literature to review, an emphasis has been placed on the currency of included knowledge, with the majority of data sources dated post-2015. This is due to the surge in attention to the climate crisis since the 2015 Paris Agreement was signed and an increased understanding of its intersection with investment within the finance industry (Mercer, 2019; Nedopil, Dordi & Weber, 2021).

The process for the selection of sources was as follows:

i. A search for peer-reviewed literature was undertaken using the Scopus database using keywords in each of the related domains
ii. Irrelevant literature was excluded
iii. Articles from an Australian context were prioritised
iv. Emphasis was also placed on the most current articles
v. An effort was made to find sources with different perspectives
vi. An equivalent search process was undertaken using a Google search for grey literature where Australian government documents, documents of international governments

and reports from large, well-reputed interest groups were prioritised for their authority, currency and credibility.

vii. Other sources included publicly available submissions to Australian government consultations.

viii. Contrasting viewpoints in grey literature were mostly obtained through a search of media using the Factiva database.

ix. A further reference layer was sourced and snowballed from the initial search process.

The literature review was initially written in early 2022; however, because of the topical nature of this study and the high volume of new research production, this section was significantly updated in late 2024. The cut-off point for inclusion in the literature review is December 2024.

2.3. Climate Risk Knowledge

This discussion on climate risk focuses on the forces and processes that have supported or stymied net zero commitments. Knowledge of the Australian government's position on climate politics is central to the context of this inquiry, as are the multilateral developments that influence policy and practice. This section also introduces the differing disciplinary interpretations of climate risk.

2.3.1. Incorporating Climate Risk in Legislation, Policy and Industry Practice

Understanding and acceptance by industry and policymakers of the need to address climate risk has been a turbulent process. This section provides a chronological context emphasising the circumstances in Australia.

Concern for the environment from an economic, policy and business perspective dates back to the 1970s when the Stockholm Declaration noted, "*a point has been reached in history when we must shape our actions throughout the world with a more prudent care for their environmental consequences.*" It led to the formation of the United Nations Environment Programme (UNEP) (UN, 1972, p. 3). Several responses to climate risk from the finance sector followed shortly after that. The "Report of the Committee on Environmental Effects of Organization Behavior," 1973) identified the financial significance of air and water pollution and anticipated a growing need for accounting reform to measure these externalities more accurately. The report commented, however, that due to the inaccuracy of measurement techniques for the expected social costs of environmental pollution, only known expenses or losses, such as physical damage due to extreme weather or reputational costs due to stakeholder agitation, should be included. Therefore, neglecting early innovation to measure

and manage climate risk. In 1973, polluting GHG emissions were explored in a macroeconomic context by Nordhaus (2019), who estimated carbon prices based on the likelihood of future programs to control emissions. Once again, action was not prioritised.

Simultaneously, Meadows and Meadows (2007) used Forrester's systems dynamics method to explore the 'limits to growth' and identified five factors that needed to be addressed to avoid the collapse of planetary systems: population growth, agricultural and industrial production practices, resource depletion and pollution effects (The Club of Rome, 2024). Their 1973 findings are now widely accepted, but at the time, they were ridiculed and dismissed so as not to disrupt the prevailing societal state (Jackson, 2019a; Kahn, 2022; Meadows & Meadows, 2007).

The historical context for climate risk has been intertwined with competing economic and political interests that delayed action. In 1981, in Australia, a confidential government report identified the high emissions caused by fossil fuel combustion and the damage caused by global warming (Office of National Assessments, 1981). The document anticipated that increased awareness of this threat would trigger public alarm. Regrettably, the report reassured the government that a time lag would prevent the need for policy action and enable export industries such as Australian coal to remain secure until at least the end of the century. Although scientists presented substantial evidence of the damaging effects of fossil fuel emissions, the working group on emissions of CO_2 at the 1985 UNEP conference determined that "*the implementation of policy options to modify or control the use of fossil fuels is not warranted on the basis of the climate change problem alone*." (UNEP, 1986, p. 42). This questionable conclusion is difficult to separate from the interests of the major climate science research funding sources such as Humble Oil, The American Petroleum Institute and ExxonMobil (Targeted News Service, 2016).

In 1986, The Intergovernmental Panel on Climate Change (IPCC) was established by the UN and The World Meteorological Organization to provide scientific knowledge of climate change impacts and expected risks to policymakers (IPCC, 2023). These reports continue to play a fundamental role in underpinning transnational agreements and climate policy. A characteristic of the IPCC reporting process is its open review structure, which aims to ensure the highest possible scientific accuracy (IPCC, 2021). This offered the additional benefit of increasing stakeholder confidence and support for a topic that was considered "*politically sensitive*" (Brundtland, 1987).

In the business sector, many regarded the 1988 speech by NASA scientist James Hansen as the point where they were more cognisant of climate risk. *"There had been earlier studies on climate change, but none had the media impact of Hansen's testimony, which emphasised the immediacy and dangers of climate change… and catapulted climate change onto corporate radar screens."* (Levy & Rothenberg, 2015). In order to explore the changing level of media attention during this period, a search of newspaper articles with the terms "Greenhouse Effect", "Global Warming", or "Climate change" was conducted on the Factiva database. The search was repeated for four countries, Australia, Canada, the USA and the United Kingdom and can be found in

Appendix D. The search showed that media attention in Australia multiplied 22x between 1987 and 1988. The other point of interest is that The New York Times and The Washington Post published articles on climate risk one decade earlier than other media outlets. Investigating the reasons for this occurrence is outside the scope of this research. However, it is intriguing that no media outlets in Australia, Canada or the United Kingdom considered it suitable to echo news of global warming printed by both of these well-regarded publications in the USA.

A notable challenge to the acceptance of climate change as a risk was 'uncertainty'. The typically prudent scientific discipline documented climate change with caution. "*There are many uncertainties in our predictions, particularly with regard to the timing, magnitude and regional patterns of climate change due to our incomplete understanding*" (IPCC, 1992). However, the unintended effect of scientific caution was climate scepticism. Reporting on CSIRO's 'Greenhouse '87' conference in Melbourne, Jones (1987) noted that "*The Greenhouse Effect is among the latest in a line of disaster scenarios, and as such tends to be taken fairly sceptically by those of us who have lived long enough to have heard similar gloom-and-doom forecasts before*".

Despite disbelief by some, public alarm over global warming had increased by the late 1980s, and the ALP Government led by Hawke (1983-1991) leveraged this for political gain (Dunn, 1989; Woodward, 1989). However, despite their rhetoric that implied concern, the Hawke government adopted uncoordinated and ineffective climate policies to prevent an 'adverse' effect on the economy and high-emissions industries (Burgmann & Baer, 2012). The ALP Keating government (1991-1996) was also eager to appease the growing public concern about global warming without upsetting the business community (Dwyer, 1994a, 1994b; Hooper, 1994). Australia signed the 1992 Rio Agreement and although the treaty was a significant international accomplishment, it had been minimised to remove any economic threat (Garran,

1992b). The Keating government also implemented the National Greenhouse Response Strategy, which also reduced emissions without impacting the economy (Burgmann & Baer, 2012; Garran, 1992a).

A surge of anti-environment movement books were published in the early 1990s (Ruben, 1994). Washington Post editor described the media attention, “Environmental hysteria may be the nation's fastest-growing *industry. Thanks to the tireless alacrity of activist groups and dread-mongering in the media, scarcely a week goes by without some breathless report*” (Ruben, 1994). Therefore recommending, the anti-environmental book, ‘Science under siege’ as a “rational antidote” to temper the propaganda. Similarly hostile, the Financial Times (1994a) reported, “*A climate-change conference has been told that animals release massive amounts of methane into the atmosphere, a major cause of the so-called greenhouse warming effect. Who's going to tackle the hot air released by think tanks, politicians, spokesmen, media types, luvvies...”* Groups such as the European Science and the Environment Forum argued against the danger and severity of climate risk, saying, “*Global warming theory is not supported by the data and as a consequence we can’t yet know that climate disasters are becoming worse and more frequent”*(Bate, 1995).

The deceivingly named ‘Global Climate Coalition’ (GCC) took an even harsher approach against climate change action (Brulle, 2023). They vigorously discredited the IPCC and succeeded in preventing binding emissions reduction regulations in the UNFCCC treaty. They continued to lobby the Clinton government and to testify to congressional committees for voluntary emissions reductions to prevent economic damage (Brulle, 2023). Their actions were ‘successful’ until the Berlin Mandate in 1995 enforced quantified carbon reductions (UNFCCC, 1995). By 1994, environmental politics had become fierce, and media coverage was widespread (Global Environmental Change Report, 1994). On primetime television, US Vice President Al Gore criticised anti-environment activists for receiving financial support from interested groups. The popular show host countered Gore and argued that Exxon and Shell also fund environmental groups. The fossil fuel industry overtly and falsely denied climate change (Levy & Rothenberg, 2015; Mansley & Dlugolecki, 2001).

‘Climate change uncertainty’ continued to be used as a tactical strategy for climate change inaction (Flavin & Tunali, 1995). Environmental Research Foundation Peter Montague said, "*A little confusion in the public is very important in the political process. If policymakers are getting calls with a lot of contradictory evidence, they're going to say, we better wait until we get more proof until we do anything*" (Ruben, 1994). The American Petroleum Institute

endorsed the 1991 Montgomery study, and came to the self-interested conclusion that, "*after analysing six different emission control models and their economic aspects, that emission reductions would be costly and bring uncertain, if any, benefits.*" (Global Warming Network, 1991). Some companies argued that the costs of action would be so high that they would be ruinous. For example, BHP, Shell Australia and the Australian Coal Association commissioned a study that found emissions reduction measures would be "*a threat to their existence*" (McKanna, 1992). Many business groups argued that the horizon for impact and action was unknown; therefore, mitigation was a questionable investment (Los Angeles Times, 1992).

Studies such as Fankhauser (1994) calculated the social cost of GHG emissions and identified the increased costs of a delayed response. Using Monte Carlo simulations, Fankhauser found the expected costs of carbon to reach about $33/ tC, noting that the cost of emissions increased with income and population growth, accumulation of emissions and incidences of extreme weather. Future GHG emissions were naturally uncertain and have since exceeded most estimates. Most financial analysts in a 1994 survey expected climate risk to become important to business competition in the next ten years and relevant to fiduciary duty once it affected asset valuation (Financial Times, 1994). Nevertheless, even acknowledging future climate risk and cost was not a catalyst for urgent action.

Although concern about the financial impacts of climate change had proliferated the insurance sector (Atkins, 1995; Bate, 1995). This was significant as insurance is a sub-sector of the finance industry – that largely believed "*that the only consequences that should be considered in making investment decisions are those related to the pecuniary rate of return*" (Hayden, 1989, p. 1032). The 1994 report, 'Global warming, Element of Risk' by multinational insurer Swiss Re was particularly revealing of the growing concern about climate change costs and risks for insurers (Booth, 1995). Schmidheiny (1996) referred to a surge in attention to climate change in the insurance sector and comments by Frank Nutter, president of the Reinsurance Association of America, who said, "*The insurance industry is first in line to be affected by climate change… It could bankrupt the industry*." Booth (1995) described *"an unprecedented meeting in Berlin between insurers, financial institutions and environmental activists Greenpeace to discuss strategies for limiting the effects of global warming."* Major insurance companies, in conjunction with the UNEP, signed a "Statement of Environmental Commitment' stressing the industry's vulnerability to climate change-induced extreme weather and their commitment to environmental improvement (Environment Liability Report, 1995).

Multilateral climate actions increased with annual Conference of Parties (COP) meetings beginning in 1995 and the Kyoto Protocol, established in 1997. Transnational governance has been a powerful force for setting an agenda and improving expertise to achieve it (Bulkeley & Newell, 2015). By then, concern about climate risk expanded through the business community, with 'climate change' voted as the most significant planetary issue at the 2000 Davos summit (Mansley & Dlugolecki, 2001; Toepfer, 2000).

However, the Howard Government (1996-2007) was sceptical of climate change and refused to accept a binding international emissions reduction agreement. He reasoned that his "bullish" opposition to the 1997 Kyoto Protocol was to protect national economic interests (Lunn, 1997). Howard's loyalties were with the coal industry, showing rare climate support only when there was potential political gain (Associated Press Newswires, 1997; Gordon, 1996). After the Kyoto negotiations, Australia was allowed to increase GHG emissions by 8%, compared to most other nations that agreed to reduce their emissions by 8% below 1990 levels by 2012 (Nelson, 1997). Some media reports at the time referred to Australia's actions negatively, using language such as "Hoodwinking", "a tremendous blow", "coup", and "got away with it" (Lunn & Garran, 1997; Nelson, 1997; Skelton, 1997). In contrast, John Howard commented on the outcome as a "*splendid result, particularly gratifying for Australia*" (Taylor, 1997).

The Australian government's position contrasted with the former US Vice President Al Gore, who championed the fiduciary duty to manage climate risk. Speaking to the Investor Network on Climate Risk, Gore said, "*You have a responsibility as fiduciaries... to analyse risk and look for opportunities*" (Investor Network on Climate Risk, 2003). Executive Director of interest group CERES, Mindy Lubber, was also an important spokesperson for raising awareness of climate risk: "*In this country we've been so determined to disconnect environmental challenges from financial realities that we are missing very real potential liabilities that are right in front of us*'' (Thompson & Beckley, 2004). The high profile of those paying attention to climate risk also served to elevate the problem of financially material climate risk. For example, the comptrollers of New York state and city and the treasurers of California, Oregon, Maine, Connecticut, Vermont and New Mexico attended the United Nations INCR Summit (Murray, 2004). Meanwhile, "Sean Harrigan, President of the CalPERS Board, called it good corporate governance to examine climate risk" (Investor Network on Climate Risk, 2003).

The election of the ALP government led by Rudd (2007-2010, 2013) in 2007 was called the first 'Climate change election', it being the decisive issue for voters (Burgmann & Baer, 2012). Rudd ratified the Kyoto Protocol shortly after becoming prime minister. His key climate policy, the

Carbon Pollution Reduction Scheme, a cap and trade scheme, was defeated in parliament and heavily criticised for having a high cap and issuing concessions to coal-fired power plants. However, the Renewable Energy Target legislation to achieve 20% national renewable power by 2020 passed. As did the Resource Super Profits Tax (RSPT) on mining that led to the end of his leadership (Burgmann & Baer, 2012). The ALP Gillard government (2010-2013) reduced the RSPT but introduced a Carbon Pricing Mechanism. Whilst it was a modest $23/tonne with a complicated set of subsidies for some industries and for households, the pricing saw a drop in (coal-based) electricity demand and emissions (Crowley, 2017). The Gillard government also established the Clean Energy Finance Corporation (CEFC) and the Australian Renewable Energy Agency (ARENA). Australia is especially vulnerable to transitional carbon risk, given our national prominence in carbon-intensive industries such as iron ore, coal and gas (APRA, 2019).

Australian political leadership on climate risk halted with the Coalition government led by Abbott (2013-2015), who took a climate denial stance and repealed the carbon pricing scheme in 2014 (Crowley, 2021). Carbon had been priced at $25.40 per tonne and was estimated to cost business 7.4 billion AUD in its first four years (Taylor, 2014). The repeal's accompanying explanatory memorandum justified the decision on the basis that it would improve national economic growth and remove the administrative and cost pressures for households and businesses, especially coal mining and coal-fired electricity (Commonwealth of Australia, 2013). Funds no longer generated by tax resulted in the removal of climate financing mechanisms, such as the Steel Transformation Plan, which aimed to assist the transition to a low-carbon economy (Commonwealth of Australia, 2013). The repeal act memorandum also comments on instances where businesses invested in clean technology in response to the carbon tax and, ironically, the valid argument that there will be ongoing benefits to lower energy use and waste disposal costs. The Abbott Government were unsuccessful in dismantling the CEFC and ARENA but reduced funding to the latter (Baer, 2021). Abbott achieved an emissions reduction of only 5% by 2020 through a policy of solar panel rebates, tree-planting and changes to consumer behaviour (Baer, 2021). Despite the disregard of the Abbott government to climate change, a new period of global climate risk awareness was underway, including in the finance sector.

Policy formation is explained by Kingdon (2014) in Multiple Streams Theory (MST) where problem attention, policy and political conditions must be aligned in order for policy to be progressed. MST also explained that policy formation will be most effective when 'policy entrepreneurs' invest their own time, money and or reputation to promote the outcome (Kingdon, 2014). A policy entrepreneur requires expertise, authority over others, political

connections, and the willingness to wait for the opportune time to champion their cause and solution. Past US Vice President Al Gore played this role and championed the fiduciary duty to manage climate risk.

Former Governor of the Bank of England and the Bank of Canada, Mark Carney, played a role as a policy entrepreneur. He delivered an influential speech, 'Tragedy of the Horizons' just prior to COP21, that highlighted climate risk to mainstream finance. Carney stated that "*once climate change becomes a defining issue for financial stability, it may already be too late*" (Carney, 2015). The COP21 Paris Agreement also made clear the role of finance in the climate transition and committed signatories to *"make finance flows consistent with a pathway towards low greenhouse gas emissions and climate-resilient development*"(United Nations, 2015a, p. 3) also calling for the development of appropriate financial instruments for capital from private sources (UNFCCC, 2022b). It is widely acknowledged that the Paris Agreement brought greater policy and industry attention to the climate crisis and also increased the finance industry's understanding of its intersection with investment (Mercer, 2019; Nedopil et al., 2021).

The Australian government's position curtailed global action on climate, where the Coalition Turnbull government (2015-2018) made the election promise to leave Abbott's meagre climate policies unchanged and again tried unsuccessfully to shut the CEFC and ARENA (Baer, 2021). On the positive, the Turnbull government signed the 2015 Paris Agreement and, in 2016, attempted to reposition the ALP government climate policy with a National Energy Guarantee but was unsuccessful with the latter. In a further setback and turnaround on national climate policy, the coalition Morrison government (2018-2022) found an accounting loophole to dodge Australia's emissions reduction requirements under the Kyoto Protocol (Baer, 2021).

The 2022 Federal election showed a shift towards pro-climate public sentiment and political support (Stevenson, 2022). Australia's Climate Change Act was legislated in 2022. It echoed the temperature goal of the Paris Agreement with a net zero by 2050 target and a 43% reduction below 2005 emissions by 2030 (Commonwealth of Australia, 2022). The Act includes a target of 82% renewable electricity by 2030. Advice for an enhanced goal is currently in the consultation phase and expected in 2024, ahead of the next Paris Agreement ratchet in 2025 (Climate Change Authority, 2023). A series of actions by the Federal Government to support sustainable investment in Australia were subsequently announced or are currently under development (Chalmers, 2023a). This progress has occurred since this thesis commenced.

House of Representatives and Senate voting records show that although legislation has passed, many of these bills have been highly contested. Recent government developments include:

- Draft sustainability reporting standards released in October 2023 (Australian Accounting Standards Board, 2023),
- Legislated climate-related financial disclosure commencing in January 2025 (Australian Government, 2024f),
- The Sustainable Finance Strategy consultation in November 2023 (Australian Government, 2023e),
- Partnership in the development of the Australian Sustainable finance taxonomy (Chalmers, 2023a, 2023b)
- Sector Pathways Review for emissions reduction and transition to net zero 2050 in six key sectors (Climate Change Authority, 2024)
- Decarbonisation investment coordination within the Net zero economy authority (Albanese, 2024; Chalmers, 2023b)
- Sovereign green bond program (Chalmers, 2023a, 2023b) (Australian Government, 2023c)
- Future Made in Australia, National Interest Framework (Australian Government, 2024h)
- Introduction of the Net Zero Economy Authority into legislation in September 2024 (Parliament of Australia, 2024)

These changes are consistent with global efforts towards mainstreaming climate-related risk into routine practice (Hale et al., 2024). Mainstreaming involves multiple parts of the investment chain across markets, adopting regulations, practices and capital flows (Caldecott, 2018). Increased climate attention from central bank supervisors and financial institution executives, as well as climate reporting developments, were evident within a couple of years of the Paris Agreement (Caldecott, 2018). The UNEP FI and PRI (2019) found that 89% of the top fifty economies have some form of sustainable finance policy, 97% of which have been developed since 2000. The complexity and urgency of climate risk, has stimulated international coordination across a range of multilateral organisations including the Financial Stability Board (FSB), Bank for International Settlements (BIS), Organisation for Economic Cooperation and Development (OECD) and Group of 20 (G20)(G20 SFWG Sustainable Finance Working Group, 2021). Arguably, climate-related regulation and climate-aware investment have proliferated the finance sector and are now better incorporated into practice. Caldecott (2018) includes

irreversibility and shared understanding as further criteria for mainstreaming, but the achievement of this higher threshold is not yet evident.

This section showed the volatile history of Australian climate policy that has affected the settings for climate-focused investment. Importantly, the current government is signalling support for industry climate commitments. It is also seeking private capital to achieve national climate goals. Fragmented climate-related regulation and guidance support climate-aware practices and investment, but a common and permanent understanding of the risks of and appropriate response to climate change has not been fully accomplished.

2.3.2. The Rise of Net Zero Commitments

This discussion focuses on knowledge about net zero commitments, their appeal and achievement in scale, and commentary on their meaning.

Globally, climate momentum built following the Paris Agreement and the term 'net zero' is often attributed to the IPCC (2018) report that referred to the point when "*anthropogenic CO2 emissions are balanced globally by anthropogenic CO2 removals over a specified period*" to stay within the less risky 1.5 degrees Celsius limit set out in the Paris Agreement. GHG emissions reduction was detailed in the first COP in 1992 (UNEP, 1993) However, the term 'net zero' concerning climate change is credited to industry. For example Pauli (1995) who established the Zero Emissions Research Initiative at the United Nations University in 1994, anticipated that "*zero emissions will become a standard objective for industry over the next decade*" (Pauli, 1995, p. 1) and developed a five-step waste removal process based on total quality management, effectively, a circular economy where;

- Companies identify any manufacturing waste they cannot use
- A search begins for other companies who can use that waste
- The companies work together
- Existing processes are redesigned to identify new waste-use partnerships or improve existing
- Policy processes are evaluated to ensure they are supporting net zero emissions.

Another net zero industry initiative was the carbon-neutral carpet by Interface, developed in 1994 with 'mission zero' towards a sustainable product life cycle (UNFCCC, 2023b). The term net zero later expanded into the building sector in relation to energy-saving construction (Christian et al., 2004), car manufacturing (Waeber, 2006), urban planning (Blanco et al., 2009) and renewable energy systems (Edenhofer et al., 2011). Sharan (2011) argued for carbon-

linked economic reform to reach net zero emissions. Elkington (2012), also the creator of the concept of the triple bottom line (Elkington, 1998), brought together the disparate industry ideas of 'net zero' and 'zero carbon footprint' into a "Pathways to Zero" model promoting economic transformation towards a sustainable future.

The main body of literature on net zero as a climate action commitment was published in 2018. Whilst the appeal of net zero as a straightforward metric has been important for achieving scale (Fankhauser et al., 2022), a number of articles criticise net zero goals for being simplistic with potentially misleading temperature outcomes (Fulton et al., 2020; Geden, 2016; Reisinger et al., 2024; Rogelj et al., 2021). Countries and companies can adjust their emissions pathway and timeframe to limit their risk of failure. Further concerns about net zero targets in the literature are that the goal implies completion by 2050 rather than the scientific reality that emissions reduction must be sustained to limit warming, especially in the event of overshooting. They also assume inequitable reduction where higher emitters begin from a higher baseline (Reisinger et al., 2024). Fankhauser et al. (2022) argues that net zero goals are much greater than a carbon emissions calculation and outlines seven net zero requirements that show broader system change within the commitment, including early and broad emissions reduction, sustainable development principles and credible carbon removal and offsets.

The global UN Race to Zero campaign commenced in 2020 and led to a surge of net zero commitments that have become the principal signal of climate action by companies and countries (Hale et al., 2024; Net Zero Tracker, 2023). As at 2023, country commitments cover 80% of global emissions (UNEP, 2023) and 65% of global 2000 companies have net zero commitments (Net Zero Tracker, 2023). The Race to Zero campaign has extensive partnerships across major sustainable finance interest groups globally, the Science-based Targets Initiative, Net Zero Asset Owner Alliance (NZAOA) and Net Zero Asset Managers Initiative (NZAMI), noting that UNEP FI and PRI convene the latter two.

Their definition of net zero is,

"*When an actor reduces its emissions following science-based pathways, with any remaining GHG emissions attributable to that actor being fully neutralized by like-for-like removals (e.g. permanent removals for fossil carbon emissions) exclusively claimed by that actor, either within the value chain or through purchase of valid offset credits"* (UN Race to Zero, 2021b, p. 2). They further emphasise that for a net zero commitment to be credible, an entity should (UN Race to Zero, 2021a);

- Provide a net zero plan that includes steps for the next five years,
- Ensure the commitment includes an interim target of at least 50% emissions reduction by 2030, as well as an end target of net zero before 2050,
- Commit and publicly report on scope 1,2 and 3 emissions,
- Limit offsetting to hard-to-abate emissions only.

While many superannuation funds already had some level of climate change plan in place, the majority of Australia's largest superannuation funds committed to net zero targets between 2020-21. Asset owners are positioned at the top of the investment value chain. Australian superannuation funds have multi-sector portfolios with a strong domestic bias and wide global reach. Given the prominent role of superannuation funds in the Australian economy, progress towards achieving net zero superannuation portfolios is also an indicator of the decarbonisation of the Australian economy. It is also possible that some superannuation funds have held back from making a public commitment, 'greenhushing', until they have a rigorous action plan in place due to fear of adverse consequences (ASFI, 2022a).

Net zero plans developed beside high concern about climate risk within the financial sector. A survey of 425 institutional investors in 27 countries found that 88% of participants considered climate-related risks the greatest risk within their portfolio (BlackRock, 2020). A third of executives also stated that their company has already been impacted by climate change and that sustainable finance had become central to corporate strategy over the last few years (Deloitte et al., 2022). Further, in a survey of 1000 executive directors and managers, 40% stated their business had adopted a carbon reduction target, the authors noted that this was a drastic change from 2 years prior when most companies were unwilling to set and state a carbon target (KPMG & Evershed Sutherland, 2020).

Fankhauser et al. (2013) observed policymakers' emphasis on economic opportunity in the global race to a green transition and investigated the determinants of green competitiveness in manufacturing. The study is now over a decade old and did not include Australian data in the eight countries that were compared. That is understandable, given Australia's relatively small industry activity level. However, their framework could be replicated for a current perspective of other economic sectors and regions. Importantly, they found three determinates for success in a context of system-wide economic change. These are green innovation and speed of replacement, a competitive starting point and comparative advantage to win and hold market share. They also commented on the critical role of policy that incorporates externalities and overcomes market failures.

That research may have informed Australia's 2024 Future Made in Australia policy, which is consistent with the determinants identified by Fankhauser. The strategy document acknowledged the current challenges for institutional investment in climate solutions, including project approval delays, the lack of carbon pricing and early-stage investment risk. It sought to find a competitive starting point and improve replacement speed with a streamlined "front door" to facilitate investment. The plan also devised a strategy to scale and attract private funding for the net zero transformation. It identified five industries for investment to develop for national comparative advantage, including renewable hydrogen, green metals and low-carbon liquid fuels. It also outlined a suite of concessions, incentives and other measures to attract domestic and global private funding for relevant projects. The strategy is centred on scaling private capital for national economic interests and "*maximising the economic and industrial benefits of the move to net zero and securing Australia's place in a changing global economic and strategic landscape*" (Australian Government, 2024e).

There is a substantial overlap between the Future Made in Australia Treasury National Interest Framework paper and the ideas proposed by the Superpower Institute (Sims, 2024). According to Sims (2024), the use and export of Australian green products, including green iron and green aluminium, could reduce Australian and global emissions by about 10%. Interestingly, the Superpower Institute raised the problematic issue of a lack of carbon pricing and recommended the adoption of a Carbon Solutions Levy (CSL) on fossil fuel extraction sites and fossil fuel imports. The CSL was not included in the Future Made in Australia plan.

Carbon taxes are widely thought to incorporate the costs of negative externalities properly. Sen and Vollebergh (2018) in OECD (2021) estimate that for every 100 Euros per ton of carbon that is taxed, emissions reduce by 73%. According to World Bank Group (2023) as at January 2023, below 5% of GHG emissions globally are supported by a direct carbon price or are insufficiently priced. These include Australia's Emissions Reduction Fund (ERF), which has been operating since 2012. This small-scale emissions trading scheme for agriculture gave participants 1 Australian Carbon Credit Units (ACCUs) for each tonne of carbon that is stored or avoided (Clean Energy Regulator Australia, 2022a), the credits can be sold. In the decade since its inception to May 2022, the program has issued just under 110 million credits (Clean Energy Regulator Australia, 2022b), which equals 110 Megatonnes of carbon avoided. By comparison, in 2021 alone, Australia emitted 585 Megatonnes of carbon (Climate Watch, 2021).

Despite opposition by the public, as well as by fossil fuel interests, especially in Australia Carattini et al. (2018) argue that with better design, carbon taxes could be successfully

introduced. They propose a gradual phase-in, clear use of proceeds for climate change mitigation, considered equity measures and comprehensive communication. Caldecott et al. (2021) comment on the problematic balance between equity and economic efficiency in government carbon pricing policy. They reason that a phased-in carbon price results in fossil fuel asset losses and public cost but limits their premature devaluation. Additionally, they assert the need for financial institutions and supervisors to develop strategies to manage stranded assets beyond fossil fuel investments, including assets affected by exposure to physical climate risk as well as litigation attributed to it. A related discussion on scenario analysis is found in 2.3.5.

The potential for net zero goals in climate change mitigation and adaptation is significant but full implementation of a net zero commitment requires multi-faceted systems change (Fankhauser, 2021). Fankhauser (2021) identifies five vast interventions required for system change all of which are relevant to net zero superannuation portfolios, in particular scaled investment in net zero-aligned energy and infrastructure technology but also carbon fiscal measures, climate skills, carbon offset regulation and carbon removals are also pertinent to this topic. Each of these interventions requires a system response and policy support.

Broader approaches to systems change have been adopted through the use of well-being economic measures to inform policymaking, such as in New Zealand (The Treasury (NZ), 2021). These holistic frameworks refer to intergenerational equity and support net zero transformation. A wellbeing framework was proposed but not implemented across all of Australia (Smith, 2022). The ACT Government (2020) adopted a well-being framework that requires policymaking and investment decisions not to deteriorate climate change for the environmental sustainability of future generations. These frameworks rest on a body of research that contests material prosperity as the measure of well-being in capitalism. They argue that it has caused consumerism, shareholder primacy, inequality and prioritised short-term profit (Snower, 2019). Snower (2019) proposed a new “human-centred capitalism” that recognises the need for deep collaboration to mitigate climate change impact across society. Obst 2105 in Coulson et al. (2015) questioned the inattention of natural capital against financial capital and argued that they could both be included in GDP.

Bansal and DesJardine (2015) clarify that the focus of sustainability is ultimately about intergenerational equity. They warn that it should not be confused with efforts by corporations to compensate stakeholders for damages such as externalities, such as community development infrastructure built in a mining region. From the perspective of a net zero goal

this is comparable to a fund with a net zero commitment compensating for high emissions investments with offsets outside their value chain, in lieu of viable emissions reduction. Their emissions accounting may appear better but the investment does not improve outcomes for future generations.

This section revealed knowledge on the appeal and scaling of net zero commitments. The research also supports a broader interpretation of net zero than GHG emissions measurement. Most significantly, the research shows the extent of transformation needed to properly reach net zero. Political resistance to carbon fiscal mechanisms and holistic economy measures makes the ambition more challenging.

2.3.3. Climate Risk – A Finance Sector Perspective

A finance sector perspective of climate risk is presented in the discussion below. This knowledge shows the disciplinary focus when considering climate risk. This perspective informs the industry's net zero intentions.

The uncertainty, capital intensity and long-term payoff of climate-focused investments is outlined in the literature (Aguilera et al., 2021; Homroy & Slechten, 2019). Yet, the much larger financial threat of unpreparedness for climate risk is also well-supported by scholarly studies (Fankhauser & Jotzo, 2018). According to institutional investor group, Climate Action 100+ (2024a), the costs of inaction could result in $23 Trillion USD of systematic economic losses globally over the next eighty years. Despite the known financial risks of climate change, global GHG emissions have continued to grow (IEA, 2024). In 2022 the International Energy Agency (2022) reported that despite lowered CO2 emissions due to the COVID-19 pandemic, these reverted to their highest historic levels in 2021. They noted also that the 6% growth of emissions in 2021, aligned with 5.9% average global GDP growth. The IEA (2024) identified a noteworthy change in their 2024 report, the rate of GHG emissions growth was about a third of the rate of GDP growth as a result of renewable energy adoption.

The finance sector divides climate risks into three categories, physical, transition and liability climate risk. Transition and liability risk are also referred to as 'societal risks', a typology that encompasses the broad range of societal and regulatory responses to environmental-related risk, including evolving norms (Caldecott, 2018).

Physical climate risks

Physical climate risks are damages resulting from events such as drought, bushfires, floods or changes in weather patterns due to climate change. Many climate change impacts have

already been observed; the most recent report by IPCC (2022) referred to high coastal flood storm damages, high infrastructure damages, and high impacts on crop production, which have already been experienced in Australasia. IPCC (2022) also warned of the multiple adverse impacts on humans and ecosystems if global warming reaches 1.5 degrees in the next two decades and noted that some risks can no longer be mitigated. NASA (2022) explained that even if the release of all greenhouse gases were to cease instantly, the impact of past emissions would remain in the atmosphere and oceans for centuries. The impacts of climate change on property assets are growing, and whilst flood and fire risks can be measured with existing tools, quantifying and modelling the impacts of heat waves and water access is more complicated to measure (Bonnie, 2021).

Transition climate risks

Transition climate risks occur through reassessment of valuation because of changes in demand or policy in the shift to a low-carbon economy. These include 'stranded assets', defined as assets "*that have suffered from unanticipated or premature write-downs, devaluations, or conversions to liabilities*" (Caldecott et al., 2013, p. 7). Conventional financial risk modelling is unsuitable for calculating climate transition risks due to future uncertainties, such as potential climate policy decisions and the impact of these on various assets (Battiston et al., 2017).

Policy: The PRI (2022) database of sustainable finance regulation documented the substantial increase in policy globally and found 750-related policies as at March 2022. With this exponential rise in policy, PRI (2024b) shifted to categorisation and found that most regulations are no longer merely focused on prudential risk mitigation at a financial institution-level but instead aim for economy-wide transition that aligns policy with capital reallocation.

Demand: In relation to changes to demand, climate risk modelling for a 2-degree scenario shows a cumulative loss of 58.9%, 42.1% and 39.2% for coal, oil and gas, and electric utilities sector returns, respectively, in the decade to 2030. In contrast, cumulative returns in sustainably themed infrastructure and renewables, sectors were estimated to rise 42.3% and 105.9%, respectively (Mercer, 2019). Andres et al. (2024) calculated country risk of 'stranded assets' as a result of their ability to transition away from fossil-fuel-powered energy and redeploy production to a climate-compatible one. They found that although Australia ranked in the top 40 nations by the proportion of emissions-intensive exports, its transition outlook was optimistic with opportunities such as green hydrogen.

Liability climate risks

Liability risk occurs when stakeholders seek to penalise entities that do not meet their responsibilities or falsely claim to be doing so. Schmidt (2024) also explores “legal arbitrage” in an intriguing study on profits derived from legal action where hedge funds, debt, and insurance claim investors profited from the PG & E reorganisation case resulting from the 2018 Californian wildfires. They strategically aligned themselves with the wildfire victims who were paid in equity in PG & E. The financial outcome of the legal proceedings is relevant to the rising number of climate risk events that could occur and, especially as insurers refuse to cover the highest climate risks.

Novel nature of climate risk

Climate risks are different from other financially material risks and require novel analysis methods. Some recognised challenges to understanding them have been:

i. **Time horizon**: Climate risks can play out over decades, a horizon that is not typically captured in corporate risk analysis. For example, a macroeconomic analysis or an equity valuation would, at most, have a horizon of up to 10 years and 5 years, respectively (Carney, 2015).
ii. **Uncertain pathways**: Predicting climate risks is difficult because GHG emissions depend on government commitments and policy levers and the subsequent private sector response, none of which are certain in the short term, let alone in the extended horizon. Whilst the scientific community is unanimous on the increasingly detrimental hazards of climate change, there are a relatively wide range of scenarios that may eventuate (Inevitable Policy Response, 2023; IPCC, 2022). These uncertainties are complex for investors to interpret for investing decisions (KPMG, 2020).
iii. **Climate risks are complex.** From an environmental perspective, if a climate feedback loop were to be triggered, it could accelerate further warming, irrespective of GHG emissions. For example, large-scale permafrost thaw would have the dangerous flow-on effect of releasing immense amounts of carbon. Risk modelling rarely includes tipping points (Trust et al., 2023).
iv. **Systemic risk:** Financial systems are also interconnected, and a sudden transition to net zero could mean rapid changes across the economy, in pricing, in demand and valuations across sectors and regions. Physical risks also pose systemic threats; for example, sea level rise could lead to non-insurance and climate refugees. A disorderly transition would threaten financial system stability (Carney, 2016).
v. **Historical data cannot predict the future**: As the effects of climate change worsen, historic baselines are shifting. An example is PG & E which was one of the first cases of

climate change bankruptcy globally. Extreme weather events and Californian Wildfires had worsened in the years leading up to the chapter 11, but historic data was not enough for PG&E, or most institutional investors, to forecast the risk (Nature editorial, 2019). As the effects of climate change worsen, historic data will become increasingly inaccurate for future consideration.

vi. **Lack of comparable, consistent and reliable climate risk data**. Given that mandatory reporting has not yet encompassed all entities and regions, investors are frequently faced with gaps or poor-quality climate risk data for their decision-making (De Silva Lokuwaduge & De Silva, 2020).

Caldecott (2018) distinguishes between the established body of research on physical climate risk where scientists and geographers have observed and measured environmental change since the mid-1800s. Whereas, Caldecott comments that societal responses lagged well behind physical climate risk knowledge, and although the implications of climate risk for financial markets were acknowledged by the 1980s, they did not gain momentum until it was an economic imperative. Societal risk knowledge also faces a 'disciplinary gap' both from climate science and across the broad set of disciplines, including finance, that relate to it (Caldecott, 2018).

Bouchet et al. (2022) found that collaboration between the finance and climate disciplines is challenged by their differing perspectives and approaches to climate risk. They explain that risk is part of financial valuation. Risk is acceptable and can be priced; importantly, it must be quantified to a narrow range of probability and, therefore, is rarely considered beyond a ten-year time horizon. In contrast, climate science is focused on the scientific pursuit of understanding the physical world. Socio-economic risk is a recent addition to scientific knowledge, and in contrast to the finance discipline, the time frame for observations frequently spans thousands of years. Whilst both disciplines rely on mathematical modelling, their methods are vastly different (Bouchet et al., 2022). For example, climate scientists work in large teams on a single earth system model. Teams interact over various components using standardised peer review processes. By comparison, numerous risk models are used by a single fund management company, and they can be quickly adjusted without the need for a peer review consultation.

Bouchet et al. (2022) explain that climate science models are designed over many months and are intended to incorporate uncertainty. Bouchet et al. (2022) applied Boholm and Corvellec's (2011) relational theory of risk, which interpreted risk as a socially constructed perception of

an ‘object at risk’ and a ‘risk object’. Using this frame, they explained that the finance sector views markets as vulnerable and threatened by climate risk. In contrast, climate scientists see the financial system as somewhat culpable for climate risk. Even within the discipline of finance, social and sustainable research is frequently excluded from academic financial journals due to its incongruence with conventional financial ontology (Lagoarde-Segot, 2019). The term ‘transition risk’ used by the finance sector is solely a strategy to reduce risk from the perspective of climate science (Bouchet et al., 2022). They also point out that climate risk is just one of numerous issues that pose risks to the financial system, in contrast with the singular focus on planetary systems for climate science. Their research uncovered and crystallised the challenges for sustainable finance and transdisciplinary interaction in general.

The finance sector perspective on climate risk showed how the problem definition of climate risk differs according to disciplinary notions of risk. In the superannuation sector, transition and liability risk are understood in terms of devaluation, cost or arbitrage. Whereas the climate science discipline sees transition risk as a climate management strategy. Knowledge of distinct disciplinary concerns provides insights into the interpretation and ensuing implementation of net zero superannuation portfolios.

2.3.4. Climate Risk Modelling for Socio-Economic Purposes – A Climate Science Perspective

In the first instance, the finance sector relies on climate science inputs in its risk modelling. In that context, it is vital to consider the climate science perspective in climate risk models.

Climate risk modelling was initially used in meteorology to alert society to the risks of climate change (Van Beek et al., 2020). Later, climate risk modelling benefited from increasing technological sophistication and took the form of Integrated Assessment Models (IAMs), where large volumes of cross-disciplinary information are processed to explore climate futures. The IAMs demonstrated complex natural systems and their socioeconomic impacts to inform policy-making. They have been strongly intertwined with the agenda-setting work of the IPCC since its inception, including in relation to the reasoning of the adoption of a 1.5^{o} or 2^{o} target (Van Beek et al., 2020). Van Beek et al. (2020) note that the use of IAMs is rooted in the Western belief in quantitative rigour that proliferated from the nineteenth century. Objectivism does not acknowledge the role of the modeller in framing the scenarios, judging what to include and how to value it, especially in the contested issue of loss and damage in developing countries.

Representative Concentration Pathways (RCPs)

RCPS were designed to translate climate science knowledge time-efficiently for socioeconomic and policy decision-making. The IPCC also wanted to overcome the criticisms it faced in their modelling design selection by bringing different modelling communities to work together. The sharing of knowledge across different scientific disciplines was an evolution in climate risk modelling processes, as was the prediction of climate risks in decade-long increments, a timeframe that is significantly shorter than traditionally used in climate science (Moss et al., 2010; Pielke & Ritchie, 2021; Van Vuuren et al., 2011). The use of a limited number of RCPs was intentional in order to increase the speed of future analysis and also be able to devote resources to modelling subsequent climate change outcomes (Moss et al., 2010). Oddly, the IPCC selected one of four plausible future GHG emissions concentrations scenarios and time trajectories from each of the contributing modelling communities to represent a different radiative forcing level, RCP2.6, RCP4.5, RCP6.0 and RCP8.5, as shown shaded in the figure below (Pielke & Ritchie, 2021).

Table 1. IAM Modelling Community Contribution to RCPs Adapted from Pielke (2021)

		Modelling community			
		IMAGE	MiniCAM	AIM	MESSAGE
Level of radiative forcing	8.5	RCP8.5	RCP8.5	RCP8.5	RCP8.5
	6.0	RCP6.0	RCP6.0	RCP6.0	RCP6.0
	4.5	RCP4.5	RCP4.5	RCP4.5	RCP4.5
	2.6	RCP2.6	RCP2.6	RCP2.6	RCP2.6

RCP2.6 – is the most significant emissions reduction where rapid decarbonisation, including from developing countries, sees emissions peak at 440 parts per million (ppm) by 2040 and then reduce to 420 ppm by 2100. In RCP2.6, the projected global surface temperature increase by 2100 is 1.75^{o}C (IPCC, 2022). In an extension of the modelling to the year 2300, the radiative forcing reduces further to levels last recorded in the year 2000 (Van Vuuren et al., 2011).

RCP4.5 – emissions also peak in 2040, but CO2 increases to 540 ppm by 2100. In RCP4.5, the very likely projected global surface temperature increase by 2100 is 2.8^{o}C (IPCC, 2022).

RCP6.0 – sees some reduction but emission concentration reaches 660ppm by 2100 and stabilises from then. In RCP6.0, the very likely projected global surface temperature increase by 2100 is 3.85^{o}C (IPCC, 2022).

RCP8.5 – there is little change in emissions, resulting in 940 ppm by 2100. In RCP8.5, the very likely projected global surface temperature increase by 2100 is 4.7^{o}C (IPCC, 2022).

As at July 2024 NASA (2024) measured 426 ppm in the atmosphere. It should be noted that 2100 is within the expected lifespan of younger current superannuation members.

Shared Socio-economic Pathways (SSPs)

SSPs were developed from the RCPs to portray a series of uncertain but plausible socio-economic narratives describing human lifestyle and development, policies, technology and environment that could be underpinning them (O'Neill et al., 2014). SSP1 is Paris Agreement aligned (Meinshausen et al., 2024; Siabi et al., 2023), whereas SSP2 is reflective of current policies and trends (Meinshausen et al., 2024). Importantly, the SSPs are used in other climate risk models, for example, the SSPs are used alongside energy transition risk modelling by the International Energy Agency (2022) and are a crucial component of the IPCC reports. SSP2 was used to explore 90% of the climate assessments in IPCC (2022) (Meinshausen et al., 2024). As with the RCPs, a limited number of basic SSPs were developed to represent a broad set of outcomes, but can also be extended to incorporate more detailed variables (O'Neill et al., 2014). The outcomes are based on two key variables: low or high challenges to adaptation and low or high challenges to mitigation, with a further scenario, SSP2, that is moderate.

O'Neill et al. (2017) outlines these;

SSP1 Sustainability: Taking the green road – low challenges in mitigation and adaptation: This scenario assumes global collaboration for a just and rapid transition to a low-carbon economy. Population growth slows, resource efficiency improves, and consumption lowers. It will need to be accompanied by significant policy changes and slower economic growth in advanced economies to support equality, development and high economic growth in developing economies. Energy intensity is low.

SSP2 Middle of the Road – intermediate challenges in mitigation and adaptation: SSP2 does not change significantly from the historical patterns of the last century. International coordination is weak, and development and growth are unequal, with slow progress in achieving sustainable development goals in developing countries. Advanced economies gradually transition away from fossil fuels. Energy and resources use declines and emissions reduce moderately. Energy intensity lowers for developed countries but not developing nations.

SSP3 Regional Rivalry – high challenges in mitigation and adaptation: This scenario is characterised by a reversal of globalisation due to increased regional conflict, trade barriers particularly in energy and agriculture, and highly regulated economies. Income growth and technological change is slow. Immense inequality sees areas of extreme poverty, particularly in developing countries. Environmental impact of SSP3 is severe. Energy intensity is high.

SSP4 Inequality – low challenges for mitigation, high challenges for adaptation: SSP4 sees wage inequality not just between regions but within countries. The elite are powerful with high economic growth and sophisticated technological expertise to mitigate climate change. International coordination only includes wealthy, powerful groups. However, low-income economies continue to struggle with sanitation, water and health care. The inequality gap widens and poverty also affects lower-income populations in advanced economies. The drivers of inequality in this scenario are barriers to education and skill-based training. The vulnerable group has a low ability to adapt to climate change. Social cohesion is poor. Energy intensity lowers for elites but not the global population.

SSP5 Fossil-fuelled development – high challenges for mitigation, low challenges for adaptation: This scenario emphasises high economic growth and global socio-economic development with rapid progress in meeting the basic needs of the most vulnerable populations. Technology is an enabler of improved global coordination. Environmental investment is fragmented and limited to local contexts despite the global social agenda. This scenario is still reliant on carbon-intensive fuels, and coordinated global environmental outcomes are not prioritised. Energy demands are high, and as they grow, investment in geoengineering may be used as a fossil-fuelled technological solution to worsening environmental issues.

Modelling is, by design, a process that requires assumptions and simplifications, but Pielke and Ritchie condemn the decision to narrow the sixteen scenarios down to four for computing ease. They argue that they do not represent the range of plausible futures, were not adequately explored before they were established as a reference point for climate research, lack scientific integrity, and do not include a probability statement. A further issue they raise is the difference in modelling assumptions across each of the separate IAMs that makes the selection of an RCP from each methodologically incomparable (Pielke & Ritchie, 2021). They also criticised the SSPs, firstly because they are based on the methodologically flawed RCPs, secondly because the storylines were almost unchanged from the legacy ones created by IPCC in their Special Report on Emission Scenarios in the year 2000, more than 15 years earlier and

thirdly, that their design distanced them from the plausible IAM models on which they were based, therefore reducing their accuracy and currency (Pielke & Ritchie, 2021).

Some critics argue that the RCP and SSP scenarios are politicised (Pielke & Ritchie, 2021; Scafetta, 2024). They comment that RCP8.5 is unrealistically extreme, alarmist and widely but falsely used as a 'no policy change' baseline. Scafetta (2024) further claims that future climate change will be modest, that SSP2 will likely be sufficient to meet the 2-degree warming goal of the Paris Agreement and that costly, urgent and technologically-intensive decarbonisation is superfluous. Walker Wood et al. (2024) are also critical of reliance on technological growth-based climate solutions but on an opposing basis. They believe that the SSPs are too reliant on economic growth and should instead equitably reduce production, consumption and seek transformative economic models of well-being. Meinshausen et al. (2024) acknowledge that the RCPs and SSPs need to be updated to understand emissions overshoot and social equity better. Yet they emphasise the severe damage and cost implications of delayed action and inaction. They also comment on the immense distinction between the impacts of incrementally higher emissions peaks and, therefore, prompt immediate climate science and climate policy attention.

Meinshausen et al. (2024) present Representative Emissions Pathways (REPs) as an evolution from RCPs. They propose that these geophysical pathways also have accompanying and updated socioeconomic scenarios building on the SSPs. In addition to addressing some of the recognised limitations of the RCPs, the REPs would provide a more detailed understanding of the 1.5 – 2-degree pathways with three detailed REP variations in the range of SSP1. They also introduce the Delayed Action Peak and Decline (DAPD) REP that is partially Paris-Aligned in seeking a below 2-degree temperature goal but only achieves net zero by 2070-2080 and is heavily reliant on negative emissions technology. They comment that investigating plausible future pathways is critical to policy and investment decisions before the second Paris Agreement Global Stocktake in 2027. The expected dissolve of US climate commitment under Trump leadership further enhances the urgency of these decisions.

This part uncovered the essential climate modelling on which policy and industry models are typically based. Of note are the shared socio-economic pathways that provide narratives for a greater understanding of plausible futures. These are a valuable foundation for contemplating the varying interpretations and outcomes of net zero superannuation portfolios. It is also necessary to be aware of the challenges and criticisms of RCPs and SSPs, given the extent of policy and industry models that build on them.

2.3.5. Financial Climate Risk Modelling – A Finance Sector Perspective

The discussion in this part builds on the differing perspectives of climate science, policy-making and finance. It explores how these occur in the climate risk analysis processes used by the finance sector.

Modelling is used to understand portfolio exposure to climate-related financial risks for investment decision-making and financial stability analysis. Climate risk insights are also essential for informing global capital market risk-return expectations for superannuation funds at the strategic asset allocation level (SAA). Unlike most financial risk models that apply historical data, the unprecedented, non-linear and extreme risks of climate change require the use of forward-looking methods and climate science data (Bingler & Colesanti Senni, 2022). A common method is scenario analysis, where assumptions are made based on differing emissions pathways. Numerous differing reference scenarios have been created by leading international agencies such as IEA and NGFS (IEA, 2021; NGFS, 2023a). These mostly build on RCP and SSP models.

Financially material climate risk analysis

Given the surge of net zero commitments across the finance sector and commercial pressures, there is a high demand for streamlined climate risk modelling tools integrated with existing financial software tools. Bottom-up methods provide more detail and consider all aspects of a company's supply chain, but can also be fraught by data gaps (P. Smith, 2021). The financial bias of the climate data is a further concern discussed in 2.7.2. ALADDIN (Asset, Liability, Debt, Derivative Investment Network), owned by BlackRock, is an example of a mainstream risk management platform that introduced climate risk analytics in 2020 (Segal, 2020). The bottom-up tool relies on partnerships with both Sustainalytics and Refinitiv for sustainability data to flow into the ALADDIN interface (Finextra, 2020) and input into their climate scenario model (Business Wire, 2021). In 2024, ALADDIN Climate expanded to include climate information such as decarbonisation and temperature alignment for private equity, credit, and real assets (BlackRock, 2024). BlackRock (2022b) promote ALADDIN Climate as a tool to translate climate risk information into financial language with climate-adjusted financial valuation and risk metrics. It is typically used by asset owners and managers and incorporates both physical and transitional risk information. Country Head of BlackRock Iberia, Aitor Jauregui, noted that sustainability is a focus for most clients keen to improve their capabilities and seek streamlined climate risk analytics (Jauregui et al., 2022). Jauregui et al. (2022) also commented that ALADDIN's use is so widespread that it underpins the global finance sector.

BlackRock (2024) states that the information is based on climate science from IPCC and NGFS scenarios.

Top-down methods, such as Ortec Finance's Climate MAPS, use county-level emissions data and are also helpful for policy risk analysis and understanding physical risk (P. Smith, 2021). Battiston et al. (2017) created a top-down risk model to calculate pension fund exposure to climate-vulnerable equities. They found that although pension fund fossil-fuel exposures were low, on average, 45% of their equity portfolios were at risk of climate change impact. S & P Global Market Intelligence Climate Credit Analytics is a model that combines top-down and bottom-up methods. Bingler and Colesanti Senni (2022) investigated the sixteen most commonly used scenario analysis tools by institutional investors, including Ortec Finance, S & P Global Market Intelligence and Battiston and found that they are mostly built on the IEA scenario or one of a limited number of IAMs endorsed by the IPCC (Bingler & Colesanti Senni, 2022). In the tools they reviewed, Bingler and Colesanti Senni (2022) refer to a problematic lack of transparency and peer review in the model methodology and an inadequate acknowledgement of the uncertainty of outputs.

Another example of a climate model orientated to the finance sector is the One Earth Climate Model (OECM). It takes the SSP1 1.5^{o} low overshoot scenario as a starting point. Using a MATLAB-based energy system model with OECD data to show twelve finance-defined industry sectors GICS, the OECM sets energy targets to net zero by sector investors and policymakers to understand the remaining carbon budget and emissions reductions that will be needed to reach net zero by sector (Teske & Guerrero, 2022; Teske et al., 2024).

Financial stability analysis

NGFS (2023b) scenarios are commonly used by prudential regulators globally to understand climate-related financial stability risks. Their scenarios are based on the SSP2 variables and use inputs from a collection of models, ISIMIP and CLIMADA for physical risk, REMIND-MAgPIE, Message and GCAM for transition risk, and NiGEM for macroeconomic risks, to understand how physical, transition and macro-economic climate risks may occur (NGFS, 2023a). The model parameters are regularly updated with evolving climate science and global events, for example, the fourth iteration of the NGFS (2023b) scenarios note the effect of the war in Ukraine on energy prices and markets, and therefore, the 'orderly' NFGS scenario was adjusted to become more disorderly. Yet, some modelling assumptions may not eventuate; for example carbon dioxide removal is assumed to have removed 5 GtCO2 annually by 2050, although this technology currently remains limited (NGFS, 2023a). It is also noteworthy that NGFS have

selected the SSP2 assumptions for their model inputs. This could indicate a middle-of-the-road net zero intention by central banks.

In 2021- 2022, APRA conducted a scenario analysis of Australia's five large banks to assess their exposure to climate risks, the Climate Vulnerability Assessment (CVA). The assessment was designed to apply to other financial organisations including the superannuation sector and may be required in other finance sub-sectors in the future (APRA, 2021a). The information generated by the CVA also informed climate stress testing, which calculated the potential and size of risks to the financial system overall. The CVA selected two of six NGFS scenarios, **'Delayed Transition'**, which assumes no global emissions decrease until 2030 and 'Current Policy Scenario', which assumes emissions grow until 2080. The CVA findings showed significant data challenges with a noted need for improvements of localised physical data. The data the banks provided differed, with inputs ranging from seven to forty-three sectors. APRA (2022a) commented that the differences between bank results were most likely explained by the differing levels of data used and the banks' modelling capabilities. Most banks used external partners to uplift their modelling skills as the scenario analysis needed a multidisciplinary team with capabilities beyond traditional banking and finance roles (APRA, 2022a).

The CVA revealed immense divergence between residential lending losses across regions, with Queensland and Northern Territory expected to suffer the most physical risk in both scenarios, with the 20% worst affected postcodes experiencing 75% of all loss (APRA, 2022a). The modelling assumed lending reductions to those areas. The CVA also found heightened losses in mining, manufacturing, transport and wholesale trade, but most banks assumed that non-agricultural business counterparties could rely on insurance to mitigate climate-related financial impacts. Crucially, some banks questioned whether the insurers would respond to climate risk with under or non-insurance and/ or pricing changes. Caldecott et al. (2021) comment that unwillingness to insure vulnerable assets could worsen transition risk rather than prevent it. Most asset owners do not have access to information on the location, vulnerability, and exposure of each facility across their investment supply chains. This adds to the enormity of the portfolio data challenge and underestimation of systemic climate risk, also worsened by the poorly understood interactions and lags of climate impacts (Caldecott et al., 2021).

These findings reveal the challenge of modelling interconnected impacts that are needed to calculate the potential and size of risks to the financial system overall. As noted by Van Beek et

al. (2020) modellers must make judgements on reasonable regional and sector carbon budgets. Scenario analysis is a highly values-based technique that is reliant on assumptions. For example, in the CVA, Australian banks viewed insurers as the strategy for climate risk mitigation, implying a financial focus rather than an environmental one.

This section showed the methodological critique of financial climate risk modelling. Knowledge revealed that the scenario analysis tools do not fully capture system-wide risks because tipping points are absent, and there is a reliance on the insurance sector for financial risk mitigation, whereas they may refuse to insure. The other issues identified in the models are the financial emphasis in the climate data, insufficient physical risk information and the lack of transparency in method. The use of SSP2 inputs in the NGFS scenarios also has important implications for net zero interpretation by policymakers.

2.3.6. Need for Climate Finance

The enormity of financially material climate risk, the methodological challenges in its conceptualisation and deep politicisation were discussed in the previous sections. One of the most contested aspect of net zero relates to the climate finance needs of developing countries. This section expands on the broader meaning of reaching net zero globally by reviewing knowledge of climate finance.

Advanced economies have provided this capital to developing countries on the basis that;

i. Historically emissions have primarily been generated by advanced economies, who should now take responsibility for these (Anderson et al., 2017), and
ii. developing nations have little ability to generate the substantial investment funds required to mitigate and adapt to climate change (Anderson et al., 2017).

70% of all human-caused GHG emissions are the result of the fossil fuel industry and its products, which are about forty percent investor-owned and the remainder are state-owned (Griffin, 2017). Climate finance from advanced economies to developing countries has been provided on the basis that they should now take responsibility for their historic and current per capita carbon emissions (Anderson et al., 2017).

The transition away from emissions-intensive coal and wood energy, which is used by 1.4 billion people globally, to clean renewable energy sources is a key priority for carbon mitigation (Global Environmental Facility, 2021). Whilst the UN Framework Convention for Climate Change (UNFCCC) has called for finance and technology knowledge sharing to assist developing countries dates since 1994, continued disagreement over burden sharing has

lessened funding progress (Anderson et al., 2017). The need for climate finance was reiterated in subsequent agreements including 1997 COP3 in Kyoto and 2015 COP21in Paris (UNFCCC, 2022a). This excerpt from the Paris Agreement below shows that the concept of net zero incorporates principles of global responsibility.

"In order to achieve the long-term temperature goal set out in Article 2, Parties aim to reach global peaking of greenhouse gas emissions as soon as possible, recognizing that peaking will take longer for developing country Parties, and to undertake rapid reductions thereafter in accordance with best available science, so as to achieve a balance between anthropogenic emissions by sources and removals by sinks of greenhouse gases in the second half of this century, on the basis of equity, and in the context of sustainable development and efforts to eradicate poverty."(United Nations, 2015a)

Two financial mechanisms were formed to implement UNFCCC's multilateral environmental agreements:

Global Environment Facility (GEF) was formed in 1994, and over thirty years to June 2024 has contributed 25 billion USD in financing and 145 billion for climate resilience projects for 186 countries and partners (Global Environmental Facility, 2024).

Green Climate Fund (GCF) was formed in 2010 at COP16, it also calls for finance from private sources and the development of appropriate financial instruments (UNFCCC, 2022b). GCF must invest its funds equally into climate mitigation and climate adaptation projects (Green Climate Fund, 2021). GCF have approved 58.7 billion USD of financed and co-funded projects to July 2024, (Green Climate Fund, 2024).

GEF and GCF estimate that their combined funding makes up less than 5 percent of global climate finance (GCF Green Climate Fund & GEF Global Environment Facility, 2021). They note, though, that they could attract high levels of co-financing. For example, in April 2022, GCF began a 25:1 investment partnership with US Private equity Pegasus Capital Advisors in the Global Fund for Coral Reef (Green Climate Fund, 2021, 2022). Importantly, in the context of Australian Superannuation funds, GCF seeks capital that can be used for long-horizon investments.

Climate Finance is well below the 100 billion USD per year from 2020 pledged by developed countries (UNFCCC, 2019). Gabbatiss (2021) notes that the pledged 100 billion USD is also well below the climate finance needs of developing nations that would need a total of $5.8 trillion USD by 2030 to meet only half of their climate action plans. Global Environmental Facility

(2021) refer to private sector finance as “largely untapped” and note that investment conditions must suit sector standards and risk management requirements. Therefore, they aim to provide suitable information and standards to facilitate private-sector investment. COP29 saw the climate finance pledge from developed countries increase to 300 billion USD annually by 2035 with the aim to scale this sum to 1.3 trillion USD annually by attracting private finance (UNFCCC, 2024a). Unfortunately, the New Collective Quantified Goal pledge is not immediate and does not meet the climate finance needs of developing countries to reach net zero.

National governments require the cooperation of the finance sector to meet both developed and developing country emission reduction targets and climate transition commitments. The UNEP FI and PRI (2019) also note the sector's responsibility to do this. The G20 group similarly appeal to the finance sector to provide funding for climate transition in their sustainable finance roadmap (G20 SFWG Sustainable Finance Working Group, 2021). Annual finance needed for clean energy globally is estimated to be 4 Trillion USD by 2030 (Moarif et al., 2022). Bulkeley and Newell (2015, p. 139) emphasise the importance of public-private networks alongside public pressure. They note, “*It is hoped that enough powerful allies in the world of finance and business can be brought on board alongside enough governments with the will and power to lead on action on climate change, and be pressured, cajoled, and shamed into action by an increasingly active public and civil society, to adequately address perhaps the greatest collective action problem the world currently faces*.”

In their 2024 report, the IEA (2024) identified that industrial outputs in developed economies had fallen, especially in coal demand. Whereas by comparison, coal demand in EMDE had increased, as had GHG emissions. Despite these developments, CO_2 emissions per capita in advanced economies in 2023 remained 70% above the global per capita average (IEA, 2024). These findings are evidence of an unequal economic transition to lowered carbon (Fankhauser & Jotzo, 2018), disproportionate global emissions in developed nations compared to EMDE, transition risk due to changes in demand and regulation. Another relevant consideration supported by vast bodies of literature is the level of emissions in EMDE resulting from MNC offshoring that rarely apply the better sustainability practices of their home nation (Florini & Pauli, 2018; Lartey et al., 2021; Popowska & Ratkowska, 2018). Future carbon output will be a product of both economic growth and emissions intensity. Whilst the global population is stabilising, (Piketty, 2018), per capital output till 2100, is projected to grow at a rate of 1.2% per annum in the wealthiest nations such as Western Europe and North America, whilst emerging economies per capita output are expected to increase 4-5% until 2050 when growth converges globally.

There is consensus in the literature on the vast climate finance developing countries need to reach net zero. This part also showed the immense gap between financial needs and allocated capital.

The discussion on climate risk knowledge in section 2.3 affirmed the critical link between government, policy and climate action. The literature also revealed a history of political hostility and prioritisation of economic and fossil fuel interests over environmental concerns. These observations are especially relevant to Australia, where past government decisions have favoured the protection of heavy industry. Despite the proliferation of net zero commitments as a climate action strategy, the interpretation of net zero is nascent and still contested. The concept of net zero as a system-wide transformation for sustainability is supported in the literature, yet research also reveals the Government and the finance sector's emphasis on enterprise value in climate risk mitigation. The competing interests of the environment and economy were also evident in the knowledge of climate risk modelling from the perspective of the finance sector, compared to the climate science discipline. This section has shown the opposing attitudes to climate risk and the transdisciplinary challenges existing for net zero superannuation portfolios.

2.4. APRA-Regulated Superannuation Knowledge

Noting the acute government impact on climate action discussed in the previous section, the following part introduces the regulatory design of Australia's superannuation system. Specifically, this section identifies some contextual issues that impact progress towards net zero superannuation portfolios.

The purpose of superannuation

Mandatory superannuation was established in 1992 as a pillar of the Australian retirement system. It aimed to enable Australia's aging population to have higher living standards than with reliance only on the age pension and private savings (Australian Government, 2016b). However, the legislatively defined 'purpose' of superannuation has been an ongoing deliberation. Previously, the objective of superannuation was simply to 'supplement the age pension' (Australian Government, 2016b). However, in November 2024, the objective of superannuation was revised "to preserve savings to deliver income for a dignified retirement, alongside government support, in an equitable and sustainable way" (Commonwealth of Australia, 2024c; Parliament of Australia, 2023c). The use of the word 'sustainable' implies fiscally sustainable but still remained unclear despite the consultation paper and explanatory

memorandum guidance (Australian Government, 2023d; Commonwealth of Australia, 2023b). Submissions to the Objective of Superannuation bill referred to potential for confusion that superannuation may be required for ESG purposes or to finance a net zero economy (Financial Services Council, 2023; Provis, 2023; Warren & Bell, 2023). Key industry interest groups, including PRI (2023c) and RIAA (2023c), stressed the risks of climate change and urged regulators to clarify the meaning of sustainability within the objective of superannuation. Note that as at November 2023, eight of Australia's largest eleven APRA-regulated funds are both RIAA members and UN PRI signatories (PRI, 2023d; RIAA, 2023b).

APRA-regulated superannuation funds

The majority of superannuation assets, approximately 23 million member accounts, are held in APRA-regulated funds with an average member balance of about 170,000 AUD as at March 2024 (APRA, 2024c). The remaining quarter of the assets in the superannuation system are self-managed (SMSF) and reported to the Australian taxation office. SMSF included just over 1.1 million members (Australian Government, 2024j) with an average account balance of 1.5 million AUD (APRA, 2024b). SMSF are outside the scope of this research and hence-forth reference to superannuation funds should be read as APRA-regulated, intermediated funds.

Superannuation fund investment

Superannuation performance is driven by global and domestic financial market returns and bond yields (Yeoh, 2021). Almost 40% of superannuation assets are invested in Australian equity, fixed income and listed infrastructure, (APRA, 2024b) representing a high exposure to the domestic market and economy. The immense asset value of the superannuation sector and the domestic bias in portfolio holdings, owing partly to the tax benefit of dividend imputation, means that large trustees hold a significant stake in most ASX300 companies. The influence of the superannuation sector, as owners, of Australian companies is considerable. The large size of funds under management has made it difficult for the largest funds to find sufficient domestic investment opportunities, resulting in increased international investment. The breadth and diversity of their ownership across Australian markets makes the superannuation sector a 'universal owner', meaning that they have a long-term interest in the entire market (Monks & Minow, 2011).

Often termed, 'patient capital', the superannuation sector is also an essential source of funding for national infrastructure projects and other long horizon investments such as energy generation, public transport and hospitals (ASFA, 2020). As at September 2023 $87.37 billion AUD of superannuation funds were invested in unlisted Australian infrastructure (APRA,

2024c). Superannuation funds then, are a critical player within Australian markets and infrastructure financing.

A brief overview of superannuation system issues

Existing superannuation knowledge critiques the adequacy of funds to support living standards in retirement (Evans & Razeed, 2020; Ganegoda & Evans, 2017; Heng et al., 2015; Kingston & Thorp, 2019; Samarkovski et al., 2017). The issue of superannuation system equality is prominent in the literature especially in relation to women (Sheen, 2017, {Best, 2021 #7824), Indigenous Australians (Bianchi et al., 2016), and equity for future generations (Kingston & Thorp, 2019, {Australian Government, 2020 #6063). These issues relate to the design of the superannuation system. The system design favours those with higher incomes who have participated for longer in the labour force and disadvantages those who have had a break in employment (Australian Government, 2020). Superannuation is typically taxed at the relatively low rate of 15% in accumulation phase, and tax-free in pension phase, to a cap of $1.6 million as at March 2022 (Australian Government, 2020) the tax concessions also incentivise voluntary contributions. However, the ability to forgo income for future savings is reliant on an individuals' employment and lifestyle circumstances. Pickette (2021) explains that despite superannuation's origin for protection of the working class, the system design has perversely added to inequality. In addition to workforce participation, life expectancy, wages, and cost of living, the Australian retirement system is strongly affected by domestic economic factors including the inflation rate, and government decisions on the rate of compulsory superannuation and tax concessions.

The Australian Government recognised problems within the Superannuation system in its 2020 Retirement Income Review (Australian Government, 2020), Misconduct in the Banking, Superannuation and Financial Services Industry Report (Commonwealth of Australia, 2019) and Superannuation: Assessing Efficiency and Competitiveness Report (Australian Government Productivity Commission, 2018). The Misconduct in the Banking, Superannuation and Financial Services Industry Report (Commonwealth of Australia, 2019) found structural issues with conflicted remuneration and lack of independent advice. It also identified unfair fees to members and inappropriate sale of products. The Australian Government Productivity Commission (2018) report found large variations between fund performance and fees. The Your Future, Your Super (YFYS) Act was implemented to increase public awareness and encourage fund answerability to the $270 billion AUD in persistently underperforming funds (APRA, 2022c). In YFYS, annual fund returns are tested against a benchmark and the results are

published, with members of failing products also notified. If a fund fails over two consecutive years, new members will not be allowed until they pass a future test (APRA, 2022c).

Competitive pressure to reduce expenses and lower fees has resulted in increased concentration in the industry. The three largest funds, Australian Super, Australian Retirement Trust and Aware Super, comprise about 30% of all funds under management. As at March 2024, they manage 335 billion AUD, 286 billion AUD and 175 billion AUD assets, respectively (APRA, 2024a). Larger funds benefit from economies of scale both in terms of operational expenses but also in terms of investment opportunities. Their scale has also been advantageous in the context of increased international asset allocation. Larger superannuation funds have started to integrate their processes vertically and are less reliant on outsourcing fund management to external asset managers. It is expected that further mergers will take place in the next five years (Yeoh, 2021).

Superannuation fund members

As at March 2024 there were just over 22 million member accounts across 93 APRA-regulated funds (with more than six members) (APRA, 2024a) representing a high proportion of the Australian population. Despite the importance of superannuation for post-employment quality of life, two-thirds of members make no active superannuation selection and are consequently allocated to their employer's default fund (Australian Government Productivity Commission, 2018; The Australian Government, 2015). The lowest level of engagement is with members who are young and/ or have low balances (Australian Government, 2018; Cole, 2021; The Australian Government, 2015). Simplified MySuper products were developed to enforce additional responsibilities on trustees in recognition of the risks that could arise from member inattention (Australian Government Productivity Commission, 2018; Commonwealth of Australia, 2019; The Australian Government, 2015). Disengagement has been explained by low levels of financial literacy across the population, as well as the long time frames until early career members retire (Australian Government, 2020). Member disengagement is a circumstance that enabled funds to charge high fees and underperformance, resulting in a call for APRA and ASIC to become "member champions" and also boost fund competition (Australian Government, 2018, pp. 157, 179, 483, 516). Another symptom of members' disengagement is the issue that some 4 million members, about a quarter of all members, are inefficiently holding multiple accounts, with some accounts even becoming lost or unclaimed (Australian Government, 2022). In 2021, this issue was addressed with YFYS stapling rules connecting members to their superannuation accounts in their transitions between

workplaces where no selection has been made (APRA, 2022c). The unintended consequence of this policy is a disproportionate inflow of funds to retail and hospitality industry funds that typically offer employment opportunities to new workforce entrants (KPMG, 2024).

The YFYS performance test is intended to alert members to underperforming funds and encourage them to move their funds elsewhere. According to Australian Government The Treasury (2022) as at 31 January 2022, just 10% of member accounts in failing funds had been closed after being advised of their fund's underperformance. This is evidence of a lack of member engagement (J. Smith, 2021). In 2022, 4 funds with 559,000 member accounts and $24.6 billion AUD under management failed the performance test for the second time (APRA, 2022c). Of the thirteen funds that failed the first YFYS performance test in 2021, ten have merged or closed, and the remainder are under increased APRA supervision (Australian Government The Treasury, 2022).

Climate choice funds

Through member engagement, superannuation funds aim to understand their members' expectations and priorities. Most have had a low uptake of members selecting climate choice funds where they were available. Investigation into member engagement and fund selection is outside the scope of this paper; however, this topic in relation to climate-related products is an area that would benefit from future research. Member disengagement has likely reduced the pool of members who would consider selecting a climate choice fund. Another area of research that is not included in this thesis but is another interesting area for further research is member education to support net zero superannuation portfolios. The Productivity Commission's Inquiry into superannuation noted that an independent body on behalf of members is lacking in the system (Australian Government, 2018, p. 245), *"The system also lacks a dedicated 'member voice' — an independent body to undertake authoritative data analytics, advocate on behalf of members in policy and regulatory considerations, and to assist members to navigate the system. This is well overdue and the Government should fund such a body as a priority."* An independent body could be useful to increase member engagement. There would also be the opportunity for the body to raise awareness of the relationship between net zero actions and superannuation portfolios.

The existing research on APRA-regulated superannuation funds observes their national importance, government sponsorship, regulated design and long-term mandate. There is also evidence of their growing size, concentration and privileged position at the top of the investment hierarchy. The literature has broad agreement on superannuation system

inequality and retirement savings inadequacy. Knowledge of underperformance by some funds triggered a regulatory response and has added competitive pressure. A further topic in superannuation research has been a lack of engagement by members, especially younger people or those with smaller balances. Disengagement of members is likely to have unintentionally obstructed net zero superannuation portfolios, however scholarly research on this issue is needed. There is also limited literature connecting national climate commitments with superannuation as a source of capital, however both latter topics are recognised in government documents and submissions and are important areas for further research.

2.5. Exploring Net Zero Responsibility

This section investigates the responsibility of superannuation funds to set and achieve a net zero commitment within the boundary of their fiduciary duty and in compliance with regulation. The discussion also introduces the distinctions between ESG and SR Investment and financial and impact materiality.

2.5.1. Fiduciary Duty

Understanding the regulatory definition of fiduciary duty is central to exploring the climate-related obligations of a superannuation fund. This discussion synthesises knowledge on government and legal perspectives relating to climate risk and net zero commitments.

Relevance of Knowledge on Fiduciary Duty

A fiduciary refers to someone who has been entrusted with the responsibility and legal authority to meet the reasonable expectations and make decisions in the best interests and for the benefit of others (Australian Institute of Company Directors, 2020; Commonwealth of Australia, 1993; Tsuji, 2021). The application of fiduciary duty requires judgment and differs according to the context of that duty. For example, the duty of governments to the public, the duty of company directors to shareholders, and the duty of superannuation trustees to members.

Company directors and superannuation trustees were conventionally expected to maximise profits and act solely in the best financial interests of beneficiaries. As the urgency and magnitude of financial risk posed by the climate crisis have been recognised, it must now incorporated into decision-making (UNEP FI & PRI, 2019). Determining the scope of fiduciary duty in relation to net zero goals is unresolved but essential to the transition's progress.

Regulatory Statements and Legal Interpretations of Fiduciary Duty

In 2005 Freshfields Bruckhaus Deringer Lawyers provided the opinion that fiduciaries have a legal duty to consider ESG in investment (UNEP FI, 2005). Their progressive report commented on the power of the international law discipline in generating significant change throughout history and startled the finance sector globally. Their opinion challenged the dominant shareholder primacy view that the sole purpose of corporate finance is to maximise profits for owners and that consideration of other social responsibilities is seditious (UNEP FI, 2005). Secondly, it clarified that the 1985 English civil law case against a pension trust, Cowan v Scargill, was misunderstood, and myopic profit-maximisation by fiduciaries had not been supported. The legal opinion also asserted that pension funds should consider a longer horizon perspective, including long-term environmental risks {UNEP FI, 2005 #6009}.

The UNEP FI (2005) legal opinion was predated by a report by industry interest group, CERES whose 'Value at risk' report in 2002 was "*one of the first to make explicit the direct link among climate change, fiduciary responsibility, and shareholder value… environmental issues does indeed affect their competitiveness, profitability, and share price performance*"*(CERES Sustainable Governance Project Report & Inc., 2002)*. Interest groups have played an important role in advocating that it is a fiduciary duty to consider financially material climate risk for over two decades.

Trustees or corporations must hold a Registrable Superannuation Entity (RSE) licence and comply with prudential standards to operate an APRA-regulated Superannuation entity (APRA, 2017). APRA followed behind other global regulators in issuing climate risk guidance with APRA Prudential Practice Guide on Climate Change Financial Risks CPG22 issued in November 2021 (APRA, 2021b). In CPG229, APRA (2021b) emphasised the need for and outlined processes that are expected to be undertaken by trustees for the prudent consideration of financial risks and opportunities due to climate change. CPG229 is non-enforceable and rests on already existing prudential standards. It does not assure a rapid and consistent response to climate risk. While the guidance comments on the interconnectedness of the financial sector and the financial stability risks that could arise from the systematic nature of climate risk, it is enterprise-orientated. Further, CPG229 explains that investment opportunities will occur due to climate change, but the guidance does not connect climate risk mitigation to climate adaptation or state any investment fiduciary duty in relation to this.

Climate risks are incorporated within regulation in the context described below:

- **SPS 220 Risk Management:** requires the entity to have sufficient processes in place to manage material risks – this standard includes climate risks.

- **SPS 231 Outsourcing:** Given the wide use of outsourcing to external fund managers, the RSE licence includes the requirement that trustees do sufficient due diligence to ensure that a mandate will not add undue investment risk. Outsourcing adds a layer of complexity to decision-making and compliance. In the context of carbon risk mitigation, unless the issue has been explicitly stated in an investment mandate, decision-making will rely on the sub-manager's discretion which could expose the fund to unintended carbon risk. Australian legal opinion cautions trustees to ensure they are not overly reliant on the managers they outsource investment mandates to and to enforce necessary guarantees (Read et al., 2021).
- **SPS 510 Governance:** This standard requires the board to have the sufficient skill needed for judgement. Climate risk evaluation requires the board to have adequate knowledge or receive expert advice for decision-making.
- **SPS 530 Investment Governance:** Licensees must demonstrate systems incorporating stress testing and risk evaluation within investment selection processes. APRA (2023a, 2023b) updated their Prudential Standard and Guidance on Investment Governance SPS530 to create a formal link to CPG229 and regulate the need for board-approved risk analysis, stress testing and asset valuation that considers financially material climate risk.
- Regulatory action has also been taken by ASIC in greenwashing guidance and surveillance (ASIC, 2022a, 2023b).

In their response to draft CPG229 feedback, APRA (2021e) replied to concerns over the prioritisation of climate change financial risks over the YFYS performance test. APRA reaffirmed that climate change risks are material and should be considered like other investment risks to meet members' best financial interests. Yet, climate change risks differ from other financial risks, and the ability of superannuation to manage superannuation portfolio carbon risk requires transformative change to net zero.

The YFYS performance test has instead had a negative impact on climate risk. ASFI (2024a) articulates this issue on behalf of its membership, stating, "*The test is significantly constraining the ability of super funds to adopt green or sustainable finance investment strategies at scale…and inhibits appropriate management of systemic climate and other sustainability risks."*

Even though CPG229 supports climate-aware investment with a fiduciary's duties, its application alongside Australian legislation has been challenging for trustees. In particular, best financial interests duty (BFID) that were introduced within the 2021 Your Future Your Super

Act when the word 'financial' (shown *underlined)* was added to the Superannuation industry Supervision Act.

"*52 2. (c) to perform the trustee's duties and exercise the trustee's powers* ***in the best financial interests of the beneficiaries****;"* SIS Act (Commonwealth of Australia, 1993, 2021b)

The YFYS legislation also reversed and placed the responsibility on trustees to provide evidence that all actions were consistent with financial best interests. This added pressure to demonstrate short-term outperformance. Additionally, the updated SPS530 references the best financial interests duty (APRA, 2023b, p. 1) and requires demonstration of how investment decisions and stewardship activities provide value creation to beneficiaries (APRA, 2023a). Findings from Treasury discussions with 100 stakeholders and 66 submissions noted that climate actions were hard to apply BFID (Australian Government, 2023f). The literature also found that the interpretation of 'best interests' has made fiduciaries hesitant to make climate-aware decisions unless the profit incentive is clear (Pryor et al., 2021; Sigel, 2021).

In that context, the timeframe for considering 'best interests' is key. In CPG229 APRA (2021b) refer to the distinguishing and "unprecedented" features of climate risk, including "extended and uncertain horizons" and advising entities to consider both short-term climate risks as well as longer-term risk scenarios "extending to 2050 or beyond" (APRA, 2021b, p. 17). Prior to the BFID, the Productivity Commission Report on the superannuation system (Australian Government, 2016a, p. 63) recommended that best interests must "*encourage long-term investing*" and allocative efficiency would "*maximise members' wellbeing to the greatest extent possible*." In the UK, The House of Commons Environment Audit Committee (2018, p. 10) noted that *"the 'fiduciary duty' of pension scheme trustees is misinterpreted as a duty to maximise short-term returns."* They reasoned that the long-term risk of climate change must be accounted for, given the extended investment horizons of pension beneficiaries. UK Pension Trustees had hesitated on climate-aware investment because they had been consistently warned against any stance that could affect member returns. Yet recent risk modelling for a balanced scheme showed that in all scenarios by 2040, climate risks eroded retirement funding. The actuaries modelling this data emphasised that their approach was conservative. As discussed in 2.3.4 they also acknowledged that the models do not include all the risks that are connected to climate change (Pryor et al., 2021). These questions are further explored in section 2.5.2.

Stewart (2020) argued that pension funds may minimise their exposure to carbon risk but that this is insufficient for meeting their fiduciary duty, and instead, pension funds must also invest in the climate solutions needed to facilitate a low-carbon transition. Stewart (2020) referred to Canada's Expert Panel on Sustainable Finance, which concluded that its ten largest pension funds must be directed to meet national low carbon goals. Their recommendations included 'comply or explain' carbon disclosure regulation and advice to pension funds that their fiduciary duty is to "*meaningfully contribute*" to Canada's low-carbon transition. Stewart (2020) reviewed publicly available 2018-19 data to find the extent of pension fund investment in projects such as renewable energy infrastructure, green bonds etc. Across the eight funds that disclosed any low-carbon investment information, adaptation finance made up only 3.7% of pension fund investment in climate solutions (Stewart, 2020).

UN PRI believes that the finance sector has a fiduciary duty to invest in climate solutions and engaged Freshfields Bruckhaus Deringer (2021) to provide a legal opinion on the extent to which institutional investors should and can 'invest for social impact'. They refer to the paradox where damage to socio-environmental systems from economic activity has become a risk to the economy itself. The dilemma can be likened to the 1804 Lauderdale paradox and other ecologic economic theories analysed by Hupfel and Missemer (2023) that argue an opposing relationship between public and private wealth. Freshfields Bruckhaus Deringer (2021, p. 164), found that legislation has been designed to ensure that financial goals must be prioritised for most fiduciaries but there was variance across jurisdictions and investor classifications, especially where climate-related risks were most material. They noted that regulation for APRA-regulated funds "*restricts their capacity to design and offer investment options that have objectives other than financial return*."

Regulatory Lag in Clarifying Fiduciary Duty has also Provoked Climate Litigation

Common law systems, as followed in Australia, are based on the interpretation of previous court decisions. In that context, legal opinion is highly valued as a precursor to future rulings. Climate change litigation in Australia has been rising and is further fuelled by advances in climate science and expectations of business (Peel et al., 2017). Three strong themes in cases against the finance sector have occurred globally; corporate liability resulting in payable damages, insufficient or false climate risk disclosure, and financial risk and fiduciary duty (Setzer & Higham, 2021). In 2016, Senior Counsel Noel Hutley and Sebastian Hartford-David issued a legal opinion to say that company directors who failed to consider climate change risks could be liable for breaching their duty of care in the future (Hutley & Hartford-Davis,

2016). There is a danger of litigation where stakeholders feel company directors are overlooking their fiduciary duty by providing insufficient consideration and inaccurate or incomplete risk disclosure. Dishonesty, reckless judgement and improper director behaviour are criminal offences, and other failures of duty can be brought as civil action against directors. According to Barker et al. (2016), directors of institutional investment trusts are subject to the greatest level of fiduciary duty in all corporations and securities laws. Under the Superannuation Industry Supervisory Act (SIS), 'business judgment' does not cover directors of superannuation trustees (Barker et al., 2016).

An example of trustee director failure of duty in insufficient climate risk consideration was Mark McVeigh v REST Superannuation. McVeigh, who will not be eligible for retirement income before 2055, alleged that the fund's trustee failed to act in his best interests by not properly considering climate change risks in their fund investments. That fiduciary duty case was settled in favour of McVeigh in November 2020, and it set a precedent for the fiduciary duty of pension funds globally (Equity Generation Lawyers, 2020). Under the SIS Act, REST's investment committee should have provided climate change information to REST's Board of Directors. Additionally, it should have disclosed its climate risk. The Federal Court ordered REST to amend and provide evidence of their revised Climate Change, Sustainability and Stress Test policies, TCFD and PRI consideration, and Risk management strategy.

By 2019 Hutley and Hartford Davis issued a supplementary opinion noting the "profound and accelerating shift in the way that Australian regulators, firms and the public perceive climate risk" indicating an increasing exposure of individual directors to liability for failure to consider climate change risks (Hutley & Hartford-Davis, 2019). Their view at that time also commented on the RBA, ASIC, APRA as well as the ASX Corporate Governance Council endorsement of TCFD recommendations. By 2021, Hutley and Hartford Davis issued a revised opinion. They noted further pressure for climate action and a view that climate risk consideration and disclosure were no longer sufficient (Hutley & Hartford-Davis, 2021). The Australian legal expectation, they said, was now for companies to take positive steps to manage climate risks by developing a well-documented net zero strategy, and where targets are announced, they needed to be backed with the genuine intention to deliver them. Their opinion warned companies that there was an acute litigation risk if their net zero commitments were found to be misleading. Their opinion is highly relevant to this thesis and could expose superannuation funds without a net zero goal to litigation risk.

Sigel (2021) explained that directors also feared liability if their products were seen to fall below their commitments, so they had been reluctant to make forward-looking statements on ESG issues in operating and financial reviews and integrated reports. They recommended review processes to weigh up whether a statement was well-intended but inadvertently fell below the target with deliberately false sustainability claims. An example of a false environmental statement case was Australasian Centre for Corporate Responsibility action against Oil and Gas company, Santos. Australasian Centre for Corporate Responsibility (2021) argued that 80% of Santos' net zero plan was based on Carbon Capture and Storage (CCS) technology. Yet, CCS technology is undependable due to its high cost, leak risk and unproven track record (Australasian Centre for Corporate Responsibility, 2021). The case set new guidance on director obligations and expectations (Wooton, 2021).

Under the Australian 2001 Corporations Act, statements found to be misleading or deceptive could become personal legal liabilities to company directors. Australia has experienced a rise in shareholder class actions but, unlike the US and UK, did not introduce 'safe harbour reforms' or other provisions to protect directors making forward-looking statements, instead warning directors in 2013 against 'misleading statements' (Huggins et al., 2015). ASIC later clarified this in RG247, which noted the financial materiality of climate risks and suggested directors consider its disclosure. The revision also sought to reassure directors that the 'unreasonable prejudice' or 'misleading information' in forward-looking statements should not be a concern that prevented climate risk disclosure (ASIC, 2019).

Submissions to the Australian Government climate-related financial disclosure standards consultation also raised concerns over the risk of litigation which respondents wanted safe harbours or other increased protection (Business Council of Australia, 2023; Unisuper, 2023a). They were particularly worried about risks arising from unreliable scope 3 emissions information and forward-looking statements. On the other hand, key industry interest groups RIAA, IGCC, and ACSI sought a legal opinion from Hartford-Davis and Dyon, who stated that a safe harbour is "*not necessary or desirable*" (IGCC, 2023c). Modified liability will apply to forward-looking statements for one year and scope 3 emissions, scenario analysis and transition plans for three years following the introduction of mandatory climate-related financial disclosure that is being phased in from January 2025 (ASIC, 2024).

There is now regulatory and legal consensus on the fiduciary duty to address financially material climate risk. Legal opinion extends this duty to the expectation that companies should set and implement net zero goals. Those entities without net zero commitments may be

exposed to liability risk. Knowledge on the scope of fiduciary duty within a net zero goal and the timeframe for interpretation of BFID remains unclear for net zero superannuation portfolios.

2.5.2. ESG and Financial Materiality Versus SRI and Impact Materiality

The following discussion notes the contested scope of net zero fiduciary duty and seeks to explore differing views on materiality. Knowledge on financial materiality in ESG investment versus impact materiality in socially responsible investment (SRI) is considered.

The terms SRI and ESG investment are sometimes used interchangeably; while both may incorporate sustainability consideration, they are distinct, especially in their orientation on materiality (Eccles et al., 2019; Martini, 2021; Strakodonskaya, 2021). Socially responsible investment (SRI) is values-focused, where investors seek to generate social improvement (or avoid social harm) by aligning their ethical beliefs and investment portfolios. Values-focused investment encompasses broad-ranging concerns from environmental sustainability to gambling exclusion to gender equality (Martini, 2021). Materiality is an assessment of the relevance of an issue. SRI uses impact materiality, which is defined by the impact that firms have on communities, employees, and the environment. ESG applies financial materiality, where environmental, social, and governance issues that pose a risk to expected returns must be considered. In contrast, topics that are judged to have no impact on returns can be ignored.

Determining materiality is divisive and deeply intertwined with an actor's beliefs in the relevance of an issue. SRI is rooted in interpretivism, where qualitative analysis is the main mode of inquiry to understand the perspective of different actors. The financial materiality basis of ESG investment is impartial and positioned within the more familiar risk-reward paradigms of the finance discipline (Eccles, 2016; Lagoarde-Segot, 2015). Views of materiality in traditional accounting only deemed information relevant *"if it is material in financial terms"* (Global Reporting Initiative, 1999). Australian economists Hoggett and Nahan (2002) strongly opposed SRI, arguing that "*trustees are legally bound to act in the interests of their beneficiaries, not for social, non-financial causes.*" The belief in exclusively serving financial interests originated from shareholder primacy arguments, such as Milton Friedman's 1962 view that the sole purpose of corporate finance is to maximise profits for owners and consideration of other social responsibilities is seditious (UNEP FI, 2005). Deviating from a 'best financial interests' rationale was seen as a potential litigation risk for company directors and superannuation trustees (Sigel, 2021).

The UNEP FI (2005) coined the phrase ESG in 2005. Their report at the time outlined the arguments of impact materiality, financial materiality and dynamic materiality, although that terminology was introduced later by the Sustainable Accounting Standards Board (2022). According to the FASB and SEC definition, materiality was based on the perception of a 'reasonable investor' so that disclosure was only required if the information was likely to be economically important (SASB, 2018). A financial emphasis on materiality was similarly adopted in the ISSB Climate-Related Disclosure Standard, where entities are asked to judge whether the climate-risk information is material to the enterprise value before deciding whether to report it (International Sustainability Standards Board, 2022). Cort and Esty (2020) argue that impact and financial materiality perspectives are hard to reconcile as ESG relies on risk metrics that can be input into valuation data, whilst SRI requires data on investment impact, for example, reduced emissions or improved labour conditions that are often hard to isolate from other 'attribution and multiplier' factors that may have contributed to the investment outcomes.

The Sustainability Accounting Standards Board (SASB) attracted support for ESG from the finance sector by emphasising its financial materiality to market participants (Hall & Whieldon, 2022a) and arguably setting the foundation for mandatory climate-related reporting. Investors responded actively to a financially material focus that manages ESG risks to protect financial returns (Hall & Whieldon, 2022a; Young-Ferris & Roberts, 2023). ESG's appeal to the mainstream finance sector was strategic, "*its architects deliberately eschewed traditional moral or ethical arguments, and instead relied upon a purely economic rationale for ESG incorporation*" (Young-Ferris & Roberts, 2023, p. 718). Senior Adviser GFANZ and TCFD Secretariat Member, Curtis Ravanel stated, "*a focus on financial materiality becomes really important and frankly, depoliticises a very politicised issue. Sustainability, for better or worse, is a very political issue for some folks, and we found that market participants all care about financially material information* (Hall & Whieldon, 2022a, p. [Audio time] 5:02).

Amel-Zadeh and Serafeim's (2018) global survey of professionals at investment organisations found "investment performance, client demand and product strategy" to be the key driver for sustainable investment. "*Overall, the evidence in our sample suggests that the use of ESG information is driven primarily by financial rather than ethical motives but that motives vary considerably by geographical area*" (Amel-Zadeh & Serafeim, 2018, p. 92). The appeal of ESG is well articulated by (Hardyment, 2024, p. 96) who comments, "*The idea that ESG enhances shareholder value was instrumental to its ascendancy*". The idea traces back to the 'Value at risk' report by CERES' (Centre for Education and Research in Environmental Strategies) (2002)

that was "*one of the first to make explicit the direct link among climate change, fiduciary responsibility, and shareholder value. The evidence is increasingly compelling: companies' performance on environmental issues does indeed affect their competitiveness, profitability, and share price performance*"(CERES Sustainable Governance Project Report & Inc., 2002, p. i).

Critics of ESG reason that its profit motivation prevents it from properly serving sustainability and system change (Adams, 2017a; Bhattacharya & Zaman, 2023; Cho, 2020; Damodaran, 2020; Hardyment, 2024; Sandberg, 2011). Arjaliès and Bansal (2018) argue that the financialisation of value systems in ESG is mismatched, where, "*financializing ESG criteria decontextualizes the societal and natural environment, so that the criteria no longer reflect the phenomena they were intended to represent*." (Arjaliès & Bansal, 2018, p. 695). Similar concerns have endured since at least the 1986 Villach conference when Clark stated that "*In real world messes of multiple actors and actions, no-one's needs will be served by single "bottom line" assessments that purport to speak for all people and all times*" (UNEP, 1986, p. 25). Yet, finance practitioners tend to be sceptical of SRI and indicate that its accomplishments can be easily manipulated (Diouf & Boiral, 2017).

Eccles et al. (2019) believe that SRI and ESG will converge as the finance sector is entering a new phase of sustainable investment, where ESG is insufficient and investors seek to solve the wicked problems such as climate change, with finance. Materiality is also dynamic, so the timeframe for consideration of materiality is paramount. The convergence of SRI and ESG happens when issues that initially impacted stakeholders (impact materiality) also become financially material (financial materiality)(CDP et al., 2020). World Economic Forum (2020) reinforced that view stating that materiality is dynamic and broader stakeholder concerns can rapidly become financially material, especially as technology has enabled stakeholder concerns to escalate quickly. European Commission (2023) referred to the inside-out perspective of materiality, where decisions made inside a firm can impact stakeholders outside it. Their report describes an outside-in perspective of materiality, as an ESG issue outside a firm affects its internal value. Importantly though, the European Commission (2021c) also argues that the two perspectives are interrelated in 'double materiality'.

Double Materiality is the theoretical point where financial materiality and impact materiality converge. Long-termism in governance, fiduciary duty and incentives is essential to climate outcomes (Caldecott, 2018). Yet, legal opinion reasons that materiality is conventionally assessed according to the same timeframe as the fund's investment horizon (Freshfields Bruckhaus Deringer, 2021). The SIS Act refers to a ten year investment horizon

(Commonwealth of Australia, 2023c). Solana (2020) systematically reviewed climate litigation in the financial sector and found that on the topic of fiduciary duty, arguments were centred on best short-term financial interests versus a longer-term perspective on the financial materiality of sustainability risks. The long-term position has received financial regulator support and adequate ESG consideration within investment decisions is widely required across jurisdictions (Solana, 2020).

The different focuses of SRI and ESG are similarly reflected in the ideas of shareholder primacy and stakeholder capitalism where opinions are also divided. The stakeholder capitalism view argues that traditional perspectives of business that focus exclusively on profit are no longer tolerable in the context of the growing environmental crisis that must be addressed (Business Roundtable, 2019; Cheffins, 2020; De Silva Lokuwaduge & De Silva, 2020; Ziolo et al., 2019). Bansal et al. (2024) criticises stakeholder capitalism for still centralising the business perspective in considering views of employers, suppliers, shareholders and customers, but not necessarily planetary emissions. Instead, Bansal et al. (2024) argue that the field of strategy could better address climate impact through a shift from firm competition to collaboration, from sovereign governance to polycentric cooperation to manage wicked problems such as climate change and that economic systems should be reimagined for ecosystem prosperity (Bansal et al., 2024). The latter proposal connects with the well-being economic frameworks discussed in 2.3.2.

This section critiqued the emphasis on financial materiality in regulatory sustainable finance documents and in international sustainability standards. The problem with financial materiality is that it limits information and therefore action. The literature indicates that as the impacts of climate change worsen, double materiality will eventuate. A materiality paradox is theoretically possible. If the shortened perspective of financial materiality overlooked the information needed to prevent catastrophic climate impacts then financial and impact materiality would converge and be entirely replaced by double materiality. The only way to avoid that is with the use of impact materiality.

There is substantial evidence in the literature that fiduciaries are responsible for protecting their beneficiaries' returns from the financial risks of climate change and these require a long term perspective. However, the timeframe and scope of their responsibility remains ambiguous. Regulation implies that the horizon for consideration should follow conventional financial risk analysis yet policymakers acknowledge the different and unprecedented nature

of climate risk. Critics of ESG and financial materiality question its ability to achieve urgently needed system transformation to avert the worst impacts of the climate crisis. Impact materiality offers the potential to scale capital flows to climate solutions but challenges the paradigms and conventions of the finance systems. Relying on the convergence of financial and impact materiality will be destructively slow. A convergence to double materiality indicates that action has been insufficient. Impact materiality seeks to identify socio-environmental damages inflicted by entity value chains in the first instance. Legal opinion stated the expectation of net zero commitment and implementation. It emphasised the risks of disingenuous net zero claims and confirmed that in some jurisdictions financial interests are prioritised by legislation. This section has shown that the interpretation of fiduciary duty and materiality are strongly contested and politicised.

2.6. Short-Termism in Industry Practices

This section discusses knowledge on short-termism within industry practices in order to understand how they act as a counter-force to net zero superannuation portfolios. Short-termism is the prioritisation of immediate outcomes without focus on the long-term impact of those decisions (Atherton et al., 2007). There is a body of literature revealing the many ways that short-termism is embedded into corporate and finance sector processes and practices, and obstructs long-run, value-creating sustainability goals (Carney, 2016; Diane-Laure et al., 2019; Louche et al., 2019). The following discussion explores the depth of short-termism entrenched in conventional finance sector processes such as reduced share holding periods, earnings pressure and short-term performance benchmarking.

2.6.1. Investor Short-Termism: Reduced Stock Holding

This section synthesises knowledge on the impact of shortened stock holding on net zero portfolios.

There is pressure on investors to outperform peers and generate the highest risk-adjusted returns over a short time horizon. Shortened stock-holding periods hinder sustainability goals (Dow et al., 2024; Louche et al., 2019). Whilst short-term investment can be beneficial for increased market liquidity and availability of capital, it can also diminish long-run performance as there is no incentive to support value-creating projects with lengthy payoffs (Dow et al., 2024; Louche et al., 2019; Warren, 2014). On the other hand, long-term investors are less likely to manipulate earnings for short-term gain and have an interest in management decisions, especially when the investor has large holdings or when the company is small (Jang & Lee, 2022). Warren (2014) explains that the propensity to hold an investment over a long horizon

requires an investment strategy that is orientated towards long-term outcomes and supported by favourable capital market structures and lengthened remuneration practices.

The most commonly used measure of the timeframe over which assets are held, and also an indicator of short-termism, is portfolio turnover ratio (PTR). It shows the proportion of assets bought or sold annually in relation to the value of the portfolio. As PTRs were designed to calculate transaction costs Tucker (2018) recommended combining PTR with duration, churn rate and modified turnover metrics as a proxy for stock holding time horizons. Tucker found that on average US mutual funds between 2005-2015 had a 79% annual turnover. By comparison, the annual turnover was only 26% in 1945 and 45% in 1975 (Tucker, 2018). Those findings are consistent with other studies that found higher portfolio churn rates in the last two decades (Jang & Lee, 2022) but notably longer average holding periods less recently, for example, 7.5 years in 1963 compared to 5.5 months in 2020 (Chatterjee & Adinarayan, 2020). The literature remains ambiguous on a definition of a holding period that implies short or long-term investment. Some refer to a PTR below 35% as long-term but Garel et al. (2022) contests the different methods of classifying investors as short or long-term investors, arguing that a specific cut-off needs to be contextualised according to their investment type.

Research also showed that the level of institutional investor ownership is not correlated with churn rate, as that remained relatively stable whilst institutional investor ownership in US Stocks grew from about 10% in 1998 to 60% in 2014 (Jang & Lee, 2022). Active investment and especially value strategies have lower PTR, where stock selections often take years to pay off (Cremers & Sepe, 2018; Garel, 2017). Whilst investors trading on market mispricing and momentum, arbitrage on short-term trends and have high PTR (Badrinath & Wahal, 2002; Zeng, 2016). There is also evidence that sentiment and speculation are stronger predictors of market pricing in the short-term, than company fundamentals or macroeconomic conditions (Baker et al., 2015; Fong, 2015). When investors trade frequently to profit from market movement, their attention is diverted from the stewardship of the underlying company (Mercer LLC, 2017) which diminishes net zero influence.

An extreme form of short-termism is algorithmic and high-frequency trading (HFT). This nanosecond-paced strategy does not focus on the fundamentals on which the business is composed. The concentrated and disconnected ownership of HFT is a challenge to sustainability in finance (Diane-Laure et al., 2019; Lagoarde-Segot, 2017). The sophisticated HFT automation process incorporates social media, alongside other information, to signal rapid trades that aim to profit from market movement (Ma & McGroarty, 2017). Sewchurran et al.

(2019) explain that instant news can cause stock volatility, which also increases risk and raises the cost of capital. This can prevent managers from making long-term, value-creating decisions if they could jeopardise short-term returns and result in costly headlines.

Higher cost of capital also harms the ability of companies to fund sustainability projects. HFT is not typically used in core superannuation portfolio allocations, but the rise of technology has enabled it to become a dominant investment strategy so that it accounted for between 20% - 40% of all global trading volume as measured in 2019-2021 (Aquilina et al., 2021; Diane-Laure et al., 2019; Ma & McGroarty, 2017). A further issue with HFT and algorithmic trading for net zero portfolios is that it tends to occur in 'dark pools', anonymous stock exchanges that were traditionally open only to institutional investors. Whilst dark pools have the trading benefits of liquidity and anonymity, not all of them have robust corporate governance principles. Many anonymous exchanges are now operated by public exchanges such as ASX's Centre Point and require all traders to meet their limit rules. The ASX is part of the Sustainable Stock Exchange Initiative (SSEI) and is included in the 67% of SSEI-aligned exchanges providing guidance on ESG disclosure (Sustainable Stock Exchanges Initiative, 2022).

Garel (2017) describes a duality where, on the one hand, superannuation funds prefer to hold dividend-paying stocks for longer, to fund members in pension phase, as well as for their tax benefit. Sewchurran et al. (2019) claim that pension funds are not truly long-term investors as they claim but, "*perpetual investors, making short-term investments, forever*" Lydenberg 2014 in (Sewchurran et al., 2019, p. 999). The UK House of Commons Environment Audit Committee (2018) found that 51% of UK pension funds invested with a time horizon shorter than five years. Although, Warren (2014) argues that opportunistic trading in reaction to price movements is not short-termism if it is accompanied by consideration of the long-run value of the investment. Altı et al. (2012) also claim that investors do not chase returns but receive financial results as information that may confirm a view and lead to trade.

Fusso (2012) proposes that investors are rewarded with more power for holding shares for long periods as a way to attract long-term value-oriented owners. In addition to rewarding investor loyalty, Fusso (2012) recommends fiscal mechanisms such as financial transaction taxes to encourage longer holding periods. The Australian Taxation Office (2022) incentivises complying superannuation funds with a 33.3% discount on capital gains for assets held for longer than twelve months. Extending the time period needed to receive the discount beyond twelve months, would incentivise a longer holding period. Another proposal to motivate investors to hold stocks for longer is tenure voting, that is increased voting power depending

on the time the stock has been owned. Berger et al. (2017) note the limitations of tenure voting, include its departure from majority shareholder voting advantage, as well as its administrative tracking burden. Further, they found that only twelve US companies used tenure voting in the thirty years to 2017. Most of them were mature, family-dominated companies. More than half of them had abandoned that practice before the 2017 study, and there was no research to show if it had increased stockholding time. Further research could continue to explore incentives to lengthen investment holding periods.

Reduced stock holding is prevalent in financial markets due to competitive pressure. This impacts net zero outcomes. Incentives or fiscal mechanisms could be used to lengthen ownership but have not been optimised for net zero.

2.6.2. Manager Short-Termism: Quarterly Earnings and Investment

This section provides knowledge on quarterly earnings. These are another short-term competitive pressure that limits net zero portfolios.

Market pressure and especially quarterly earnings guidance for investors puts pressure on firms to deliver profits, often at the expense of value-adding investment (Business Roundtable, 2018; Diane-Laure et al., 2019). Increased competition and reduced cash flow results in shorter project deadlines and lower innovation (Dow et al., 2024). Sewchurran et al. (2019) found evidence that 80% of Chief Financial Officers would reduce advertising and R&D investment to ensure they met their quarterly earnings expectations. Brochet et al. (2015) conducted a novel study of companies who did quarterly earnings conference calls, arguing that the practice was a strong proxy for short-termism. The erosion of company value in their sample was so significant, that all companies had lowered return on earnings over the subsequent two years. In earlier literature, Fusso (2012) explained that there is a disconnect between financial market expectations and the outperformance of goods and services in 'real markets' where pressure conversely causes growth in real markets to diminish. Dow et al. (2024) argued that the short-termism trap was so problematic it had led some firms to stay private.

However, ending quarterly guidance also has its challenges. Firstly, some say it would be ineffective because short-term sell-side analyst coverage would replace quarterly guidance if that practice ended (Australian Institute of Company Directors, 2008). Further, small companies, especially those with little or low analyst coverage, fear they will no longer be perceived as transparent if they cease quarterly earnings guidance (Orsagh et al., 2020; Park & Patterson, 2021). A survey commissioned by the SEC of their 160,000 institutional investor

members found 84% of respondents relied on earning release webcasts with manager comment at reporting times but 52% agreed that "*companies should stop offering quarterly guidance because it creates an undue focus on short-term results.*" The CFA were unsupportive of a move to semi-annual reporting, instead demanding quarterly information (Singh, 2019). In their 2020 report, CFA commented that although the number of companies providing quarterly earnings guidance had reduced, it remained a market driver (Orsagh et al., 2020). They did however, emphasise the distinction between quarterly earnings guidance and quarterly reporting, and recommend that companies report on long-term growth drivers, such as, "*long-term strategy and agreed-on metrics that drive that strategic success as substitution for stepping away from earnings guidance*" (Orsagh et al., 2020, p. 8). Business Roundtable (2018) also urged companies to report on their progress against strategic metrics and embed a culture of capital investment for long-term growth.

Kim et al. (2017) found that after ending their practice of quarterly earnings guidance, companies attracted a higher proportion of long-term investors. On the other hand, Pozen et al. (2017) studied UK-listed companies following the removal of required quarterly reporting and noted that by the end of 2015, only 10% had ceased quarterly reporting, predominantly small-cap companies from the energy and utility sector. They explained the low level of reporting decrease was due to competitive pressure from industry peers, especially those with a dual US listing where quarterly reporting was, and still is, required. They also noted that there was no difference between their level of capital investment compared with the other companies.

Given the regional breadth of superannuation portfolio holdings, the issue of earnings guidance internationally is pertinent to the ability of superannuation portfolios to reach net zero. Note that in Australia, disclosing entities are required to report bi-annually (ASIC, 2022b, p. 23). Similar to other public markets, there is the additional requirement of continuous disclosure of information that a reasonable person would expect to cause a material price or value change (ASX Compliance, 2020). Continuous guidance conditions in Australia explicitly requires company disclosure, *"even if it is contrary to the short-term interests of the entity*" (ASX Compliance, 2020, p. 23). Post-announcement trading volume increases for up to four days (Mahipala et al., 2009) and short-horizon investors profit from news that raises a company's price, without being affected by its damage to future company value (Berger et al., 2017). Arguably then, when reporting is focused on short-term profit drivers rather than value creation, then the core practice of timely and transparent market information could be seen to encourage short-termism. This emphasises the need for information to focus on long-term

outcomes. Deliberate mechanisms to encourage long-term investment could be a fruitful topic for further research.

Other factors contributing to decision-making for short-term gain included pressure on companies to maintain their dividend ratio to remain attractive to investors. Companies were found to sometimes resort to raising equity to distribute to shareholders, instead of funding value-creating projects (KPMG, 2020). In interviews with nine Australian company directors, Adams (2017b) found that all of them were frustrated by pressure from investors who were unsupportive of long-term value creation due to their shorter investment horizon. They echoed the issue of equity raising for balance sheet management rather than company expansion. Short-termism by executives wanting to lift their performance incentives is also prevalent across the industry and is a further pressure for short-termism in earnings and is discussed further in 4.2.4.

Short-termism is harmful to sustainability outcomes. due to quarterly earnings requirements in the US flows through global markets as numerous companies have multiple listings. Institutional investors rely heavily on quarterly earnings and do not support ceasing its practice. Net zero outcomes would be better supported by reporting focused on long-term value creation rather than short-term profit. Whether the nature of reporting can shift and whether this would result in other sources of equivalent information for short-term arbitrage could be a subject of further research.

2.6.3. Performance Benchmarks

This discussion outlines knowledge on a further practice that encourages short-termism in finance practice; performance benchmarks.

Financial benchmarks are used for the comparative assessment of financial performance as well as economic productivity. This discussion is limited to the use of financial benchmarks although both types are used for varying purposes within the superannuation sector. It is important to note that benchmarks can be used to measure returns over different periods. The focus of this discussion relates to the impact of benchmarking over shortened time periods, although several other net zero-related challenges in the use of benchmarks are also included.

The longest timeframes used in investment rarely extend beyond 10 years, which is far shorter than the timeframe needed to consider climate risk and adaptation measures (Bouchet et al., 2022). Instead of a consensus timeframe used to denote a short-term or long-term investment horizon, the convention dictates that investors should consider the timeframe of a benchmark

in line with their risk tolerance (The Research Foundation of the Association for Investment Management and Research, 2003). Superannuation funds typically suggest investment in their lowest risk (conservative) fund portfolios for return outcomes over at least a three-year horizon, whereas their highest risk (high growth) portfolios are recommended over at least a ten-year horizon (ART, 2024; Aware Super, 2024; HESTA, 2024).

Asset class, sector and regional benchmarks are used for comparison of a single holding or a portfolio against the average performance of assets within the same category. In equities, stock selection contributes more to returns than the sector in which they choose to invest (Hall & McVicar, 2013). So, there is competition pressure between sector peers to outperform benchmarks over the short term and attract capital. This also flows through loan financing and is a cause of corporate short-termism that can affect public and private companies (Bird et al., 2022).

With 56% of assets in superannuation funds (with more than 4 members) outsourced and externally managed by investment managers (Association of Superannuation Funds of Australia, 2022) superannuation funds use benchmarks to assess the performance of their external asset managers. In some financial services businesses, funds management is vertically integrated, where their aligned asset management business offers services to their asset owner business, which can be advantageous for economic efficiency but can also be a conflict of interest in considering competitive alternatives (Deloitte Access Economics & ASIC, 2021). Noting a lack of availability of investment managers in certain asset classes, persistently poor funds still risk losing their mandate if they continue to underperform their benchmark.

A further body of research critiques the ability of investors to outperform a market benchmark over the long term. Deloitte Access Economics and ASIC (2021) compared relative returns for Australian shares, Australian fixed interest, Australian property, International shares and International fixed interest over 3, 5 and 10-year horizons to 2019. They found that despite past returns being a strong factor in the decision of principals to move their money, over a ten-year horizon, only 20% of funds outperformed an asset class benchmark, with the majority generating below-index returns net of fees. Similarly, Drew et al. (2002) studied monthly returns for 148 retail Australian Equity superannuation funds in the ten years to 2000. They also found that a fund's historic returns were not a good predictor of future outperformance. Both studies concluded that;

1. Over a sufficient time horizon performance will revert to the mean
2. Fund fees were more impactful on total returns than stock selection.

Unsurprisingly, their findings are contested by institutional investors. There is also a risk that funds may choose an easy-to-beat benchmark that results in a false perception of outperformance and unfair achievement of performance fees where these apply (Deloitte Access Economics & ASIC, 2021). The selection of benchmarks in Australia is not regulated and is decided by funds. Conflicted allocation of funds and inappropriate fees were found in the Royal Commission Inquiry (Commonwealth of Australia, 2019), therefore mistrust has increased attention on the short-term performance of underlying managers.

Strategy benchmarks are used for comparison of a portfolio against other similar investment strategies or themes. Despite the prevalence of market-cap weighted indices used as benchmarks, Broeders and de Haan (2020) explain the advantage of using a proprietary benchmark for several reasons. Firstly, a proprietary benchmark can reflect a fund's investment universe and remove stocks that are excluded from the portfolio. That is relevant to climate-aware investment because negative externalities, such as GHG emissions, are not fully priced by the market due to insufficient information and a lack of carbon pricing, therefore the performance of investments is being compared to some entities that are not incurring the full costs of their emissions. Secondly, they explain that a portfolio's risk preference and investment style, such as the extent of its reliance on growth or value strategies can be captured in the benchmark.

Portfolios could measure their net zero progress against a sustainability benchmark, however, there would need to be market consensus on which index methodology would be best suited as a benchmark. There are a growing number of sustainable finance benchmarks, most launched after 2005, with very different focuses, methodologies and rules (Cunha et al., 2020). Dow Jones Sustainability Index (DJSI) takes an ethical-based approach that is distinct from climate-aware investing. DSJI for example, excludes investments such as alcohol, gambling, tobacco and firearms but includes companies that perform well on their Corporate Sustainability Assessment compared with others in their industry (S & P Global, 2022a). On that basis, high emitters, Woodside Energy and Rio Tinto were included in the DSJI Australian Portfolio as at October 2024 (S & P Global, 2024).

In 2020, Dow Jones Standard Poor expanded their series of sustainability indices to include Paris-aligned climate transition and Carbon Efficient indices. The S&P 500 Net Zero 2050 Climate Transition Index incorporates findings of the EU Climate Benchmarks and Benchmarks Report and excludes Fossil Fuels, Tobacco and Firearms (S & P Global, 2022c). The Carbon Efficient indices firstly exclude companies with high GHG emissions and insufficient disclosure

and secondly weighs its 500 companies according to industry group and their carbon-to-revenue footprint. Beyond, the selection of a suitable benchmark, other challenges remain with the quality of carbon data and the efficacy of ESG ratings used to construct the index (Gocher & Australasian Centre for Corporate Responsibility, 2021; Wong & Petroy, 2020). ESG data and ratings are discussed further in section 2.7.2.

Multi-sector benchmarks are used to compare a portfolio's performance against the multiple asset classes in which it is invested. The selection and weighting of underlying indices should reflect the portfolio's strategic asset allocation and investment approach, for example, some funds have a formal 'tracking error' requirement that limits their investment flexibility. Broeders and de Haan (2020) found that whilst 82% of pension fund returns over time are attributed to strategic asset allocation, 8% of performance was the result of benchmark selection, indicating that if a strategy is a poor fit to its benchmark, it is at risk of underperformance. Conversely, benchmark comparisons relative to a composite benchmark that mirrors the fund's strategic asset allocation do not measure the performance attribution of the asset class decision. Ameli et al. (2019) asserts that the short-term pressures on pension funds with a long-term investment horizon is due to mistrust between principals (superannuation members) and agents (trustees), where principals seek ongoing evidence of strong returns. Funds argue that scrutiny of agents to prove short-term performance stops them from realising climate-aware investment.

In addition to peer comparison, multi-sector benchmarks are used by regulators and superannuation members to assess relative performance. As previously discussed, a critically important benchmark for Australian superannuation funds is the YFYS Performance Test's legislated benchmark. This annual test commenced in July 2021 with the requirement that funds that underperform by more than 0.5% per annum must notify their members. In the event of failing two consecutive annual tests, funds are barred from accepting new members (APRA, 2022c). Depending on the proportion of members in a failing fund, that outcome could mean the end of operations. APRA accounts for the differing risk and return objectives of funds through a reference portfolio that is risk-adjusted according to the strategy asset allocation reported to APRA by the fund (APRA, 2021c). The benchmark has been simplified to suit many portfolios, meaning that numerous assumptions are necessary. Assumptions include the suitability of each asset class index, and this is difficult for very broad indices such as listed infrastructure and for those asset classes such as private equity which may offer significant climate solution investment opportunities but have no accepted index.

The benchmark performance test also applies the same fees and expenses to all products within an asset class. The legislated assumed annual fee for Australian Equity investments was just 0.05%, whereas no fee was allocated for Australian unlisted infrastructure (Commonwealth of Australia, 2021a). In 2020-21 representative administration fees and expenses (RAFE) were 0.3286% (APRA, 2024a). Superannuation funds are under significant cost pressure and have embraced the cost efficiencies of allocating some of their core Australian equity to an index provider. As at July 2022, the annual management fee for Blackrock iShares Australian Equity Index Fund was just 0.2% (Blackrock, 2022a). It is possible, but commercial in confidence, that superannuation funds pay an even lower wholesale fee.

The YFYS test also assumes that superannuation funds will invest in alignment with the mainstream benchmarks that are incorporated in its legislated benchmark. Trustees seeking climate-aware investment must deviate from traditional benchmarks but will be deterred under the YFYS performance test (Bell, 2021). Many superannuation Fund Chief Investment Officers interviewed by Bell (2022) acknowledged that the YFYS test had changed their investment emphasis and added pressure for short-term results at the risk of important finance for public-private partnerships and other investments that deviated from the legislated benchmark. The UK court case, Butler-Sloss v The Charity Commission, accepted that short-term sacrifice of returns in Paris-aligned investment strategies may be necessary for a greater long-term gain and ruled it preferable (Simms, 2022). Yet, with the YFYS test occurring annually, short-term sacrifice of returns for longer-term gains is not viable. Whilst the test considers a horizon of up to ten years, the unintended consequence of an annual performance test; is competitive pressure on funds through their publicised comparison to ensure returns are always high. Australian Portfolio Manager for Fidelity, Howitt (2022) asserts that markets operate well with quality information and calls on regulators to overcome the short-term performance pressures caused by the YFYS test. Submissions to the Australian Government (2024b, p. 8) review of the Your Future, Your super performance test in 2024 provided evidence that trustees felt the test incentivised passive bench-mark hugging and was "*discouraging investment in assets that are not well-represented in the benchmark indices, including emerging asset classes such as those associated with the climate and energy transition.*"

Another comparison tool that is used to compare the superannuation sector globally is the Mercer CFA Institute Global Pension Index. This annual report compares retirement income systems in 39 countries using about 50 indicators to reveal areas needing improvement (Mercer, 2020). Each system is compared on the basis of its adequacy to provide for members

in the future, the ability for the pension to meet the needs of future population and the integrity with which the system is governed. The 2020 report referred to an increase in recognition of ESG consideration required by nine countries. Despite the acknowledgement of the importance of ESG, the scoring system placed a low value on the question, '*Is it a requirement for the trustees/ fiduciaries to consider Environmental, Social and Governance (ESG) issues in developing their investment policies or strategies?*' Apart from increasing the weight of sustainability in their assessment, there is an opportunity for the Mercer test to also consider how superannuation funds are tracking in terms of their net zero commitments.

Benchmarks could be used to measure climate-focused criteria although with limited exceptions they have not been used in that way by regulators or industry. Conversely, the literature shows that they are being used in a way that exacerbates short-termism.

The negative effects of short-termism in corporate and financial practice are well-documented in existing knowledge. The literature reveals that investor are affected by competitive pressure in their stock holding period and certain investment strategies are especially counterproductive for long-term value creation and climate outcomes. Similarly, this section synthesised knowledge of corporate managers' response to market pressures with reduced innovation and other company decisions to boost short-term profit. Short termism limits investment into the solutions required for climate mitigation and adaptation and therefore restricts net zero transition. Some proposals to overcome short termism and motivate climate-focused investment were found in the existing research including tax incentives to extend the period of shareholding, tenure voting, reorientating reporting content to emphasise long term value creation and climate-aware benchmarking over extended investment horizons. These solutions to industry practice would require regulator intervention. Change would be complex though, because governments are also under pressure to demonstrate national economic performance using traditional GDP measures that include corporate and financial market investment.

2.7. Tools for Change

Sustainable finance tools, standards and products are the foundations on which net zero superannuation portfolios need to be built. This section analyses existing knowledge and the historical context of climate-related financial reporting, climate data and sustainable finance taxonomies and investment products.

2.7.1. Climate-related Financial Reporting

A vast body of academic research contributes knowledge on climate reporting methods and posits on its arising duties. The following discussion considers the historical context for climate-related financial reporting and presents key issues to understand how they impact net zero superannuation portfolios.

Relevance of climate-related financial reporting knowledge

Access to credible, quality climate-related financial disclosures is needed for proper valuation of portfolio assets and to measure a fund's progress against a net zero superannuation goal (Ameli et al., 2021). Yet, climate-related financial information is difficult to quantify and requires novel, forward-looking calculation methods (UNEP FI, 2005). Debates over the responsibility to manage disclosed issues are unresolved for the reporting entities, users of climate-related disclosures and community stakeholders (Adams, 2020). These concerns were raised two decades ago by Adams and Zutshi (2004b), who also acknowledged the need to develop innovative environmental reporting methods but recognised that international standards, mandatory reporting and proper enforcement would be needed.

Progress in climate reporting policy and practice has been arguably slow, with climate disclosure referred to as "still in its infancy" regarding the quality and quantity of companies reporting in 2020 (TCFD, 2020). Comparability through the adoption of standards is widely seen as key to improving the usability of disclosures, although their emphasis on enterprise value does not represent the interests of all actors (Adams, 2020). The topic has become especially dynamic since the International Sustainability Standards Board issued the first climate-related disclosure standards in 2023 (International Sustainability Standards Board, 2023). These have been adapted for mandatory use in a growing number of jurisdictions, including Australia, where their phased commencement has been legislated and will begin in January 2025 (Commonwealth of Australia, 2024b).

A historical context of climate-related financial reporting

Scholarly attention on environmental financial reporting began in the 1970s in a context of growing sustainability awareness, refer to section 2.3.1 for further background discussion. At that time, the accounting discipline saw the unconventional practice as offensive, so it was not well-accepted within the mainstream journals that favoured 'scientific' research either (Mathews, 1997). Some related contributions to climate risk valuation came from

management and economics scholars, such as the 1972 work of Nordhaus (2019) who sought to price carbon as an externality. Investigation of environmental impact and climate change in accounting literature (then referred to as environmental management accounting) mainly gained momentum almost two decades later but tended not to distinguish between environmental, social and ethical issues (Adams et al., 1998; Mathews, 1997).

A basic search was conducted to scope the overarching topic of sustainability-related financial reporting in academia and the media over time. The Proquest database was used to find peer-reviewed articles, whilst a Factiva search was used as a proxy for media interest. The search term results can be found in

Appendix A. Firstly, the search confirmed that academic interest arose in the 2000s, initially in relation to Corporate Social Responsibility and then a decade later, ESG. Secondly, media interest in sustainability doubled between 2000 and 2020. Thirdly, the search reveals a surge in attention to ESG from 2015. The time period is notable for the momentous Paris Agreement but also the influential 'Tragedy of the Horizon' speech by the respected former Governor of the Bank of England and the Bank of Canada Mark Carney, which increased attention on the need for climate action especially in the finance sector (Carney, 2015). Articles on ESG disclosure outnumber CSR reporting from 2015, indicating a shift away from impact materiality and towards financial materiality.

As the 2000s approached, the literature on critical theory had increased (Mathews, 1997) and financial reporting was reviewed and scrutinised (The Committee on the Financial Aspects of Corporate Governance, 1992). When deficiencies in corporate governance emerged CERES developed The Valdez Principles to improve corporate environmental accountability. The ten principles for environmental performance disclosure were foundational for voluntary reporting frameworks (Smith, 1993). However, many larger companies and industry groups such as Global Environmental Management Initiative (1994), avoided CERES' framework and developed their own environmental reporting approaches (Zack, 1992). However, they were criticised for providing information that lacked credibility (Financial Times, 1994b) and disclosures that affected no genuine change (Zack, 1992). Columnist Corcoran (2001) criticised the Canadian Institute of Chartered Accounting for the increased incorporation of climate risk in financial reporting referring to it as "*unfathomable babble" and* stating, "*this kind of institutional self-immolation is rampant throughout the accounting profession*".

A survey of the Chief Financial Officers of the top 500 Australian companies by Frost and Wilmshurst (1998) found three-quarters of respondents analysed energy efficiency internally

yet the majority did not report environmental information externally and believed its preparation would be too costly. Arguments over the cost of preparing climate-related financial information have persisted and the judgement for 'proportionality' in the preparation of financial information is discussed in this thesis. Australian economists, Hoggett and Nahan (2002) believed that reporting would be a cost burden on companies. They were further concerned that stakeholders would demand 'ludicrous' levels of ethical performance that would be detrimental to owner returns.

By 2001 in Australia, superannuation funds were required to disclose the extent to which their funds were taking into account environmental considerations in their investment decisions (Australian Government, 2001). However, as argued by Adams and Zutshi (2004a) the absence of mandatory reporting standards enabled companies to omit problematic environmental issues from their disclosures. Their same article set a research agenda for climate-related reporting that would achieve impact through measurement and reporting practices with;

- Effective corporate engagement
- Climate-focused organisational and governance culture
- Improvements in climate-related reporting.

All of these are necessary for reaching net zero superannuation portfolios.

Climate-related financial information was attacked by some actors such as The Australian Shareholders Association Deputy Chairman who called sustainability reports 'unreliable' and declared that the government needed to ensure business practices were acceptable and not impose that responsibility on shareholders (Day, 2004).

Adams and Frost (2007) found that less than 20% of Australian company disclosures had measured their performance against a target or used that information for decision-making. They explained that voluntary disclosure practices were being used as positive stakeholder communication but lacked complete decision-useful information. Importantly, they referred to the 2006 Parliamentary Joint Committee on Corporations and Financial Services Enquiry on CSR Reporting that recommended disclosures that properly evaluated material risks. A discussion on materiality is found in 2.5.2.

Carbon dioxide equivalent greenhouse gases

Carbon metrics have been more robustly defined, measured and more strongly regulated than other financial environmental analysis (Datt et al., 2019). Despite this, carbon emissions data is

still inconsistent, hard to compare and often low-quality (Gocher & Australasian Centre for Corporate Responsibility, 2021). Calculating greenhouse gas emissions depends on which processes are available and practical. Continuous Emissions Monitor System (CEM) measures ducted emissions directly; however, this can be costly and is not always a suitable calculation method (The Greenhouse Gas Protocol, 2004). Alternatively, the data can be calculated according to the amount of fuel used and its emissions factor. However, the emissions rate by a single fuel type is not always consistent, so sampling is needed. The heat generated in combustion is another method to calculate emissions, but it assumes a constant level of moisture content in the fuel, which is also inaccurate (The Greenhouse Gas Protocol, 2005). Other emissions calculation methods exist and similarly rely on imprecise assumptions.

Greenhouse gases, Methane, Nitrous Oxide, Hydrofluorocarbons, Perfluorocarbons and Sulphur Hexafluoride, are usually measured in comparison to carbon dioxide equivalent emissions (CO2e). The decision of whether an entity's net zero commitment includes all greenhouse gases or only CO_2 is often unclear (Rogelj et al., 2021). Carbon Dioxide data coverage is relatively high, but often, non-CO_2 gases are excluded from conversion and, therefore, are unreported. Greenhouse gases leave the atmosphere over different timescales, and awareness of their different behaviour is important for limiting the impacts of climate change. Methane has about a ten-year atmospheric life compared to CO_2, which remains for centuries (Enting & Clisby, 2021; Sun et al., 2022). Methane is second to CO_2 in its contribution to global warming, but early mitigation alongside carbon dioxide reduction offers significant benefits. Early methane reduction could reduce the risk of losing summer arctic ice, which may occur in the 2030s (Sun et al., 2022). Melting summer arctic ice would change the reflective ice to a dark surface that would absorb more warmth, it would disrupt the polar ecosystem and lead to thawing permafrost, releasing more GHG emissions. A further issue is that carbon capture and storage solutions are less effective for methane emissions (Sun et al., 2022).

There are myriad ways to adjust for these differences but the calculation for conversion is typically simplified to ensure low calculation cost and ease of use (Enting & Clisby, 2021). The standard method of GHG conversion in international agreements is the Global Warming Potential (GWP) equation measured over 100 years but using this calculation is imprecise for short-lived climate pollutants such as methane, resulting in insufficient CO_2e targets (Cain et al., 2019; Enting & Clisby, 2021; Jenkins et al., 2018). Cain et al. (2019) propose a correction to the GWP equation to better represent the temperature effects of methane and other GHGs.

Additionally, organisational and operational boundaries are not always clear. Businesses may have multiple equity owners with varying shares of financial or operations controls, making it difficult to determine carbon accountability. The equity share method counts emissions based on the company's stake of economic ownership in an entity or project. The ownership control method calculates emissions for entities or projects where it has financial control. Whilst ownership and control rights are often aligned, The Greenhouse Gas Protocol (2004) explains that affiliated companies would be treated differently under these methods, as the parent company has equity share and influence but does not control the affiliated company financially. Franchises work in reverse, where the franchisee holds equity but control is held by the franchiser.

Due to the variance in possible emissions methods, companies are expected to keep thorough documentation of their calculation process and assumptions (The Greenhouse Gas Protocol, 2005). In some jurisdictions, these may be subject to assurance and verification processes. International standards for assurance of Greenhouse Gas Statements are set out in ISAE 3410, which was issued in 2012 and used in Australia for NGER. In November 2024 IAASB (2024) issued ISSA 5000, a standard for assurance of sustainability reporting, commencing in December 2026. It will replace ISAE 3410. The Australian Auditing and Assurance Standards Board has issued a draft standard ASSA 5010 that was at the consultation stage in late 2024 at the time of writing (AUASB, 2024).

Quality, consistency and comparability hinder the useability of climate reporting

There has been wide agreement in the literature on the problematic state of climate-related financial disclosures, with incomplete, outdated and hard-to-compare information that is not decision-useful (Amel-Zadeh & Serafeim, 2018; De Silva Lokuwaduge & De Silva, 2020; Diouf & Boiral, 2017; Nilipour et al., 2020). The research also concurs on the challenge of transferring difficult-to-collect and unfamiliar qualitative information into financial data in a resource-pressured operating environment (Amel-Zadeh & Serafeim, 2018; Arvidsson & Johansson, 2018; Diouf & Boiral, 2017).

As at 2021, there were more than 400 disclosure frameworks related to climate or sustainability reporting (NGFS, 2021). A description of some dominant reporting frameworks, including their user orientation, can be found in Appendix B. The TCFD climate-reporting framework is widely used by ASX200 companies, with 75% committed to reporting against it in 2024 (ACSI, 2023). This is a significant increase from the 40% of ASX200 companies that were using it in 2021 when the literature review for this thesis was initially written. However, just

22% of ASX200 companies were comprehensively addressing all elements of the TCFD framework in 2021 (ACSI, 2021b), and partial reporting has remained problematic (ACSI, 2023).

Legitimacy theory and Credibility of climate-related reporting

There is a robust link between 'legitimacy theory' and climate reporting for corporate social license (Arvidsson & Johansson, 2018; Baldini et al., 2018; Buallay et al., 2020). The evidence has shown that building a trustworthy reputation reduces societal pressures on a company and reduces legislative risk (Amer, 2018; Buallay et al., 2020; Clarkson et al., 2019; Datt et al., 2019; De Silva Lokuwaduge & De Silva, 2020; Yoo, 2021). On the other hand, a body of research questions the credibility of climate-related information with disingenuous reporting that includes non-disclosure, selective disclosure or deliberate deception. This includes sustainability reports that take a marketing approach in emphasising positive achievements whilst glossing over genuine issues and "managerial capture", claiming that reporting is solely for corporate social licence (Adams & Larrinaga, 2019; Amer, 2018; Arvidsson & Johansson, 2018; Diouf & Boiral, 2017; García-Sánchez et al., 2020; Marquis et al., 2016; Wedari et al., 2021; Zharfpeykan, 2021).

Whilst the literature supports improved financial performance and value-creating corporate strategy through reporting (Adams et al., 2017; Albitar et al., 2020; Lee & Maxfield, 2015) evidence of climate impact is mixed. Some studies found climate reporting to improve climate risk management (Arvidsson & Johansson, 2018) but other studies claim that climate-related reporting has minimal impact because reporting emphasises past corporate environmental performance instead of future strategy (Pérez-López et al., 2015). Mistrust of sustainability reporting has led to growing demand for external assurance and auditing to increase the credibility of disclosures (Cort & Esty, 2020; Datt et al., 2019; Diouf & Boiral, 2017; Dutta & Dutta, 2021; El-Hage, 2021). Currently, firms with the greatest reputational risk, either due to their large size or their high emissions, were found to be more likely to disclose emissions using external assurance for improved validity (Datt et al., 2019). The literature found that voluntary assurance tended to be used by a company with a high sustainability commitment. If a large well-reputed accounting firm provided the assurance, it was viewed especially favourably by market participants, and it also increased the chance of inclusion in an ESG index, which led to further market valuation growth (Clarkson et al., 2019).

The use of stakeholder scrutiny to improve legitimacy is also examined in the literature (E. P. Y. Yu et al., 2020). Climate-related legal risk is itself an emerging field of research where an array of novel possibilities are being explored, including litigation due to misleading climate risk

disclosure, also referred to as 'greenwashing' (Wetzer et al., 2024). This is especially relevant to Australia which between 2015-2023 had the second largest number of climate lawsuits globally, after the United States (Wetzer et al., 2024). Common law 'risk of negligence' in Australia is more likely to be manipulated than 'strict liability' in other jurisdictions (Grahn, 2020). Some greenwashing cases that have already been brought to the Federal Court of Australia are the Australasian Centre for Corporate Responsibility against Santos for deceptive net zero by 2040 disclosure and ASIC against Mercer Superannuation for misleading product labelling (Hartford-Davis, 2023).

Achieving decision-useful information with international standards and mandatory reporting

The need for standardisation and mandatory disclosure to improve climate-related financial information quality and comparability has been well-accepted (Arvidsson & Johansson, 2018; Dietz et al., 2021; Dietz et al., 2018). Support for mandatory sustainability disclosure in the literature has centred on two themes. Firstly, to improve the useability of information (Perera et al., 2019; E. P.-y. Yu et al., 2020). Secondly, its positive impact on the entity's environmental performance and reputation (Cordazzo et al., 2017; Downar et al., 2021). The body of scholarly evidence identifying the need for mandated disclosure has been instrumental to regulatory progress. Additionally, the government's duty to ensure fiscal stability has also been a driver for regulation (NGFS, 2024a). It is also acknowledged that disclosure quality would be improved by forward-looking activities and scenario analysis (Battiston et al., 2017; P. Smith, 2021).

Literature in opposition to mandatory reporting has discussed the cost burden and potential legal risks that arise from overly-prescribed mandates (De Silva Lokuwaduge & De Silva, 2020; Krasodomska & Godawska, 2020). The counter-argument is that the cost burden of sustainability reporting is instead due to the multitude of unstandardised information requests that demotivate companies from timely reporting and would improve with mandatory disclosure (El-Hage, 2021; Jonsdottir et al., 2022). Where mandatory reporting has already been implemented its effect on the financial performance of entities has not been adverse (Downar et al., 2021) and in fact, reporting lowers risk and reduces the cost of capital (Buallay, 2019). Schütze and Stede (2021) challenged concerns about the proportionately higher cost of sustainability disclosure for smaller firms, as measured by employees, and the false assumption that small companies all have low carbon emission intensity. They found that the highest emissions sectors in the EU are responsible for 80% of emissions but have just 20% of the labour force. Their findings indicate the need for mandatory reporting to include smaller firms with high emissions in reporting regulation.

In 2020, leading climate-reporting framework organisations issued a Statement of Intent to Work Together Towards Comprehensive Corporate Reporting (CDP et al., 2020). This feat in international cooperation and collaboration was realised in November 2021 with the establishment of the International Sustainability Standards Board ISSB (IFRS, 2022) who released a Sustainability standard and a Climate standard in 2023 (International Sustainability Standards Board, 2022). Their announcement acknowledged the confusion of multiple sustainability reporting guidelines and the distinction between reporting on financial or on impact materiality.

Australia rapidly followed the ISSB with draft mandatory reporting standards that require entities to disclose "*climate-related risks and opportunities, that could reasonably be expected to affect (their) prospects*" as well as their "*their progress towards any (climate-related) targets*" (Australian Accounting Standards Board, 2023). The release of the climate-related disclosure marks a new phase of support and adoption by policymakers (Rajan, 2023) and the Vice Chair of ISSB stated that the focus of their work is now engagement with jurisdictions in their adoption of the standards (Hall & Whieldon, 2024).

Interoperability is another area of focus as global investors need to comply with different reporting requirements on a variety of issues across jurisdictions (FSB Financial Stability Board, 2021). Whilst most jurisdictions have mandated some level of environmental reporting, the requirement to provide GHG disclosures and concepts of materiality have differed (European Commission, 2021c; NGFS, 2021). Noting the climate-related disclosure developments in progress, it is expected that knowledge will increase and processes will be refined. Nedopil et al. (2021) similarly found that sustainability standards issued by regulators, NGOs and multilateral organisations varied according to their different policy contexts for example emerging markets had a positive correlation with biodiversity but a negative one with climate.

Materiality in reporting standards

Yet determining which information and factors should be measured has been strongly contested (Eccles et al., 2011; El-Hage, 2021). The ISSB standards have a heavy bias towards financial materiality and draw on TCFD's four-pillar framework of governance, strategy, risk management, metrics and targets. Through analysis of submissions to the consultation process Adams and Mueller (2022) find evidence that the selection of IFRS to create the climate-reporting standards and the consultation process for their development did not properly consider the views of all actors, including academics.

Following the release of their first prototypes, interim GRI CEO Hespenheide (2021) declared support for ISSB, yet indicated disappointment in recognising the broader stakeholder aims and impact materiality in GRI's approach. He states, *"The sustainability pillar, under which GRI sits, addresses a company's external impacts on society and the environment, while the financial pillar needs to reflect sustainability risks to a company's value. Today's announcement marks a significant step towards strengthening that second pillar"* (Hespenheide, 2021, p. 1). In March 2022, GRI announced a new agreement with ISSB to develop an 'interconnected and compatible' additional sustainable reporting 'pillar' that focused on impact materiality to facilitate collaboration from both materiality perspectives and support sustainability standards improvements for all users (GRI, 2022). Interoperability between the two standards was first explored for reporting GHG emissions where alignment is strong (GRI & ISSB, 2024) however, interoperability on aspects of the reporting standards where financial and impact materiality is divided, such as compatibility with the UN SDGs, is likely to be more challenging.

Phasing in mandatory climate reporting is a beneficial step in the sustainable finance ecosystem needed to reach net zero superannuation portfolios. However, the emphasis on financial materiality over impact materiality is problematic for sustainability outcomes. Of strong relevance to this thesis is the critique on the impact of climate-related financial reporting by Adams (2020). Adams reflects on the 2006 article by Rob Gray that questioned whether climate-related reporting was prioritising enterprise value or planetary impact. Gray had developed three categories in climate-reporting; 'business-as-(almost)-usual', triple bottom line and eco-justice informed. Adams, writing before the completion of the ISSB standards, anticipated their enterprise value approach that adopts a business-as-(almost)-usual stance. Adams cautioned that materiality must be urgently re-defined in reporting standards to incorporate long-term societal value and sustainable development goals, or reporting will not only fail to generate a positive impact but will lead to a detrimental climate future.

This section outlined the progression of climate-related financial reporting from a marginalised CSR position in the 1970s to a growing mainstream concern alongside recognition of the grave risks of climate change. The discussion identified measurement challenges and differing beliefs underpinning climate information preparation and use, including financial materiality and decisions on proportionate reporting. Financialisation has been important for scaling climate reporting, but its deliberate financial stance also limits its climate-aware impact.

2.7.2. ESG Data and Ratings

This chapter reviews the literature on ESG data and ratings and shows their proliferation through finance sector climate consideration and implementation. This knowledge provides an understanding of their immense impact on net zero Australian superannuation portfolios.

Relevance of ESG data and ratings

ESG providers, also known as sustainable rating agencies, sell streamlined, easy-to-use ESG data solutions to institutional investors seeking information across a range of asset classes globally. The convenience of ESG data has increased ESG integration and engagement practice in mainstream investment processes. Their appeal is increased by the time pressures on investors and the existing climate-related reporting challenges discussed previously (Eccles et al., 2019; Gyonyorova et al., 2023). Investors also use ESG Data to inform reporting to their own members and to satisfy regulatory purposes. The increasing financial regulator attention on ESG investment consideration has contributed to higher investor demand (Gyonyorova et al., 2023). As at 2021, 60% of global ESG data expenditure came from Europe, a global leader in ESG regulation (IOSCO, 2021). Demand for ESG data is also higher in jurisdictions with high litigation levels, including Australia. Several participants in a survey of Australian institutional investors claimed that investors subscribe to MSCI ESG research to state that they integrate ESG considerations, even though they did not incorporate this information into their valuation processes (CFA Institute & PRI, 2019). This opinion was echoed by investors surveyed by Wong and Petroy (2020), who accused peers of using ratings to feign ESG consideration.

Rapid growth in ESG data and ratings demand has seen this market increase from 0.2 Billion USD in 2019 Nauman (2019) to 1.9 Billion USD in 2023 (Balluffi, 2024). The dominant ESG data and ratings providers are summarised in Appendix C. Competitors have raced to expand coverage and increase their market share. As at 2023, four players dominate, MSCI with 25%, S & P Global with 16%, ISS ESG with 14% and Moodys with 12% market share, respectively (Balluffi, 2024). Mainstream ESG data and ratings providers are biased towards equities research with niche vendors used for alternative assets, private equity, infrastructure and property ESG information (Founta, 2021). Merger activity has been used to expand data providers' internal capability and increase coverage (Balluffi, 2024).

ESG ratings are also used for the selection of ESG index constituents. Given the increasing size of passive ESG funds, index inclusion is valuable to companies. As at December 2023, passive ESG funds under management stood at approximately 2.5 Trillion USD in Europe, 324 Billion USD in United States, 31 Billion in Canada and 33 Billion USD in Australia and New Zealand

(Morningstar Inc., 2023). In Australia, 30% of sustainable investment funds under management were invested in passive funds as at December 2022 (Hall, 2023). Note that passive strategies make up a rising share of superannuation fund assets (Parliament of Australia, 2022) particularly due to fee pressures.

Despite surging demand, ESG data has been criticised. Concerns relate to insufficient transparency so as to protect proprietary interests, poor quality information (Gyonyorova et al., 2023; Mayer & Reizingerné Ducsai, 2023; Wolfe, 2022) and falsely promoting its scientific rigour (Hardyment, 2024).

Contributions to academic literature on ESG data from the business, finance and economics disciplines are dominant. Scholarly exploration has focused on the credibility of data, divergence of ESG ratings, conflicts of interest for ESG providers and the impact of ESG data and ratings providers on companies. In August 2024, a search for “ESG data” or “ESG rating” on the Scopus database revealed almost 4,500 items, with 85% of them written from 2022, revealing the rise of interest in ESG data and ratings. The importance of the currency of works in this emerging area prompted a large update to this section that was initially written in early 2022 prior to much existing knowledge in this topic. The following discussion considers the prevalent thinking on ESG data and its implications for net zero portfolios.

ESG information is incomplete so providers impute data to fill the gaps

Much literature criticises the quality of ESG information that is sourced from often unaudited; non-public data, company reports, company websites and news (S & P Global, 2022b). The concerns extend to the generation of information that is used to fill gaps in the available data (Clementino & Perkins, 2021; Kotsantonis & Serafeim, 2019; Wong & Petroy, 2020). As at June 2019, MSCI relied on 65% of their data to be completed from alternative sources. The introduction of mandated climate-related financial reporting will continue to improve the availability and standardisation of information. However, mandated reporting is yet to be required for all entities in all jurisdictions, meaning that incomplete information will persist for some companies and their supply chains. ESG information is limited and performance is not well-disclosed in the Asia Pacific region (IOSCO 2021), emerging markets (Linnenluecke, 2022) and for small-cap companies (Gupta et al., 2021). In their survey of ESG data and ratings IOSCO (2021) found that users rarely verify raw data prepared by providers due to resource constraints. As the financial value of ESG investment rises, many financial supervisors, industry associations and even providers, have called for scrutiny and market regulation (IOSCO, 2021; Wolfe, 2022).

As at September 2021, MSCI confirmed that ESG data also remains more limited for small-cap companies globally. Therefore, their ratings methodology has been enhanced to manage these gaps but they have not provided details as to how they do this (Gupta et al., 2021). Incomplete data is typically approximated by imputing assumed information based on a company's sector or geographical characteristics or scaling top-down industry average data to fit a business's size. More sophisticated statistical models have been developed to improve the estimation, yet the methods can result in significantly different rating outcomes (Kotsantonis & Serafeim, 2019). Bender et al. (2019) refer to the unique imputation methodologies data providers use to overcome missing data, such as S & P's environmental impact model, which uses more than 700 indicators to generate data estimates. The other method used by data and rating companies to fill in missing information is by requesting it directly. However, information requests are not standardised and the regularity of data collection varies greatly. IOSCO (2021) notes that unregulated data collection is counter to the information symmetry sought for efficient market transparency and recommends using a single streamlined report for all ESG disclosures, and confidentiality agreements for any additional information requested. Individual information requests for varying information are frequently sent to companies with unrealistic deadlines to provide and/ or check information (Jonsdottir et al., 2022) and can include ambiguous or difficult-to-answer questions (IOSCO, 2021).

Serafeim and Yoon (2022) emphasise the suitability of technological solutions that can provide granularity and allow for dynamic use of data to improve ESG information, as they note that matters of relevance change over time. The fintech industry has responded to data challenges with suggestions for improvements although existing research on this topic is limited. A comparative analysis of existing fintech data infrastructure by Duran and Tierney (2023) revealed the potential to provide data provenance to trace the selection of data included in a company scope 3 emissions disclosure and improve consistency. They found commonalities between the early stages of financial market data and transactions with ESG developments. In the former, data access control and assimilation of data were used to overcome fragmentation and diverse data sources. Another novel solution is proposed by Lee et al. (2024) who use advanced natural language processing tools to provide an ESG rating based on earnings call transcripts.

Commercial considerations of ESG data

The selection of a provider is often based on the broadest coverage available, so the data can interface with internal systems (Wong & Petroy, 2020). Therefore, there is pressure on

providers to offer data for the largest investment universe possible, even if that reduces the quality of information (IOSCO, 2021). Investors seek reliability of data sources and check the depth of team skills, yet survey respondents in Wong and Petroy (2020) expressed frustration with the inexperience of ESG data and rating research teams. There was a common belief among institutional investors that their analyst teams had much longer tenure and experience. Alongside rating divergence, this lack of confidence also explains why ratings are often seen as the first step in information gathering, rather than a definitive one and why many large firms subscribe to multiple ESG rating providers (Wong & Petroy, 2020).

Despite the cost of subscription, global investors tend to access multiple ESG ratings to benefit from broader opinion (IOSCO, 2021). Small and Medium-sized asset managers, however, indicated they were unable to subscribe to multiple providers and seldom had resources to develop internal ESG ratings. This is a significant drawback for the ability of these firms to adequately consider ESG factors (Founta, 2021). Subscriber models can result in differing depth of information available to users, depending on their ability to pay. Several large ESG ratings providers, such as Sustainalytics, have introduced open access to a condensed version of their company ratings (Sustainalytics, 2020). A further ESG data development in progress is the Net Zero Data Public Utility (NZDPU), designed to be an open-access climate data utility providing "*entity-level GHG emissions and emissions reduction targets data with both current and historical views*" (CDSC, 2023). Initiated in June 2022, this collaboration is intended to help increase the pace of net zero action and overcome the pay-walls and lack of transparency in climate data (Bloomberg, 2022). The Technical Advisory Board includes major data providers Bloomberg, CDP, LSEG, Moody's, Morningstar, MSCI and S&P Global (CDSC, 2023).

The other issue raised in the literature is the revenue model used by ESG rating businesses. It is estimated that 85% of ESG rating companies have a subscriber fee model, where users pay to access ESG data and Ratings. The remainder used an issuer fee model, where companies pay to be assessed (IOSCO, 2021). The obvious conflict of interest with an issuer fee is the incentive to reward clients with a positive rating. This situation is common to auditing and assurance services, which similarly receive payment from the firms they are evaluating. However, ESG ratings, are not subject to international standards like auditing and assurance services. An additional concern is that some agencies operate an ESG advisory revenue stream, so companies can simultaneously receive advice from one side of the business, whilst being rated by the other. IOSCO (2021) recommends separation processes should be implemented to avoid a definite conflict of interest.

Science Based Targets Initiative is a joint project by well-reputed global not-for-profit organisations UN Global Compact, World Wide Fund for Nature (WWF), World Resources Institute (WRI) and CDP. Yet their funding model is contentious with a target validation fee model that was as high as $14,500 USD per company (Science Based Targets Initiative, 2022b). SBTi issued a conflict of interest policy that aims for impartiality by requiring unanimous validation by all partners and technical directors for the assessment of companies with a conflict of interest. Any attempt by a funding company to intervene with their own assessment outcomes would result in a misconduct investigation (Science Based Targets Initiative, 2022a). Whilst funding sources are necessary to support SBTi, and the conflict of interest policy aims to protect the integrity of the process, there remains a possibility that a company's funding status could influence assessment outcomes.

Influence in ESG ratings is a topic of contention with some critics questioning the involvement of firms in rating processes (El-Hage, 2021). IOSCO (2021) explains that at times, and mostly at their own request, companies are allowed to review their ESG rating before publication to fact-check and provide other information that may change their rating outcome. This is not always done on an equitable basis, as some rating providers insist on payment to see the report pre-publication and their costs may be too high for smaller companies to afford. Some companies argued about the suitability of the methodology used in the rating and the relevance of certain issues to gain a more favourable result (Clementino & Perkins, 2021). A couple of companies interviewed by Clementino and Perkins (2021) also referred to known methods to exploit some rating methodologies and acknowledged the practice of hiring consultants to improve their responses for a better rating outcome, a further slight on data integrity.

Despite the risk that a company could sway their rating result, it is important to recognise that there is also a positive aspect of company interaction with ESG rating providers. Companies benefit from a learning process where they recognise the issues that need to be addressed. Companies can also compete with peers and understand best practice ESG management. For example, as companies respond to information requests by ESG data and rating providers they are increasing the disclosure of information and they can begin to monitor and improve their operations. There is also a benefit for data providers, through their interaction with companies, as the process will also provide them with the learning opportunity to refine their methodologies.

Scoring and weighting judgements in ESG ratings cause divergence

ESG rating outcomes are most often generated by comparing and aggregating data across selected criteria and peer groups according to a proprietary methodology. When data is missing, companies cannot be accurately assessed on a peer comparison basis across a normal distribution curve (Kotsantonis & Serafeim, 2019). A further issue is the definition of the peer group, which affects relative ESG performance. The selection of the best companies in a group with poor climate performance challenges the validity of ESG ratings (Levine, 2019). Another consideration is how to classify diversified businesses, as a rating can overlook ESG issues occurring for the company outside of its primary industry. (Kotsantonis & Serafeim, 2019). Beals (2022) called for more accurate ESG terminology and product labelling and argued that a low carbon-themed fund underpinned by ESG ratings may be invested in renewable energy owned by a traditional oil and gas company that is still deriving the majority of revenue from traditional energy sources rather than renewables. To overcome peer comparison issues, Kotsantonis and Serafeim (2019) recommend the use of universal targets in ESG ratings, such as a science-based climate target, to calculate GHG performance. However, a commitment does not ensure the entity will sufficiently reduce emissions.

Ratings can be highly divergent across providers depending on the selection of information that has been used to determine the rating (Berg et al., 2022; El-Hage, 2021; Jonsdottir et al., 2022; Mayer & Reizingerné Ducsai, 2023; Serafeim & Yoon, 2022). As with climate-related financial disclosure, backward-looking ESG data is not a good indicator of future ESG performance risk, so many data providers provide a forward-looking analysis of a company's preparedness to manage ESG risks (Wong & Petroy, 2020). For example, in their ESG risk rating, a company is assessed according to their commitments towards and management of ESG issues that their subindustry is typically exposed to (Sustainalytics, 2022). The number of factors considered in ESG ratings varies from several to more than seven hundred and the way they are aggregated and calculated has been found to differ significantly (Mayer & Reizingerné Ducsai, 2023). This results in a transparency paradox, where companies are making disclosures for transparency, whereas ESG rating providers are concealing much of their ESG scoring, data sources and ratings weighting behind a paywall, or restricting its access altogether (Hardyment, 2024).

Methodological variances cause significantly different ESG ratings with correlations for some companies as low as 38%. This reduces investor confidence in the use of ratings and makes it hard for companies to interpret its signal, posing a threat to the credibility of ESG data (Berg et al., 2022). Berg et al. (2022) ascertained three different aspects of divergence in the ESG rating methodologies;

scope – the areas of focus within a rating,

measurement – the indicators used to determine the company performance in a focus area,

- weights divergence – the weighting used in aggregating different data points within the rating.

They found that measuring different indicators was the key reason for rating divergence at 56%, followed by scope divergence making up 38% of the difference. Rosenberg (2021) notes that the differing focus in ESG assessment shows that it is a topic of subjective ethical opinion rather than a neutral assessment of financial materiality and, therefore, challenges the meaning and relevance of ESG. Others argue that there should be differences between ESG ratings in the same way that there are differences between sell-side analyst opinion ratings on companies (Nauman, 2019). Whereas, Berg et al. (2022) believe that for ESG ratings to act as an indicator of sustainability risk, they should be similar and thus compare ESG ratings to company credit ratings, where different providers are correlated at 99%.

ESG assessment of an entity is certainly subjective and rating outcomes depend on the orientation of the data provider (Eccles et al., 2019; Young-Ferris & Roberts, 2023). Eccles et al. (2019) comment that many academic studies find a financially-material approach to ESG ratings to be problematic but contests that as long as the underlying values of the assessment are made explicit, the approach is satisfactory for meeting the needs of that user group. Likewise, Amel-Zadeh and Serafeim (2018) note that within the scope of issues considered, there is variance in which elements are prioritised therefore careful selection and alignment with user requirements is critical to ensure the suitability of ESG ratings.

Young-Ferris and Roberts (2023) argue that when ESG data has a financial materiality orientation it emphasises short-term investment, which paradoxically overlooks long-term sustainability impacts. Hardyment (2024, p. 93) has a more scathing view of ESG data commenting that it has little real-world impact and instead, "*offer[s] a false reassurance through imagined precision.*" Hardyment provided the example of MSCI's grossly distorted environmental score of McDonalds Corporation that de-emphasised methane emissions and deforestation from beef production and instead focused on 'water stress'. Even then, the water stress data point referred to sufficient water supply for company operations, as compared to a measure of local water supply (Hardyment, 2024; Simpson et al., 2021).

The global relevance of ESG ratings is also questioned. As these ratings have mainly been developed in the USA, UK and Europe, Linnenluecke (2022) suggests they may not be

transferrable to companies in emerging market countries. For example, a company in EMDE could receive a low ESG rating on the basis that its climate disclosures were delayed rather than reflecting its climate performance. Further, ESG ratings do not accurately account for the supply chain activities of MNCs occurring in EMDE, where ESG performance is lower than in their home country. However, information is improving, and some data providers are searching for this manually and offering this information to customers. Finally, Linnenluecke (2022) makes the important comment that ESG ratings are orientated to providers' ethical values and do not include the views of local and indigenous communities.

Climate-related ESG data

Climate-related data is a subset of ESG data and ratings. Gibson Brandon et al. (2021) reason that it is more easily quantified than governance or social issues due to greater consensus and regulation on measurement standards. Mayer and Reizingerné Ducsai (2023) also found that the accuracy and correlation of climate-related ratings was stronger than other ESG indicators. Hardyment (2024) accepts that emissions measurements are somewhat more standardisable and 'Newtonian' but stresses that climate metrics are complex, dynamic, non-linear and imprecise.

Despite efforts to standardise GHG emissions, there is confusion over which emissions scopes should be included. Further, different measurement techniques can be applied to capture these data points. Berg et al. (2022) compare the number of indicators used by raters to measure GHG emissions. They found large differences, as KLD and Moodys ESG each used 1 indicator; S & P Global used 2; Sustainalytics used 8; Refinitiv used 9, and none were reported for MSCI. The highest correlation on company emissions across data providers was 63%, whilst the lowest had a negative correlation of 6%. The establishment of climate standards by the ISSB will improve the rigour of disclosed data. Yet, gaps will remain for smaller companies and certain geographies, especially where reporting is not mandated. Approximation by ESG data providers will still be required for broad coverage. At present, these issues are unresolved and pose a problem for asset owners and their managers' ability to confidently rely on the unaudited information ESG data and ratings providers.

Lacking evidence of climate performance from ESG ratings

A body of literature examines the link between ESG data and ratings and sustainability performance. Studies by Arian and Sands (2024), Peng et al. (2024), Niblock (2024) and Xue et al. (2023) found little evidence of alignment between climate performance and ESG data and ratings. They provided a variety of explanations for it, an emphasis on short-term financially

material risks and disclosure used for strategic communication (Arian & Sands, 2024), disingenuous company climate statements (Peng et al., 2024), the ineffectiveness of aggregated ESG ratings (Xue et al., 2023) and conversely, the belief that regulation and scrutiny already satisfied risk metrics and excess ESG leadership is costly and risky (Niblock, 2024). Xue et al. (2023) found the inclusion of a rating penalty after a scandal to be a strong indicator of financial underperformance but conceded that past performance may not be indicative of future efforts to prevent ESG incidents.

On the other hand, Clementino and Perkins (2021) found a body of evidence that companies with poor ESG ratings compared themselves to peers and adjusted their operations to avoid reputational damage. The motivation of attracting capital, boosting their standing with investors and maintaining a competitive position against peers were strong motivators for poorly performing companies. Firms seeking inclusion in ESG indices were motivated to make improvements if they received a rating that threatened their inclusion. The literature on company ratings draws on theories of 'new institutionalism', where business conforms to industry norms and is responsive to key stakeholder expectations, especially those with a controlling influence, such as superannuation. A strong ESG rating from a credible rating agency with sufficient authority boosts standing with external stakeholders. Yet, it should also be noted that Clementino and Perkins (2021) also found that most of the changes made by the companies involved in the study were amendments to disclosure rather than improvements in the sustainability of their operations. Suggesting that the ESG rating was not a credible measure of climate performance.

There is a strong consensus in the literature on the high investor demand and recent expansion of ESG data and rating business. The Australian Superannuation sector is reliant on ESG data and ratings for stewardship and investment decisions. The data also informs the constituents in ESG Indices, in which they are heavily invested. Mandated reporting standards and assurance will improve the quality of underlying data, but gaps and imputation concerns will remain. Judgements on the information that is considered relevant, its financial materiality basis and objectivist reduction of complex systems to quantitative measures are problematic for climate outcomes. The scoring methods used and the judgements on its weighting in an aggregated score are also values judgements. These are key considerations affecting these widely used data points. The efficacy of ESG ratings as an indicator of sustainability performance depends on whether they are tempered to maintain business as usual patterns or indicators of transformative change.

2.7.3. Sustainable Finance Taxonomies

The following section will review knowledge of Sustainable finance taxonomies. This tool is used to identify green and transition-aligned economic activity.

Relevance of knowledge on Sustainable Finance Taxonomies (SFTs)

Sustainable finance taxonomies (SFTs) are used to help investors clearly identify sustainable economic activity (European Parliament, 2020b) and are foundational for directing capital to climate adaptation aims (European Commission, 2023). Climate-related taxonomies and national sector decarbonisation pathways provide important investor guidance and are also helpful for governments in documenting their own financial priorities towards net zero transition (IPSF, 2023). There are no international standards for sustainable finance taxonomies (SFT) and numerous developments are occurring concurrently across a growing list of regions (Kirby et al., 2024). The most significant SFT progress has been made in the EU, which has also taken a leadership role and facilitated the collaborative International Platform for Sustainable Finance (European Commission, 2023). The determinations of a sustainable finance taxonomy are underpinned by the judgements and values of its architects, and in the case of national taxonomies, the country's objectives. For example the Australian Government (2023e, p. 16) stated that "*The taxonomy will be a key foundation for the Government's sustainable finance agenda*."

Work on the Australian SFT was initiated by the private sector. Unlike most national sustainable finance organisations that were created with regulator input (Verney, 2022) the government leadership were unwilling (Edwards et al., 2019) so the private sector established the Australian Sustainable Finance Institute (ASFI). The Australian Council of Financial Regulators (CFR) later announced their support in 2021 (Council of Financial Regulators, 2021) and provided input to the advisory committee beginning from the following year (ASFI, 2022b). In 2022, ASFI announced that the development of an Australian Sustainable Finance Taxonomy was a key priority project (ASFI, 2022c) with the aim to "*provide common, consistent, scientifically rigorous definitions for green and transition finance in Australia*" (ASFI, 2024b, p. 8).

Six sectoral areas have been the focus of the taxonomy development in 2024; they are aligned with the Australian government's sectoral decarbonisation pathways, also in progress (ASFI, 2024b). Australia's SFT is due for release in mid-2025 after the current consultation phase. One of the main objectives of the SFT is to achieve a Paris-aligned net zero temperature goal;

therefore, the selected reference scenarios are ambitious and Paris-aligned (ASFI, 2024b). ASFI (2024b) advises that the taxonomy will be voluntary but that the Council of Financial Regulators are seeking opportunities to incorporate it into regulation. Australia's SFT is an essential document that will impact the allocation of capital from superannuation funds and other institutional investors. There is significant potential for capital allocation to climate solutions. For example, according to Corbell et al. (2018) the Australian superannuation sector could finance Australia's complete transition to renewable energy by 2030 using just 7.7% of superannuation savings.

Most significantly SFTs provide criteria for using funds invested in green, social and sustainability bonds. These are discussed in section 2.7.5. The market-based SFT established in 2013 by The Climate Bonds Initiative (CBI) has been a foundational basis for developing other SFTs. The CBI SFT underpins the selection and approval of projects that are funded by the sustainable debt it certifies (Climate Bonds Initiative, 2021). The CBI SFT is a helpful indicator of projects and assets that are deemed compatible with the Paris Agreement.

SDI Asset Owner Platform (2024) is an example of a global asset owner-led taxonomy used by some of Australia's largest superannuation funds for alignment to the UN sustainable development goals (SDG). The taxonomy relies on natural language processing artificial intelligence of publicly-available financial reporting to apply data rules linking investments to SDG goals and conversely, identifying those that have a negative impact. Other uses for SFT include its application as a portfolio alignment tool (SBTi, 2023a) as well as a proxy benchmark for environmental risk analysis or stress test Esposito et al. (2022).

Academic literature on SFTs is limited but growing, a scopus search for "Sustainable finance taxonom*" showed more than 90% of the articles were published from 2022 onwards. Kirby et al. (2024) comments that knowledge on SFTs is embryonic for each of its key stakeholder groups, policymakers, finance sector and stakeholders.

National interests and interoperability

The EU SFT has been influential for the development of other SFTs. It was designed to clarify sustainable economic activities for investors; including climate change mitigation and adaptation investment (European Parliament, 2020b). Investment must satisfy one of six environmental objectives in the taxonomy without harming any of the others and the taxonomy also aims to address the other UN SDGs and ensure activities comply with social safeguards (European Commission, 2022c; European Parliament, 2020b, p. L. 198/ 113).

Additionally, for the EU Commission, their SFT is part of a plan to achieve the European Green Deal (European Commission, 2022c) making Europe the first climate-neutral continent and according to the Green Deal Industrial Plan, "*secure Europe's place as the home of industrial innovation and clean tech*" (European Commission, 2024). The use of taxonomies as a tool for articulating government net zero priorities has motivated a rising number of regional and national SFTs IIGCC (2023a); (IPSF, 2023).

The EU has made efforts to boost regulation globally but even for jurisdictions that do not adopt a SFT, the EU taxonomy has wide-reaching implications. This is because, in addition to any listed EU company with more than 500 employees, any financial product offered in the EU must disclose the proportion of their turnover, expenditure and holdings that are aligned with the EU taxonomy (European Commission, 2021a). This process is also intended to eradicate false product labelling and scale up sustainable finance (European Parliament, 2020b).

China also has well-established legislative sustainable finance frameworks many of which pre-date the EU SFT. These have been critical to China's transition to a lower carbon economy. There are 3 main frameworks;

- 'Guiding Catalogue for the Green Industry' is China's core sustainable finance taxonomy, and was developed in 2016, with a 2024 update that added transition activities, hydrogen energy and green technology and infrastructure (Interesse, 2024).
- 'Green Credit Guidelines' is a set of recommendations that includes a list of green industries and key performance indications for green lending, to meet the objective of lowering emissions (OECD, 2022a).
- 'The Green Bond Catalogue' was released in April 2021 combining guidelines for investment in green bonds that were issued initially by three financial agencies in China. The framework classifies activities that meet environmental criteria and is regularly updated in response to technological improvements, policy changes and environmental developments (OECD, 2022a; Whiley, 2018)

Through their work with the IPSF, the EU has assisted interoperability between taxonomies. As at June 2024, twenty member countries are working together to exchange SFT best practices. Key multilateral organisations including OECD, World Bank, NGFS, UNEP, IOSCO and IFRS are part of its observer committee, and have played an important collaborative role in sharing information for SFT development (European Commission, 2023). In 2020, The Common Ground Taxonomy, an initial working group within IPSF was established to compare SFTs. It found the environmental goals of the EU and Chinese SFTs aligned but unlike the EU SFT which

is linked to several multilateral human rights codes, the Chinese SFT refers to National Environmental, Health and Safety policies (European Commission, 2023).

Transition activities are contested

A number of transition activities have sparked disagreement among actors (Kirby et al., 2024). Disagreement and pressure to support oil and gas projects has occurred in Australia, Canada and the EU (Albuquerque, 2022; De Kretser, 2022; Gordon, 2022). After postponing the decision and convening expert panels, the EU taxonomy allowed fossil gas and nuclear energy to be classified as 'transitional', *"given that technologically and economically feasible low-carbon alternatives may not yet be commercially available at a sufficient scale to cover the energy demand in a continuous and reliable manner"* (European Commission, 2022a, p. 8). The EU SFT sets out regulatory criteria and timeframes for this classification to be used. The decision to permit gas and nuclear energy was widely contested, with veto threats from some member states (Abnett, 2021; Binne & Abnett, 2022; Gabor, 2021).

The consultation phase Australian SFT excludes abated fossil fuel-powered energy noting the CCS is at a low technological readiness level but that the taxonomy would be updated regularly and is not an indication of whether it will be included in the future (ASFI, 2024b). Another area of contention is nuclear power, which was also deemed out of scope in Australia's taxonomy but has been a topic of debate within the opposition government (Grattan, 2024). These arguments are revealing of competing stakeholder priorities and politics that are emerging in the decarbonisation of the economy. Similarly, IIGCC (2023a) refer to the benefit of taxonomies as a basis for investment but criticise taxonomies that are not always based on credible net zero scenarios. They argue that including gas within the EU taxonomy is inconsistent with the IEA net zero model.

Schütze and Stede (2021) explain the need for regular taxonomy updates to respond to emerging technologies. Progress by Climate Bonds Initiative (2021) expert technical working group is ongoing with many of the activities listed in it, such as bioenergy production processes, still being debated and researched by its expert technical working groups. Therefore SFTs are an important indicator of the activities and assets that have potential for a net zero economy but whose development needs greater attention and resources.

Schütze and Stede (2021) also noted the risk of sector lobbying on the classification of 'transitional' activities. They referred to many organisations replying to public consultations as evidence of industry concern. They further analysed activities labelled as 'transitional' in the

taxonomy and found inconsistencies in threshold timing across sectors, particularly those without a well-defined pathway. For example, fully decarbonised cement has not yet been scaled as a commercial substitute and without a threshold in the taxonomy, there is less incentive to find a substitute (Schütze & Stede, 2021). According to Teske et al. (2020), cement production emissions will not reach zero with existing technology, and without these, will need to rely on nature-based offsets. The CBI taxonomy identifies public walking and cycling infrastructure as Paris-aligned and automatically certifiable (Climate Bonds Initiative, 2021). Yet, cement and steel production are noted in the taxonomy as requiring more work to be Paris-aligned. Given the ubiquitous use of cement and steel in the production of public walking and cycling infrastructure, even high-quality labelled green bonds may still need to provide further granularity on the embodied energy of the selected construction materials. Another example of emerging technology is Ciula et al. (2024) who found that landfill biogas could be effectively purified using activated carbon. The authors noted the benefit of the EU Taxonomy for supporting investment into novel biogas projects such as theirs that are aligned with climate change mitigation and adaptation.

The investor perspective: SFTs provide credibility on sustainability

Another necessary function of SFTs is to eradicate false claims or "greenwashing" and ensure sustainable investment products are genuinely beneficial in achieving environmental objectives (European Parliament, 2020b). The literature on the efficacy of SFTs is mixed. SFTs have been strongly praised for their role in determining environmental impact through positive investment and exclusion of investments that may cause social harm despite being environmentally beneficial (Vu, 2022). IPSF (2023, p. 12) comment that they try to "*manage the balance between maintaining ambition towards achieving a lower carbon economy, while not excluding companies from the ability to access the finance that they need."* Kirby et al. (2024) acknowledges their imperfections but considers them to be a positive step, whereas Knapp et al. (2024, p. 85) is scornful of SFTs, arguing that they are subject to political interests. They claim the EU SFT maintains "*the increasingly questioned hegemony of the neoliberal, finance-dominated, imperial capitalist system*" rather than enforce transformative green activities. The assessments of impact, positive investment and the boundary for inclusion of capital are inevitably subjective.

Knowledge of SFTs is growing and will be necessarily dynamic to respond to the development of technologies and activities they deem acceptable. As a concept, SFTs have immense potential to assert new criteria for investment towards a decarbonised economy. However, as

with climate-related financial reporting and ESG data, there is the possibility that SFTs do not promote deep transformation to sustainability and instead sponsor a business-almost-as-usual future. This remains to be seen as SFTs are issued, investors determine how they will allocate capital in response, and governments decide if they will be enforced.

2.7.4. Sustainable and Climate-Focused Investment Products

The following section reviews knowledge and shows the need for sustainable investment product labelling. Whilst this has not yet been implemented in Australia, its adoption in the US, UK and EU provides a foundation for forthcoming debate.

With increased climate commitment, financial market participants have attracted more capital and launched more sustainable funds and products. Investment in sustainable funds globally reached 3 trillion USD invested as at December 2023 (Morningstar Inc., 2023). There have been a wide range of Sustainable Investment market size estimates, due to the market being defined inconsistently (Morningstar Inc., 2021). Morningstar define Sustainable Funds as any whose prospectus or fund objective is deliberately focused on sustainability, impact or environmental, social or governance considerations (Morningstar Inc., 2022). About 3% of all Australian and New Zealand funds fit that definition, totalling 33 Billion AUD, of the 1.1 Trillion AUD funds under management as at December 2023 (Morningstar Inc., 2023). Other market size estimates included mainstream funds whose holdings happen to have a bias towards sustainability or who have made some investment decisions based on any ethical or ESG basis, for example, the exclusion of tobacco companies. For example, RIAA (2021) noted that 89% of all managed funds declared that they considered ESG issues in their investment processes. RIAA also created a proprietary scoring system as a way to identify sustainable investment funds. Using their classification system, they assessed funds and classified 27% of Australian Managed Funds as 'Responsible Leaders' (RIAA, 2021). Classification of sustainable funds is made even more complicated as the total funds under management are also calculated differently. RIAA referred to Australian Bureau of Statistics (2021) data whilst the Morningstar data adjusted assets due to mergers, liquidations and corporate actions and excluded duplicate funds of funds and collective investment trusts.

Sustainable investment fund labelling

The uncertain classification of sustainable funds is widely acknowledged issue for sustainable investment (KPMG, 2020; UK FCA, 2023). Sustainable fund labelling has been introduced in some jurisdictions to overcome this lack of clarity, set market expectations of a product and improve green-washing (SEC, 2023; UK FCA, 2023). Sustainable finance labelling is intended to

begin in Australia in 2025 (Australian Government, 2024k). Also, in Australia, RIAA (2023a) expanded its responsible investment certification program from 2024 with the addition of 'sustainable' and 'sustainable plus' classifications to identify sustainable investment products using similar labelling frameworks to the US, EU and UK (McNally, 2024).

A discussion of the sustainable finance labelling frameworks in the US and UK follows. Products in the EU have adopted the SFDR categories 'sustainable' and 'transitioning' in their product labelling, although this was not the intention of regulators who are now developing new investment product categories (European Supervisory Authorities, 2024). They also aim to be interoperable (European Supervisory Authorities, 2024; UK FCA, 2023) so the section below suggests comparative groupings. The UK FCA offers an additional label, 'sustainability mixed goals' for funds that cross sufficiently over multiple categories.

ESG Integration (SEC US) –

For the SEC, these funds are conventional; however, as one or more ESG considerations are considered alongside other factors within the investment strategy, they fit into this group. Securities and Exchange Commission (2022, p. 174) notes that "*virtually all asset managers have incorporated ESG considerations to some degree.*" Their approach to ESG consideration, though, differs greatly. Some funds may consider just one ESG issue, whilst others have deliberately added broad ESG components into their investment process. Under the SEC proposal, the fund must specify which ESG factors they consider. If a fund refers to the consideration of GHG emissions, then the fund must also describe the methodology it uses and the extent to which it considers GHG emissions (Securities and Exchange Commission, 2022). There is an element of uncertainty in classifying funds whose investment process has always considered ESG issues without intentionally seeing them as such (Hall & Whieldon, 2022b). Suppose a fundamental analysis process would always have questioned a business's governance process and structures as part of their due diligence. Would that be a reason to name it as an ESG Integration fund?

By contrast, European Supervisory Authorities (2024) proposed that products not meeting minimum sustainability criteria must include a disclaimer on the product's negative impact. The UK FCA (2023) considered the same but dismissed it on the opinion that it was disproportionate at this stage. However, they require any products that use sustainability-related terms in their names to provide a disclaimer if they have not met minimum labelling requirements.

Sustainability Focus (FCA UK), Sustainability Improvers (FCA UK), ESG-Focused (SEC US) –

These strategies apply ESG or sustainability factors as a main component of their investment strategy.

For the SEC, a strategy's focus on ESG may be indicated by a fund with an ESG name, a marketing approach that emphasises ESG as central to the fund, an ESG-orientated investment process and/ or significant attention on corporate engagement. ESG process will need to be disclosed granularly, detailing any third-party data providers used to inform investment decisions (Securities and Exchange Commission, 2022).

The UK FCA (2023) criteria are more stringent, requiring funds to use a sustainability label to include it in the fund investment objective and for at least 70% of the assets to be invested accordingly. The fund must also disclose and demonstrate its progress against an absolute social or environmental target. These can be labelled as Sustainability Focus or Sustainability Improvers and must link to the UK or EU taxonomy or an environmental or social metric assessed independently.

The EU has proposed using a threshold where at least 80% of the investments in a fund must meet environmental, social or sustainable investment categories for it to be named as an ESG fund (European Supervisory Authorities, 2024). Both the proposed 'sustainable' and 'transition' labels would be EU taxonomy-aligned and would require these to be stated in the fund objective and meet a required threshold. The former must have already been assessed as sustainable, whereas transition investments would need to meet the timeframe of an accepted pathway or KPIs (European Supervisory Authorities, 2024).

Impact Funds (SEC US), Sustainability Impact (FCA UK) –

For the SEC, these are a subset of ESG-Focused funds with a deliberate ESG impact goal. Their performance is measured in relation to that goal (Securities and Exchange Commission, 2022). In addition to the requirements for ESG-focused funds, under the new disclosure proposal, an impact fund will need to report its impact goal and progress in achieving it annually.

Similarly in the UK FCA (2023) framework, this label is for products that explicitly aim to deliver measurable sustainability impact and provide an accompanying theory of change. If the strategy is likely to have a material impact on financial return, this needs to be disclosed. Impact measurement can be quantitative or qualitative. If satisfactory progress cannot be demonstrated, then an escalation plan must be implemented. This category of funds only fits with existing Australian BFID requirements if trustees can concurrently demonstrate the investment's strong financial performance.

Financial performance of sustainable investment funds

A significant challenge for Sustainable Investment has been the perception that it will compromise returns. An extensive body of literature tests sustainable funds' financial performance against traditional funds. Performance findings are immensely mixed but might be explained by the breadth of fund types named sustainable investment products without a labelling regime that properly identifies these. Sustainable investment strategies are used in a wide variety of investment approaches, from quantitative to fundamental analysis to passive funds across all asset classes. The vast array of approaches that can be used to build a sustainable fund determine returns and costs could also be a reason for mixed results. Many of the researchers note the effect of the limited ESG time frame, data coverage and quality that affected their results (Alshehhi et al., 2018; Tan et al., 2023). The high expense ratios and the effect of fees on ESG fund returns are other considerations in the literature (Bradley, 2021; Sharma et al., 2024). The cost of ESG funds has been higher than traditional funds due to the greater level of research required (Bones et al., 2018).

Some studies contest that even with high fees, they outperform traditional funds (Sharma et al., 2024). They also emphasise the lower risk of sustainable funds (Das et al., 2018; Gonçalves et al., 2021). Several meta-analyses have been conducted to seek a definitive answer on the correlation between sustainability and financial outperformance. Alshehhi et al. (2018) examined 138 studies and found 78% of results had a positive correlation between sustainability and financial performance. Friede et al. (2015) did a meta-analysis of 2200 studies and found a small positive correlation but found that 90% had no negative correlation, indicating that the sustainable investment funds were not damaging to financial results. Demonstration of financial performance is a criterion of BFID. On the other hand, some studies claim the financial performance of sustainable investment funds is negative, arguing that ESG investment is harmful to returns (Alexandre et al., 2022; Bhagat, 2022; Hartzmark & Sussman, 2019; Tan et al., 2023). A study of 81 finance sector practitioners in the three years to 2020 found a negative sentiment towards ESG investment due to poor data quality and scepticism of ESG factors as risk indicators (Zeidan, 2022).

Buallay et al. (2020) conducted a study of 59 listed banks in Middle East and North African countries and on the contrary, found investors incurring additional costs for the banks which had a higher focus on sustainability. These findings are consistent with other studies that have indicated the need for targeted research on the enhanced challenges for investment in the net zero transition of EMDE countries. Studies refer to a range of financial barriers that limit their

adaptation capacity (Crick et al., 2018). Therefore, in addition to policy intervention, development finance institutions must play a role in attracting and leveraging private capital to enable short-term transition away from emissions-intensive assets according to a pathway that also acknowledges the need for poverty reduction (Fankhauser et al., 2023).

Given the breadth of focus within sustainable investment funds, it is also helpful to consider research that is specifically related to climate. Abrams et al. (2021), found that if companies with the poorest carbon performance in their industry can reduce and reach their industry average, then their valuation would increase by about 5%. Trinks et al. (2018) studied the performance of portfolio exposure to fossil fuel stocks over almost 90 years to 2016. They concluded that fossil fuel exclusion had no negative impact over that long horizon. They explain that whilst fossil fuel stocks might rally over a short horizon and their exclusion could lead to short-term underperformance, their performance was market-like over a long horizon. This is also supported by the performance of the MSCI World ex Fossil Fuels Index against the MSCI World index in the ten years to November 2024, where the former under-performed in 2011, 2016, 2021 and 2022 but out-performed over both a five and ten-year cumulative horizon (MSCI Inc, 2024b). A further example is Bender et al. (2019) who built a theoretical equity portfolio that limits emissions to below 2 degrees according to the RCP climate scenario and optimised climate risk mitigation and adaptation investment. Using historical data over a five-year period to June 2018, they found that it delivered higher risk-adjusted returns than global markets. Studies also showed the financial benefit of voluntary environmental disclosure for reducing risk and, therefore the cost of equity (Albarrak et al., 2019; Buallay, 2019; Clarkson et al., 2019).

The discussion in 2.7.4 showed the vast range of products associated with sustainable finance. Labelling is still emerging and differences by jurisdiction and the special needs of labelling that incorporates EMDE are apparent. Better classification will enable investment clarity and more granular research. This may result in more consistent findings on financial performance.

2.7.5. Sustainable Debt Types and Labels

The following section synthesises knowledge on sustainable debt. Labelling and investment criteria in this asset class are also integral to net zero superannuation portfolios.

Sustainable debt refers to capital that is loaned for projects with an environmental or social benefit. According to Climate Bonds Initiative (2024b), as at June 2024 sustainable debt reached a cumulative volume of 5.1 trillion USD, with more than two-thirds invested in green bonds. Sustainable debt, also referred to as GSS+ bonds is divided into five main categories

determined by the use of proceeds for green, social, sustainability and transition bonds, whilst sustainability-linked bonds are performance-based (Climate Bonds Initiative, 2022). The quality of green bonds differs so verification and labelling help investors avoid greenwashing (Boermans, 2023). An array of green debt frameworks provide disclosure and verification processes, that are often linked to taxonomies for improved credibility (IOSCO, 2023). As discussed in 2.7.3 in relation to SFTs, the values of their creators are embedded in their judgements of environmental criteria and thresholds.

Research on green bond issuers and holders is evolving, just as the market itself is still emerging. Boermans (2023) suggests that previous research may no longer be relevant given the extent of market development. Green bond issuers tend to be large banks, as green investment is considered riskier and requires sufficient assets to mitigate default risk (Akomea-Frimpong et al., 2020). Climate finance could be incentivised with policy changes such as reduced bank capital reserve requirements for green loans as was considered by the European Parliament and Commission (Ameli et al., 2021). Green bondholders are most often mutual funds and pension funds, with a likelihood that mutual funds are invested in these on behalf of pension funds (Boermans, 2023). Research also showed that demand for green bonds by mutual funds and pension funds was so high that they are willing to pay a 'greenium' that increased further if the bond was issued domestically (Boermans, 2023; Chenguel & Mansour, 2024). This study has important relevance for net zero Australian superannuation portfolios.

Sovereign bonds are a recent development for GSS+ debt. They help 'mainstream' and improve the credibility of sustainable debt and assist other investors set a GSS reference point, by establishing a sustainable debt yield curve. Sovereign bond issuances help governments achieve their climate commitments. An early example was two green gilts at a combined value of 15 Billion GBP launched by the UK in 2021 with a maturity of 2033 and 2053. Proceeds will be used for renewable energy, clean transportation and other climate change mitigation and adaptation investments to help the UK achieve their 68% emissions reduction commitment by 2030 (HM Treasury & United Kingdom Debt Management Office, 2021). The Australian Government (2023c) developed a Green bond framework, with the first issue launched in June 2024 with a 10-year maturity and an issuance size of 7 billion, further Australian green bonds with other maturities are expected to follow (Australian Government, 2024i). The Australian green bond market, which also includes bank, state and AUD-denominated offshore issuances, has expanded but is still small relative to the asset class (Armour et al., 2023). The use of sovereign bonds by EMDE is also encouraged by investor interest groups although many of the

countries that would benefit from this most do not satisfy the investment criteria for inclusion in the universe of bonds (IIGCC, 2024b).

Sustainability-linked bonds and loans (SLBs and SLLs) incorporate measurable, externally verified environmental or social performance goals with linked penalties and rewards and are applicable for companies that do not have a specific environmental or social impact project or product. The issuer sets the targets and should be ambitious, reporting should be public and external-verified (International Capital Market Association, 2020). Akomea-Frimpong et al. (2020) explain that interest charges are typically low to increase green investment. An example of a sustainability-linked bond target is by utility company Enel (2020), who used two performance indicators: their stated emissions target in 2030 and 60% renewable energy installed by 2022. Enel agreed that if they did not achieve one of these targets in their 7-year tenor, then their debt payment margin across their 35 Billion Euro SLB, would be increased by 25 basis points. This is material for a company with net profits in 2021 of 5.6 Billion euros and net debt of 52 Billion euros (Enel, 2022). This framework was reviewed by ESG data firm Vigeo Eiris (now owned by Moodys ESG) and KPMG for limited external assurance (Enel, 2020). In January 2022, Enel improved their emissions reduction target, to eliminate all scope 1 emissions by 2040, previously 2050 (Enel, 2022). They also noted that they intended to increase their ratio of debt from sustainable debt sources, which they expected would reduce their cost of debt from 3.5% in 2021 to 2.9% in 2024. However, although Enel reduced their scope 1 emissions by 30%, they missed their renewable energy target, which they attributed to the energy crisis caused by the Russia-Ukraine war (Joubert & Oblin, 2024). In addition to the interest charges that increased by 25 million EUR. Joubert and Oblin (2024), argue that investors will likely penalise Enel with an increased cost of capital.

On the other hand, SLBs have been criticised for having unambitious targets, low penalties and structural loopholes favouring issuers. Haq and Doumbia (2022) found that the target date for step-up penalties of SLBs was on average set at 57% of the bond tenor, compared to step-down incentives that were set at 36%, therefore minimising the cost of the penalty by setting a later target date or raising the incentive with an earlier date. Similarly, they found that SLBs were five times more likely to have a call provision enabling early redemption than conventional corporate bonds. If the call date is close to the step-up penalty target date issuers could reduce or avoid the penalty.

This section illustrated the potential for sustainable debt to attract capital for climate solutions given the substantial size of the asset class and the willingness of investors to pay a ‘greenium’.

SLBs and SLLs further incentivise ambitious transition if their arranged conditions are meaningful but may be damaging to entities if they fail to meet their agreed KPI. Unambitious or contrived SLB penalties and structures pose a reputational risk to the financing instrument. The emergence of green sovereign bonds is used by Governments to attract fixed income investment in national climate transition. The proceeds could also be used to assist developing countries although the rhetoric of Australia's green bonds is nationalised. EMDE green sovereign bond issuance could also scale climate solutions. The use of proceeds terms and taxonomy provide sustainable debt credibility, but these are also imbued with value judgements, and national SFTs can be politicised. Developments in verification and labelling could improve the integrity of sustainable debt but investors will need to be diligent in ensuring the use of proceeds, taxonomies and incentives are aligned to their net zero interpretation.

2.7.6. Carbon Credits

Topics related to compliance and voluntary carbon credits are fiercely debated. This section synthesises the literature to extract the key issues relating to net zero superannuation portfolios.

A carbon credit is deemed equivalent to one tonne of CO_2 equivalent emissions. The credits are generated from a range of carbon reduction projects including reforesting land or GHG gas capture. Carbon credits are traded in carbon markets that are either compliance markets operating in jurisdictions with an emissions trading schemes (ETS), or voluntary carbon markets (VCMs).

Compliance carbon markets

Compliance markets cap the combined emissions of companies included in the scheme to ensure emissions do not exceed that limit. Companies must match the emissions they generate with allowances, that are surrendered annually. Companies that reduce their emissions and have surplus allowances, can sell them to other companies or save them for the future. In a limited and lessening number of cases, allowances are allocated at no cost, usually to assist industries that would not otherwise remain economically viable in that region. By design, the cap reduces, and prices increase over time, to further incentivise emissions reduction (International Carbon Action Partnership, 2022). As at April 2022, 38 countries have an emissions Trading Scheme, which together covers 17% of GHG emissions globally (The World Bank, 2023). As with other carbon fiscal mechanisms such as carbon pricing, ETS are

politically polarising and have been manipulated and fiercely contested in Australia by fossil fuel interests (Gergis, 2024).

Launched in 2005, the EU ETS is the largest and most advanced carbon market, with allowances set in line with the EU 2030 climate target to reduce carbon emissions by 55% from 1990 levels (International Carbon Action Partnership, 2022; The World Bank, 2023). Auctions are open to companies that require them for compliance with the ETS, as well as voluntary participants. As at April 2022, carbon under the EU ETS cost an average $87 USD/tCO2 (The World Bank, 2023). In 2021, the EU ETS Carbon market revenue from auctions was $37.6 billion USD (International Carbon Action Partnership, 2022). Funds are allocated to member national budgets who must report the use of proceeds to the EU Commission. In addition to the primary auctions on European Energy Exchange (EEX), there is a secondary market. The secondary market, ICE, trades carbon spot, futures and options. The EU ETS will be introducing a carbon border adjustment mechanism (CBAM) from 2026, that will alter prices to incorporate their embedded emissions (International Carbon Action Partnership, 2022). This measure is especially important for equitable trading with jurisdictions such as Australia, that have an unambitious, or no ETS in place.

Another well-established carbon ETS is the California Cap and Trade program where allowances reflect the 2030 target of 40% GHG decreases from a 1990 base. Like the EU ETS, credits are traded for ETS compliance or voluntary participation in primary market auctions or distributed without cost to eligible organisations. Funds raised from carbon auction allowances are invested in projects including renewable fuels, soil regeneration and recycled material product manufacture (CalRecycle, 2022). In addition to buying carbon credits from brokers, on exchanges and from project developers, their derivative products are also traded in the secondary market with ICE or CME (International Swaps and Derivatives Association, 2021a).

Australia legislated The Safeguard Mechanism in 2014, allowing nominated entities whose emissions are below their required baseline to apply for Safeguard Mechanism Credits (SMCs) that can be sold to other entities in the scheme, or kept for future use (Australian Government, 2024a). The scheme was reformed in 2023 following Australia's legislated climate target and other global developments such as the EU Carbon Border Adjustment Mechanism plans. It is more effective now that baseline emissions must be reduced by 4.9% each year to 2030 (Australian Government, 2024a). The Australian government has also initiated an Australian Carbon Exchange to begin trading ACCUs in 2025 (Australian

Government, 2024c). Unfortunately, as at June 2023 ACCU spot prices were 32 AUD/carbon tonne, far lower than in the EU market.

The effect of the Safeguard Mechanism has been small relative to national emissions. For example, the overall emissions reduction goal for the Safeguard Mechanism is less than the emissions that will occur from one hydraulic fracturing project planned in the Beetaloo basin. The fracking plans are part of a precinct that was worryingly promoted as sustainable under the Morrison government and has attracted 1.5 billion AUD of funding by the Albanese government despite forecasted 1.2 billion tonnes of emissions over 25 years (Gergis, 2024; Mitchell, 2024). In addition to SMCs, entities can use Australian carbon credit units ACCUs to cover their emissions. An explanatory statement is required if more than 30% of emissions are covered by ACCUs. If an entity does not meet their baseline they can purchase up to 10% of it in ACCUs from the government at a growing rate of 75 AUD + annual increase of (CPI + 2%)/ tonne. The entity is also penalised with a 10% interest rate increase throughout the following year. If required, a plan and monitoring period may be established and compliance failure would be penalised (Australian Government, 2024a). ACCUs can also be created through voluntary participation in Australia's Emissions Reduction Fund, which has been in place since 2011.

Voluntary Carbon Markets

The use of carbon credits generated in voluntary markets to offset emissions in an entity value chain is fragmented and debated (Saric et al., 2021). Supporters argue that carbon has no boundaries, so any global emissions reduction is an effective tool. They explain that VCMs support innovation in carbon reduction projects with investment streams that were not otherwise accessible (Saric et al., 2021). Taskforce On Scaling Voluntary Carbon Markets (2021) convened more than fifty carbon market experts, and 120 institutions to recommend and report on necessary improvements to scale strong, verifiable VCMs. The report notes that the market has the potential to grow from $723 million USD in 2023 to $50 billion USD by 2030 (Ecosystem Marketplace, 2024). The average price per ton of carbon in VCMs in 2020 was only $7.37 USD (Ecosystem Marketplace, 2024). However, has the potential to reach $90/ CO_2e tonne by 2030 (Taskforce On Scaling Voluntary Carbon Markets, 2021).

The opposing view to VCMs is that offsets are a quick solution but that carbon transition needs deeper decarbonisation. Science Based Targets Initiative (2021) argued that carbon credits should not be counted in emissions targets and instead reduction must happen within a company's own value chain. They believe offset use should be limited to residual emissions

where there are no alternative technologies and surplus climate finance only. The EU ETS does not allow the use of offsets due to the pricing of carbon in VCMs being significantly lower than in compliance systems and concerns about the differing international carbon standards and lack of reliability (Saric et al., 2021).

Carbon project quality and credibility has improved over time. Schneider and Kollmuss (2015) refer to the lack of integrity in past carbon offset projects, where emissions were deliberately generated by a polymer plant in Russia, where dangerous sulfur hexafluoride emissions more than doubled despite no changes to plant design or outputs, to unduly gain credits from their abatement by combustion. More recently, Aston (2021) criticised Westpac's use of voluntary carbon offsets as immaterial to Australian sustainability outcomes and ineffective in providing necessary carbon finance, stating that Westpac was investing in "*a highly profitable green power plant in Tamil Nadu, which doesn't need money to get off the ground nor to stay afloat.*" Another concern has been the duplication of credits from a single project to falsely create additional offset credits. For this reason, projects should be uniquely numbered and independently verified in reputable VCMs (Greely, 2022). Another consideration is permanence, which is the lifespan of the offset; for example, if a tree is cut down, it will no longer be reducing emissions. Lack of transparency and a series of mismanaged incidents have led to scathing views of carbon offsetting. Gelmini (2021), writing on behalf of Greenpeace, says, "*Offsetting has become the most popular and sophisticated form of greenwash around*." Due diligence is important to ensure the credibility of the project (Greely, 2022b). Although Reisinger et al. (2024) argue that the disingenuous use of offsets has resulted in overly stringent rules that disrupt the flow of capital, especially in EMDE regions that will require carbon removal.

Processes to improve the credibility of carbon markets are in progress. To overcome credibility concerns, VCMs advertise robust standards to give integrity to the claim that GHG emissions are being reduced with the credits (Greely, 2022). For example, Verra, the largest voluntary GHG market requires projects to comply with the following criteria:

(i) Additionality – that the project could not have been implemented without climate finance and that carbon has been credibly reduced.
(ii) Approval - Projects are diverse but must be approved by peer review.
(iii) Occurrence – credits are not issued until the carbon has been credibly removed as opposed to circumstances when the credits are issued in advance of the project commencement.

(iv) Buffer account – an account is held in order to support any carbon reversals due to previously removed carbon being released.

(v) Verification – independently audited, numbered and registered projects.

Investors need an active standardised secondary and over-the-counter markets, standardised spot and futures contracts with transparent market prices and liquidity (Taskforce On Scaling Voluntary Carbon Markets, 2021). In 2024 ICVCM (2024) released carbon credit principles to support supply-side and market credibility, and the Voluntary Carbon Markets Integrity Initiative (VCMII) is centred on demand-side integrity (Greely, 2022a). VCMII also developed a Claims Code of Practice in 2023 that included monitoring, reporting and assurance (ICVCM, 2024; Voluntary Carbon Markets Integrity Initiative, 2023).

The historic operation of the safeguard mechanism in Australia has been politically feeble and thus ineffective. VCMs have also been tarnished by disingenuous practice and at times used in place of feasible decarbonisation. The conditions in which ETS and VCMs credits are created, traded and used are critical to their integrity and underutilised potential. Adequate regulatory parameters must be set to ensure their credibility and value. As global investors, superannuation funds are exposed to an array of compliance credits and their border adjustment mechanisms. This section showed the relevance and complexity of both compliance and voluntary carbon credits for supporting net zero transformation.

2.7.7. Sustainable Derivatives Instruments

Derivative investments are used as a further tool to support net zero portfolios. This section outlines knowledge of derivative products to understand their potential contribution and challenges that have arisen.

Although ESG issues were sometimes integrated into derivative markets previously, 'sustainable derivatives' were first officially traded in 2019 (Arias-Barrera, 2024; BDO United Kingdom, 2021). The range of sustainable derivative instruments, structures and payoffs is vast but their level of use has been low, and predominantly issued in European markets where counter-parties are typically banks (BDO United Kingdom, 2021; O'Leary, 2022). Research is similarly limited, although a main contribution is a legal analysis by Arias-Barrera (2024) that supports the role of ESG derivatives as a risk tool and argues for improved EU and UK regulation linking derivatives markets to ESG frameworks as well as to robust KPIs.

Arias-Barrera (2024) categorise three types of sustainability derivatives; traditional derivatives with an ESG overlay, sustainability-linked derivatives and voluntary carbon market credit derivatives.

Traditional Derivatives, such as credit default swaps, can be structured to respond to company performance against a pre-determined ESG KPI (Arias-Barrera, 2024). The market size is sufficient enough for Markit iTraxx MSCI ESG Screened Europe to offer an index of credit default swap (CDS) using ESG exclusions, performance against UN Global compact principles and MSCI ESG ratings. The index is promoted as a way to increase ESG exposure or for counter-parties to hedge the risk of ESG bonds (IHS Markit, 2020). The product was criticised for its low trading volumes and the quality of data within its ESG rating construction (Asgari, 2020; Elsenegger, 2021; Macaskill, 2021). A further type of ESG overlay is catastrophe weather derivatives, a type of insurance-linked security. Although these are mainly traded between insurers and reinsurers they offer risk protection against extreme weather events.

A Sustainability-linked Derivative using a conventional credit default swap or an interest rate swap structure can be used to hedge the risks of a sustainable debt issuance against a KPI (National Australia Bank, 2021). For example, the credit spread charged on an interest rate swap linked to an SLB could be reduced by up to 20% if the company meets their KPI (National Australia Bank, 2021). Sustainable derivatives can be layered over sustainable debt or created as independent products. Depending on the agreed structure, the benefits of achieving an agreed SLB KPI can be increased by using sustainability derivatives. Despite the lower returns, banks are incentivised by reputational benefits, Global Head of Sustainable Finance at National Australia Bank said, "*We need to show we are working with our customers to transition toward a Paris Agreement-aligned world*" (O'Leary, 2022).

If the company does not meet their KPI there is a compensation payment structure with penalty funds directed to a charity or climate action project (International Swaps and Derivatives Association, 2021a). For example, HBSC issued a sustainability-linked interest rate swap with Siemens Gamesa, a wind power company. The swap converted half of an existing floating rate SLL to a fixed rate. The fixed rate does not change if Siemens Gamesa does not reach their KPI - an improved ESG rating – but they have agreed to donate to a non-profit project. Conversely, HSBC will pay for the donation if they do achieve the ESG rating improvement (International Swaps and Derivatives Association, 2021a). Although the wind-turbine projects resulted in 4 billion EUR losses and a low investment grade rating in 2023, Siemens Gamesa achieved an AA MSCI ESG rating (Bloomberg, 2024; Siemens Gamesa, 2024).

Despite the wind turbine unit's unimpressive financial position, a group of 26 banks motivated by climate outcomes agreed to a new 5 billion EUR sustainability-linked finance deal (Bloomberg, 2024).

SLDs are typically bespoke with differing rewards or penalties, such as improved foreign exchange rates or interest rate/spread changes. Efforts have been made by International Swaps and Derivatives Association (2024) to provide standardised KPI guidelines, they developed a clause library to improve the drafting and negation processes and establish clear consequences if requirements are unmet. Arias-Barrera (2024) strongly supports scaling SLDs but again raises concerns about their link to ineffective ESG ratings. Given the challenges of climate uncertainty in SLDs Arias-Barrera (2024) recommends that counterparties prepare dispute resolution mechanisms.

Carbon Credit Derivatives

A carbon futures contract is an agreement to purchase carbon credits at an agreed future price and date. Alternatively, the company or investors can trade the futures before expiry, seeking to profit from price increases in the futures contract. A carbon credit option (or put) is similar, although the holder can decide whether or not they want to buy (or sell). Companies under carbon compliance systems use carbon credit derivatives to hedge their future emissions production, whilst companies also buy carbon derivatives to hedge future carbon price adjustments (International Swaps and Derivatives Association, 2021b). Future pricing is also helpful information for investors and regulators.

The most established carbon markets are the EU ETS, the Western Climate Initiative in California, The Regional Greenhouse Gas Initiative and The UK ETS. Each has a variety of futures and options traded over their ETS (International Swaps and Derivatives Association, 2021a). Some examples of highly-traded emissions derivatives are,

- Californian Carbon Offset Futures, which are available on several exchanges including Intercontinental Exchange (ICE). Certificates allowing future emissions under the California Cap and Trade program are issued in bundles of 1000 offsets, with expiry dates of up to ten years (Intercontinental Exchange, 2022).
- European Union Allowance (EUAs) Futures are traded in relation to the EU ETS, listings are found on several exchanges including (Nasdaq, 2022). EUAs are issued annually and traded in bundles of 1000 offsets. Contracts will be terminated after 2030 and are

subject to strict rules that limit the amount of allowances that can be issued and stored (European Commission, 2022b).

- CBL Global Emissions Offset (GEO) Futures is an example of a product that caters for voluntary carbon markets. The underlying GEO has been aligned to the 'Carbon Offsetting and Reduction Scheme for International Aviation' standards that set out protocols and verification processes for offsets. GEO was launched in 2020 and is a credit system intended for use across a broad set of organisations with voluntary carbon-offsetting programs (Xpansiv, 2022). Derivatives exchange CME Group (2022) trade these voluntary carbon futures in bundles of 1000 offsets with an expiry of up to three years.

The US Commodity Futures Trading Commission (2024) provided regulatory guidance on carbon derivatives contract listings in September 2024. They reiterated some of the concerns relating to the credibility of voluntary carbon credits noting that derivatives must be underpinned by robust credits. Additionally, they proposed exchange processes in case of a physical contract settlement. Regulatory categorisation is critical to carbon derivatives functionality, but carbon credits are not globally defined as either a financial instrument or a commodity (Arias-Barrera, 2024).

The net zero benefits of sustainable derivatives are greater market liquidity, scale and finance conditions. As with other tools for change, the criteria applied to their use are key to their successful use for net zero transformation as opposed to their market benefit.

Climate-related financial information, ESG data and ratings, sustainable finance taxonomies, products and their labelling structure are important tools to support the implementation of net zero superannuation portfolios. The development of all these tools, however, is nascent. Academic knowledge of these tools has also expanded and provided an important analysis of their efficacy. The involvement of regulators has and will continue to help scale, standardise, incentivise and build capacity for sustainable investment. The financial and national prioritisation within these tools is a recurring issue in the literature. This was found in the financial materiality orientation of reporting and data, national comparative advantage emphasis in sustainable finance taxonomies, as well as the short-term financial return pressures and low ambition within many of the sustainable investment products. This part showed the necessity of research to understand the climate emphasis compared to financial

and national prioritisation in the tools for change used by superannuation funds with net zero goals.

2.8. A Research Opportunity

A review of the literature identified the following debates:

a. The concept of net zero can potentially achieve the system change described in the Paris Agreement. Its simplicity and calculable appeal have enabled net zero commitments on a broad scale. However, the strategic objectivism in the net zero campaign has also obscured its intent and reduced complex natural systems to incomplete metrics. The interpretation and fiduciary duty of net zero is unclear and contested by actors.
b. Even with certain evidence of its worsening state and the need for transformative global action, planetary emissions have continued to rise. Whilst some climate action is evident in developing countries, unequal transition and economic interests are at the core of the disputed extent of net zero responsibility.

These observations are explored in the research sub-question, **'How are actors interpreting net zero superannuation portfolios?'**

c. The obligation and opportunity for APRA-regulated superannuation portfolios to manage climate risk is supported in the literature and is aligned with its long-horizon mandate. Yet, competing demands and characteristics of the sector and the unintended consequences of regulation have impacted the sectors' net zero progress. Current regulatory conditions are at odds with Australia's climate commitments and need for private capital.

This research will fill a gap in scholarly research by contextualising net zero action with the transition of the superannuation sector.

d. Financial materiality is prioritised within regulatory interpretations of fiduciary duty, posing a challenge to the ability of net zero to address planetary sustainability and introducing a legal risk of greenwashing.
e. Competitive pressure in finance sector conventions favours short-term profit over long-term value creation and, therefore, limits climate solutions investment. Governments also try to demonstrate national economic performance using short-term measures.

These issues indicate the need to examine the sub-research question, **'Which are the most effective places to intervene in the system to support net zero superannuation portfolios?**'

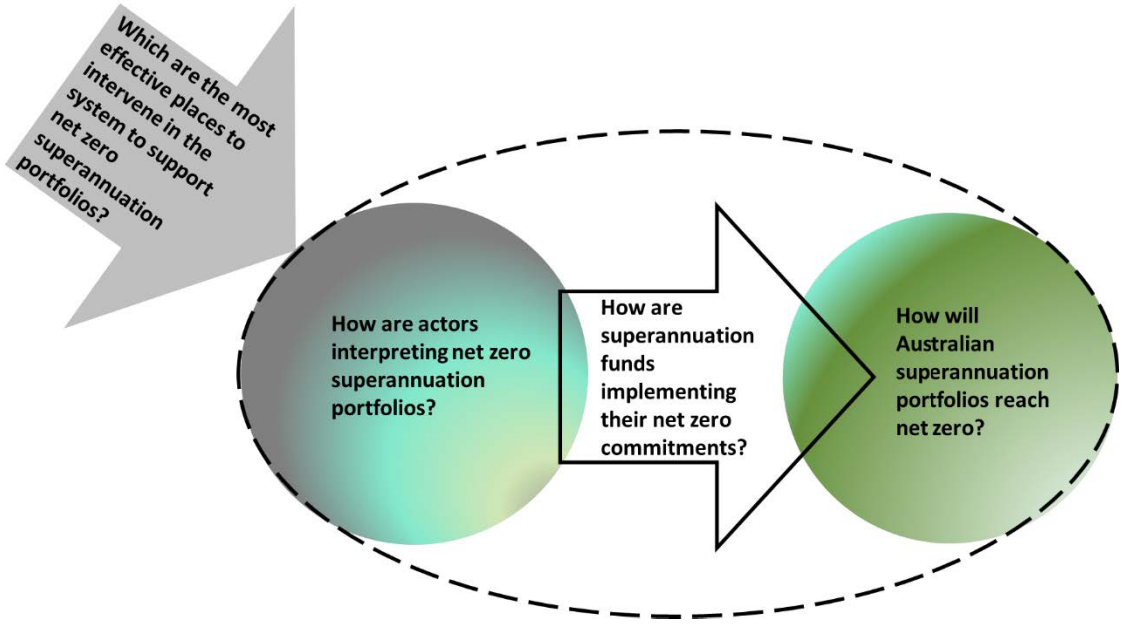
f. A set of sustainable finance tools needed to support net zero investment have been developed and continue to be refined. There is boundless potential for these tools to reorientate capital to address the planetary impacts of climate change. Despite claims of objectivity in their quantitative orientation, the tools supporting net zero transition are inevitably underpinned by assumptions and values. Their net zero potential has been constrained by the financial materiality and short-termism within industry conventions and policy regulation.

Given these concerns, there is a need for research to address the sub-question, **'How are superannuation funds implementing their net zero commitments?'**

This review of the literature provides a basis for the research and shows the urgent context for examination of these sub-questions, which together lead to the overall thesis question

'How will Australian superannuation portfolios reach net zero?'

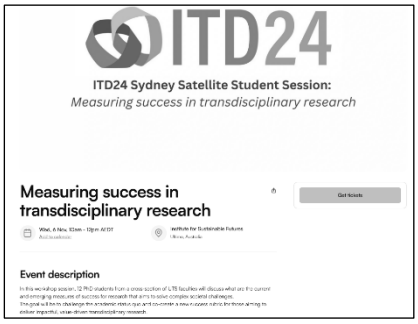
Their diagrammatic representation is repeated below. The thesis aims to build on existing literature by providing knowledge that supports policy and practice transition towards net zero superannuation portfolios in a way that sustainably limits the impacts of climate change.



Chapter 3.

Theoretical Framework and Methodology

I had the privilege of working alongside transdisciplinary research expert Michael O'Rourke to design and deliver a workshop as part of the Global Alliance for Inter- and Transdisciplinarity ITD24 conference. The session brought together PhD students from across UTS faculties to interrogate determinants of success in transdisciplinary doctorate research. We designed the workshop using O'Rourke's Toolbox Dialogue Initiative method. The session built on the journal article by Willetts and Mitchell (2017) to determine success criteria for a transdisciplinary doctoral thesis. The workshop dialogue was robust and raised challenging conversations, such as if complex situations cannot be controlled, then intended socio-environmental improvements could become future problems. The experience added to my conviction in the value of transdisciplinary research and broadened my understanding of its distinction from single-discipline research. During the workshops, participants co-created a matrix of transdisciplinary success; a version is shown below.



Demonstrated TDR criteria	Single discipline research	TDR partial	Transdisciplinary Research
Value of research contribution	The thesis findings make an original contribution to disciplinary knowledge but may not have an immediate social and environmental benefit.	The thesis findings make an original contribution to knowledge and could be used to directly improve socio-environmental futures.	The thesis findings make an original contribution to knowledge and aims to solve complex socio-environmental problems
Reflexivity	Reflexivity may be present but is not emphasised.	The researcher makes evident their awareness of divergent stakeholder perspectives.	The researcher provides evidence of how they have questioned their own attitude to the topic through the thesis process and how they made that process iterative and incorporate the knowledge from the co-creation process..
Research integrity	Research has been conducted with rigour and credibility according to disciplinary conventions. The selected methodology is well justified and meets disciplinary expectations.	The problem is addressed with clear positionality so that the knowledge is valid and usable and the conduct of the research is rigorous and ethical	The problem has been framed with clear positionality so that this is evident and open to stakeholders perspectives so that the co-created knowledge is valid and usable and the conduct of the research is rigorous and ethical
Research coherence	Adhere and align to relevant disciplinary epistemology, methodology, methods, results, and conclusions	Alignment of epistemology, methodology, methods, results, conclusions, contribution, Make inevitable incoherence and tensions between different disciplinary perspectives explicit	Alignment of epistemology, methodology, methods, results, conclusions, contribution, Make inevitable incoherence and tensions between different disciplinary perspectives explicit
Research breadth	Research beyond a single discipline is not a requirement.	The researcher extends the boundary of their topic sufficiently to demonstrate its societal context	The research incorporates multiple disciplinary perspectives as well as stakeholder perspectives and is broad enough to credibly create change.
Research outputs	Scholarly outputs are generated from the research.	The scholarly research findings have the potential for real world application and societal improvement.	The research and scholarly findings are communicated in a way that has potential to improve policy and practice for positive societal outcomes.

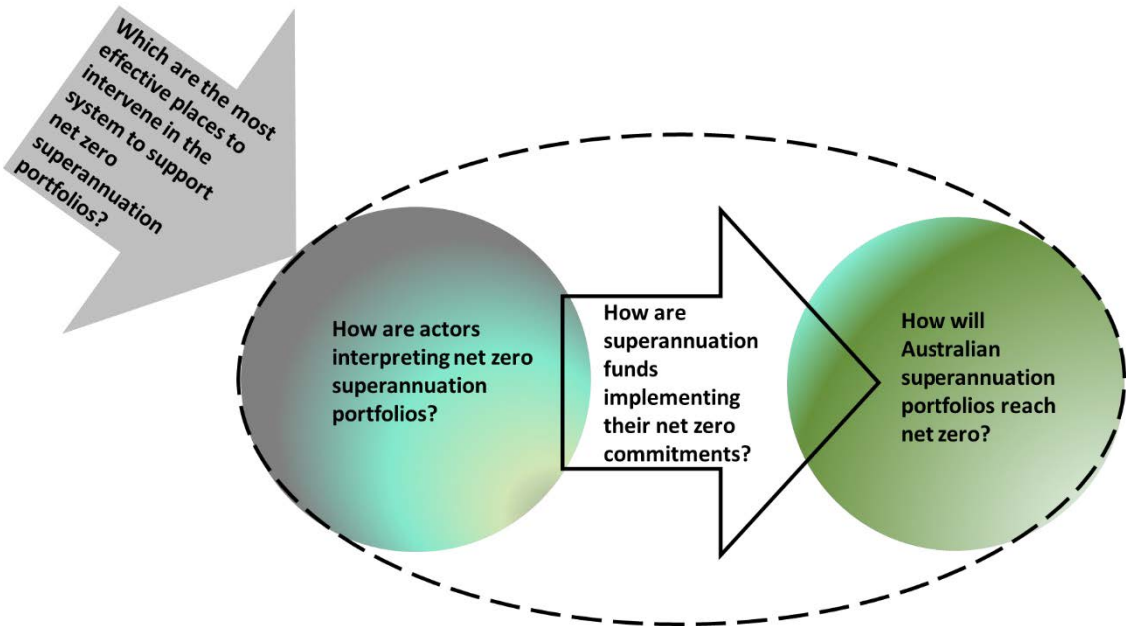
3.0. Overview

My motivation for this research is to support the superannuation sectors' transition to net zero and provide knowledge that is useful to policy and practice. In the literature review, I identified a need to improve understanding of;

- How actors are interpreting net zero superannuation portfolios,
- How superannuation funds are implementing their net zero commitment, and
- Which are the most effective places to intervene in the system to support net-zero superannuation portfolios?

And therefore;

- How will Australian superannuation portfolios reach net zero?



This chapter first provides an overview of the theoretical framework which has guided my research. A discussion then follows on the theories and frameworks that I have selected to examine the research questions. Thirdly, I detail the methodology that I used to conduct this research. Consistent with the guidelines for assessment of a TDR doctoral thesis proposed by Willetts and Mitchell (2017), this section aims to demonstrate my coherent theoretical framework, rigorous research and reflexivity.

3.1. Theoretical Framework

3.1 introduces the theoretical framework adopted in this thesis and provides a rationale for its suitability. Given the specific challenges of TDR for a PhD thesis, the following section justifies this decision in relation to doctoral research and reflects on the proposed criteria.

3.1.1. Transdisciplinarity - A Theoretical Framework

A theoretical framework is the lens through which a problem is examined and research is undertaken (Van der Waldt, 2024) and the scholarly basis for an investigation (Kivunja, 2018). It encompasses a researcher's overarching philosophical and epistemological assumptions on how knowledge is constructed and the disciplinary propositions for explaining and predicting situations of concern (Van der Waldt, 2024). However, disciplinary academic knowledge is specialised and contained by the boundaries of that field (Bergmann et al., 2012; Van der Waldt, 2024). I have expressed this idea diagrammatically in Figure 5

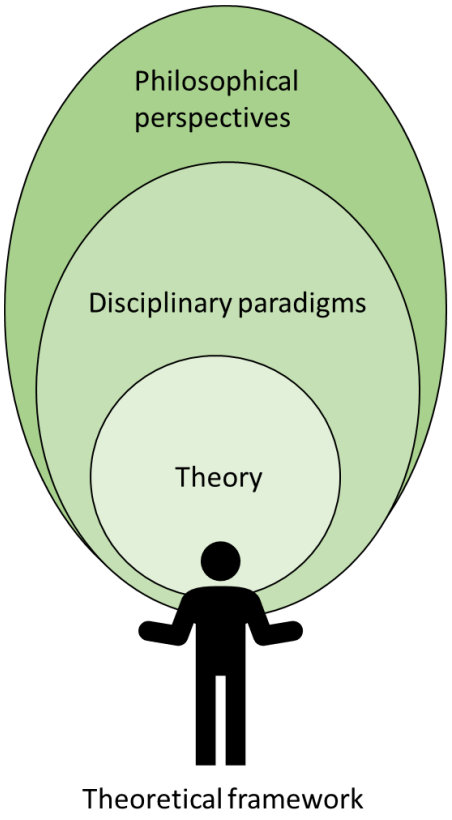


Figure 5 Theoretical Framework

Transdisciplinarity is defined by its belief that to improve complex societal problems, research must depart from traditional academic boundaries and instead integrate knowledge from multiple disciplines, industry practice and stakeholder perspectives (Bammer, 2013; Bergmann et al., 2012; Fam et al., 2017; Hirsch Hadorn et al., 2008; Lawrence et al., 2022; Van der Waldt,

2024). Similar purpose-driven cross-disciplinary methodologies such as purposive transdisciplinary research, integrative applied research, engagement research and knowledge co-creation are also designed to bridge the 'research-practice' gap in addressing complex societal problems (Adams & Larrinaga, 2019; Norström et al., 2020; Pohl et al., 2021; Sharma & Bansal, 2020). TDR extends past interdisciplinarity, where disciplines are synthesised and instead 'transgress' disciplinary boundaries to provide outcomes that transform complex real-world problems (Pohl et al., 2021). The Institute for Sustainable Futures (ISF) is committed to creating positive change towards sustainable futures and believes that TDR is the most effective methodology to achieve that vision (Reidy, Willett & Mitchell in Fam et al., 2017, pp. 94, 123; Institute for Sustainable Futures, 2022). My research is aligned with those values, and as a student in the ISF graduate research program, I have gained conviction in transdisciplinarity through my exposure to ISF research projects.

I have expressed a transdisciplinarity theoretical framework diagrammatically in Figure 6.

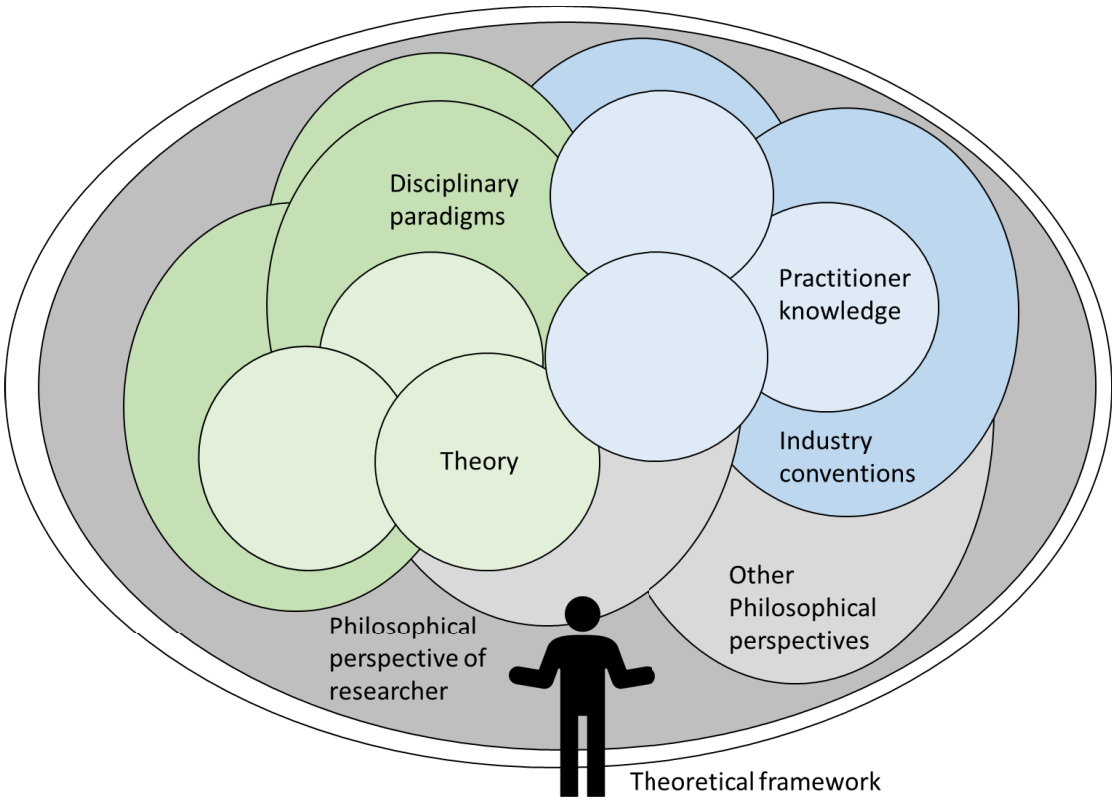


Figure 6 Transdisciplinarity Theoretical Framework

'Complex' situations should be addressed in a way that is distinct from known, complicated or chaotic problems (Snowden, 2002). Complex problems can be identified by their immense

scale, extensive uncertainty, dynamic evolution, conflicting interests and interconnectedness (Sebastian & Riedy, 2023; Snowden, 2002). These characteristics are common to the goal of reaching net zero superannuation portfolios where;

Immense scale: superannuation portfolios span the global economy, including sovereign debt and investment in goods and services with extensive supply chains.

Extensive uncertainty: the goal of net zero is ambiguously defined, and unknowns exist in numerous dimensions of climate science, such as tipping points and future policy action.

Dynamic evolution: knowledge in relation to net zero is continually developing. The consensus view is that the severe consequences of climate change require urgent action even if tools and processes have not yet been perfected; for example, advances in carbon measurement mean that net zero baselines require ongoing recalculation. From a thesis research perspective, the rapid increase in net zero attention has been simultaneously heartening but also difficult to keep pace with.

Conflicting interests: the goal of net zero superannuation portfolios is heavily debated on fair share principles and sustainability transformation versus the dominant capitalist paradigm. Further, the situation is highly emotive for stakeholders who fear the consequences of failure to reach net zero.

Interconnectedness: The interaction of planetary systems as well as the systemic nature of the finance system can result in widespread effects resulting from a single change. It is also difficult to clearly delineate boundaries in this situation.

Core to TDR is the recognition that stakeholders have differing values, theoretical perspectives and views on desirable outcomes that must be understood to provide effective outcomes (Lawrence et al., 2022; Reynolds & Holwell, 2020). Therefore, TDR emphasises the validity of all forms of knowledge and epistemological beliefs in order to engage with diverse stakeholders (Fam et al., 2017). Further, TDR is pragmatic towards a theoretical position, rather prioritising the methods that can be used to deliver outcomes for improvement (Jackson, 2019a). Despite its pluralistic approach, TDR is aligned with constructionism (Reynolds & Holwell, 2020) and the belief that knowledge is based on our individual interpretation of the objects we experience within the world (Crotty, 1998).

Recognising differing philosophical perspectives is pertinent to sustainable finance research and my PhD. The dominant paradigm in the discipline of finance is positivism, where knowledge is objective and is generated by using quantitative, verifiable, replicable methods.

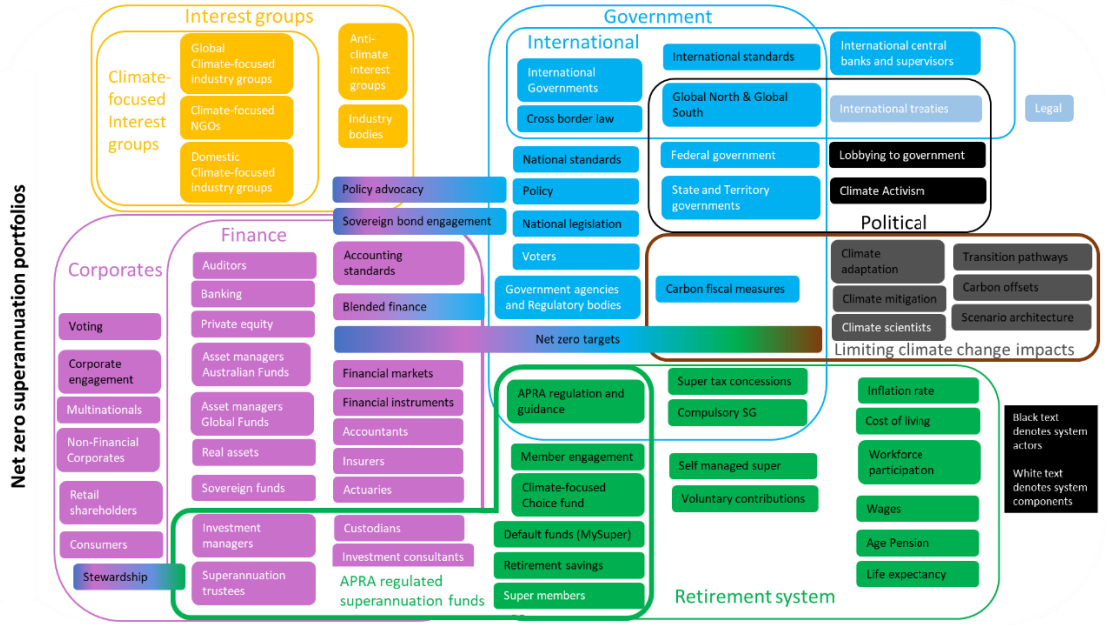
The measurement of carbon using a financial materiality lens and the high-level definition of net zero is intentionally impartial and strategically situated within the familiar risk-reward paradigms of the finance discipline. Whereas the study of sustainability is pluralistic, simultaneously blending environmental, economic, social and intergenerational knowledge across disciplines (Lozano, 2008). Sustainability is solution-orientated and requires 'socioecological systems research' to "*understand and appreciate the complex interdependence of human wellbeing and planetary health*"(Abson et al., 2017; Raworth, 2017). Raworth (2017) diagrammatically conceptualised this theory of sustainability in the doughnut model. The doughnut model also critiques social inequality and power dynamics, which are closely linked to philosophical perspectives of critical inquiry and feminism. In addition to sustainable finance knowledge, this thesis research also incorporates knowledge from law, political science and climate science disciplines, as well as related industry knowledge. TDR explains that by integrating knowledge from differing philosophical perspectives, new knowledge can be generated that would not otherwise be possible (Bergmann et al., 2012; Hodgson, 2020).

Divergent individual perspectives also result in different views on which aspects of a problem are relevant and should be considered, based on researcher judgement, values and factual beliefs (Ulrich & Reynolds, 2010). Bammer (2013, p. 39) explains that "*boundary setting occurs in all research, usually intuitively.*" Given that boundary assumptions determine how the problem is framed and influence the research outcomes, TDR requires stakeholders to clarify their views and be reflexive on the values and politics affecting the judgement of the problem to be explored (Bammer, 2013; Jackson, 2019b; Norström et al., 2020). Challenging assumed problem boundaries can also reveal the places of power within a system (Hodgson, 2020).

An example of reflexive learning that occurred during my doctoral thesis was a new understanding of 'climate transition risk.' The term is widely used in policy and the finance industry to describe the risk of asset devaluation due to regulatory and demand shifts in the transition to a low-carbon economy. Having begun this PhD journey with finance industry experience, I had previously accepted the concept unquestioningly. The realisation that some stakeholders, quite reasonably, did not consider climate transition to be a risk was quite astounding to me. The self-aware role of the researcher is well-articulated by Hodgson (2020, p. 24), who asserted that "*Objectivity is an extreme case of subjectivity where we have agreed to eliminate ourselves from consideration without actually doing so."* For example, scientific research uses the third person tense to emphasise detachment and objectivity, whereas researchers conducting qualitative research should recognise their role as observers (Paltridge

& Starfield, 2019). However, writing in the first person singular is still less common in academic conventions (Creswell, 2018; Paltridge & Starfield, 2019). I have used first person tense for this chapter and signposting throughout the document to reveal my voice and explain my research design decisions. Whereas, I have used the third person tense throughout the remainder of this thesis to align with the academic convention of a researcher as an observer. I also see the use of the third person tense as a way of recognising the privilege of my PhD journey, where I have paused the commercial time pressures of my previous work experience and been an observer of my industry.

Figure 3 (repeated below) introduced the context diagram depicting the stakeholders and components that I considered in this study to be related to the superannuation sectors' transition to net zero. The stakeholders and components bring a multitude of philosophical perspectives, disciplinary paradigms, industry conventions and knowledge that should be considered to understand how Australian superannuation portfolios will reach net zero wholly. Recognising how they interact and overlap dynamically in intertwined systems and sub-systems is also relevant to the study. The complexity of this situation, then, is well-suited to a transdisciplinary research approach.



Transdisciplinary research (TDR) entails three main phases, problem interpretation, goal analysis and outputs for improvement (Lawrence et al., 2022). Due to the complexity of the problems, solutions are iterative and uncertainties remain (Reynolds & Holwell, 2020). A challenging aspect in TDR is that many factors interact and unknowns can prevail in complex

societal problems, making it difficult to judge the direct impact of the research (Bammer, 2013). Of particular relevance to understanding complex problems such as climate change, is the acknowledgement of unknowns and an acceptance that, "*unknowns cannot be eliminated and that imperfection is an inevitable result*" (Bammer, 2013, p. 16). In exploring unknowns it is important to be deliberate in determining whether they can be reduced or should be accepted, and also whether unknowns have been exploited or denied (Bammer, 2013; Hirsch Hadorn et al., 2008).

TDR combines naturally with systems thinking to explore the interacting elements and interpretations of complex problems (Bammer, 2013; Hirsch Hadorn et al., 2008; Jackson, 2019a; Lawrence et al., 2022). Systems thinking predates TDR and a brief discussion of its development is helpful for understanding its connection to TDR. Systems thinking is often described as occurring in three waves (i) unitary or hard, (ii) pluralist or soft and (iii) coercive or critical (Jackson, 2019a; Reynolds & Holwell, 2020; Sebastian & Riedy, 2023). The first wave began in the mid-1950s from an objectivist theoretical stance and applied mechanical systems thinking methods such as 'systems dynamics' (SD) to solve concrete problems with the understanding that the system goal was undisputed and agreed (Reynolds & Holwell, 2020). However, by the late 1960s a second wave of systems thinking took a constructionist perspective and argued that solving complex problems required multiple stakeholder perspectives to be considered. Methods such as 'soft systems thinking' (SSM) emphasise the need to seek the views and support of participants in determining culturally preferable and politically feasible outcomes (Jackson, 2019a). Yet, the third wave of systems thinking in the early 1980s claimed that whilst the perspective of powerful stakeholders may have been considered by SSM, other stakeholders were affected but had not been included by the system. Methods such as 'critical systems heuristics' provide a way to interrogate the way that stakeholders define a system and the boundary judgements they have made to understand who is benefiting from it and empower vulnerable stakeholders (Jackson, 2019b).

TDR is considered to have two modes, (i) Unity of knowledge and (ii) Real-world transformation (Schloz and Steiner, 2015 in Fam et al., 2017; Lawrence et al., 2022). The first mode began in 1970 and included thinkers such as Jean Piaget and Eric Jantsch, who sought better organisation and integration of knowledge across disciplines so that it was better aligned with common goal-orientated systems, such as education (Bernstein, 2015; Hirsch Hadorn et al., 2008). Bernstein (2015) notes that the concept of transdisciplinarity introduced in the 1970s was not well-developed or much cited until two decades later when Basarab Nicolescu led the first World Congress on transdisciplinarity, emphasising complexity and the

need to pursue knowledge beyond disciplines (Bernstein, 2015). The second mode also began in 1994 but conceptualised a different purpose of TDR in the book, 'The New Production of Knowledge' by (Gibbons et al., 1994)The team of six from diverse disciplinary backgrounds describes the need to integrate academic, industry and government knowledge to improve specific real-world issues (Hirsch Hadorn et al., 2008; Lawrence et al., 2022). The second mode of TDR shares many similarities with the second and third waves of systems thinking in emphasising the importance of stakeholder perspectives and knowledge co-production to improving complex problems.

The only notable difference between TDR and systems thinking is the order in which the research is orientated. Whilst TDR starts by exploring and determining the goal, the second and third waves of systems thinking start by probing the problem. However, both methodologies emphasise the need for iteration and recurrent consideration to allow flexibility in response to complex problems. Exploration and greater knowledge of a complex problem can reveal the need to make changes, such as adjusting the goal, including new stakeholder perspectives or applying different research methods (Bammer, 2013; Hirsch Hadorn et al., 2008; Reynolds & Holwell, 2020). Cordell (2010) claimed that TDR overlaps with systems thinking but that TDR has a strong theoretical framework.

A further stream of research that has informed my theoretical approach to this thesis is futures research, which seeks to understand 'exploratory' futures, those that are plausible, and 'normative' futures, those that are desirable (James, 2016). By anticipating possible and desirable futures, research can provide pathways for change-making, such as policy action (Gerhold et al., 2022, p. 3). Futures studies were developed in the 1940s and mainly applied to social enquiry in Europe and economic development in the USA (Krawczyk & Slaughter, 2010). Future studies were influenced by the concurrent waves of systems thinking, hard objectivist methods in the early 1960s and subsequently, critical futures, simultaneously with critical systems thinking. Many of the characteristics of future studies are common to TDR. For example, normative futures are values-dependant, applied to complex problems, incorporate uncertainty, often include stakeholder perspectives to achieve real-world impact and future transformation and are widely used in sustainability research (Gerhold et al., 2022; James, 2016; Robinson, 1988). Additionally, as with TDR, futures studies draw on methods from multiple disciplines to pragmatically achieve its purpose.

TDR, systems thinking and futures research have a strong applicability and history of use in sustainability research in addressing sustainability problems given their complex and wicked

characteristics (Bammer, 2013; Bernstein, 2015; Fam et al., 2017; Hirsch Hadorn et al., 2008; Jackson, 2019a; Lawrence et al., 2022). Meadows and Meadows (2007) used Forrester's systems dynamics method for their revolutionary 'limits to growth' model in 1972. Early sustainability practitioners recognised the importance of a systems thinking approach to solve the emerging environmental problems with the, then recently established, UNEP (1975, p. 17) noting *"The ultimate self-interest of all nations is inevitably merged in the inescapable web of interdependences. An integrated co-operative approach is needed."*

A feature of TDR and systems thinking methodologies is a broader acceptance of knowledge sources to address complex societal problems. This occurs at several levels. To begin with, the 'unity of knowledge' in the first mode of TDR explains the opportunity for new knowledge to emerge through the integration of disciplines, where previously an area of concern was beyond the scope or methodological capacity of siloed academic disciplines (Hirsch Hadorn et al., 2008). Secondly, the inclusion of non-academic knowledge expanded the extent of information available to improve complex sustainability problems (Fam et al., 2017). Thirdly, the practice of mutual learning through dialogue provides the opportunity for further knowledge to be co-developed. Broader information acceptance in TDR enables knowledge-sharing in new and practical ways because practice can change rapidly whereas academic knowledge production can require years (Fam et al., 2017, p. 33).

Addressing a complex situation requires deep understanding of the context in which it is located and the different interests of stakeholder groups (Norström et al., 2020). Analysis should identify the stakeholders who have the power to affect or constrain change, as well as the cultural beliefs that shape policy and industry design (Norström et al., 2020). The global interconnections and multitude of forces within complex problems therefore require TDR consideration over multiple scales. The goals that are set and perceptions of success cannot be assumed in TDR, which also recognises that marginalised groups may not be included in the process of normative target-setting (Adams et al., 2011; Norström et al., 2020). For example, EMDE perspectives are under-represented in the literature on environmental accounting and in organisational culture, which limits understanding and problem-solving (Adams et al., 2011; Adams & Larrinaga, 2019).

As TDR has many more stakeholder and disciplinary knowledge sources, conventions cannot be assumed. Judgement of which stakeholders should be included, the boundary of the situation they are trying to improve, what a desirable improvement should be, as well as determination of acceptable and reliable methods in order to generate positive outputs must

be brokered prior to the research, and then reassessed iteratively as greater understanding of the complex problem is furthered. Hirsch Hadorn et al. (2008) stresses the benefit of participant inclusion in order to better understand the situation, possibilities for intervention and feasibility of TDR outcomes. Conversely, they also note though that although participatory engagement is a common feature of TDR there is disagreement over whether it is an absolute requirement especially in contexts where it does not add further to the understanding of the situation. Considerations such as which stakeholders to include and the best method for knowledge exchange are significant decisions.

Transdisciplinary researchers acknowledge that the deliberately flexible methodology encompasses a vast range of approaches and differs from academic norms (Bammer, 2013; Fam et al., 2017; Hirsch Hadorn et al., 2008; Lawrence et al., 2022). Conventional academic research is conducted with the theoretical and methodological assumptions and uses the methods that are accepted as valid and reliable in that discipline. Conventional academic knowledge looks for patterns that can be widely-applied and generalised and may not directly apply to a real-world situation or to societal concerns, whereas industry knowledge is action-orientated and sector-specific (Hirsch Hadorn et al., 2008; Simsek et al., 2018). Even when academic research is funded by the private sector and built on the funders' knowledge of a problematic situation, the academic information that will be generated is still contained within the conventions of the discipline (Hirsch Hadorn et al., 2008). There are challenges in the accessibility of research knowledge for practitioners, where academic language conventions can make ideas "*impenetrable for managers*" (Simsek et al., 2018) and articles may require subscriptions.

Numerous experts in TDR refer to its 'peripheral' or 'marginalised' position within academia and call for further work to establish its academic value (Bammer, 2013; Hirsch Hadorn et al., 2008). A promising development was the recognition of 'Systems Thinking Practitioner' as a professional occupation in the UK in 2019, resulting in government funding for postgraduate training (Reynolds & Holwell, 2020). Adams et al. (2011) called on business education that encourages students to challenge the existing status-quo, increase their self-awareness and improve their skills so that they can bring about transformative change for sustainability. Additionally, the use of TDR has been widely embraced for its impact and applicability to generating knowledge for societal benefit (Jackson, 2019a; Lawrence et al., 2022). The value and validity of TDR can be evaluated according to how well its knowledge outputs meet its purpose because impact is part of the process, rather than an external addition (Pohl, 2011; Simsek et al., 2018).

Evaluating the efficacy of TDR then, becomes a question of measurement of research impact (Institute for Sustainable Futures, 2022). Institute for Sustainable Futures (2022) describe impact as a pathway, where progress is incremental and builds on the policy and practice outcomes of research outputs and knowledge co-creation with stakeholders. Similarly, Sharma and Bansal (2020) explain that research impact is a multi-event process where a research phase should also take prior and future research events into account. Norström et al. (2020) reflect on the wide realm of possibilities for assessing research impact covered by the literature but conclude that TDR evaluation should focus on iterative learning and improvement that ultimately seeks the leverage points that can achieve transformative change.

3.1.2. Considerations for TDR Doctoral Assessment

Traditionally doctoral theses are written to be read by examiners who determine whether the candidate will be admitted into the disciplinary community (Paltridge & Starfield, 2019). However, in a context where the Australian Research Council (2019) has emphasised the need for academic research that delivers societal impact and engages with non-academic organisations to inform policy and practice, it is also appropriate for PhD research outputs to seek impact. Impact outcomes of research are similarly reflected in the UTS (2023) Higher Degree Research Capability Framework that outlines the need to, “demonstrate the potential impact of one’s work in the broader context of society and community.” Further, Australian Universities Accord Final Report recommendation 25 notes the need to strengthen pathways between PhD and industry knowledge in research outputs that address complex societal issues such as climate change (Australian Government, 2024d). A similar process of impact accountability on government research funding is evident in the UK Research Excellence Framework (2023), which asserts that impact and real benefits outside of academia are to be delivered through research. TDR is impact-orientated and therefore well-suited to improve complex, real-world problems.

Despite the suitability of a TDR PhD for delivering outcomes in sustainability research, Willetts and Mitchell (2017) argue that because of the limited time and resources in a doctoral process it can be challenging for candidates to meet all aspects of TDR. They developed guidelines on how assessment of TDR should be modified from traditional doctoral examination criteria. In line with the importance of critical reflection in TDR, I have discussed these limitations and identified research improvements in section 3.3.

In the first instance, 'broad preparation' is needed to ensure that the complexity of the issue including stakeholder perspectives have been considered (Wickson et al., 2006 in Fam et al., 2017, p. 130). TDR contributions to knowledge tend to synthesise broad realms of research from a range of disciplinary and practice purposes, whereas conventional PhD contributions focus more on disciplinary depth (Willetts & Mitchell, 2017). Secondly, the inclusion of a larger spectrum of literature will be necessary than is commonly used in disciplinary research, including grey literature such as industry and government reports (Mitchell and Willets, 2009 in Fam et al., 2017). Thirdly, the integration of cross disciplinary knowledge will also expand the theoretical and methodological possibilities and require the researcher to take a reflexive approach to justify their values and research design within the context of the complex problem (Willetts & Mitchell, 2017). Willetts and Mitchell (2017) propose a set of guidelines for the assessment of TDR doctoral thesis. These have been summarised as;

(i) original and substantial research that synthesises knowledge, including and beyond academia, for societal outcomes,
(ii) critical reflection and justification of the use of TDR
(iii) rigorous research that demonstrates an awareness of the differing stakeholders' perspectives in a complex situation and produces outputs that are useable for industry participants, policy makers and other actors
(iv) appropriate breadth of research and justification on research boundary judgements
(v) coherent, convincing and well-structured arguments.

This section introduced the theoretical perspective of TDR and contrasted it with single discipline scholarship. To justify its use for this research, the discussion presented the characteristics of TDR alongside its relevance for net zero superannuation portfolios. The section demonstrated its suitability for improvement of complex problems and acknowledgement of differing stakeholder perspectives. The relationship between systems thinking methods and TDR and their applicability to sustainability research is also discussed to further situate this research within a purposive scholarly context. Finally, the limitations of TDR for doctoral research are examined, including the challenge of a writing a thesis to demonstrate academic rigour whilst using a theoretical framework that disrupts disciplinary conventions.

3.2. Theoretical Analysis

Consistent with my selected transdisciplinary theoretical framework I have used systems thinking paradigms to exploring the complexity of net zero superannuation portfolios. In the

following section I explain the key theories and frameworks which frame my analysis and add rigour and useability to this research; Places to intervene in a system, by Meadows (1999) and Critical System Heuristics, by Ulrich (1994).

3.2.1. Places To Intervene In A System

The lead author of the 'Limits to Growth' model, Donella Meadows, was also the creator of the seminal systems analysis framework 'Places to intervene in a system.' This widely applicable model for understanding complex systems provides a way to identify leverage points for transformation. 'Places to intervene in a system' may have been developed as a framework to structure research but it is also a theory because it is a general explanation of a process, situation or phenomena (Creswell, 2018; Kivunja, 2018), that is, how complex systems work and how to affect change. Some examples of how the twelve places for intervention framework has been used in other sustainability studies is in systematic quantitative literature reviews (Dorninger et al., 2020), case studies and industry projects (Birney, 2021) and participatory research (Norton et al., 2024).

Leverage points are places of power, where a minor shift can produce a system change (Meadows, 1999). In the theory, Meadows (1999) defined a hierarchy of twelve points ranging from shallow to deeper places to intervene in a system but cautioned that "*the deeper the leverage point, the more the system will resist changing it*." Abson et al. (2017, p. 33) concurred, noting that, "*shallow interventions are important and can generate beneficial outcomes but, on their own, are unlikely to lead to transformational change*." The twelve points identified by Meadows (1999) can be readily applied to net zero superannuation portfolios. I have explained the twelve places by identifying one example of the many ways that these relate to the system components of net zero superannuation portfolios.

12. **Constants, parameters, and numbers** are the numeric conditions in a system that can be easily adjusted with minimal change. For example, the superannuation guarantee is a determinant of the size of the superannuation system as this is the flow of capital paid by employers on behalf of members.

11. **The size of buffers and stocks, relative to their flows** is the capacity for system response, if the buffer is too big, the reaction will be slow and if it is too small, it will be very vulnerable to changes in flow. Climate transition risk is a concern to the finance sector where asset devaluations could cause a disorderly transition and systemic financial shock.

10. **The structure of material stocks and flows** is the way that a system is constructed so that system processes can take place. In the case of climate solutions investment, capital flows occur within existing finance system structures and can only flow with ease to 'investable' economies and projects.

9. **System delays** is the time taken to be aware of feedback, if the feedback delay in a system is too long then collapse or overshoot could occur. The rate at which useful climate-related reporting occurs across jurisdictions and entities provides climate risk information to the system and affects decision-making by investors and other actors.

8. **The strength of negative, also known as balancing, feedback loops** is the way that monitoring and control processes occur in a system. For example, carbon pricing identifies the emissions created by entities and seeks to reduce these by imposing an appropriate price per tonne of carbon.

7. **The strength of reinforcing feedback loops** determines beneficial or problematic growth in a system. Stewardship, especially through collaborative action, has led to a beneficial rise in climate risk awareness and pressure for legitimacy that has increased the scale of net zero commitments in the system.

6. **Information privilege** is the structure of who has access to information. The emphasis of financial materiality over impact materiality in climate-related financial reporting means that information that does not affect an enterprise's value but which affects other actors, is unknown.

5. **Rules** are the constraints and incentives that have been devised in a system. For Australian superannuation, legislation and regulations such as Best Financial Interests Duty and the My Future, Your Super Performance test unintentionally constrains net zero actions by superannuation funds.

4. **Self-organisation** is the extent to which social evolution and system change can occur by adding new structures, feedback loops or rules. The objective for impact investment funds changes from solely the measurement of financial returns to include the measurement of social and environmental benefits.

3. **Goals** are the over-arching purpose of a system. The purpose of neoliberal economies is profit maximisation in finance and national comparative advantage at a country level.

2. **Paradigms** are the unstated and deep-set beliefs from which a system arises. Sustainability, at the core of net zero superannuation portfolios, raises the fundamental question of decision-making in the short-term interest of individuals or the long-term global interest of future generations.

1. **Transcending paradigms** is about the process of transformation which requires awareness of existing paradigms and the willingness for change. The shared socioeconomic pathway SSP1 is a projection of global collaboration for a just and rapid transition to a low-carbon economy. Achieving that requires system transformation.

Through their extensive experience in using systems thinking methods and Meadows' framework, Birney (2021) commends its suitability for systems analysis. They also reflect on the common use of the framework by sustainability practitioners for the evaluation of impact but argue that impact is too often focused on results within the timespan of a program cycle and should instead find ways to measure system change.

Abson et al. (2017) developed 'realms of leverage' based on Meadows' framework. These are groupings that correspond to the twelve places for intervention, parameters (10 -12), feedbacks (7-9), design (4-6) and intent (1-3). They observed characteristics of the groupings and explained that; parameters were modifiable and tended to be the focus for policy, feedback explained the interactions and working of the system, design refers to social structures and institutions, and intent is the assumed goals, values and beliefs within the system.

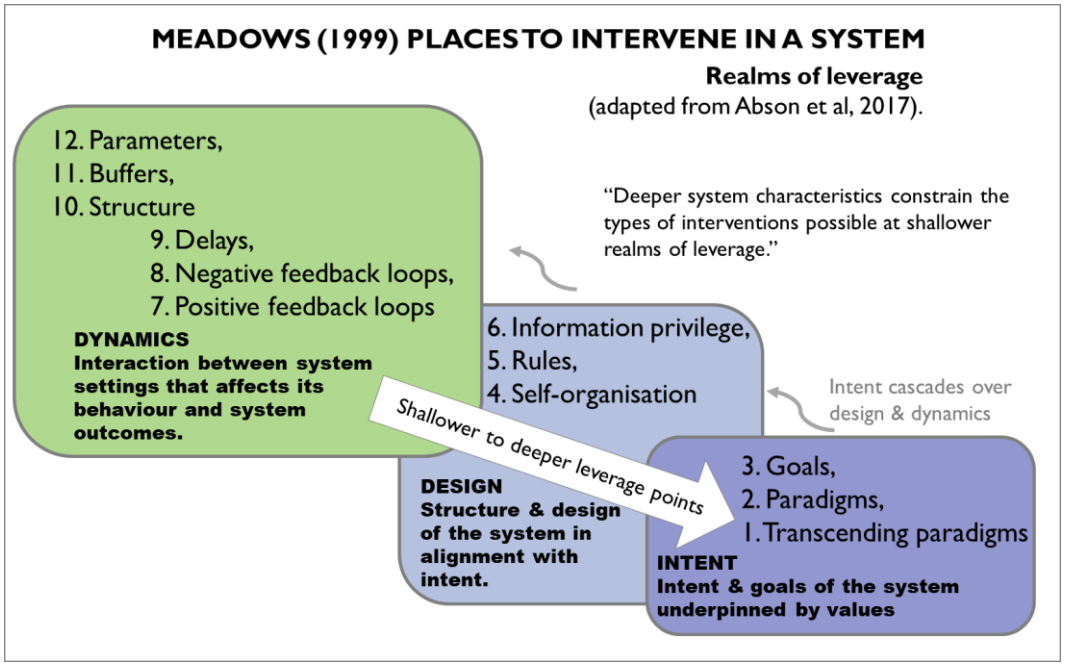
Their work provided the valuable observation that although shallower leverage points such as parameters and feedback can affect deeper ones, ultimately, they are constrained by the deeper system design and intentions. Abson et al. (2017) emphasise the nested nature of Meadows' places for intervention and argue that system change depends on deep points of intervention. They note that intervention at shallow places affects change at deeper leverage points. However, they explain that the deeper leverage points are the most powerful places to intervene in a system and that they impose constraints on shallower places. They suggest three realms of leverage for transformation, restructuring of institutions, reconnection to nature and rethinking of the production and the use of knowledge.

Fischer and Riechers (2019) built on the 'realms of leverage' proposed by Abson et al. (2017) in support of a leverage points perspective and raised additional areas for attention. They supported the ideas proposed by Abson et. al for systems transformation but emphasised the

importance of a re-evaluation of worldviews and values in order to seek transformation. Secondly, they noted the way that the framework provides a way to explore a system from both causal and teleological vantages, explaining that the two ways of thinking frequently conflict and are rarely combined. In twelve places to intervene in a system, shallower leverage points are based on cause and effect relationships whereas deeper leverage points are 'teleological' in explaining a system's purpose and considering desired futures. They proposed the idea of studying 'chains of leverage' to see how both shallower and deeper interventions interacted. Finally, they praised the versatility of leverage points across qualitative and quantitative research methods and in translation to non-academic so as to promote sustainability influence.

I have adapted the framework by Abson et al. (2017) as shown in Figure 7. The term 'dynamics' has been used to refer to the shallower half of the framework, places numbered 7-12 which are the settings that affect the system behaviour through the structure and interaction of system elements. This framework provides a strong foundation for my analysis of the research sub-question, *Which are the most effective places to intervene in the system to support net zero superannuation portfolios*.

Figure 7. Leverage Points for Sustainability Transformation



3.2.2. Critical Systems Heuristics

Critical Systems Thinking argued that the foundation of systems thinking was a belief in rationality and challenged it by asking, "*Whose rationality is 'rational'?*" (Ulrich, 2003, p. 325).

Critical systems thinkers argue that the boundary judgements within a system need to be explored, debated and not positioned as a singular agreed goal by powerful decisionmakers (Jackson, 2019b; Reynolds & Holwell, 2020). Critical systems thinking then, seeks social change by identifying the power relations within systems (Sebastian & Riedy, 2023).

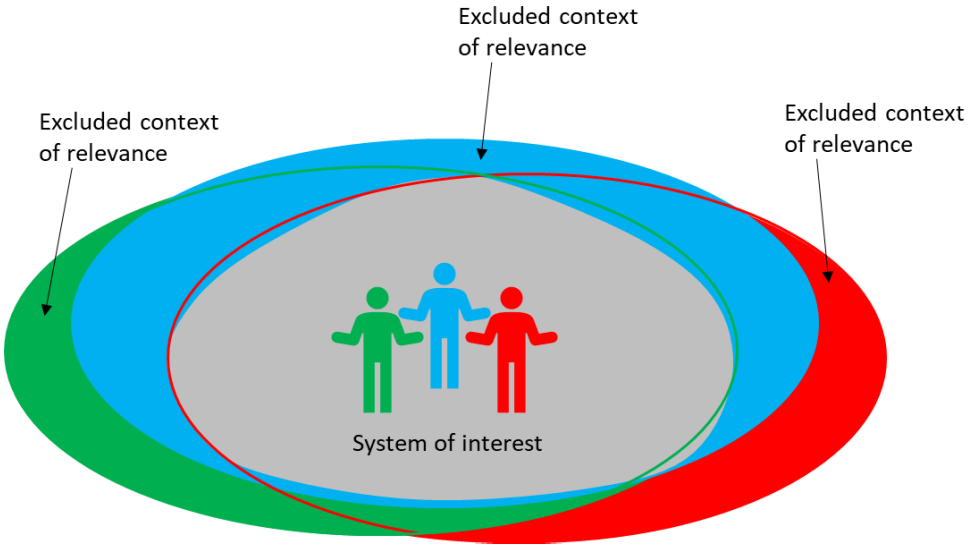
Critical systems heuristics (CSH) provides a framework to critically analyse the way that a system has been defined by its stakeholders, what they have included or excluded, and the future that they deem desirable (Bammer, 2013; Reynolds & Holwell, 2020; Ulrich & Reynolds, 2010). The critique is based on Habermans' Theory of communicative action where powerless people have limited access to knowledge so that the powerful cannot be sufficiently challenged (Midgley, 1997; Ulrich, 1988). Ulrich (2003) believed that unequal influence and access to information is the norm in organisational contexts and referred to them as 'coercive' but later adjusted that wording to the more moderate term, 'sources of selectivity.'

Ulrich (2003) claimed that as well as being a discursive framework, CSH also provided the first philosophic foundation for critical systems thinking and supported 'emancipatory' practice. Ulrich (2003) later clarified that the concept of 'emancipation' was not a radical ideology, as could be implied by its etymologic origins of liberation from slavery. Instead, Ulrich emphasised that CSH was not asserting any particular ethical stance and should be used for public debate.

The key concept of CSH is boundary critique (Ulrich, 2003). Bammer (2013, p. 45) notes that "*Boundary setting is not just about practicalities; it is also intimately tied to values*." Hodgson (2020) comments that boundary critique is revealing of the power dynamics in a system and for whose benefit it is functioning.

Figure 8 is an adaptation of the basic concept of boundary critique developed by Hodgson (2020). It denotes the system of interest in grey, however the differing boundary judgement of actors and the context they deem relevant is not always aligned with the system.

Figure 8 Boundary Judgements



CSH askes twelve questions to explicitly understand, compare and ideally, bridge, the boundary assumptions that have been made by different stakeholders (Checkland & Poulter, 2020). In the context of this research, they enable the specifics of a superannuation fund net zero commitment to be explored in greater depth. The following boundary judgements have been adapted from Ulrich and Reynolds (2010) and Jackson (2019b) and have been used for my analysis in Chapter 4, *How are superannuation funds implementing their net zero commitments?* The twelve questions are shown in brief in

Figure 9 and described in Table 2.

Figure 9 Critical System Heuristics - 12 Questions

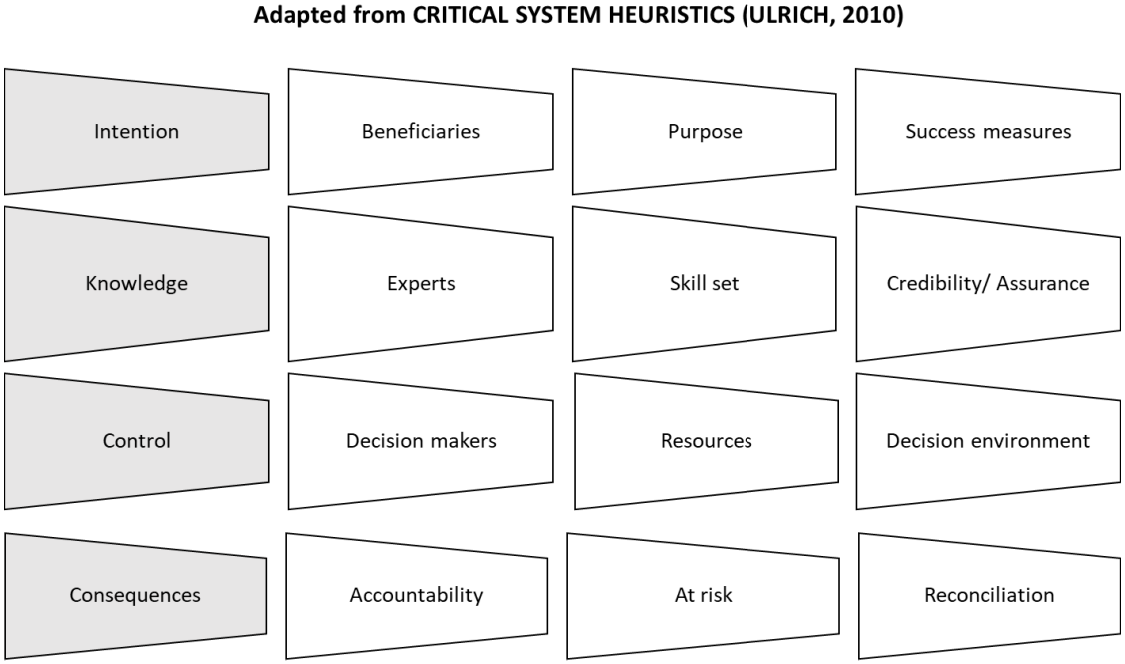


Table 2 Description of Critical System Heuristics - 12 Questions

		Stakeholders	Stakes	Issues
Those involved	Sources of Intent	**Beneficiary** – who should benefit from the system?	**Purpose** – what should be the purpose of the system?	**Success measure** – what should be the indicators of system improvement?
	Sources of knowledge	**Expert** – who should determine the knowledge and skills that are relevant to the system?	**Expertise** – what knowledge and skills should be relevant to the system?	**Guarantor** – What assurances should there be for success measures?
	Sources of control	**Decision maker** – who should be in control of the conditions of system success?	**Resources** – What conditions of success should be controlled in the system?	**Decision environment** – what should be outside the decision maker's control?
Those affected	Consequences	**Witness** – whose interests should be represented but is not involved in the system?	**Emancipation** – What opportunities have those who are negatively affected had to express their views of the system?	**Worldview** – What reconciliation is possible for differing views of the affected and involved.

Jackson (2019b) contested that CSH should be explorative and cannot result in a "right" answer where instead of empowering stakeholders to see more broadly, it imposes a new

form of coercion. The notion of CSH as a replacement to other approaches to systems thinking was heavily criticised with some arguing that it should be used as a complement to them (Midgley, 1997). Ulrich (2003) counter-argued that CSH was always intended to be used as a complementary systems methodology at a shallow level however its core methodological concept, boundary critique, was so indispensable to critical reasoning and practice that it should be repositioned as 'Critical Systems Discourse.' Ulrich (2003) then claimed that at a deeper level critical systems discourse could not be seen as a complementary systems methodology and was instead the essential starting point of any authentic research inquiry.

I think Ulrich's defence is unpleasantly supercilious but have taken the pragmatic view that the framework is well-suited to this investigation. CSH provides a robust basis to interrogate and make explicit the interpretation and implementation of a net zero superannuation portfolio.

In 3.2 I presented Places to intervene in a system, by Meadows (1999) and Critical System Heuristics, by Ulrich (1994). These each offer beneficial strategies for understand the complexity of net zero superannuation portfolios. Both theoretical approaches have been widely used in practice (Birney, 2021; Fam et al., 2017; Williams & Hummelbrunner, 2010), which is encouraging for the aim of providing tangible outcomes from this research. The theory by Meadows (1999) and adapted by Abson et. al (2017) is beneficial for understanding the net zero superannuation system leverage points and seeking places for effective intervention. The CSH framework is helpful for uncovering the judgements and assumptions within net zero interpretation and their impact on its implementation.

3.3. Research Methods

This section explains my selection of research methods and outlines the process that I have used.

3.3.1. Qualitative Research Methods

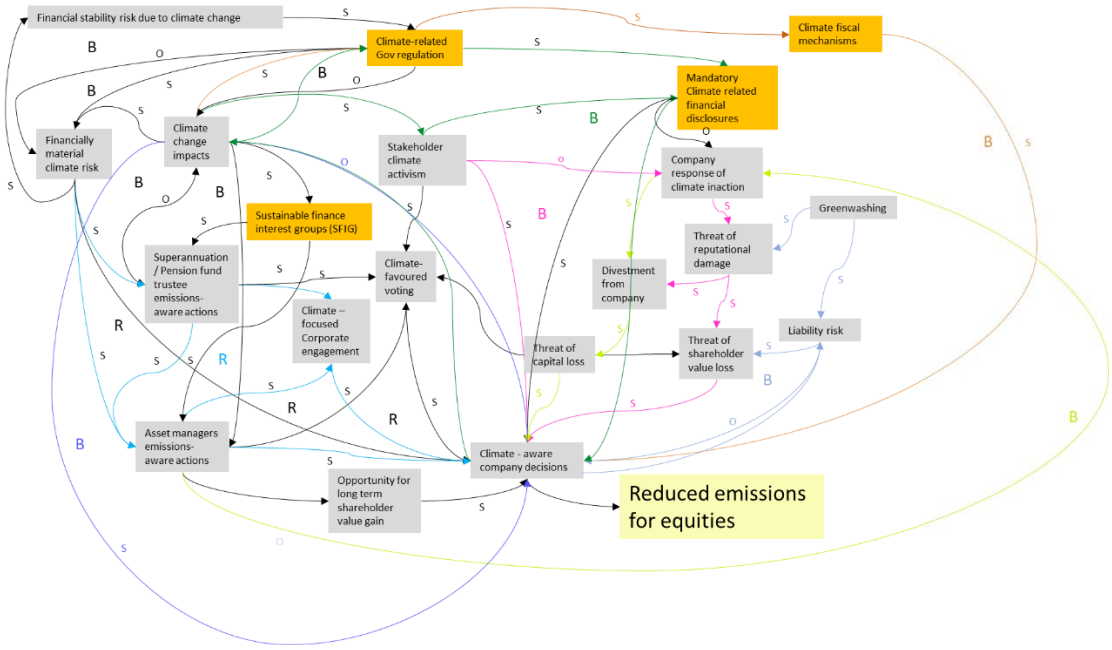
Qualitative research methods are used to gather socially constructed meaning from study participants and are consistent with a constructionist epistemology (Creswell, 2018). I consider qualitative research to be the most appropriate choice for exploring different stakeholder perspectives on the transition to net zero superannuation portfolios, which is also coherent with the TDR approach and constructivism epistemology of this thesis.

Context Diagrams

Context diagrams and systems maps are used to communicate assumptions on the interconnecting components that make up a system and to consider the differing perspectives

of interested stakeholders (Barbrook-Johnson & Penn, 2022; Foster et al., 2016; Sedlacko et al., 2014). Embedded assumptions on the defined problem has implications for the problem analysis and research outcomes (Barbrook-Johnson & Penn, 2022; Sedlacko et al., 2014). Context diagrams are a helpful step in developing causal loop diagrams, where the cause and effect of interacting system components are mapped. This is helpful for finding places to intervene in a complex system and have been used as such for TDR on sustainability-related issues (Foster et al., 2016; Kiekens et al., 2022; Sedlacko et al., 2014; Witte & Mansouri, 2020). Context diagrams and Causal Loop Diagrams (CLD) can be created by individual researchers or in a participatory workshop and can evolve iteratively as the situation is better understood (Sedlacko et al., 2014). CLD were useful in understanding and exploring the reinforcing (s) and balancing (o) effects within components of the complex system, an example is shown in Figure 10.

Figure 10 Causal Loop Diagram Exploration of Equities Emissions Reduction



An example of a study using several of the tools that were applied in this thesis is the systems thinking study on transport infrastructure in Norway by Witte and Mansouri (2020). They developed a context diagram on the components of the problem based on the level of control and influence of stakeholders. They used the context diagram to build concentric circles of influence that are similar to the 'Circles of influence' explained by Covey (1988) and discussed in Chapter 4, where control and influence is greatest at the centre circle and reduces as the circles expand. They then conducted a stakeholder analysis to understand the differing interests of the identified actors. That analysis was used to inform a causal loop diagram and

identify system leverage points. Their findings supported the iterative solution of autonomous and flexible transport.

3.3.2. Semi-structured Interviews

Qualitative interviewing enables an understanding of a participant's perspective and is fitting with constructivist epistemology where actors provide meaning to their experience of reality. The word interview originated in the 17th century to describe "*an inter-view, an interchange of views between two persons conversing about a theme of common interest"* (Kvale, 2008). This study used semi-structured interviews so that participant responses are flexible but also have sufficient structure so as to facilitate comparison and data quality appropriate for analysis (Gillham, 2005).

Participant Recruitment and Characteristics

Two types of participants met the selection criteria.

Superannuation fund participants in the sustainability team of a fund with a climate commitment or in a role involved in climate-related investment and stewardship

Participants in a current or former role with an interest group or organisation involved in the superannuation sectors' transition to net zero

Participants were mainly recruited via an introductory email through industry connections or following a face-to-face approach at an industry event. The introductory email was designed to appeal to a shared mission in supporting net zero superannuation portfolios, as well as to show credibility in shared previous industry experience and knowledge of the subject matter. A $100 Visa voucher for participation was offered to participants. Although it was mostly declined by participants due to their organisation compliance policies that either prevented the acceptance of gifts or participants considered the compliance process to be too involved to warrant its acceptance. More than half of the participants were recruited as a result of snowballing from previous interviews. It was kind of the participants who shared their connections and facilitated introductions and also reflective of the interconnected nature of the industry and collaborative work in sustainable finance. A limitation of the recruitment process was that participation was self-selected and voluntary which is known to cause a bias in the collective research perspectives. On the other hand, qualitative interviewing is necessarily biased (Kvale, 2008), and the selection criteria seeking expertise in net zero superannuation portfolios, also encouraged a participant bias.

Eleven of the participants were in the superannuation fund category, whilst fourteen were from a related organisation.

As discussed in Chapter 4, as at May 2024, it was found that twenty funds had a net zero by 2050 commitment. Together they manage 1.679 Trillion AUD, which represents more than 60% of all APRA-regulated funds under management. I interviewed participants from eleven of the twenty funds with a net zero commitment. The selected superannuation participants represent a cross-section of funds with respect to the size of assets under management and age of members. Although 40% of the funds with a net zero commitment are for-profit funds, only three participants were from this group, including ethical funds, as the for-profit funds, as were mostly unavailable.

The second group of participants were from a cross-section of sustainable finance interest groups and related roles. They were either Australian organisations or had a presence in Australia and influence over the superannuation sectors' transition to net zero.

Pre-interview Preparation

In this phase of the interview process, I conducted a desktop review of the publicly available reports, policies and statements by the participants' organisation, as well as a search of the participants' LinkedIn profiles and posts, depending on their role(s). The LinkedIn connection has been beneficial in retaining the currency of the organisation's net zero progress, as well as engagement with the participant. The reasons for pre-interview preparation were to show respect to the participant by indicating interest and attention to their existing work, maximising the available interview time by establishing a common baseline of understanding and identifying areas of participant expertise and attention within the topic. Pre-interview preparation had been an important research step in my previous role at Morningstar and influenced the type of information I looked at prior to the interviews such as organisation structure, team, fund objective, returns, portfolio holdings and fees. I also researched the organisations' climate policy, investments and stewardship activities so that I was informed prior to the interview. I undertook similar pre-interview preparation for the interest group participants.

The Interview Process

I conducted twenty-six interviews between June and November 2023. The superannuation fund interviews were 45 minutes, whilst the interest group interviews were 30 minutes. Many of the interest group participants were very senior and time-pressured. Prior to beginning the

interview recording I tried to build rapport and credibility with the participant with a brief introduction of the study aims and establish my shared interest in the topic. Clear and simple questions were designed and sequenced to cover and flow over a range of distinct issues. Kvale (2008) advises that a quality interview will elicit rich responses from the participant with minimal interviewer comment other than to clarify meaning and verify their interpretations of participant answers. Gillham (2005) suggests that interviews should usually be limited to 45 minutes so as not to be tiring for the participant and interviewer.

The two groups had a different set of questions with the interest group participant questions designed to answer the sub-research question, '**Which are the most effective places to intervene in the system to support net zero superannuation portfolios?**'

Whilst the superannuation fund interviews were designed to answer the sub-research question, **'How are superannuation funds implementing their net zero commitments?'** Both sets of supported the sub-research question **'How are actors interpreting net zero superannuation funds?'** as well as the overarching thesis question, '**How will Australian Superannuation portfolios reach net zero?'** The question guides can be found in Appendix E.

Online Interviews

All twenty-six interviews were conducted via zoom, which made the process more convenient for time-poor participants and facilitated access to participants, many of whom were located outside of Sydney. All participants were experienced with online meetings and had access to a reliable internet connection. Many of the participants were operating two screens and used the second screen both to reference the question guide and occasionally to fact-check or substantiate their comments during the interview. Zoom also offers transcribing software which was initially used as a starting point for the transcribing of interviews but proved to be slower and less accurate than dedicated software.

Transcript

I prepared a transcript of each interview with transcribing software, otter.ai, and cross-checked and completed the missed or inaccurate content with a recording of the Zoom call. Per ethics approval, the transcript enabled participants and their organisations to approve, redact and check for any identifying or sensitive commercial information. The transcript was documented verbatim with any identifying participant and organisation details removed. All recordings were deleted after note-taking. The changes made by participants to their completed transcripts were only minor but were important as they provided comfort to the

participants to speak with confidence and know that they would not breach company policy or incur commercial risk. The ability to approve the de-identified transcript was a focus for many interviewees at the recruitment stage and participant numbers would otherwise have lessened. The other benefit of the transcription process was that it provided a check of any missed or incorrect syntax or wording. Finally, the transcript was part of the post-interview process where participants were thanked for their contribution. In several cases, further email exchange and additional resource-sharing followed.

Inductive Coding

The transcript was also the first step in my coding and analysis process. Coding is a reflexive and iterative analysis process where researchers organise their data by identifying patterns that can be analysed to answer their research questions (Rogers, 2023). The data can be broken down in myriad ways that make sense and align with their theoretical framework (Rogers, 2023). Coding of transcripts was done using NVivo software, which is well-suited to text-based thematic analysis (Tang, 2023). An example showing the way that the transcripts were coded can be seen in Figure 11.

Figure 12 shows how my mapping process was used iteratively to further analyse and organise the coded 'nodes'.

Figure 11 Excerpt of a Coded Nvivo Transcript

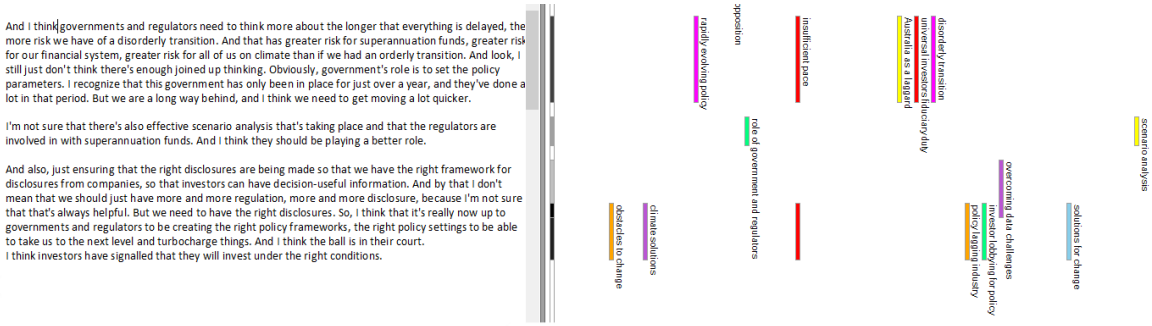
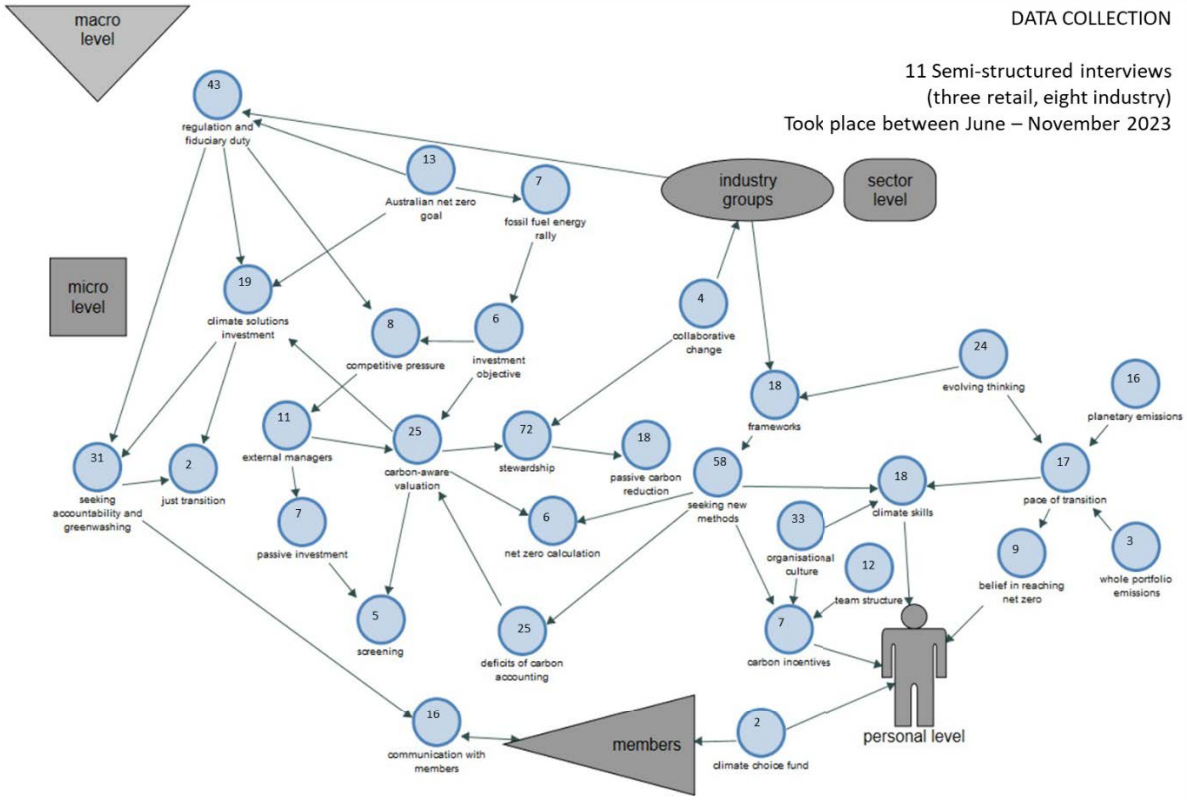


Figure 12 Net Zero Implementation Coding



3.3.3. Thematic Analysis

Thematic analysis (TA) is a way of organising and analysing large quantities of data to identify themes (Braun et al., 2019; Squires, 2023). I selected thematic analysis in my research because I have synthesised, coded and analysed vast sums of data in interview transcripts, and triangulated the interview data with academic and grey literature spanning across disciplines and industry knowledge. The breadth of research is also highlighted by (Willetts & Mitchell, 2017) as a quality criterion for a TDR PhD.

Thematic analysis takes place in coding, refining, analysis and reporting phases (Braun et al., 2019). Braun et al. (2019) provides three guidelines for the use of thematic analysis. Firstly, they distinguished between the coding of implicit ideas, from semantics. I have used the former approach, which adds richness to the research but also can be subject to misinterpretation. Secondly, themes can be developed through the analysis of the data or preset before coding. I developed the themes iteratively through a process of coding the data and revised and regrouped these in my analysis. Thirdly, they suggest that the theoretical perspective of the research may also affect the process of thematic analysis. Those thematic analysis processes are associated with different philosophical perspectives and it is important to be explicit about these assumptions for research quality and to avoid confusion (Trainor & Bundon, 2021).

‘Reflexive thematic analysis’, using iterative coding is linked to constructionism and qualitative research methods and offers rich and nuanced analysis. Whereas, ‘coding reliability thematic analysis’ is a mixed method where multiple researchers analyse and may also score the data for rigour and in an attempt to remove researcher bias (Braun et al., 2019; Morgan, 2022). Both types have been criticised, reflexive thematic analysis for being subjective, and coding reliability for distorting the research with quantitative inputs (Braun et al., 2019; Morgan, 2022; Squires, 2023). Ultimately methodology selection should be chosen on the best fit with the research goals. My selection of reflexive thematic analysis is coherent with the research design selected for this thesis.

Trainor and Bundon (2021) provide a demonstration of reflective thematic analysis with helpful reflection on their inquiry. Trainor, acknowledged having a personal experience with the research topic which was helpful for rapport with participants but also required frequent self-checks and journal-style reflection to avoid misinterpretation arising through projecting self-experience onto their comments. I similarly felt rapport with my participants and benefited from a deeper understanding of the topic due to my prior industry experience and tried to be similarly careful and reflective. Trainor and Bundon (2021) refers to the “complexities, interactions and creativity” in reflective thematic analysis as “remarkable.” I also found my research journey and analysis process to be dynamic, layered and creative. An example is that I attended a conference shortly prior to conducting some of the interviews. Some of the participants were presenters and others were attendees. The shared experience, and dialogue on topical industry issues, allowed me to build from there as a starting point to our interview.

The other purpose of thematic analysis in my thesis is to incorporate new industry knowledge and academic literature that has either arisen since the interviews took place or is explored as a result of a participant's comment. My literature review sets the foundation for the topic and explains the rationale and validity of the research questions. As this topic has rapidly evolved including extensive policy reform, I have broken convention and introduced new sources into the discussion to triangulate the results. This has enabled deeper research analysis and added currency to the findings.

3.3.4. The Role of the Researcher

In qualitative research, the researcher does not purport to be an unbiased objective observer and should therefore recognise how their beliefs have shaped the study. Acknowledging the

researchers' influence in the research and the evolution of the inquiry is part of a reflexive process (Creswell, 2009; Paltridge & Starfield, 2019). Willetts and Mitchell (2017) propose that reflexivity is demonstrated as a quality criteria in a TDR PhD. They distinguish between reflection, where we review our feelings on an issue, and reflexivity, where we question our attitudes. They further comment that it is likely that a PhD candidate's perspectives will evolve through their research journey. Similarly, futures thinkers Sharpe and Hodgson (2019, p. 1072) argue that the process of seeking purposeful change and transformation towards a desired future is reflexive in that it requires, "*an awareness of the future potential of the present moment*."

My PhD process was informed by my past experience in the construction sector, where sustainability principles were incorporated into my early training and practice. An interest in sustainability was a common thread through my career change into the finance sector. Although I quickly realised that much of the finance sector objected to sustainability within the discipline. My role at Morningstar also shaped my thesis research by providing me with industry knowledge across asset classes as well as awareness of the evolution of sustainable finance investment and stewardship. During my role, I recognised the need for future research to support climate-aware investment which motivated my research.

As anticipated by Willetts and Mitchell (2017) my research journey was reflexive and my perspective on the topic shifted. In part this evolution was due to the development of this topical issue. For example, in early 2021 at the research proposal stage of my thesis, my topic was, "How are Australian superannuation fund managers considering and mitigating climate risk?" Fewer superannuation funds had made a net zero commitment at that time and its meaning was not well understood. My assumption in the definition of my thesis topic was mitigating 'financially material' climate risk including 'transition risk' where asset devaluation could occur due to regulatory and demand shifts in the transition to a low carbon economy. It had not occurred to me that some stakeholders did not consider climate transition to be a risk but rather, positive progress towards limiting the impacts of climate change. I also hadn't appreciated the extent of the climate emergency where climate risk had already caused irreversible damage and would not be 'mitigated' but at best, could be limited. A further realisation in my research journey was acknowledging my normative perspective on net zero. Where I had previously accepted that a net zero superannuation commitment was bounded by portfolio emissions, my research showed me that that outcome would not provide a long-term positive impact and a planetary emissions commitment is needed for a just, sustainable transition.

During my thesis journey, I have had the opportunity to be involved in the ISF business, economy and governance team where I have benefited from exposure to impactful research projects and participated in presentations and submissions to government consultations. The wider ISF community has also afforded me a broadened perspective of the way that research teams across energy, food systems, international development and other sectors address sustainability transformation. That exposure has given me conviction in TDR as an effective approach to impactful research.

A defining dimension of this PhD process has been the development of my research skills in order to produce a scholarly contribution to knowledge on my thesis topic. A realisation was the differing epistemologies of finance and sustainability and the challenge of meeting disciplinary conventions in a topic that spanned multiple fields.

My ongoing participation in sustainable finance industry events has been important for currency of knowledge and industry developments. An area that has attracted increased attention since the commencement of my studies, is the important intersection between nature, biodiversity and finance. Regrettably, due to the timing and ongoing evolution of this knowledge, it is out of scope of my PhD.

3.3.5. Transdisciplinary Outputs

TDR research values industry as well as academic knowledge. Sharma and Bansal (2020) urge scholars to 'translate' and bridge the research gap by making knowledge more timely, inclusive and accessible to stakeholders. Research translation is an essential part of TDR and knowledge co-creation where impact is most powerful because research can evolve with practice to solve the most challenging societal problems (Bansal & Sharma, 2022). Bansal and Sharma (2022) recommend that research is translated into commonly-used language, contextualised and published in places where practitioners will access it, such as social media and widely-read trade publications. Sharma and Bansal (2020) also explain that TDR research is a multi-event process spanning a phase of research that should take prior and future research events into account.

The conclusions have been designed to translate these thesis findings in a way that can support the Australian superannuation sectors' transition to net zero. The knowledge has been contextualised and uses accessible language for time-pressured practitioners. It is hoped that these outputs will trigger future engagement and impactful knowledge co-creation.

A limitation of this PhD research with respect to TDR, was the limited extent of external actor involvement in problem framing and knowledge co-creation. The generosity of feedback from sustainable finance industry experts Fiona Reynolds and Rebecca Mikula-Wright in my first and second stage annual assessments, respectively, informed the direction and framing of the research. I also benefited from comments from ISF staff and students who provided intermittent feedback throughout my PhD journey and importantly, valuable and ongoing feedback from my supervisors. All of whom have sustainability expertise and provide helpful perspectives on my research topic.

In relation to the transdisciplinary PhD quality criteria proposed by Willetts and Mitchell (2017), this research;

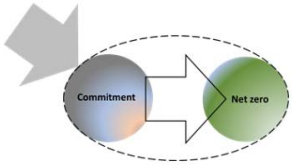
(i) Contributes new knowledge to support the Australian superannuation sectors' transition to net zero, noting its sizable influence over Australian markets and potential to provide capital towards national climate commitments
(ii) In questioning the underlying values in the interpretation, approach and extent to which the sector will reach net zero this research has prompted my own reflexivity. My topic knowledge begun as an industry participant where I accepted the priority of financialisation without question, through the thesis process my attitude has shifted.
(iii) Incorporating grey literature and interviews, the research deliberately seeks differing stakeholders' perspectives. The findings aim to support industry participants, policymakers and other actors and have therefore been translated into a format that will be useable.
(iv) The research covers a broad realm of knowledge to understand the topic in a way that can enable insights aimed at improving the situation. Judgement on the boundary of this complex situation has been made explicit through the use of systems mapping.
(v) Takes a transdisciplinary perspective to affect positive change and applies coherent methods, analysis and presentation of conclusions in alignment with this theoretical framework. Every effort has also been taken to conduct rigorous and properly justified research.

3.3.6. Diagrammatic Summary

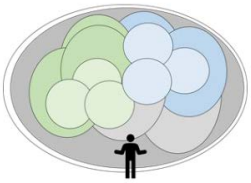
Figure 13 Methodological Summary

Epistemology: Constructionism

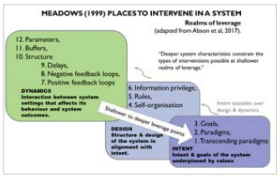
Research purpose: Net zero superannuation portfolios



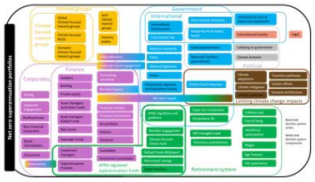
Theoretical framework: Transdisciplinarity



Theoretical analysis: Systems Dynamics and Critical Systems Thinking



Methodology: Qualitative research



Methods of Data Collection and Analysis:
Context Diagrams, Semi-structured interviews, Thematic Analysis

Section 3.3 explained the selection of methods used to investigate the thesis questions. The coherence of qualitative research methods, context diagrams, interviews and thematic analysis to this TDR PhD was presented. The methods were chosen to make different stakeholder perspective explicit and explore tensions in net zero superannuation portfolios interpretation and implementation. This section also considered the process of reflexivity in TDR, where the researcher questions their own attitude throughout the study to generate ethical and usable outputs.

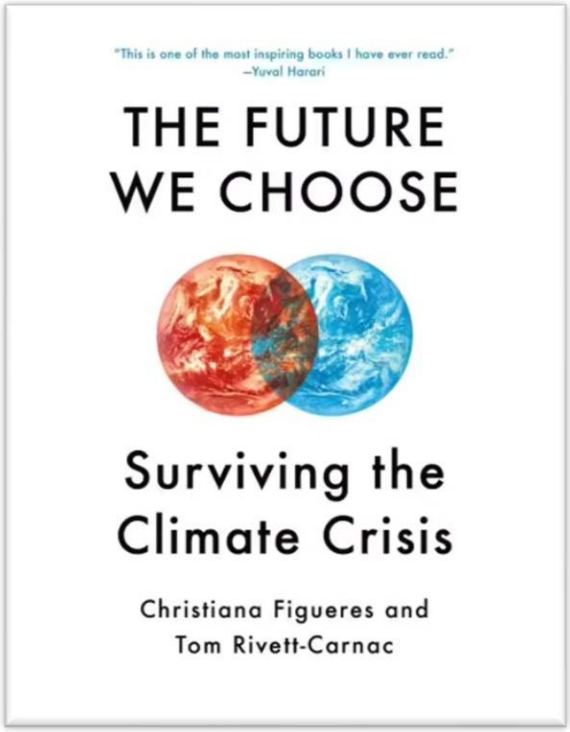
Chapter 4.

Analysis

I was influenced by the book, 'The Future We Choose' during my thesis journey.

Written by Christiana Figueres, Former Executive Secretary of the UNFCCC and Tom Rivett-Carnac, Former CEO of the CDP. These authors were key architects and advanced widespread support for the Paris Agreement. Their book inspires urgent and continued action and was formative for me in recognising my own perspective, that the critical net zero superannuation portfolio commitment is a planetary emissions one.

"We must move towards understanding our shared existence on this planet, not because it is a nice addendum to what we do but because it is a matter of survival...This is not the quest of one nation. This time it's up to all of us, to all the nations and peoples of the world. No matter how complex or deep our differences, we fundamentally share everything that is important: the desire to forge a better world for everyone alive today and all the generations to come."



4.0. Overview

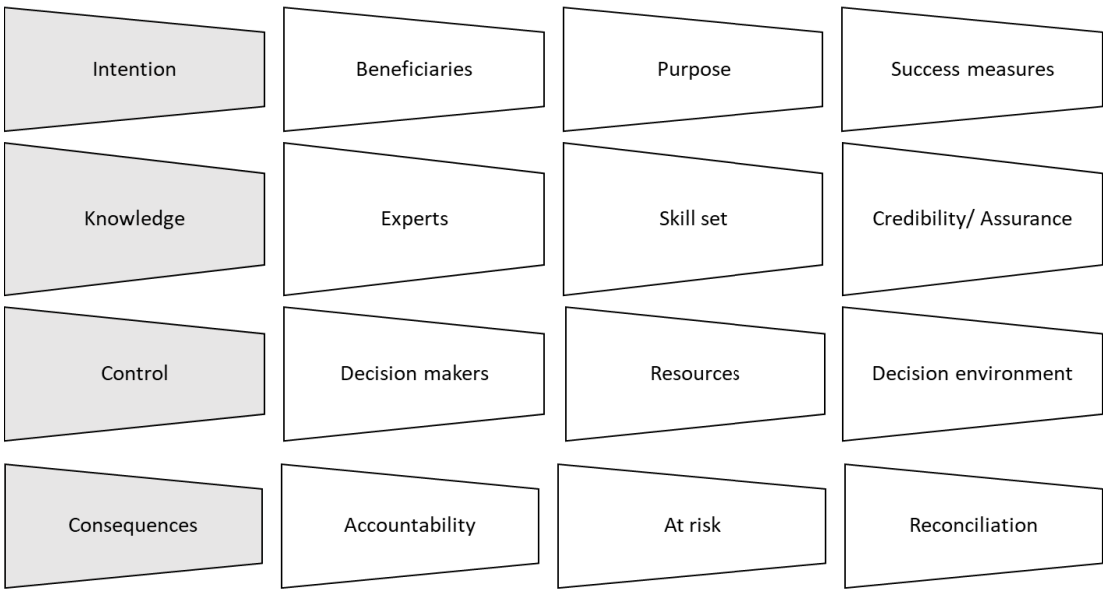
In this chapter I analyse the data to address the research sub-questions,

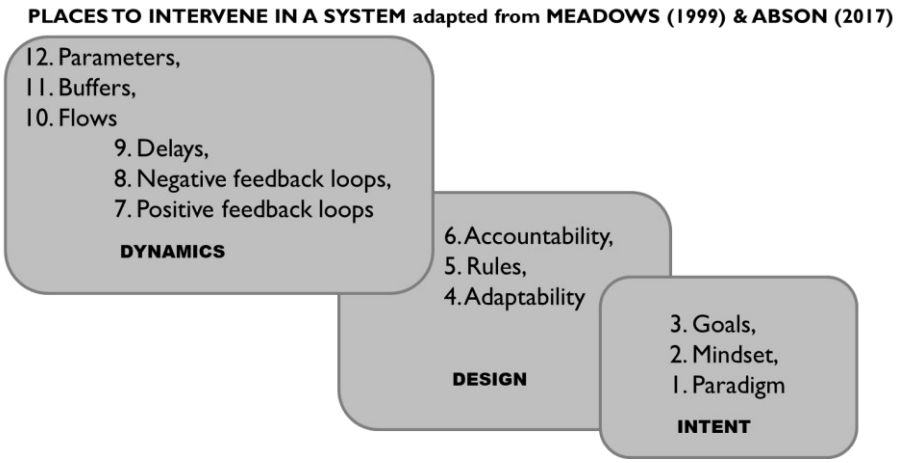
'How are actors interpreting net zero superannuation portfolios?' and **'How are superannuation funds implementing their net zero commitments?', 'Which are the most effective places to intervene in the system to support net zero superannuation portfolios?**'

The primary data was collected from twenty-six semi-structured interviews conducted between June and November 2023. Participant responses and the research findings were triangulated using thematic analysis of academic literature and grey literature, which also added currency to the dynamic topic.

The discussion is structured using the Critical Systems Heuristics framework by Ulrich and Reynolds (2010) and Places to Intervene in a system by Meadows (1999) and Abson (2017) as presented in 3.2 and duplicated in the diagrams below.

CRITICAL SYSTEM HEURISTICS adapted from ULRICH (2010)

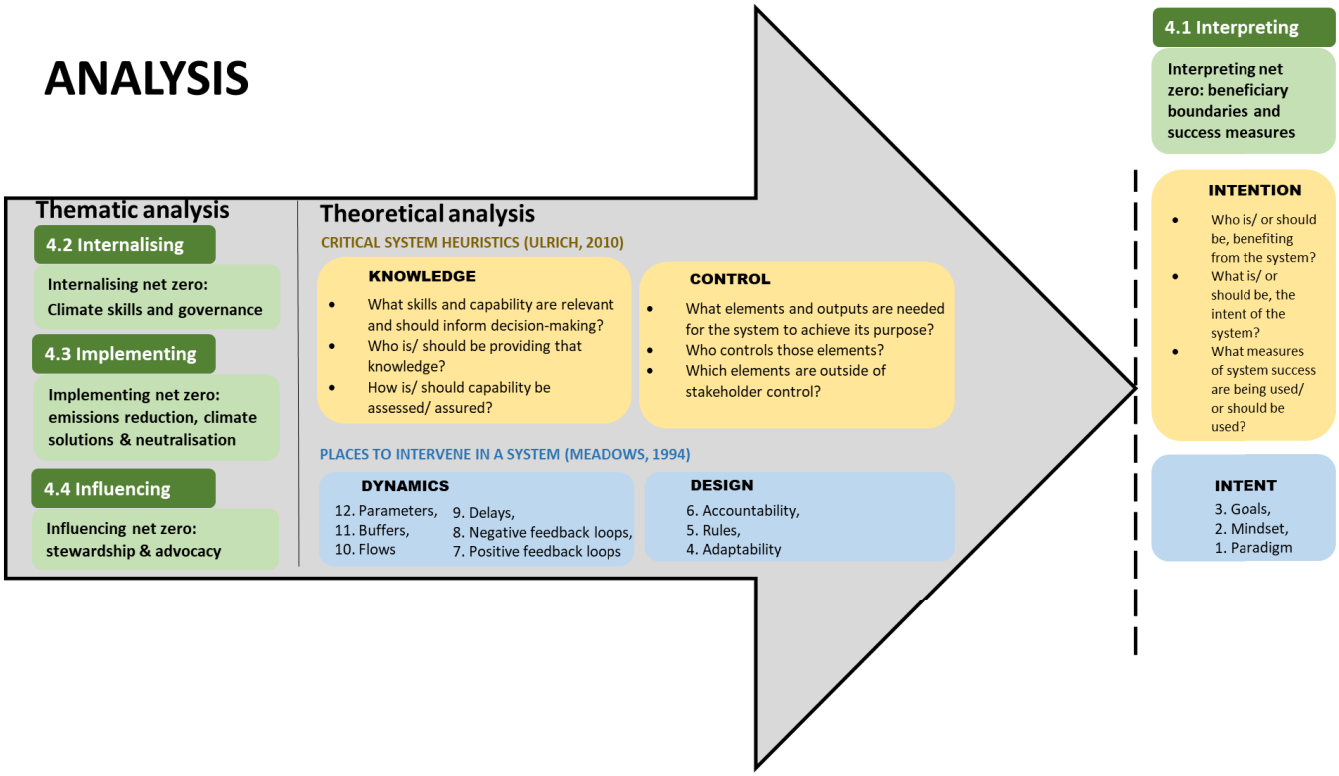




A summary of the way in which the conceptual framework has been applied and the following discussion is shown in

Figure 14.

Figure 14. Overview of Analysis



4.0.1. Commitment, Membership and Signatories

In order to appreciate the extent of commitment to reach net zero across APRA-regulated Australian superannuation funds, a review was conducted in this research of disclosed goals and climate-related statements for the largest fifty funds. The review findings are revealed in the table below and listed by assets under management (APRA, 2024a).

As at May 2024, it was found that twenty funds had a net zero by 2050 commitment. Together they manage 1.679 Trillion AUD which represents more than 60% of all APRA-regulated funds. Of the funds with net zero commitments, twelve are industry and public sector super funds. Almost all funds had an ESG or Responsible investment policy and many of the funds without a net zero commitment indicated that they had an ESG integration process. Their ESG integration process has been footnoted in the table.

The review also considered the top fifty funds' membership and signature to industry interest groups. The industry interest groups provide research, tools, frameworks and opportunities for information sharing and collaborative engagement. Membership is also an indicator of fund alignment with a particular approach. It was found that most funds with net zero commitments were signatories to at least four interest groups. The industry interest groups that have issued transition plan guidance have been colour-coded as it is reasonable to expect their members to adopt transition plan advice. Some funds without a net zero commitment were also members of sustainable finance interest groups, presenting an opportunity for the interest group to advocate for the fund to make a net zero commitment. It was also interesting to note that no interest group had attracted signatures and membership from more than 50% of the top fifty funds. Whilst this could be explained partly by alignment, some of the research participants indicated that they were sensitive to membership costs and had selected between the groups, noting also that costs must be justified in the context of best financial interests' duty to members.

"Anything that we sign up to in terms of an external commitment has to have support from our CEO. When we're doing that we need to consider the commitment that we're making. Does it help us achieve the objectives that we're seeking to achieve? Does it do that in a cost-efficient way? And then finally, what does this commit us to? And are they things that we can deliver on? You can't sign up to everything because it wouldn't be an efficient use of our resources. And obviously we need to think about members best financial interests."

- Research participant.

Table 3. Net Zero Commitments, Memberships and Signatories by Australian Superannuation Funds

Related frameworks	Fund Name	Assets as at March 2024 ($'000)	RI/ ESG statement	Disclosed commitment to reach a net zero portfolio by 2050	Fund type I- industry, P- public Sector, R – Retail, C - Corporate	Median member age	Members/ Signatories						
							IGCC	PRI	GFANZ	RIAA	ACSI	C A100+	ASFI
							NZIF2.0, ICAP	ICAP, NZAOA-TSP4	GFANZ-NZ			IGCC, PRI, IIGCC, AIGCC, CERES	
1	AustralianSuper	335,339,392,039	✓	✓	I	40	✓	✓		✓	✓	✓	
2	Australian Retirement Trust	286,318,168,846	✓	✓	I	40	✓	✓		✓	✓	✓	✓
3	Aware Super	175,416,398,477	✓	✓	PS	48	✓	✓		✓	✓	✓	✓
4	Unisuper	127,829,204,355	✓	✓	I	44	✓	✓		✓	✓	✓	
5	Host Plus Pty Ltd	111,249,399,516	✓	✓	I	34	✓	✓		✓	✓		
6	Public sector superannuation scheme	106,870,702,778	✓	No [1]	PS	57	✓						
7	Colonial First State FirstChoice Superannuation	96,456,266,240	✓	✓	R	55	✓	✓	✓	✓		✓	
8	Construction and building union superannuation fund	91,201,289,001	✓	✓	I	40	✓	✓		✓	✓	✓	✓
9	Military Superannuation and Benefits Fund No 1	84,574,000,000	✓	No [1]	PS	44	✓						

[1] "1. Investing in renewables, 2. Robust transitions from fossil fuels, 3. Improving our net portfolio carbon footprint over time."

Related frameworks	Fund Name	Assets as at March 2024 ($'000)	RI/ ESG statement	Disclosed commitment to reach a net zero portfolio by 2050	Fund type I - industry, P- public Sector, R – Retail, C - Corporate	Median member age	Members/ Signatories						
							IGCC	PRI	GFANZ	RIAA	ACSI	C A100+	ASFI
							NZIF2.0, ICAP	ICAP, NZAOA-TSP4	GFANZ-NZ			IGCC, PRI, IIGCC, AIGCC, CERES	
10	Retail Employees Superannuation Trust	84,291,051,655	✓	✓	I	29	✓	✓		✓	✓	✓	✓
11	MLC Super Fund	84,155,348,422	✓	No[2]	R	46	✓			✓			
12	HESTA Health Employees Superannuation Trust Australia	83,573,864,922	✓	✓	I	42	✓	✓	✓	✓	✓	✓	✓
13	ASGARD Independence Plan Division (Westpac Group)	71,771,077,981	✓	✓	R	60	✓		✓	✓		✓	✓
14	Mercer Super Trust	70,112,326,686	✓	✓	R	42	✓	✓		✓		✓	✓
15	IOOF Portfolio Service Superannuation Fund	64,283,211,951	✓	No[3]	R	58							
16	CSS Fund	63,035,481,144	✓	No[1]	PS	76	✓						
17	Wealth Personal Superannuation and Pension Fund	60,399,927,080	✓	No	R	64							
18	AMP Super Fund	53,582,974,376	✓	No[4]	R	48	✓	✓		✓		✓	✓

[2] "The PM may consider the following measures to support a more comprehensive understanding of climate risk: encourage Managers to demonstrate and report on their approach to evaluating climate risk within their portfolios and to disclose to the PM the investment processes supporting their views"

[3] "The content within this policy is limited to considering RI as part of the selection process for investment options, it does not outline each individual Manager's approach to RI."

[4] "Emission boundaries:
Scope 1 emissions: emissions from consumption of natural gas, diesel and refrigerants at buildings where AMP Limited has operational control over the base building or within major tenancies.

Related frameworks	Fund Name	Assets as at March 2024 ($'000)	RI/ ESG statement	Disclosed commitment to reach a net zero portfolio by 2050	Fund type I- industry, P- public Sector, R – Retail, C - Corporate	Median member age	Members/ Signatories						
							IGCC	PRI	GFANZ	RIAA	ACSI	C A100+	ASFI
							NZIF2.0, ICAP	ICAP, NZAOA-TSP4	GFANZ-NZ			IGCC, PRI, IIGCC, AIGCC, CERES	
19	Macquarie Superannuation Plan	42,449,566,509	✓	No[5]	R	62	✓	✓	✓	✓			
20	Retirement Portfolio Service	37,271,324,964	✓	No[6]	R	45		✓					
21	Equip Super	33,150,071,583	✓	✓	I	50	✓	✓		✓	✓	✓	
22	HUB24 Super Fund	32,133,046,375	✓	No[7]	R	54				✓			
23	Brighter super	32,110,908,991	✓	No[8]	PS	48	✓				✓		
24	Spirit Super	30,020,305,239	✓	No[9]	I	41		✓			✓		

Scope 2 emissions: emissions from electricity consumption at AMP Limited's corporate offices and other assets owned and operated by AMP Limited.
Scope 3 emissions: emissions arising from air travel, transmission and distribution of purchased electricity, base building, waste, paper, purchased goods and services and work from home emissions."

[5] "Scope 1 & 2 commitment by 2040. Scope 3 by 2050 only where it has control or significant influence.
Select portfolio companies and property inclusions only. Our managed funds that are sub-advised or have an external investment manager, those advisers and managers are not subject to the MAM Public Investments proxy voting guidelines and may or may not have their own voting policies or frameworks."

[6] "Limited to considering RI as part of the selection process for investment options, it does not outline each individual Manager's approach to RI."

[7] "Carbon neutral by 2030 Scope 1 and 2 emissions only. Also supports advisers and their clients in meeting their ethical, social and governance requirements HUB24 provides over 150 ESG investment options including SRI, ESG, Ethical and Impact focussed investments. To enable a sustainable advice industry HUB24 is committed to supporting advisers through ongoing education"

[8] "A reduction in carbon emissions intensity of 30% by 2030 across the equity investment portfolio from its 2022 emission levels."

[9] "We're realistic about the extent to which we can influence global outcomes. Our focus is on managing risks specific to our portfolio and targeting new opportunities that play to our strengths.
Target 1: Allocate more than 15% of our total investment portfolio to impact investments by 2030.
Target 2: Reduce our total investment portfolio's attributable carbon footprint by 2030"

Related frameworks	Fund Name	Assets as at March 2024 ($'000)	RI/ ESG statement	Disclosed commitment to reach a net zero portfolio by 2050	Fund type I- industry, P- public Sector, R – Retail, C - Corporate	Median member age	Members/ Signatories						
							IGCC	PRI	GFANZ	RIAA	ACSI	C A100+	ASFI
							NZIF2.0, ICAP	ICAP, NZAOA-TSP4	GFANZ-NZ			IGCC, PRI, IIGCC, AIGCC, CERES	
25	Netwealth Superannuation Master Fund	28,819,135,329	✓	No[10]	R	58							
26	Telstra Superannuation Scheme	26,139,656,784	✓	✓	C	53	✓	✓		✓	✓	✓	
27	Public Sector Superannuation Accumulation Plan	25,492,073,546	✓	No [1]	PS	41	✓						
28	Care Super	22,683,705,440	✓	✓	I	44	✓	✓		✓	✓	✓	
29	NGS Super	15,074,502,647	✓	✓	I	48		✓		✓	✓	✓	
30	Active super	14,453,315,500	✓	✓	PS	51	✓	✓		✓	✓	✓	
31	Mine Superannuation Fund	13,473,189,191	✓	No[11]	I	50					✓		

[10] "FY23 develop a framework to measure Netwealth's carbon emissions. We have ESG research and ratings on managed funds from Morningstar that utilise the "Morningstar Sustainability Rating" and their "Low Carbon Designation" to identify the companies held in a fund that are in general alignment with the transition to a low-carbon economy. Netwealth has a range of the ESG managed funds and managed accounts available"

[11] "support of a just transition as the global economy progresses to a low carbon future"

Related frameworks	Fund Name	Assets as at March 2024 ($'000)	RI/ ESG statement	Disclosed commitment to reach a net zero portfolio by 2050	Fund type I- industry, P- public Sector, R – Retail, C - Corporate	Median member age	Members/ Signatories						
							IGCC	PRI	GFANZ	RIAA	ACSI	C A100+	ASFI
							NZIF2.0, ICAP	ICAP, NZAOA-TSP4	GFANZ-NZ			IGCC, PRI, IIGCC, AIGCC, CERES	
32	Local Authorities Superannuation Fund	13,050,383,918	✓	No[12]	PS	53							
33	Avanteos Superannuation Trust	12,868,189,747	-	Unclear?	R	67							
34	Russell Investments Master Trust	10,879,216,000	✓	✓	R	45		✓	✓	✓		✓	
35	Qantas Superannuation Plan	8,422,036,143	✓	✓	C	52							
36	Australian Ethical Retail Superannuation Fund	8,143,429,029	✓	✓	R	36	✓	✓		✓		✓	
37	Prime Super	7,189,400,170	✓		I	36							
38	TWU Superannuation Fund	7,059,115,111	✓		I	47	✓	✓			✓		

[12] "Benchmark relative carbon allowance 30% below for Australian equities, 60% below for international equities"

							Members/ Signatories						
							IGCC	PRI	GFANZ	RIAA	ACSI	CA100+	ASFI
Related frameworks	Fund Name	Assets as at March 2024 ($'000)	RI/ ESG statement	Disclosed commitment to reach a net zero portfolio by 2050	Fund type I- industry, P- public Sector, R – Retail, C - Corporate	Median member age	NZIF2.0, ICAP	ICAP, NZAOA-TSP4	GFANZ-NZ			IGCC, PRI, IIGCC, AIGCC, CERES	
39	ANZ Australian Staff Superannuation Scheme	6,751,762,330	✓	✓	C	45			✓				✓
40	Building Unions Superannuation Scheme (Queensland)	6,605,464,069	✓	No[13]	I	42							
41	Legalsuper	5,914,828,075	✓	No[14]	I	44					✓		
42	National Mutual Retirement Fund	5,912,870,908	✓	No – ESG integration	R	59		✓		✓			
43	Smart Future Trust	5,734,140,566	✓	No – ESG integration	R	46		✓		✓			
44	Essential Super	5,221,152,653	-	Avanteos trustee - unclear	R	36							
45	One super	4,875,814,168	-	Diversa trustee	R	42							

[13] "Whilst BUSSQ has not yet developed a target and policy on net zero, the Trustee encourages our underlying investment managers to develop their own policy and action plan to move to net zero."

[14] "Legalsuper incorporates responsible investment considerations into all stages of investment analysis and decision-making processes"

Related frameworks	Fund Name	Assets as at March 2024 ($'000)	RI/ ESG statement	Disclosed commitment to reach a net zero portfolio by 2050	Fund type I- industry, P- public Sector, R – Retail, C - Corporate	Median member age	Members/ Signatories						
							IGCC	PRI	GFANZ	RIAA	ACSI	C A100+	ASFI
							NZIF2.0, ICAP	ICAP, NZAOA-TSP4	GFANZ-NZ			IGCC, PRI, IIGCC, AIGCC, CERES	
46	Praemium SMA Superannuation Fund	4,498,109,307	-	No[15]	R	59							
47	First Super	4,139,025,980	✓	No[16]	I	37					✓		
48	Centric Super	3,815,840,456	-	No[17]	R	69							
49	Guild Retirement Fund	3,209,395,195	✓	No	R	31		✓		✓			
50	Australian Meat Industry Superannuation Trust (now Australian Food Super)	3,123,634,462	-	No	I	37							
	Total		44	20	-	-	25	25	6	25	19	18	9

4.0.1 showed that twenty superannuation funds representing about 60 percent of APRA-regulated assets under management have a net zero commitment. The legal opinion of Hutley and Hartford-Davis is that there is an expectation of companies to have a net zero commitment. Arguably then, funds without one are at legal risk of not meeting member expectations, although this has not been tested through litigation. Further research would be

[15] ESG resources for financial advisers

[16] ESG risk management

[17] impact funds available on platform

beneficial to better understand the influence of interest group membership on adoption and interpretation of net zero commitment. Twenty-one of the top fifty funds were retail funds, but only five had a net zero commitment. Their business model may require distinct consideration of net zero fiduciary duty. An essential catalyst for the expansion of net zero commitments would be regulation.

4.0.2. Transition Plans

A review of a selection of commonly used voluntary and regulator transition plan frameworks for financial institutions has been conducted to identify differing net zero expectations of significant interest groups and governments. They have also been useful for triangulating the interview data and adding currency to this study.

The need to improve the integrity of net zero pledges led the High-Level Expert Group on the Net Zero Emissions Commitments of Non-State Entities established by the United Nations (2022) to recommend developing concrete transition plans that provide a basis for credible action. Transition plans deliver guidance and enable entities to demonstrate time-bound planning and implementation for a science-based, net zero business model and the dependencies to achieve it (GFANZ, 2022c; UNEP FI & PRI, 2023). Development of transition plans by interest groups and regulators has been ongoing through the duration of this thesis research and is being frequently refined.

In addition to the many sector-specific transition plans designed to assist transition by sector, benchmarks have also been established to compare net zero progress. World Benchmarking Alliance (2023) reported on the progress of 400 financial institutions against their proprietary benchmark that assessed climate governance and strategy, respecting planetary boundaries and societal conventions. AustralianSuper and Aware Super are two of the eleven Australian financial institutions included in their analysis, ranking 109th and 74th, respectively. Their report found that asset owners scored poorly on climate indicators overall. In their net zero company benchmark, investor initiative Climate Action 100+ (2024b) assessed the net zero progress of 165 high-emitting companies. They review disclosure adequacy and alignment with the Paris Agreement, using the International Energy Agency's 1.5^{o} Net Zero Scenario. One of their findings was that eight of the eleven included cement companies had reduced emissions but just three were doing so at a pace aligned with the net zero scenario.

The selected frameworks are described in Table 4. Interest groups have provided the frameworks shaded in grey for voluntary use. The guidance issued by these interest groups should correspond with the net zero implementation of the funds who are their members and

signatories. Superannuation funds also review transition plans prepared by their investee entities to assess if they are operationalising, disclosing and progressing on their commitments (UNEP FI & PRI, 2023). It is interesting to note that there is considerable overlap between the interest groups affiliated with the voluntary transition plan frameworks, these have been colour-coded for emphasis. The guidance provided in voluntary and regulatory frameworks is considered throughout the analysis across a set of net zero implementation considerations. Summaries can be found in Appendix H, commentary on the frameworks is incorporated in the analysis.

GFANZ (2022c) takes the position that net zero transition plans are orientated towards an entity's core business and own net zero goal, however, managing climate risk also requires an entity to support the broader responsibility to real economy decarbonisation. They make the secondary point that climate adaptation is closely linked and recommend that, "*financial institutions should consider pursuing opportunities where mitigation and adaptation efforts are closely linked and support both sets of objectives*" (GFANZ, 2022c, p. 14). Their framework reveals an entity-orientated focus, where investment in climate adaptation is subordinate. In contrast, UNEP FI and PRI (2024b) and IIGCC (2023a) promote climate mitigation alongside climate adaptation finance.

Table 4. Commonly-used Transition Plan Frameworks

Framework	Developed by	Underlying investor networks/
NZIF2.0 Net Zero Investment Framework 2.0 (PAII, 2024)	Paris Aligned Investment Initiative (PAII)	IGCC, IIGCC, AIGCC, Ceres
ICAP *Note: This is a 'self-assessment tool' but has been included as it provides tiered net zero guidelines* Investor Climate Action Plans, Expectations Ladder (The Investor Agenda, 2022b, 2023b)	The Investor Agenda	UNEP FI, IGCC, IIGCC, PRI, Ceres, CDP, AIGCC
GFANZ -NZ Financial Institution Net-zero Transition Plans and	Glasgow Financial Alliance for Net zero (GFANZ)	NZAOA, UNEP FI, Ceres, CDP, IIGCC, G20 FSB

supplement (GFANZ, 2022c, 2023)		
SBTi -NZ Science-Based Targets Initiative (SBTi) Financial Institutions Net-zero Standard, Conceptual framework and Initial Criteria, Consultation draft	Science-based Targets Initiative (SBTi)	UN GC, CDP, WRI, WWF
NZAOA-TSP4 The Un-Convened Net-Zero Asset Owner Alliance (NZAOA) Target Setting Protocol Fourth Edition (UNEP FI & PRI, 2024b)	Principles For Responsible Investment (PRI)	UNEP FI
Regulator-developed net zero framework		
Framework	Jurisdiction	Aligned agency
EU-CS Transition plans Corporate Sustainability Due Diligence (CSDDD) and Corporate Sustainability Reporting Directive (CSRD) (European Parliament, 2022b, 2024b)	EU	
Transition Plan Disclosure Framework and Asset Owner Guidance (TPT, 2023, 2024)	UK	IFRS, GFANZ

In a survey of 63 institutional investors in Australia, IGCC (2024b) found 65% are using climate transition plans. Research participants described the importance of the frameworks for guidance although they noted that some of the frameworks were aspirational and not yet reflective of industry practice or capability. The research participants also indicated uncertainty on the appropriate use of transition plans,

"The Paris Aligned Investment Initiative often focuses on the asset classes… it gives us that kind of practical guidance that we haven't necessarily seen be set by other bodies. I think there's a lot of guidance that's missing still, that would be very helpful. So, another example of a standard that we use to help inform us, is using the PCAF for doing our carbon intensity…Sometimes there is a bit too much ambition in it. And I think sometimes the ambition of different guidance that gets given to investors overstates what we can actually do. So, I think it's good because, it's challenging because it tells you everything that needs to happen. And I think of the same when I think of a science-based target. Or when you use, SBTi's a lot of the time they are developed with everything that you need to have done but it doesn't necessarily reflect what can be done." - Research participant

"We are calling it a transition plan internally, although we're not quite sure if it is a transition plan, because we don't necessarily have a transition pathway in a quantitative manner, it's more of a plan. So, we're just working that out, and we'll probably go and get that externally reviewed before we make it public. Just in a world of greenwashing we just need to be so careful. But we also don't want to greenhush, either. So, it's striking that right balance." - Research participant

The quote below evaluates one fund's implementation progress against the transition guidance as assessed by an external consultant.

"It did find a lot of gaps [between the NZAOA framework, APRA guidance and our progress], and that was particularly around those targets, you know, targets for active ownership, which we hadn't set. We had set a target for low carbon solutions. We had set targets for 2030 in some of the asset classes. So, we had done some elements of it, but probably not strictly to the letter. And we continue to use that as our guide, even though we're not members. So, that's a highly influential protocol for us that we follow…The other ones that we followed is the Expectations Ladder, which has just come out in a new version, and the one that we probably follow the least in terms of target setting, is SBTi. We just don't find it that user-friendly…SBTi takes it to the next level, and actually really wants you to get to that transition pathway with data…we're supportive of SBTi's precision of where they want the market to get. I just don't think the market is quite there." - Research participant

Regulators have also begun to develop transition plan guidance, the EU and UK are shown in yellow in Table 4. Under the former Biden Administration, The US Department of the Treasury (2023) also developed high-level guidelines for financial institutions that have made a voluntary net zero commitment, which includes the expectation that a transition plan is

created and implemented. In their enhanced climate-related disclosure ruling they stated that domestic and foreign issuers in the US that have a transition plan must provide information and updated annual disclosures to investors to explain the actions taken and how these materially affect or are reasonably likely to materially affect the registrant's business (US Federal Register, 2024). Climate-related financial disclosure regulation was revoked by President Trump in January 2025 (The White House, 2025b). Whilst it is not likely to occur in the US under the current Government, regulator-developed transition plans could become prudentially binding and used to prompt net zero compliance and supervisory action. They can also be used to ensure the incorporation of sector pathways and national goals (Dikau et al., 2024), such as the National Adaption Plan (Australian Government, 2024g).

Whilst the voluntary net zero frameworks developed by interest groups tend to have a strategic focus for external communication, the transition frameworks by regulators are orientated to risk assessment (KPMG UK, 2023; NGFS, 2024a). NGFS (2024a) prepared a report on transition plans that showed that existing transition plans were inconsistent and not comparable, making it difficult for financial institutions to assess their exposure to existing and forward-looking climate risk, as well as macro consideration of financial stability. They recommended that policy makers develop proportionate and interoperable transition plan standards. Although NGFS also refers to the importance of transition plans to understand and mobilise the flow of capital to climate mitigation and adaptation investment, their focus on financially-materiality climate risk and proportionality reveals their prioritisation of entity value and financialisaton. Hale et al. (2024) assert that converting voluntary net zero commitments into mandatory rules are important to overcome the current ‘implementation gap’ and ensure ongoing effort, fairness for peers and opportunity for legal scrutiny. Hale et al. (2024) comment that net zero regulation will be constrained by political economic forces in that jurisdiction and made more complex by interoperability and arguments on fairness especially for under-resourced governments.

The different net zero transition plans are testament to the divergent underlying priorities in net zero implementation. Consolidation of transition plans would require these deeply held beliefs to be made explicit. How these are reconciled will affect system outcomes. These differences should be explored and debated as they relate to the intended net zero beneficiary.

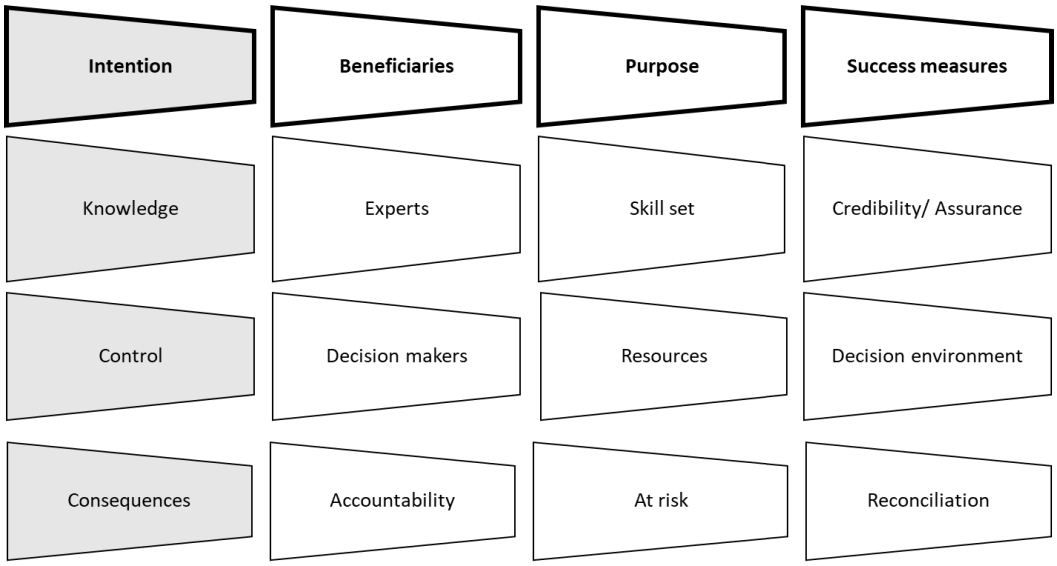
Net zero transition plans bring credibility and rigour to a net zero commitment. The selection of frameworks differs in relation to their ambition. As was the case with reporting frameworks,

transition plan frameworks may converge. Importantly, regulator involvement signals the likelihood for future compliance. The criterial for the transition plans reflect underlying values.

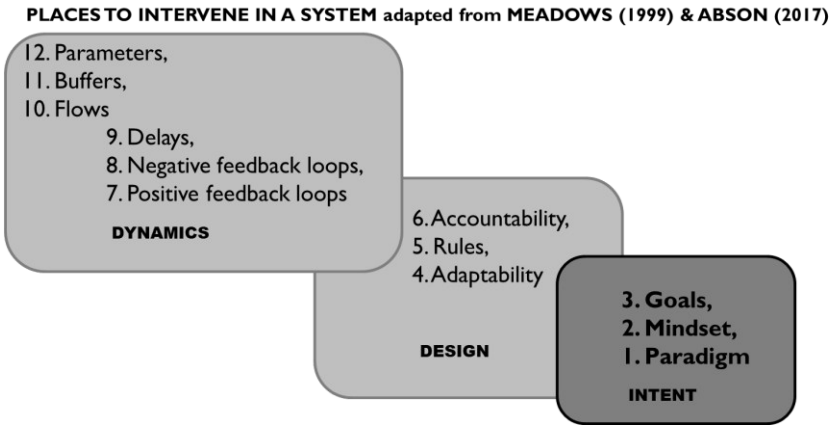
4.1. Interpreting Net Zero and Understanding System Intention

'Interpreting net zero' explores the system intent and how superannuation funds understood their commitment, who the system is trying to serve, and which metrics best demonstrate their net zero progress. Firstly, this section examines judgement on the boundary for the net zero commitment and differentiates between portfolio and planetary emissions interpretation. This determination affects the level of impact that net zero superannuation portfolios will achieve. Secondly, analysis of system beneficiaries aims to comprehend actor views on the duty of net zero superannuation portfolios to fund members, national interests, global beneficiaries and future generations. Thirdly, the analysis turns to perspectives on measures for net zero success and belief in its achievement.

The CSH Method explores the intention of a system by asking what it is trying to achieve, for whom and how its success is being measured (Ulrich & Reynolds, 2010). Williams and Hummelbrunner (2010) explain that by making these boundary judgements explicit, the value-basis of a system is revealed.



Meadows (1999) explains that the deepest places to intervene in a system are its mindset, paradigms and goals, the realm of leverage described by Abson et al. (2017) as the system intent.



4.1.1. System Purpose

There is no singular agreed definition on the extent of greenhouse gas emissions that should be included and the boundary to which an entity's net zero commitment should intend to reach. Differing perspectives are exposed in this section.

In analysing the comments by research participants, it became apparent that they had differing views. Four groupings were developed to distinguish between the net zero intent that was communicated by interview participants. These are shown in

Figure 15 and explained in

Table 5.

The groupings relate to classification by the *Greenhouse Gas Protocol GHGP* (World Business Council for Sustainable Development & World Resources Institute, 2004) where;

- Scope 1 emissions are direct greenhouse gas (GHG) emissions that are owned or controlled by the company,
- Scope 2 are indirect GHG emissions purchased by the company and,
- Scope 3 are other GHG emissions that occur indirectly due to company activities both upstream and downstream of the value chain

A useful reference that was adapted for these groupings is the 'Circles of influence' elaborated by Covey (1988) in which control and influence is greatest at the centre circle and reduces as the circles expand. Note that ambition and scope of emissions is highest in the outer circle.

Figure 15. Boundaries of Commitment to Climate Risk

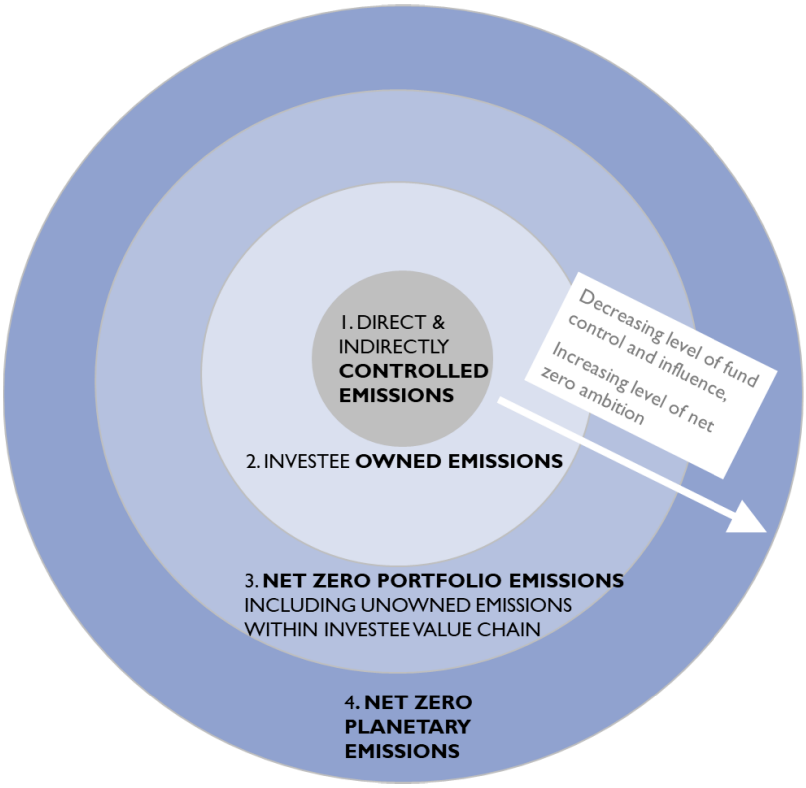


Table 5. Net Zero Interpretations of Research Participants

Group	Commitment to Manage Climate Risk	Fund Participants	Interest Group Participants
1. Controlled Emissions	Directly and indirectly controlled emissions from fund operations only (Scope 1 & 2) *eg. Scope 2 emissions reduction due to selection of renewable energy purchased by the superannuation fund for their own operations*	1	
2. Owned Emissions	**As above plus** emissions controlled by investee entities (Scope 1, 2 & 3 [scope 1 & 2]) *eg. Scope 3 emissions reduction due to*	1	

	stewardship of an investee company that has reduced the scope 1 emissions generated in their production process.		
Net zero frameworks require the inclusion of scope 1, 2 & material scope 3 emissions for investee entities			
3. Portfolio Emissions	**As above plus** all significant and measurable unowned emissions within the supply chain of investee entities (Scope 1, 2 and 3 [scope 1, 2 & 3]) *eg. Scope 3 emissions reduction due to stewardship of an investee company that has reduced their scope 3 emissions generated through materials sourced in their supply chain.*	4	5
4. Planetary Emissions	The belief that a net zero portfolio commitment is synonymous with all planetary emissions. *eg. The net zero commitment includes all global emissions even where emissions relate to 'uninvest-able' economies.*	5	10

As denoted in the table above, net zero transition plans for superannuation funds require the minimum inclusion of at least some scope 3 emissions to represent emissions from their investee companies (GFANZ, 2022d; PCAF, 2020, 2022), a discussion on these follows.

In categorising participants into these groups, it is noteworthy that most participants, particularly those from interest groups, were aligned with the most ambitious category that interpreted a net zero commitment as synonymous with a commitment to net zero planetary emissions. The other main interpretation of net zero intent was the full scope of significant and measurable emissions up to the boundary of portfolio holdings. The remaining two superannuation research participants were aligned with a narrower emissions reduction intent which would not satisfy the criteria of net zero transition plan frameworks, therefore groupings 1 and 2 are not continued further.

A limitation of this research is that the participants who were willing to participate were interested in the topic and likely biased towards stronger net zero action.

Portfolio Emissions

Participants aligned with the portfolio emissions group indicated that a net zero commitment should include all significant and measurable emissions within the supply chain of investee entities (Scope 1, 2 and 3 [scope 1, 2 & 3]). They acknowledged that their commitment did not include all asset classes, given there were currently no agreed emissions measurement methods for some investment types, for example sovereign bonds and they did not include those asset classes until data improved. Participants in this group also emphasised the limitations of their role, reasoning that stewardship was important but clarifying that ultimately their investee companies would need to drive emissions reduction. This view aligns with the Central Bank and Supervisors NGFS (2024a, p. 5) who note that, "*Financial institutions play a role as mobilisers of capital to enable the transition, but cannot drive the transition as they cannot force non-financial firms to act*."

"Ultimately, we're an aggregator of debt and equity. That phrase is often what we use, to describe it. Because we need to be really clear about what the role of an investor is and what we can actually do. We're an owner of the companies, but we don't own the underlying assets of those companies. So, we need our investee companies to do the heavy lifting."

– Research participant

"I think it will change over time. I think the end goal won't change, in that we've got to be net zero by 2050 in terms of our portfolio wide emissions – this is what is within our control. But one thing we are really clear on, with the board and publicly, is that we will only be successful if everyone moves. So, we do spend a lot of time advocating. And we also spend a lot of time thinking strategically about which levers we will pull and where our efforts are best placed."

– Research participant

"Some of our investment managers, have a net zero by 2040 target right, well, what happens on the 31st of December 2039. You just kill the strategy because it's not net zero? Or you go and buy a bunch of offsets or what happens?"

– Research participant

A portfolio emissions boundary of inclusion also allowed for a theoretical scenario where a fund that was still holding an entity that had not decarbonised in 2050 could rapidly divest from it and still achieve their own goal. That is not to say that their commitment is disingenuous or that the funds were choosing to divest in place of stewardship. Rather, it is the

observation that unlike a planetary emissions commitment, a portfolio boundary has tolerance for funds to successfully reach net zero in 2050 by divesting from investee companies in 2050. To clarify, many participants with a planetary emissions goal also saw a necessary role for divestment, particularly in an industry with no viable abatement. However, a late-stage divestment decision for net zero accounting purposes is misaligned with global decarbonisation. The Net Zero Investment Framework by PAII (2024) advises that divestment should not be used as the first method for net zero alignment but rather the result of considered climate risk assessment, a process of unsuccessful engagement or where there is no feasible path for alignment. Strong climate policy and stranded asset risk may prevent the occurrence of laggard companies. Yet the theoretical possibility of late-stage divestment is a proviso that may diminish the urgency of their net zero implementation.

Planetary Emissions

For the planetary emissions participants, a net zero portfolio commitment is synonymous with net zero planetary emissions. This group of research participants believed that as portfolios are highly diversified, with deeply complex supply chains and borderless global emissions, the only feasible way to have a net zero portfolio was with global decarbonisation. This perspective is expressed by SBTi (2023a, p. 12), " *While ensuring portfolios also reach a state of net-zero emissions is important, achieving this by simply decoupling the portfolio from the real economy will not be sufficient for supporting the wider economic transformation."* They argued that sufficient investment in emerging markets and developing economies would be needed in order for net zero planetary emissions to be reached and believed superannuation funds had a responsibility to provide capital to finance their share of EMDE climate solutions. Their reasoning corresponds with Article 2.2 of the Paris Agreement, "*This Agreement will be implemented to reflect equity and the principle of common but differentiated responsibilities and respective capabilities, in the light of different national circumstances*" (United Nations, 2015a).

"We can decarbonise our entire portfolio. We could do that and yet if the rest of the economy is burning around us - what good are we really?" – Research participant

"When we're thinking about member returns, again, if we're fully decarbonised, while there may be some winners in that, if the economy isn't decarbonising, we're going to have a massive tracking error and a disconnect to what's happening in the rest of the market. Which is not going to be in a member's best financial interest." – Research participant

The Net zero Investment Framework and proposed net zero standard by SBTi, similarly refer to the importance of incorporating 'fair share' principles into investor transition plans (PAII, 2024; SBTi, 2023a). A further distinction between a planetary emissions interpretation of net zero and a portfolio emission intent is a more sophisticated understanding of climate science and scenario architecture by the former and a view that net zero commitments require more rapid implementation and more forceful engagement (UNEP FI & PRI, 2024b).

"Something that I'm pushing is…the idea of a fair share carbon budget when it comes to investing internationally, who should carry the responsibility? How do we get sustainable development if we don't unpack those financial flows from global North to global South… Once you move away from linear reduction and have to move into thinking about a portfolio in this cyclical way, then the machinery can grind to a halt." – Research participant

Scope 3 Emissions

The critical difference between the portfolio and planetary emissions interpretation of net zero is their delineation of scope 3 emissions. The portfolio emissions group were especially concerned about the extent of the boundary judgement on scope 3 emissions. This section considers perspectives on the responsibility of funds to influence the potentially vast extent of unowned emissions in the value chain of a portfolio and where this obligation ends.

Scope 3 are GHG emissions that occur indirectly due to company activities both upstream and downstream of the value chain. The complexity of supply chains makes it difficult to identify all upstream and downstream emissions and scope 3 data is particularly challenging but levels of scope 3 reporting have increased (IIGCC, 2024a). More than 99% of financial services emissions are scope three emissions and for corporates, upstream scope 3 emissions alone are generally 1140% larger than their operational, scope 1 and 2 emissions (CDP, 2023a). Investors are required to disclose their scope 3 emissions to represent the financed emissions of portfolio holdings (Australian Accounting Standards Board, 2023; GFANZ, 2022d; International Sustainability Standards Board, 2023; PCAF, 2020, 2022). In the first year of disclosure, reporting entities are not required to report scope 3 emissions (AASB, 2024). Entities will need to disclose their measurement approach and any excluded financed emission will need to be explained. (Australian Accounting Standards Board, 2023). The Greenhouse Gas Protocol (2013) devised a classification of fifteen categories of scope 3 emissions in 2013 and it remains widely-used.

Table 6 shows these categories, with upstream emissions shaded in blue and downstream in green.

Table 6. Scope 3 Emissions Classification by GHG Protocol 2013

	Upstream emissions category		Downstream emission category
1	Purchased goods and services	9	Downstream transportation and distribution
2	Capital goods	10	Processing of sold products
3	Fuel and energy not included in S1 & 2	11	Use of sold products
4	Upstream transportation and distribution	12	End of life treatment of sold products
5	Waste generated in operations	13	Downstream leased assets not included in S1 & 2
6	Business travel	14	Franchise operations not included in S1 & 2
7	Employee commuting	15	Investments not included in S1 & 2
8	Upstream leased assets		

The GHG Protocol (2013) guidance on criteria to assess relevant scope 3 activities also remains influential (CDP, 2023a; IIGCC, 2024a). These are where emissions are:

- Of a significant size
- Likely to influence emissions reduction
- Add to the company carbon risk
- Are considered critical to stakeholders
- Are out-sourced but could be done internally
- Are deemed relevant by the company or industry according to additional criteria

However, determining the relevance of scope 3 emissions with these criteria still needs judgement. The use of imprecise words such as, ‘significant’, without further detail, also results in a problematic lack of clarity (OECD, 2022d).

A review of the advice on scope 3 emissions by differing transition plan frameworks also revealed divergent judgements in evaluating the urgency of climate change, with the cost and responsibility of managing supply chain emissions and the 'acceptable' ambition for framework users. The ICAP and GFANZ-NZ frameworks considered scope 3 emissions greater than 40% of company emissions to be material and recommended their inclusion (GFANZ, 2022b; The Investor Agenda, 2023b). GFANZ further advises that scope three emissions greater than 10MtCO2e should be included and highlights the oil and gas, electrical utilities, automotive, consumer staples and chemical sectors. The SBTi (2023a) draft framework proposes a greater level of scope 3 emissions disclosure with the requirement to include automotive, oil and gas, forest, land and agriculture scope 3 emissions, as well as estimates for all other sectors with emissions greater than 5% of entity emissions.

Table 15 in Appendix H compares treatment of scope three emissions in widely-used net zero frameworks.

Existing SBTi (2022) guidance sets out which scope 3 emissions to include as well as the appropriate measurement method based on asset class. However, even this more detailed approach is not comprehensive. An example is the exclusion of sovereign bonds because no agreed method for emissions calculation is available and is therefore considered out of scope. As the data evolves and mandatory reporting is adopted more widely, SBTi (2022) expects that the scope of included scope 3 emissions will increase.

"There are limitations in the data that we have, there's limitation in the measurement of our emissions profile. Data lags by a year and we can only measure about three-quarters of our portfolio so far." – Research participant

However, even in jurisdictions, such as the EU, where consideration of scope 3 emissions is regulated, the degree for their inclusion is limited to those deemed 'relevant' (European Parliament, 2022b). Further details on scope 3 emissions disclosure requirements are anticipated in the EU. In the UK TPT, any scope 3 emissions that are included in the target must be explained along with the reason for any exclusions and an explanation of any steps that have been taken by the entity to improve scope 3 monitoring and reporting. Judgement is core to determination of scope three materiality. Scope 3 emissions across data providers is also inconsistent due to different judgements on relevant emissions and variation in reporting dates (IGCC, 2024c).

We Mean Business Coalition (2023) note that of the 18,600 companies that reported climate change data to CDP (2023b) just 11% had a climate-related requirement in their supply contract and only 4% of those were told to set a science-based target. In their mandates to externally managed funds, superannuation funds should also set reporting requirements. Data improvements have resulted from mandated disclosure, such as the EU SFDR and UK-TPT that require scope 3 consideration by investors (IIGCC, 2024a). Scope 3 emission regulation will also become a requirement in Australia (Australian Accounting Standards Board, 2023).

Scope 3 estimation and calculation methods are continuing to evolve. Improvements in scope 3 data availability, whilst beneficial, pose an additional issue. Baseline emissions will also need to be recalculated and scope 3 emissions will seem to increase, making progress and comparability measurement challenging (IIGCC, 2024a). Some of the frameworks including PAII (2024, p. 18) recommend that scope 3 emissions are calculated separately "*due to measurement, aggregation, and agency challenges (including double counting).*"

Double counting is another scope 3-related challenge, for example a superannuation fund may have multiple holdings in a cars' value chain where emissions attributed to it by its manufacturer, fuel producer and car leasing company could result in reporting on the downstream emissions of the same cars multiple times (IIGCC, 2024a). Dupre et al. (2022) provide two methodologies for managing multiple counting. Firstly, a cross asset footprint can be used to map and calculate relationships between sector emissions or secondly, emissions can be divided across the different players in the supply chain. MSCI (2020) suggest that a large enough dataset allows the calculation of a scope 3 de-duplication multiplier to determine a more accurate absolute carbon emission metric. They found this number to be 0.205. IIGCC (2024a) advise that emphasis should be on carbon risk exposure, rather than emissions ownership.

Research participants referred to their frustrations with scope 3 data.

"We definitely track scope 3 internally, but where we just don't have confidence is - is it the right scope 3? …I think the next level of scope 3 actually gets quite granular and quite technical pretty quickly, because otherwise it's rubbish in, rubbish out. What are we looking at? What are we comparing? Every sector needs to have its own standard for scope 3. And then that gives us confidence as to what we're actually monitoring and then engaging with the company on." - Research participant

"BHP is doing a good job in terms of their scope three strategy. Others are reluctant unless they can categorically measure influence, so some are really reluctant. But I would say, you don't have to have a goal, a percentage reduction in your scope three emissions. I think the starting point is to understand your customers, understand your supply chain, understand what's possible. So, you could start these sorts of qualitative-type metrics, rather than reduction targets. And so, we encourage companies to think about that."

- Research participant

There is no standardised date from which emissions are to be measured but whichever time is selected should be disclosed (International Sustainability Standards Board, 2023). Baseline requirements also varied across frameworks. GFANZ (2022c) recommended the selection of a recent and representative year, SBTi (2023a) advised that an annual time-weighted average of portfolio holdings would be most effective and UNEP FI and PRI (2024b) recommended that the base and targets should be set and updated in five year cycles. Many of the frameworks emphasised that portfolio inclusions should be reviewed regularly.

Where assets are excluded, entities are recommended to provide an explanation and a timeline for when they will be included (PAII, 2024). This poses a challenge where baseline emissions will require recalculation, affecting their measure of emissions reduction progress. All frameworks emphasised the importance of a recalculation policy and disclosure explaining the method used and instances where recalculation was necessary.

Ultimately, the boundary judgement on scope 3 emissions is about specifying the extent of responsibility that is taken by entities. Whereas the planetary emissions participants believed that the intent of a net zero commitment was far greater, and portfolio emissions were equivalent to planetary emissions. The difference in this view is individual belief, as explained by Meadows (1999).

This part showed that participants are experiencing challenges in forward looking scope 3 climate analysis and management of double counting. Whilst these are methodologically difficult, the most impactful issue for net zero superannuation portfolios is the decision of which scope three emissions to count. Judgement on inclusion is in fact a determination of materiality which rests on intent.

The Deepest Leverage Point - Individual Intent

Intent is the deepest leverage point to activate change in a system and is discussed in the following part. Self-awareness of assumptions may be limited but uncovering these are essential to net zero interpretation.

Meadows (1999) explains that the deepest but most challenging leverage point for system change is intent. Whilst this inquiry argues that because the superannuation system is sponsored and controlled by the Australian government, they define the net zero intent of the sector. Although a broader perspective recognises the role of individual intent which acts collectively as a political force affecting the Australian government. Similarly, the individual intent of industry participants also sets norms within the finance sector.

Societal and industry assumptions can be so firmly entrenched that investors may not even reflect on their accuracy (Guyatt, 2023). In a memoir Meadows and Meadows (2007, p. 193) lamented that as early as 1971, their systems thinking team had published evidence and alerted world leaders to the dangers of unsustainable growth, including the exponential growth of air pollution. They had been unable to shift the mindset that growth was always beneficial. *"We don't have the option to grow forever, said Forrester. Our only option is to choose our own limits, or let nature choose them for us."* By 1978 they had concluded that, "*Owing to the momentum inherent in the world's physical and social processes, policy changes made soon are likely to have more impact with less effort than the same set of changes made later. By the time a problem is obvious to everyone, it is often too far advanced to be avoided"* (Meadows & Meadows, 2007, p. 197).

Climate champion and industry leader Mark Carney (2021, p. 16) argues that economic and societal value have become misaligned and are not questioned, *"The subjective (or price) theory of value – once contentious – now goes largely unchallenged in economic teaching, is taken as a given in business schools and frequently determines society's perception of its deeper values.*" For example, carbon pricing systems provide a way to incorporate the costs imposed by GHG emissions. Yet, these have not been adopted broadly or applied sufficiently. Fiscal measures such as a carbon tax or emissions trading scheme cover only 23% of global GHG emissions (The World Bank, 2023). Properly pricing the cost of GHG emissions would encourage investment valuations to align with a climate-aware mindset.

Participants from the 'planetary emissions' group discussed the need for increased determination to limit climate change. They stressed the need for deep cultural shift and an increased pace for transformation.

“The greatest challenges to net zero is, I think, wilful blindness. It's all psychology. We're walking eyes wide open into a catastrophe.“ – Research participant

“There is just so much capability and knowledge out there. But there is just a lack of will, because people don't want to find out just how horrific it's going to be. They want to keep believing that the status quo will be there. We’ve definitely got a lot of what we need to be able to understand a lot of these risks. It's just takes a lot of money and willingness to face ugly truth and challenge assumptions that are pretty axiomatic to the financial world, that people don't want to have those conversations, or be different to everybody else.”

– Research participant

“I think there can be a bit of a risk aversion into going into new areas that people aren't certain of. Of course, we haven't decarbonised the economy before. So, there's a lot of new technologies that are needed. There's a lot of new ways of doing things. And so, there's a risk aversion I think as well. And lack of knowledge, like I said, we haven't done this before. So, you're trying to build the plane and fly it at the same time. I think a lot of investors don't like uncertainty. So that's not their natural way of wanting to do things.“

– Research participant

“*The industry spends most of its time talking about the external barriers to action which we've talked about already, policy, data, standards, reporting frameworks, TCFD, etc, scenario analysis. If we had just 20% of that 100% focus diverted to looking at ‘what can we do differently? How is it that our mental models, that our mindset might be creating problems here?’”* – Research participant

Some research participants referred to a personal experience or story that changed their outlook or increased their concern about climate change. Harnessing the emotions that arise from lived experience can drive individual intent, which cascades across the entire system. Meadows (1999) identifies the deepest and most significant point for systems change is the acceptance of another worldview. However, Guyatt (2023) finds that investors are often unprepared to deeply evaluate their beliefs and overcome their perceived obstacles to net zero goals, rather emphasising the need for change in government and corporate actions.

As previously noted in this discussion, challenging deeply held assumptions is necessary for transformation to net zero superannuation portfolios. One method that could be effective for challenging individual beliefs and sharing the knowledge and emotions that arise from lived experience, is storytelling. Storytelling has been identified as an important narrative tool for

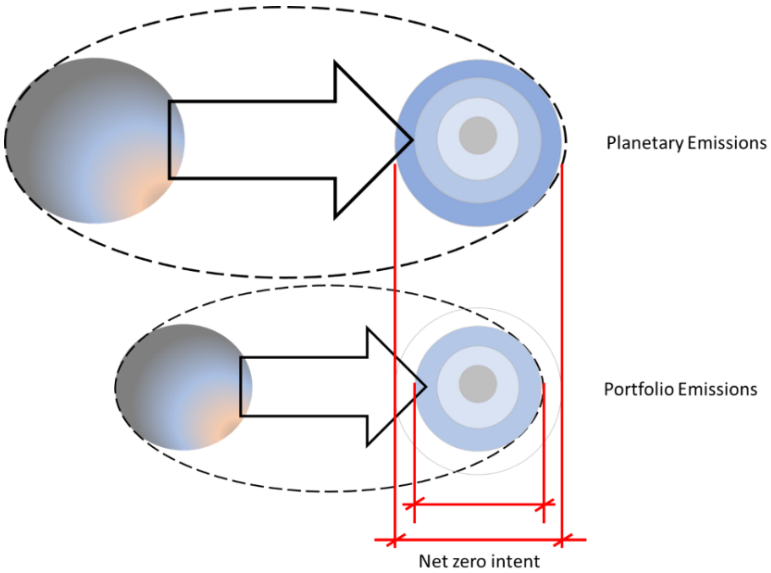
building empathy on climate change impacts and shifting behaviour and beliefs (Arnold, 2018; Bloomfield & Manktelow, 2021). Arnold (2018) emphasises that stories are not used to manipulate audiences but instead, to encourage reflection on deeply held cultural assumptions. Pardo et al. (2023) explain that data stories are an important method for communicating evidence in an accessible way. They incorporate strong data, visuals and a narrative that inspire their audience to take action. The deepest and most challenging leverage point for change is the mindset of system participants, including superannuation members. Exploring narrative tools to raise individual intent for the superannuation systems' transition to net zero would be a worthwhile topic for future research.

"I call it the 'aha moment' when each individual needs to truly feel it, and have an emotional connection to it, to that goal. This isn't the sort of language people normally use in finance…I don't think anyone's going to look at a spreadsheet and suddenly feel passionate about climate change. It's going to come from either lived experience…The more stories that they can share and then how those stories are conveyed to investment teams and how those conversations change investment processes. " -Research participant

"That one day getting up and knowing there were not just bushfires, but where I got up in the morning and I could taste the smoke. And that got me thinking more about being involved in ESG investment." -Research participant

This section showed that challenging an existing mindset and transcending accepted paradigms requires reflexivity. It may be prompted through shared narratives and lived experience.

Figure 16. Differing Intent for Net Zero Commitment



4.1.1 analysed differing interpretations of net zero purpose and showed the important difference between a portfolio emission goal and a planetary emissions goal. A portfolio emissions commitment constrains net zero superannuation portfolio transition. The diagram above illustrates that the expanded intent enlarges the impact of the commitment. Greater support for planetary emissions interpretation requires the shift of deeply held values through lived experience or profound narratives.

4.1.2. System Beneficiaries

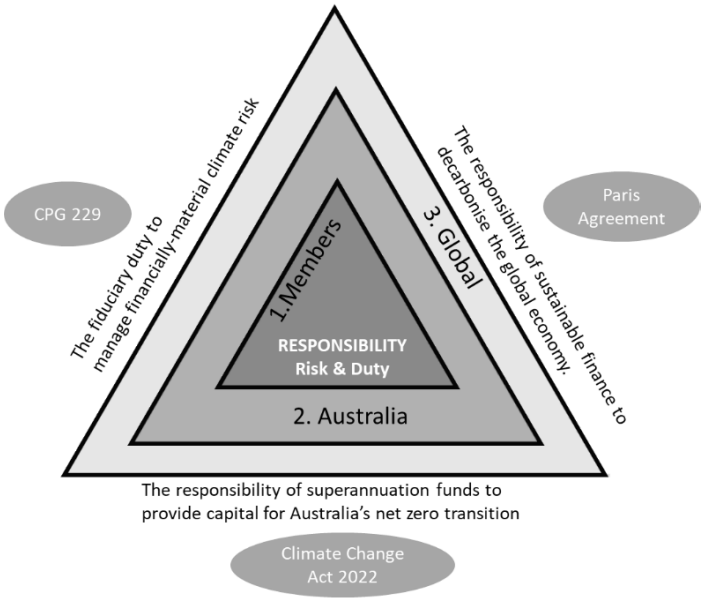
This section questions who have been deemed as the beneficiaries of a system and whose interests the net zero commitment is seeking to serve.

Net zero superannuation portfolios are motivated by duties at the fund, national and global levels for current and future generations. Whilst the benefits to these groups overlap, there are nuances in net zero implementation to best serve the interests of each group.

Recognising the perceived beneficiaries of a system also reveals the interpretation of its intention. The research participants discussed the beneficiaries in whose interests they were acting and that had led their organisation to set their net zero goal. Three expanding boundaries of climate risk responsibility were identified; duty to members, Australia and Global accountability. These have been diagrammatically explained in

Figure 17 and a more detailed discussion on each of these follows.

Figure 17. Beneficiary Triad



The Member Level: Net Zero Superannuation Funds as a Fiduciary Duty

Most fund participants explained that their primary motivation for a net zero superannuation portfolio was to meet their fiduciary duty to members. Fiduciary duty is discussed in 2.5. Whilst all research participants agreed that managing financially-material climate risk was a fiduciary duty, they were divergent on the timeframe over which climate risk should be deemed financially-material. The Australian Climate reporting standards prompt entities to advise the time frames they have deemed as short, medium and long term in their disclosure (AASB, 2024). The lack of clarity on the timeframe of financial materiality is relevant to the way that superannuation funds interpret best financial interests' duty. It was raised by participants as a constraint on their ability to implement net zero portfolios. It is an example of an underlying assumption that has not been made explicit or agreed on. Similarly, prioritising financial material over impact materiality as discussed in 2.7.1 was not concurred.

"The 'financial' was added in fairly recently, as a signal from the lovely former government about what they thought our role was in the world. And obviously we do very much want to protect our members' financial interests. And we take our role as a steward of their capital very seriously. But we also believe that climate change will have a very significant impact on their financial well-being in the future. So, there's certainly objectives and sensitivities, but often we need to frame them in a particular way to be compliant with regulation."

- Research participant

A further consideration raised by participants was whether they were satisfying their fiduciary duty to meet the expectations of members, particularly as the threat of litigation could eventuate if members were unsatisfied. 88% of superannuation participants in the climate risk survey by APRA (2022b) were concerned about the risk of litigation if they didn't meet the climate action expectations of members or other stakeholders. Growing community concerns about climate change has encouraged sustainable investing. Increased demand with above average fund flows to Australian Ethical and Future Super, achieving above 5% growth (Bell & Warren, 2024) is also evidence of changing member expectations.

"Expectations of us and other asset owners are continuously increasing. And I think the scientific evidence and all those things are continuously evolving as well. And so, it's important that we're continuously responding to that. And so, I suppose the changes that we've made are not just in the context of our targets, but that environment as well."

- Research participant

"A trustee is investing the money to obviously diversify and maximise the return, but part of the consideration in investing the money is, what is the view of the community that you represent? So, as the views of the broader community have shifted on this issue, so the trustee's fiduciary duty has had to shift to reflect their members. And of course, the obvious issue in Australia's case is that everyone's in a superfund. So, the community has shifted, the trustees have a fiduciary duty to shift…" - Research participant

"Why does everybody look at climate change and have climate change in-built into their investment strategy, because the REST [v McVeigh, legal] case says you must do it. At this point in time, net zero emission targets are not mandatory. They probably are 'volundatary'. So, lots of people are doing it, but mostly just for the PR." - Research participant

Further complexity on the question of which beneficiaries are the motivation for net zero superannuation portfolios arises when thinking about future generations. At the member level, superannuation funds already have a long-horizon fiduciary duty to their youngest members who will be unlikely to reach retirement phase before 2070. The 2023 intergenerational report explains that superannuation will be the primary source of retirement income for many future retirees. It also comments on the unavoidable physical and economic impacts of climate change such as increased temperature and natural disaster incidents that will reduce agricultural output and manual labour productivity and the need for investment to reduce future costs and build more resilient infrastructure, energy security, critical minerals and green metal investment (Australian Government, 2023a). Considerations of future generations have not been prioritised in definitions of materiality.

"I think governments and regulators need to think more about the longer that everything is delayed, the more risk we have of a disorderly transition. And that has greater risk for superannuation funds, greater risk for our financial system, greater risk for all of us on climate than if we had an orderly transition." - Research participant

The National Level: Net Zero Responsibility to Australia

The objective of superannuation outlined in 2.3.6, "*to preserve savings to deliver income for a dignified retirement, alongside government support, in an equitable and sustainable way*" (Parliament of Australia, 2023c), clearly identifies members as beneficiaries. Yet, the wording also indicates that the system has been designed for Australia's benefit. Reference to, 'government support' refers to the role of superannuation as a pillar of the national retirement system. Therefore, the system's efficacy in supplementing the age pension (Australian

Government, 2018) is a matter of national interest, especially in the context of an aging population.

Reference to 'equitable and sustainable' remains unclear despite the consultation paper and explanatory memorandum (Australian Government, 2023d; Commonwealth of Australia, 2023b). Claims that 'sustainable' may refer only to fiscal sustainability, cannot be separated from recognition of the financial risks of climate change as stated in CPG229 (APRA, 2021b) as well as the Sustainable Finance Roadmap Australian Government (2024k). As discussed in 2.4, key industry interest groups including PRI (2023c) and RIAA (2023c) emphasised the need for environmental connotations of the word 'sustainability', to be understood within the objective of superannuation. Note that as at November 2023, eight of Australia's largest eleven APRA-regulated funds are both RIAA members and UN PRI signatories (PRI, 2023d; RIAA, 2023b).

Surprisingly, the objective of superannuation legislation was not raised by any of the research participants. Those who were prompted to comment on it, did not consider it to be especially relevant to net zero superannuation portfolios.

"I don't think you'll ever change the purpose of super from providing for the retirement of employees…I don't think including the word sustainable is going to be a negative thing, but I'm not sure I fully understand what's intended…They're just trying to create some wriggle room in there… But I just don't think that, in and of itself, is going to change the best financial interest hurdle, which is the fundamental hurdle." - Research participant

The research participants referred to the political volatility surrounding climate change discourse in Australia that has detracted from climate policy settings and climate investment.

"The under-development of climate policy in Australia, and things like central pathways for the transition of key economic sectors, is creating a challenge for super funds and other investors, because there's not certainty and clarity on how government policy will back in the pathway to net zero. " – Research participant

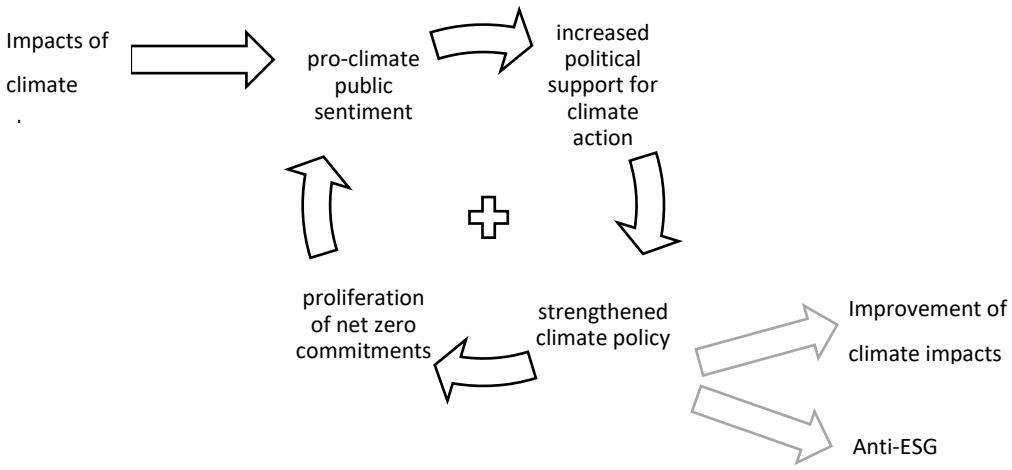
"The politics is polarising…in Australia they were the first to say, well, we've got a problem, and part of the reason is obvious. We are a resources-based economy. So, if your portfolio is full of dirty miners, then signing up to net zero is going to make you look silly."

-Research participant

As discussed in 2.3, the increase in public climate concern since the 2022 Federal election has increased political support for climate, improved certainty on government climate policy and

scaled up net zero commitments in Australia. Advice for an increased national contribution to emissions reduction is currently in consultation phase and expected in 2024, ahead of the next Paris agreement ratchet in 2025 (Climate Change Authority, 2023). These act as a reinforcing feedback loop, shown in Figure 18.

Figure 18 Increasing Climate Support



Research participants affirmed the effects of increased political and government climate support,

"There's been a huge uptake in the number of companies adopting net zero targets. Part of that, I think, is around the change in the policy environment in Australia…the change in Government has sort of seen a heightened focus on climate change as a legitimate issue. So, the increase in policy certainty has helped companies have a foundation from which they can actually make a commitment, because now they know what direction Federal policy is going." – Research participant

"Since actually, as a country committing to net zero and having a higher ambition for an interim target as a country, has changed a lot. It tells companies, it tells the market, the signal of where they need to go, which I can't underestimate. And, the policy whiplash that had occurred to that point had made it both challenging for companies, but also challenging for us as investors." -Research participant

The need for private funding to support national climate objectives was documented in the national sustainable finance strategy which commenced consultation in November 2023 and provided the basis for the roadmap released in June 2024 (Australian Government, 2023e). In 2024, the Australian government encouraged private investment in climate solutions through the announcement of the Future Made in Australia policy, discussed in 2.3. These developments occurred after the thesis interviews were conducted.

Given the recognition of superannuation as a provider of 'patient capital' for national infrastructure as discussed in 2.4, net zero superannuation investment is for the benefit of Australia.

This argument is summarised below,

- Superannuation savings are in the national interest to ease the age pension burden.
- Superannuation trustees have a fiduciary duty to protect retirement savings from financially-material climate risk
- Fiduciaries must also meet beneficiary expectations.
- There are about 21 million superannuation members in Australia, representing a majority of the nation.
- National concern about the climate has led to Australia's legislated net zero commitment.
- The Australian government requires private capital to meet its climate commitments.
- The superannuation system is a provider of patient capital
- All of the issues above must be addressed using a long-term perspective.

However, government-directed rules for climate solutions investment have not set but could be used to support superannuation climate investment targets. This is discussed in 4.3.2.

As explained by Meadows (2012) and seen in Figure 18, a balancing action will usually occur in a reinforcing feedback loop. Ideally, a balancing action, will improve climate outcomes, leading to reduced concern about climate change. Regrettably, in the case of the US, the balancing action has been Anti-ESG sentiment from climate policy backlash.

Some Research participants commented on the Anti-ESG movement in the US and suggested that Australia might experience the same situation. Republican senators campaigning against climate-aware investment have led to fear of profit loss, increased pressure to justify climate-related investment and cautionary statements (Temple-West & Masters, 2023). The Anti-ESG movement has been topical at recent industry events, including the 2023 PRI in Person, where investors described criticism or even lost mandates due to their ESG integration practices (Willems, 2023). HSBC's ESG Sentiment survey of 310 finance professionals globally also found Anti-ESG sentiment problematic and growing but specific to the US (Chan, 2023). Their report attributed anti-ESG sentiment in the US primarily to political drivers, and to a lesser extent, to frustrations with increased regulations and compliance. In the context of net zero superannuation portfolios it is important to note that ESG considerations cover a broad range

of issues and the HSBC survey found decarbonisation had remained the top area of ESG concern for respondents, and that proportion had increased over their previous survey in the prior quarter. Expectations of a US exit from the Paris Agreement, increased fossil fuel production and dismantling of clean energy policy including the Inflation Reduction Act since the election of Donald Trump in November 2024 had been anticipated and added to Anti-ESG sentiment and obstructionism (Jain, 2024). President Trump ordered a retreat from the Paris Agreement and similar UNFCCC climate commitments, and the US International Climate Finance Plan on the commencement of his second term on January 20, 2025 (The White House, 2025a).

"Be prepared for political volatility as social impacts of climate start to cause much more difficulties in the political process. We're seeing some of this now, but it's going to get much more difficult." – Research participant

"A significant group of people in the community - I think it's a minority, but it's still significant - don't believe that there is any issue with global warming. So, you've got a fundamental disagreement from a significant group of people in the community about the problem itself and how you solve it. But having said that, I do believe the considerable majority of the community believe that we shouldn't pollute the environment."

– Research participant

The Global Level: Net Zero Planetary Responsibility

Rather than net zero transition as a focus for national comparative advantage, the global beneficiary view is a cooperative duty for countries and sectors to assist each other in achieving the Paris Agreement objectives (United Nations, 2015a). The Agreement contains a cooperative agenda with "*a shared sense of responsibility. Much of the motivation appeared to be beyond narrow self- interest and was about responsibility to future generations*" (Fankhauser & Stern, 2019, p. 305). Research participants commented on the duty of the finance sector, and superannuation as a subset of that, to play a role in decarbonising the global economy as articulated in the Paris Agreement in comparison with a nationalistic stance.

"We've got to get people to play ball. And, it's a globally systemic risk. And that requires cooperation and we're pretty hopeless at cooperation unfortunately, as a planet. That's my biggest concern. The rest is all actually irrelevant at the end of the day."

- Research participant

"We are just going to see geopolitics take over all sense. And everybody's going to become inward-looking, protecting their own, protecting their own jurisdictions and all the proactive forward-looking work stops because there's going to be this massive geopolitical risk that comes and takes over everything." - Research participant

The responsibility to achieve real economy decarbonisation is shared. Net zero Asset Owners Alliance (NZAOA) commit to meeting "*their fiduciary duty to manage risks and achieve target return …[and] GHG emissions reduction outcomes in the real economy... this commitment is made in the expectation that governments will follow through on their own commitments to ensure the objectives of the Paris Agreement are met*." (UNEP FI & PRI, 2024b, p. 2).

As discussed in 2.3.6, the ability to adapt and reduce vulnerability to the impacts of climate change is heavily reliant on financial flows and public policy (IPCC, 2022). However, there is immense inequality between the richest nations who are historically responsible for the majority of global emissions and continue to cause disproportionate emissions, compared with developing nations which have high levels of poverty, greater vulnerability and exposure to climate change impacts and little economic ability to adapt to these (Morrissey & Heidkamp, 2022). Some of the research participants acknowledged EMDE inequities and the challenge of attracting climate finance for investment in climate mitigation and adaptation projects.

"Australia and the world need a massive investment in a range of climate solutions in order to facilitate the transition. It's really not just how we can invest in that, but also how that gets catalysed more broadly." - Research participant

"To address climate change, you shouldn't be looking insularly at your own portfolio without thinking about the fact that the whole economy needs to move as well. "

- Research participant

As yet, there is no agreed method for quantifying an equitable contribution to climate action at a country level. Garnaut (2022) explains the contested ethics in fair share assessment and compares seven different methods, including a delayed convergence towards per capita emissions by developing countries. The different methods result in Australian carbon emissions budgets that differ by a factor of up to four times. An avoidance of adopting any single fair share method can be seen in the Climate Action Target Evaluation Method (Climate Action Tracker, 2021) which assesses if a government has provided a transparent justification of their approach, as opposed to whether they are contributing to decarbonisation in a way that is deemed sufficiently 'fair'.

The importance of an ethical re-evaluation of fair share commitments and the development of binding frameworks in order to ensure these are met then, is critical to global decarbonisation (Morrissey & Heidkamp, 2022). It is also anticipated that carbon dioxide removals will be needed to compensate for hard-to-abate emissions and insufficient emissions reduction (GFANZ, 2023). Yet disagreements on fair share of carbon dioxide removals are exacerbated by their even greater cost and lower financial reward compared to emissions reduction (Fyson et al., 2020).

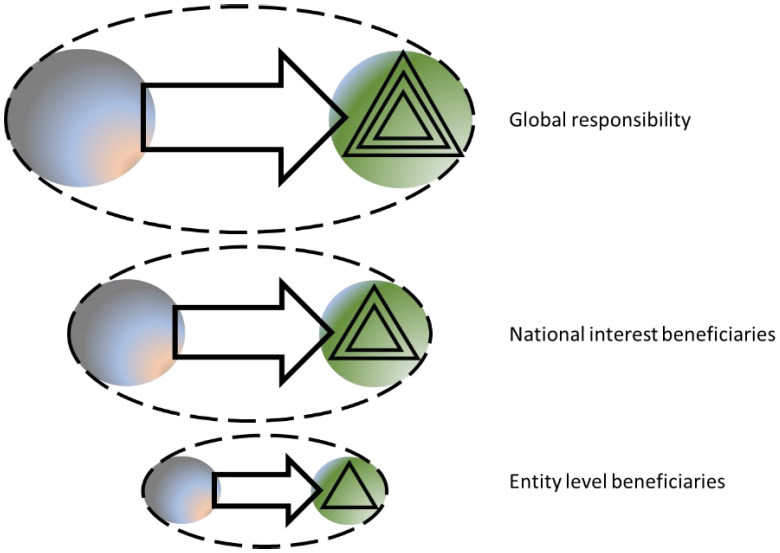
Beyond the difficulty of an agreement on a fair share carbon commitment for Australia, the question of its implication for superannuation funds remains. Ambiguity on fair share principles and mechanisms for superannuation funds to support these in their transition plans are unresolved. The Future Made in Australia policy (Australian Government, 2024h) uses public finance to scale private investment in climate solutions but is focused on the national economic interest rather than fair share finance for EMDE. The Australian Government (2023b, 2023e) has sought feedback on increasing blended finance mechanisms similar to the Australian Development Investments, in order to attract private sector finance for climate solutions in developing countries in the Indo-Pacific region. In addition to leveraged public funds, mechanisms such as carbon market finance can offer EMDE climate solution opportunities (Jotzo et al., 2011).

"Every country is looking at - to varying degrees - how they shift to net zero...The extent to which they're actually doing it, is sometimes questionable. But it is a consideration in every country….in some countries where mining is not a consideration. It seems to be a little easier for them to apply principles when they don't have an adverse practical outcome for people who are in those particular industries." - Research participant

Fankhauser and Stern (2019) argue that economic and climate objectives can be met in an innovative-growth model with adequate carbon pricing, regulation and incentives for clean technology and infrastructure, social protection and consistent policy for rapid progress. They specify the need for these efforts to focus on EMDE, which is most vulnerable to the impacts of climate change and where 60 per cent of annual emissions are generated, and future emissions growth is expected to occur. "*The economic, structural, and technological challenges of sustainable growth are massive, but the opportunities are real and very attractive*." (Fankhauser & Stern, 2019, p. 314). In a context where member risk-adjusted returns must be maximised for BFID and where performance cannot be less than the YFYS benchmark, it is challenging for superannuation funds to adopt innovative growth approaches to investment

domestically and, more so, globally. These difficulties are discussed in 2.5.1 in relation to fiduciary duty where existing definitions have been developed to support private over public wealth.

Figure 19 Differing Beneficiary Interests Impact the Net Zero Commitment



The beneficiary interest and responsibility that motivates a net zero superannuation commitment impacts its scope and therefore, as with system purpose, the extent to which it will be implemented. These contrasting sizes are shown notionally in

Figure 19. There is legal and regulatory support for entity level beneficiaries although this has not resulted in net zero goal adoption across the superannuation sector. Funds with a net zero commitment emphasise its benefit for current members but future members are not included. Noting the role of Australian superannuation funds as providers of patient capital there is a basis for net zero portfolios to serve national interest. However, only planetary emissions participants perceived a duty for the commitment to serve global beneficiaries.

4.1.3. Measures of Success

This section examines the way that net zero progress is measured. The benefits and challenges of carbon metrics are examined and the need for carbon attribution is explained. Additional metrics, such as portfolio alignment to gauge net zero success are also presented. Finally, the belief in achieving net zero superannuation portfolios is discussed.

In CSH, Ulrich and Reynolds (2010) question the indicators of system improvement and success. As discussed in 2.3, net zero commitments have achieved scale due to their simplicity, but they are criticised for their ambiguity and potential to cause misleading temperature outcomes. Many research participants referred to their adoption of a net zero target alongside

a global swell of commitments. They commented on the appeal of an objective, quantifiable and verifiable climate risk metric that aligns with the dominant theoretical frame of the sector. However, many of them also described their organisation's experience with net zero as an evolving journey where the determinants of success and metrics for proving these, were expanding and being developed in progress.

"***Given that passion for the numbers and the linearity in our industry. It's been brilliant that that has been one that has gotten through, past the keeper, so to speak, and that so many super funds have adopted it. But on the other hand, it should form the baseline of the activity and then build from there, in my view…how do you actually measure and assess such a complicated thing as the climate system on its own and we don't even understand half of it. But it's not to discount the importance of focus on decarbonisation, but I really believe strongly that on its own, it's not necessarily an accurate reflection of reaching net zero anymore.***"

- Research participant

"We have a risk dashboard that we regularly monitor, like it's weekly monitoring of key risks and indicators. And that includes a measure that looks at how we are tracking towards our emission reduction targets. So, we measure our portfolio emissions for equities once a month and other asset classes on an annualised basis, just because they don't move as rapidly. And so, we're continuously reassessing - are we on track to meet our targets?"

- Research participant

Some research participants were critical that funds had adopted a net zero target for legitimacy or had not properly understood the commitment.

"I think there are certainly people who have signed up, and thought it sounds like a good idea and then probably don't have a good idea of exactly what they're committing to. Whereas others are very deep and really understand some of the nuances."

- Research participant

"Other than the ones that I think are already the converted, the vast majority of what I've heard of is, make this [net zero] go away as quickly as possible… And there's two reasons. One they're genuinely not interested. Two, if they are interested, it's really just so they can try and avert the public naming and shaming, if they were seen to not look like they were doing the right thing. So, they're just going to do the bare minimum."

- Research participant

The following discussion identifies some of the challenges in carbon metric and carbon attribution measurement. Then, five commonly-used net zero transition frameworks for investors are analysed, showing that net zero is not limited to emissions reduction and is better described as a systemic and global decarbonisation strategy demonstrable with a set of interacting success measures. Using these enhanced success measures, the discussion shifts to the question of belief in achieving net zero.

Carbon Metric Challenges

Quality and Availability of Disclosed Carbon Emissions Data

Almost all research participants referred to problems with the quality of climate-related financial data. This is consistent with a body of literature discussed in 2.7, noting that the absence of interoperable, mandatory reporting standards, has caused investors to struggle with inconsistent and incomparable entity-level climate information (Amel-Zadeh & Serafeim, 2018; Arvidsson & Johansson, 2018; De Silva Lokuwaduge & De Silva, 2020; International Organisation of Securities Commissions, 2021).

Given that emissions information can be inconsistent, scorecard systems have been developed to indicate data quality. In the scorecard system by PCAF (2022) score 1 is given to reported and verified emissions, whereas score 5 indicates that emissions have been approximated to average revenue per sector emissions. CDP also have a data quality scoring framework and have referred to streamlining their data quality and scoring system alongside PCAF (2023b).

"On some of our portfolios, we were able to get an equivalent of a PCAF four, three and a half. And, on others, we were literally at PCAP Five. This is like a really, really high-level estimate. And it's really plus or minus 50% on these emissions. And so then, we had the realisation on those portfolios that we have got the plus or minus 50%, can we really set realistic bottom-up targets from that sector perspective?... PCAF is actually really beneficial because it gives you that scoring estimate" - Research participant

Many participants were hopeful that the recently released international climate-related disclosure standards (International Sustainability Standards Board, 2023) would improve emissions data and net zero calculations for superannuation portfolios.

"Data is a challenge. I think ISSB will help. I think the taxonomy will help. I think being able to adequately convey what it is that we're doing and how we're investing through the transition to members, to regulators, to NGOs is a challenge. But we're trying really hard to be as transparent as possible." -Research participant

However, some entities have opposed new mandated climate-reporting standards on the basis that they are too costly and legally risky. For example, global asset manager Dimensionsal (2023), with 856 billion AUD under management, responded to the Australian Government climate-related financial disclosure standards consultation and argued that existing regulation is sufficient for companies deemed to have financially-material scope 1 and 2 emissions. They believe that reporting frameworks are not appropriate for funds or asset managers. They oppose scope 3 emissions reporting, assurance and scenario analysis and emphasise the cost of reporting, commenting that it, "*will increase costs for the company without providing much, if any, tangible benefit to the company or its shareholders. Ultimately it is the company's shareholders, including investing funds and their shareholders, who bear the costs of regulations that mandate additional disclosures."* ASFA (2023) also commented on the wide differences between fund capabilities to meet the new standards and recommended a delayed phase-in approach. An overarching tension exists between the preparation of cost-effective and proportionate climate-related data and more granular and detailed disclosure. Debate on the resources and priority that should be afforded to overcoming climate-related data challenges such as these is another example of the underlying values and assumptions made by decision-makers.

Emissions data in some asset classes remained problematic. For example, devising a reliable way for investors to account for sovereign-related emissions has been challenging (IGCC, 2024b) and a generally accepted methodology is not yet available (GFANZ, 2022c; SBTi, 2023a). To date the level of sovereign bonds included in investor net zero plans has been low as a result of poor availability of high quality issuers with reliable climate policy (IIGCC, 2024b). For example of 200 transition plans analysed by IIGCC (2024b) 95% included listed equities in their targets but only 9% included sovereign bonds. Verified reported GHG emissions may be available for some countries through the NDC registry (UN Climate Change, 2024). However, these are not consistently timed, standardised or even available and they account for land-use and forestry emissions differently meaning that alternative physical or economic activity emissions accounting methods may be required (PCAF, 2022). UNFCCC inventory does not account for consumption emissions generated offshore (PCAF, 2022). Data for S2 + S3 emissions generally relies on OECD (2024) international trade data that includes CO2 emissions only and can have a time lag of four years. As explained by a participant, the issue is far greater than a lack of data and instead requires significant reform by regulators, central banks and development banks.

"How are we going to get to global emissions goals, when it's clear that the emerging and developing economies may struggle to reach 2050. But it's also clear that there's going to have to be some different forms of capital flows and some de-risking efforts and some changes in global policy architecture and financial architecture of central banks and financial regulators, and some of the operations of the DFIs and the MDBs" - Research participant

Yet, participants also explained that climate data was becoming more sophisticated, for example information on physical risk is improving, and so they could continue to adapt their net zero implementation to incorporate that deeper understanding.

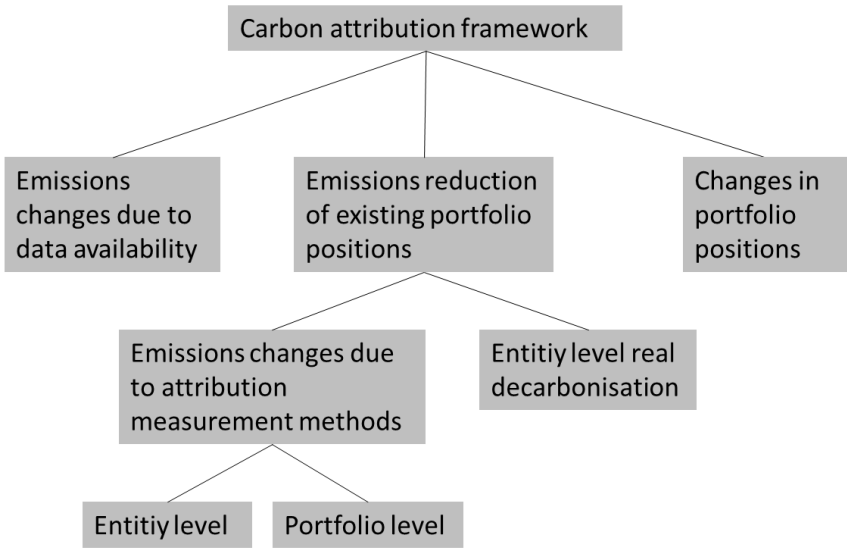
"We're quite transparent about the fact that the way that we measure will continue to evolve as data becomes available, as products become available." - Research participant

Carbon Attribution Measurement

Changes in portfolio emissions can be explained by a range of factors that are unrelated to real emissions reduction. Carbon attribution is an important tool to substantiate emissions reductions and avoid greenwashing claims (Bolliger & Cornilly, 2021; Bouchet, 2023; PAII, 2024).

Figure 20 has been adapted from the carbon attribution framework developed by MSCI (2024). It provides a way to disaggregate the factors that have contributed to portfolio emissions reduction. Importantly it separates the portion of emissions reduction that are due to real decarbonisation. Each of these factors are discussed further in this section.

Figure 20. Carbon Attribution Framework Adapted from MSCI (2024).



Emissions Changes due to Data Availability

As discussed in 4.1.1, the precision of carbon data is expected to improve in line with methodological development (SBTi, 2023a). In the interim, superannuation funds only include portfolio emissions for the asset classes with 'reasonable' carbon data.

A review of five frameworks showed differences in their current expectations of appropriate portfolio emissions inclusions, these are summarised in Table 16 in Appendix H. The Investor Agenda (2023b) requires at least 70% target coverage of all high-emitting sectors. Whereas the proposed SBTi (2023a) framework required the highest level of net zero inclusions, noting that all financed and facilitated activities were to be calculated where a suitable alignment method exists, and updated within a maximum of 18 months of their availability. Financed emissions include any loans or investments made by the fund. Facilitated emissions may not be on the fund balance sheet but their activities have enabled the investment, for example by financing other actors such as managing syndicated loans (PCAF, 2023a).

Emissions Changes due to Attribution Measurement Methods - Entity Level

At the entity level, there are two main types of GHG emissions reporting metrics used by entities, Emissions intensity or Absolute emissions.

Absolute Emissions are the total emissions generated by an entity through operational or financial control (PCAF, 2022; The Greenhouse Gas Protocol, 2004). Using this metric can provide more transparency than a ratio but it is not useful for peer comparison. Absolute emissions allow entities to monitor their total emission changes against a baseline. However, those will be distorted by any structural business changes, like mergers or outsourcing, that happen after the base emissions are set such as if the company developed a green product or sold off a high-emissions business unit to another company (Dupre et al., 2022; The Greenhouse Gas Protocol, 2004). Net zero progress is not always linear, if an entity with sector-leading decarbonisation practices expands, their emissions seem to rise, but the effect on the sector is beneficial. Conversely, a company manufacturing a more durable product may have high emissions than one that makes products that break sooner and must be replaced often. IIGCC (2024a) suggest the addition of relative industry emissions intensity metrics and nuanced qualitative information to improve data understanding. The entities that emissions are attributed to are a valuable measurement of country and company progress and accountability but at a global level, net zero requires absolute emissions reduction.

Intensity ratios state the emissions in relation to a financial unit of measure, such as emissions per revenue or per unit of activity. Intensity ratios enable benchmarking between companies, sectors, regions and asset classes. Yet intensity ratios have been criticised as the ratio is affected by other changes, such as new pricing increases affect revenue (PCAF, 2022; The Greenhouse Gas Protocol, 2004). This is evident in the intensity ratio formula where,

$$\text{Emissions intensity} = \frac{\text{emissions}}{\text{revenue}}$$

Carbon intensity measures can result in perverse outcomes, for example they could suggest that an energy efficient luxury car is preferable to an energy efficient small car that may have lower emissions (Dupre et al., 2022). If revenue increases, emissions intensity reduces mathematically but emissions will not have reduced in real terms.

Given the use of differing denominators in emissions intensity ratios the international sustainability standards do not require entities to report these (IFRS, 2023). Whereas net zero frameworks recommend the disclosure of a dashboard of climate-related metrics (GFANZ, 2022c; PAII, 2024; SBTi, 2023a; The Investor Agenda, 2023b; UNEP FI & PRI, 2024b).

Participants commented on problems with their useability and also questioned their meaning,

"Some run absolute emissions, some on emissions intensity, and some use both for different parts of their business. So, it's just quite difficult to navigate it all." - Research participant

"You can do lots of things to manage climate change investment risk, and that can be reflected in the sorts of intensity metrics that people use, tons of Co2 per million dollars of FUM or whatever it may be. But they don't necessarily translate to real world emission reductions." - Research participant

Emissions Changes due to Attribution Measurement Method - Portfolio Level

The financed emissions of listed companies and corporate bonds in a superannuation portfolio are calculated by multiplying the entity's emissions intensity by the share of emissions held by the fund. This is shown as,

$$\text{Financed emissions intensity (for listed companies)} = \text{Entity emissions intensity} \times \frac{\text{Value of portfolio holding}}{\text{Enterprise value including cash}}$$

This formula shows that financed emissions can be affected by the value of the holding in the portfolio as well as the financing structure and market capitalisation of the underlying entity

level. In the formula above, the entity value is found using the enterprise value including cash (EVIC) measure which is the sum of the market value of equity, book value of debt and cash for the underlying entity (PCAF, 2022). This measure of entity value is required by the EU benchmark regulation (European Parliament, 2020a) and also recommended in frameworks (PCAF, 2022; UNEP FI & PRI, 2024b).

Whilst the use of EVIC may capture corporate value more accurately than revenues, its use in determining financed emissions intensity has been criticised. This is because EVIC is more volatile than revenues, incentivises equity financing, favours entities with higher profitability and growth and cannot be used for measurement of private equities or private credit emissions intensity (Ducoulombier & Liu, 2021). Ducoulombier and Liu (2021) further argue that sectors, such as financial services, whose enterprise value in relation to sales ratio is above average, appear to have lower emissions intensity than if revenue was the input used in the denominator. On the other hand, sectors such as Oil/gas, metals and mining, with below average EV/ sales appear worse. A study of the MSCI all country world index found that scope one emissions decreased by 7.76% over a three-year period. However emissions reduction for the period would have been 10.33% if adjustments were made for attribution changes in the financing share in, and financing structure of entities (Wang et al., 2023).

Yet, Bouchet (2023) demonstrated that there are also anomalies when using revenue as an input in carbon calculations. He compares the effect of portfolio position changes on emissions with three metrics;

The weighted average carbon intensity (WACI) of a portfolio:

$$\text{Weighted average carbon intensity} = \sum_{\text{Sum of}} \left(\text{Financed emissions intensity} \times \frac{\text{Value of portfolio holding}}{\text{Value of portfolio}} \right)$$

The weighted average absolute emissions (WAAC) of a portfolio:

$$\text{Weighted average absolute emissions} = \sum_{\text{Sum of}} \left(\frac{\text{(Emissions intensity x Sales)}}{\text{Market capitalisation}} \times \frac{\text{Value of portfolio holding}}{\text{Value of portfolio}} \right)$$

And, absolute portfolio emissions:

$$\text{Absolute portfolio emissions} = \sum_{\text{Sum of}} \left(\text{Company Emissions} \times \frac{\text{Value of portfolio holding}}{\text{Market capitalisation}} \right)$$

Using the WACI, WAAC and absolute portfolio emissions Bouchet et al. (2022) analysed a hypothetical 10 million USD portfolio with two equally weighted stocks one generating 100 tons of carbon per million dollars of revenue, and the other generating 10 tons of carbon per million dollars.
These calculations are summarised in the table below however detailed working is shown in Appendix F.

Table 7. Portfolio Carbon Emissions Calculation Anomalies

Hypothetical portfolio	A portfolio has 5m USD each of two companies. Both are valued at 20m USD and earn 10m USD revenue. Company A emitting 100 TCO_2/ m USD and company B emitting 10 TCO_2/ m USD	The market capitalisation of company A doubles.	Some of company A is sold to buy company B so that the portfolio holdings of each are again equal
WACI (TCO_2/ m USD)	55	70	55
WAAC (TCO_2/ m USD)	27.5	18.4	14.5
Absolute portfolio emissions (TCO_2)	275	275	225

This comparison reveals anomalies where when the market capitalisation doubled, the WACI rose, the WAAC fell and the absolute portfolio emissions were unchanged.

When the portfolio positions were adjusted so that the weight of the stocks in the portfolio were equal there were further anomalies, the WACI was unchanged, the WAAC and the absolute portfolio emissions fell further.

Research participants described the challenge of market capitalisations increases across a sector and subsequent rebalances that made emissions intensity appear lower without an actual contribution to real world emissions reduction.

"We've ended the year on a weighted average carbon intensity well below our baseline. But from a technical sort of view, I am quite nervous that that number is going to go back up… what's happened over the course of the year, is that the energy stocks rallied. You'll remember their revenue shot up in the course of the year. As those revenue stabilized, our managers gradually rotated out of them and then we ended up being highly exposed to the tech stocks…And those stocks are not high carbon for scope 1 and 2 emissions. So … I can almost guarantee you - every super fund this year, will have a very good weighted average carbon intensity result." - Research participant

Due to the different denominators that can be used to calculate emissions intensity and due to the effect that these measures can have on appearance of emissions reduction, the international sustainable standards and the Australian accounting standards requires entities to report only on absolute emissions unless the emissions intensity information is material (AASB, 2023, 2024; IFRS, 2023).

Changes In Portfolio Positions

Portfolio emissions reductions may be the result of new investment or divestment decisions. Carbon attribution for these can be explained by the weight of holdings by sector (allocation effect) and by company selection (selection effect). Sector allocation has a strong effect on carbon emissions as sectors vary significantly, for example average energy sector emissions intensity are about 4150% higher than for the healthcare sector (MSCI, 2023b). Purposefully tilting a portfolio away from high emissions sectors increases active risk, that is a portfolio that screens out energy stocks will have lower emissions but can underperform relative to the benchmark if that sector rallies. Sector exclusions or maximum exposure thresholds are typically used for Paris-aligned benchmark indices. Capital allocation away from highest emitting companies, by using exclusion or maximum thresholds has a role in net zero portfolio implementation but is an ineffective strategy for real emissions reduction in hard-to abate sectors where there are no feasible alternatives available in the market (Franco et al., 2022).

Research participants also explained how the measurement of portfolio emissions intensity relative to benchmark emissions intensity can be deceiving.

"If a mining or oil producer is doing very well, they tend to have a sudden increase in the carbon emissions in those benchmarks and even if we still beat the benchmark (with our financed emissions) on or below the benchmark. Well there's no point patting ourselves on the back, because we have increased (emissions) versus last year… you are just looking at a lens relative to the benchmark and you keep on growing carbon emissions."

- Research participant

Carbon attribution allows better understanding of the allocation or selection effect between sectors and the different strategies that will be most effective for each to reach net zero portfolios. It is important for portfolio attribution to show whether emissions reduction is solely reliant on allocation effect as those emissions reductions do not represent a contribution to global decarbonisation. Divestment and corporate engagement are related to this discussion and can be found in 4.3.5 and fossil fuel phase out is discussed in 4.3.2.

Bouchet (2023) demonstrates the allocation effect and selection effect for a 'Paris-aligned climate impact' index against its S & P 500 parent index over the five years to 2019. By analysing the WACI by sector, Bouchet (2023) showed that the carbon intensity attribution of the energy holdings were explained by allocation effect, whereas the carbon intensity attribution of the utilities holdings were mainly explained by selection effect. The same analysis was repeated but there was almost no difference between the allocation and selection effect in calculated using absolute emissions. This reveals that the selected metric influences carbon attribution analysis.

Region is another consideration in carbon attribution, where developed economies have reduced emissions at a faster rate than EMDE. A portion of that is due to outsourcing high emission activities to EMDE. In a study of the MSCI ACWI, it was found that if all companies with highest quartile emissions were able to reduce them to their sector median then emissions reductions of about 60% could be reached (Franco et al., 2022). When repeated by region, the divergence between company emissions within sectors was far lower in the Eurozone and the US and higher in EM countries. A limitation of these equity index studies is that benchmarks may not be representative of global decarbonisation and market portfolios do not fully reflect all economies (Franco et al., 2022). Exported emissions and a lack of carbon accountability through the whole product life cycle distorts the understanding of who controls

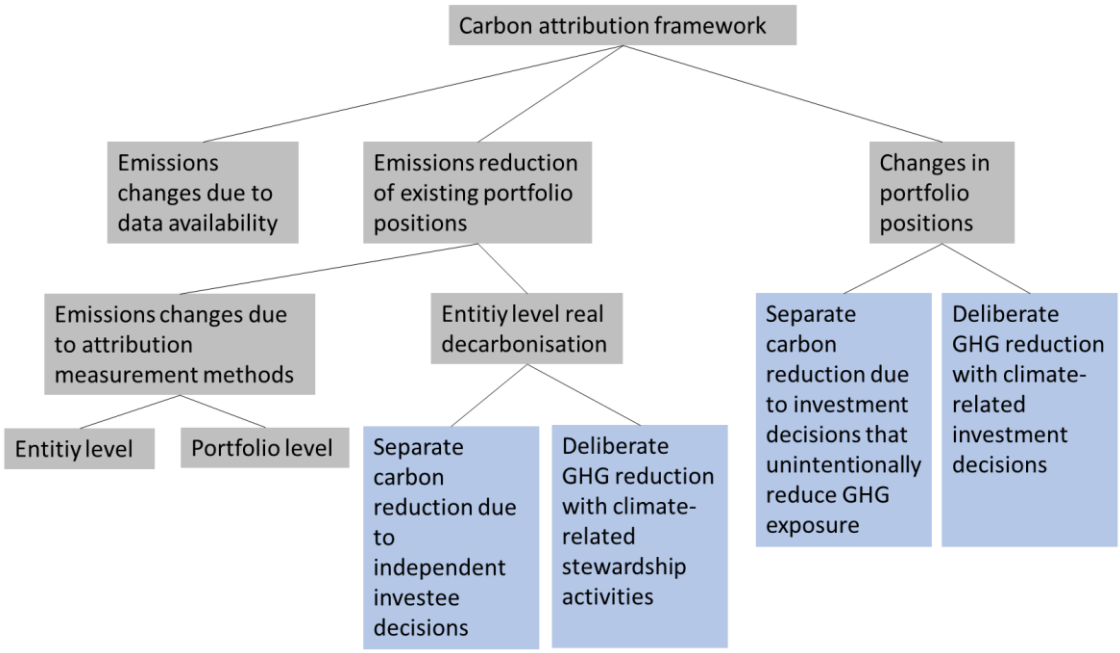
emissions and how they could be reduced. Emissions also cross borders for example, when developing nations are used for cheap labour in offshore manufacturing with demand controlled by advanced economies. Portfolio emissions calculations can lead to distortions and anomalies therefore it is important to provide net zero credibility and transparency through carbon attribution.

Given that portfolio holdings change over time, GHG recommends that portfolio emissions are either identified at a single date or averaged over a reporting year (The Greenhouse Gas Protocol, 2013).

Deliberate and Separate Carbon Reduction

A net zero commitment is a statement that the fund will undertake climate-focused investment and stewardship activities that intentionally reduce the carbon emissions associated with portfolio holdings. However, some level of portfolio emissions reduction will happen separately, as a result of decisions made by investee entities, independently of investors. According to Net Zero Tracker (2023) as at June 2023, 75% of national governments and almost 50% of Forbes global 2000 companies have net zero targets. Due to the complex set of interacting relationships that exist in the system of net zero superannuation portfolios, deliberate and separate carbon reduction cannot be easily distinguished. For example in their study of Australian stewardship practices PRI (2023e, p. 10) notes that, "*many investors remain cautious of attributing an outcome as the result of their individual engagement activities, given outcomes are usually driven* by multiple factors."Figure 21 expands on the carbon attribution framework developed by MSCI (2024) and proposes an deliberate/ separate reduction overlay. Evidence of deliberate and separate carbon reduction would be difficult to collect as strategic asset allocation and investment theses are not publicly disclosed and entity decisions cannot often be clearly attributed to stewardship activities or any single asset owner. Theoretically, however, it has the important purpose of explaining net zero intent.

Figure 21. Expanding Carbon Attribution with Deliberate and Separate Reduction



The level of net zero ambition indicated by research participants differed and affected their perception of control over active carbon emissions reduction. This was especially noticeable in relation to the participants' boundary of emissions ambition and level of responsibility described by research participants. Those who saw their net zero commitment as synonymous with reducing all planetary emissions expressed the view that superannuation funds could and should achieve a high level of deliberate carbon reduction. The participants with lower ambition were more reliant on passive carbon reduction.

"Realistically, the economy is going to shift. So, we will see changes in those baseline indices that do mean that they end up reflecting our portfolios more. Because things like fossil fuels just won't be traded on the listed markets forever. " - Research participant

"You can't discount that indexes and companies are shifting anyway from carbon. You can measure that portion, you can attribute the natural shift to a lot of that, but there is also an active play at our organisation too. So, it's almost like there is an active contribution to the decarbonization, and then the passive. And you can actually, chunk those layers and find there is a passive contribution, but this is what we've done above and beyond that."

- Research participant

Non-Linear Emissions Reduction

Another situation where emissions reduction is misleading of climate outcomes is where investors provide capital to high emissions sectors for transition. This capital is important for sector transition but will result in a rise in portfolio emissions during the time needed for decarbonisation (GFANZ, 2023; UNEP FI & PRI, 2024a). Further discussion on fossil fuel phase-out can be found in 0. The key issue however is that emissions reduction is not linear.

"We don't expect our reduction in emissions to be linear or a linear decline. We expect that they're going to go up and down because we're also committed to investing in the transition. So that means that we might take a stake in a company and work with them and fund them so that they can transition." - Research participant

The proposed SBTi (2023a) transition plan framework suggests that an attribution analysis should be presented within reporting to explain the reason for portfolio emission changes. For example, whether changes are explained by movement in fossil fuel phase-out investments, portfolio positions, changes in underlying financing structure or availability of emissions data that results in new asset class inclusions or portfolio baseline recalculations

Why Net Zero Implementation Needs to be Measured by More Than Emissions Reduction Metrics

In general, the research participants were pragmatic about the quantitative appeal of net zero to the sector but referred to carbon accounting as a crude measurement and questioned its efficacy as a sole metric of net zero success. They raised the issue of portfolio emissions as a lagging indicator in relation to climate risk.

"***Carbon reporting is talking about the outputs of existing activities. And they're fairly abstract. And it focuses very much on the outcomes of a series of decisions, right? …that's resulted in the emissions that you can then report on in your portfolios. So, when I'm talking about wanting to think a bit differently about how we think about impact. It's, well, how do we change those decisions before we get to that stage?***" - Research participant

A significant problem with carbon metrics is that selected emissions pathways may not lead to adequate temperature outcomes for climate stabilisation (Geden, 2016). Guidance from five commonly-used net zero transition plan frameworks shows consensus on a temperature outcome of 1.5^{o} with low or no overshoot (GFANZ, 2022c; PAII, 2024; SBTi, 2023a; The Investor Agenda, 2023b; UNEP FI & PRI, 2024b). OECD (2022c) also agrees that net zero targets should be consistent with limited or no overshoot of 1.5^{o} global temperature rise over preindustrial levels, with the exception of companies operating in jurisdictions with less ambitious net zero

targets that may need to align with a 2^{o} pathway in order to avoid greenwashing. Yet, methodologies gauging the extent to which portfolios are aligned to a low or no overshoot 1.5^{o} pathway are nascent and research participants were uncertain about the translation between their portfolio emissions and temperature outcomes.

"How do those [emissions] projections actually get realised?... nothing is really best practice at this stage. It's a good start, it's better than nothing, but it is a bit of a challenge in terms of how can we convert it to a temperature outcome and tweak the portfolio to go down that path and how can we rely on it." - Research participant

MSCI (2023a) analysed the net zero progress of listed companies globally as at May 2023 using an implied temperature rise metric that estimates the temperature outcome if the economy were to match the expected carbon emissions of the company. They found that average listed company emissions represented an implied temperature rise of 2.5^{o} over preindustrial levels by 2100. They further noted that if estimated emissions were unchanged, the remaining carbon budget for listed companies to align with a 1.5 ^{o} pathway would be depleted by end October 2026.

Dupre et al. (2022) distinguish between carbon risk mitigation and climate-friendly objectives, arguing that measurement of impactful decarbonisation requires metrics that signal beneficial impact such as increased capital allocation for climate solutions. Portfolio alignment has been developed to show the percentage of investments that are already aligned to a 1.5^{o} pathway (SBTi, 2023a) and better explains climate solutions activities (IIGCC, 2023a). Some other examples are avoided emissions, renewable energy generation capacity, proportion of the portfolio covered by deforestation policy (IPSF, 2023). According to PAII (2024, p. 17) *"it is expected by 2040 that 100% of assets are, as a minimum, aligned to a net zero pathway."* Over time portfolio alignment is expected to improve to the point where targets are eventually replaced by performance metrics (SBTi, 2023a). Some participants referred to their use of portfolio alignment metrics,

"Rather than a target that is based on an emissions number, our target, and it may just be internally, is shifting the aligned and the aligning percentage over time… it's making sure that the companies in our portfolio are transitioning." - Research participant

Portfolio alignment to net zero is determined in reference to a benchmark, taxonomy or another set of criteria. The determination of net zero alignment then, is not impartial and is yet another boundary judgement. Discussion on sustainable finance taxonomies can be found

in 2.7. It is also difficult to measure whether portfolio alignment is an indicator of real climate outcomes and whether the impact has been generated directly by the investment (Caldecott et al., 2024). Additionally, the techniques used to measure portfolio alignment can lead to very different results. According to GFANZ (2022a), there are three main techniques typically used to measure portfolio alignment.

Binary Target Measurements compare the percentage of investments in a portfolio that have a stated net zero target.

Benchmark Divergence Models compare individual counterparty emissions against a benchmark made up of emissions required to achieve a forward-looking target.

Implied Temperature Rise (ITR) Models convert counterparty emissions into a temperature outcome that would occur if the portfolio was representative of the global economy.

Further, decisions on the calculation, aggregation and forward-looking estimation methods also impact measurement outcomes and will be distorted by the same accounting issues as previously discussed (CDP & WWF, 2020; GFANZ, 2022a).

Bolliger and Cornilly (2021) reveal the benefit of portfolio alignment metrics in comparison to carbon intensity measurements in their study of the ICE Bank of America Global Corporate Green Bond Index to its parent index. The WACI for the Green Bond index is higher than its benchmark. Yet carbon attribution analysis reveals the Green bond index has four times the exposure to the high emitting utility sector than the benchmark yet achieves a much lower carbon intensity through its selections. They find that the portfolio achieves its objective of use of proceeds to support clean energy transition, which is not explained by the weighted average carbon intensity metric.

Dupre et al. (2022) have developed a suite of best practice of metrics for investors,

i. Prepare and disclose absolute portfolio emissions by asset-class
ii. Where relevant, compare investment alignment with sector-level emissions targets identified in decarbonisation roadmaps such as the International Energy Agency.
iii. Determine carbon intensity targets in sectors without roadmaps and compare investment alignment to these
iv. Determine absolute emissions targets based on market benchmarks in sectors without roadmaps and compare investment alignment to these
v. Use climate-relative scoring to select companies in sectors without roadmaps and sufficient carbon metrics

vi. Determine screening thresholds for investment and engagement in climate solutions and climate problems.

vii. Prioritise sectors where engagement will be most impactful towards decarbonisation.

Their advice is congruent with the net zero transition plan frameworks which recommend the use of a dashboard of climate-related metrics. IIGCC (2023a) recommend the use of multiple metrics across the climate solutions value chain. They especially advise that 'green revenue' should be included and note that it is backward looking, whilst 'green capital expenditure' is a useful forward-looking metric.

The research participants also described the importance of an increased depth of understanding of climate strategy beyond emissions calculation.

"When you only have that kind of data, you are going to miss the opportunity for additional metrics, forward-looking pieces. There are just so many other elements to what makes up an assessment of the extent to which a business is managing risk, or a fund is exposed to risk, then what we are going to get... to what will come out of those international standards."

- Research participant

"The sort of conversations we're having with companies, is around the resilience of their strategy, given where the demand for their product comes from. So, it's not just about targets - it's about really getting a better understanding of that." - Research participant

The use of broader forward-looking portfolio alignment metrics alongside emissions metrics improve understanding of an entity's net zero progress. They can describe the relationship between the entity and nature, land use and biodiversity, that are integral to net zero implementation. The intersection between finance, nature, land use and biodiversity, is still emerging and was considered too nascent at the time of the interviews to be included in this research.

Belief in Reaching Net Zero

This thesis research was initially conducted with the presumption that superannuation funds participants with net zero commitments or interest group participants who were supporting these believed that this goal would be reached. However, research participants did not necessarily think the ambition would be achieved.

"I think that there are funds who are genuine about their ambitions, but I just don't think they're going to achieve it. Because it's actually really hard. And if they do achieve it, as I said, it likely be achieved in an accounting sense, not in a real sense." – Research participant

They also questioned the credibility of investee company net zero plans.

"I think, there will be more calling out of some of the plans that we, as investors don't believe will get to where the company's telling us where they're going to get us to."

- Research participant

"The superannuation industry in Australia doesn't just invest in Australian companies. So, even if the Government here wants to target 2050 and is on track to achieve it, well we still have about 60% on average of our portfolio still depending on the decisions of governments and corporates that aren't in our jurisdiction. So, we can't influence them if locally there's no government incentives and things towards that path. It's a very difficult goal to achieve and I don't think we can achieve it." - Research participant

Similarly, Net Zero Tracker (2023) finds that despite a surge of net zero commitments by companies and national governments, they are not robust. The net zero tracker report explains that the concept of net zero has now been widely adopted but the next phase will require its realisation, rapidly.

Some participants commented that climate policy was insufficient to achieve net zero.

"Most serious people now think that there will be an overshoot, and we're not getting there. So that might be something that you need to question at some point. I hope that is wrong. If some amazing new technologies or something happens, then great. "

– Research participant

Through an analysis of the climate-related policies of 21 countries, Inevitable Policy Response (2023) also finds that only 3% of policies globally are aligned to achieving the lower Paris agreement temperature rise of 1.5 degrees, and therefore no longer considers its realisation to be attainable with no overshoot. UNEP (2023) explain that there is a vast gap between national pledges relative to 2030 emissions projections based on current policy settings, with CO_2 projections for Australia 14% behind the current Nationally Determined Contributions (NDC) and none of the G20 members achieving the necessary pace to meet their targets.

Several research participants commented that net zero achievement without overshoot was no longer possible and they were concerned about whether a temperature rise over 1.5 degrees in the near term would de-motivate superannuation funds from trying to achieve their net zero commitment. They also gave the view that carbon removal technologies including carbon capture and storage would be inevitable, this opinion is also shared by UNEP (2023) and is discussed further in 4.3.3.

"On Linkedin for the first time I read a post that was suggesting that because we can't now meet the 1.5 degrees target, we need to urgently socialize that with everyone and understand the implications… this is a long battle and it's about trying to stay positive and maintain the rage for such a long period." – Research participant

"even once it's obvious you're not going to meet it, do you double down on it and say, well, on a scope one and two basis we've done our bit, so don't point the finger as us… we think we are heading ahead for 1.8. So, the real discussion is, how do we pare back using negative emissions from 1.8 to 1.5... CCS will be needed…We're all invested in keeping the ambition. But we've argued that we want to keep it real. There's no point in setting a target for something that is unrealistic - and in the case of superannuation funds they never understood in the first place. " – Research participant

"I think it's fair to say at the moment that the growing consensus will be that we will not be able to hold at 1.5… Now people say this is a get out of jail free for the oil and gas industry and all the rest of it. I think that's a short-term view... I think funds have to understand that we are going to overshoot on current settings, even with an acceleration in policy."

– Research participant

Some participants argued that net zero would be limited to certain advanced economies and would not be achieved in non-OECD countries.

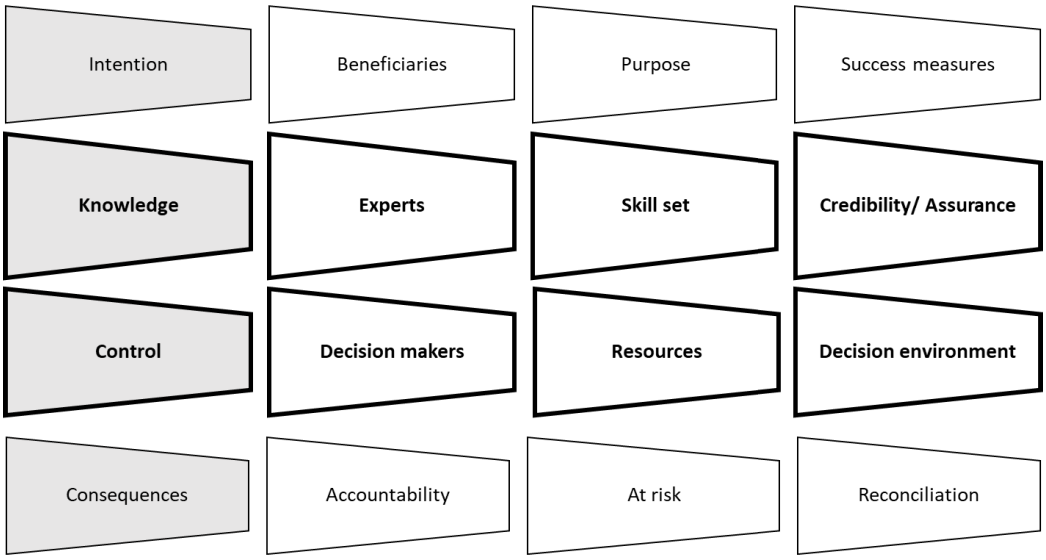
"Hats off to people like Fiona Reynolds and Mark Carney, who persuaded all of these investors to sign up to things that they didn't really understand, and some of them, even then, didn't really believe it. But it was too late. Literally, their signatures were there. 'We are signed up to net zero', and a lot of them did it without any interim targets for either 2030, or 2025. They didn't really understand pathways. They didn't understand the likelihood that this was going to be missed and so forth… there's so much bullshit in all of these target-setting methodologies, because as soon as you bring in the reality of Non-OECD countries, none of it makes any sense." – Research participant

Yet, in a poll of forty superannuation fund chairs, deputy chairs and investment committee chairs, the majority said they would meet their net zero commitments even though it would be challenging (Song, 2024). Some reports have been more sceptical, "*Some investors push for use of targets authorised by the Science Based Targets initiative (SBTi). However, these targets are pegged to the aspiration to hold global warming to less than 1.5°C, which some companies (and investors) view as a forlorn hope*" (PWC & London Business School, 2023, p. 7). Belief in reaching net zero is important in a context where a disingenuous net zero commitment would be considered greenwashing.

Measurement of net zero progress must start with clarity on its purpose and its beneficiaries and must flow from those. The fact that these are disputed by stakeholder groups poses an initial and encompassing difficulty. Success cannot be measured solely through carbon emissions, instead a dashboard of measures including leading climate action indicators such as portfolio alignment are needed for improved measurement. Carbon attribution is also essential for providing granularity on net zero progress given the complexity of the goal. The proposed attribution of passive and active carbon reduction is theoretical but is helpful in expressing the extent of intention. Boundary judgements are ingrained in both carbon attribution and portfolio alignment metrics. They occur in the form of scenario architecture choices, SFTs and other normative benchmarking. As methods continue to develop, those underlying assumptions will determine the pace and outcomes of net zero superannuation portfolios.

4.2. Internalising Net Zero: System Knowledge and Control

In CSH, Ulrich and Reynolds (2010) provide a structure to consider which skills and expertise are considered important for achieving a systems' purpose. They explain that judgement of who makes those decisions and which resources will be available to them reveals control in a system. In analysing the internalisation of a net zero superannuation commitment, issues of knowledge and control are intertwined. These boundary judgements are investigated in the following section in an analysis of how funds are internalising their net zero commitments. Topics of climate governance, leadership, capability, incentives and outsourcing are explored. It is argued that fully internalising net zero superannuation portfolios requires alignment from deepest leverage point, intent. Political and individual intent are critical to the necessary internalisation to reach net zero outcomes.



4.2.1. Climate-Related Responsibility and Governance Structures

Governance structures articulate net zero responsibility and accountability within an entity. 4.2.1 seeks to understand the board structures that superannuation funds and their investee entities have adopted. The section includes a desktop review undertaken to assess the top fifty superannuation fund climate governance structures. This is merged with interview data and literature.

Committing to, and then implementing net zero superannuation portfolios requires organisations to internalise suitable governance structures and climate capabilities. Determining the expertise that is considered necessary and its effect on organisational decisions, and which capabilities are deemed relevant or irrelevant, is telling of the underlying values that affect the system (Williams & Hummelbrunner, 2010). For net zero superannuation portfolios this requires an exploration of who has authority over net zero superannuation portfolios, how they are using their control to enforce climate governance and reporting decisions and to determine appropriate internal governance structures, recruitment and training to deliver these.

To implement net zero superannuation portfolios, trustees and executive leadership need strong strategy, monitoring and disclosure processes and structures (Arguden, 2020; Mulholland et al., 2020; The Investor Agenda, 2023b).

"Once we have targets and to plan to achieve those targets, we need to really embed those within our governance and our processes and systems and things like that."

- Research participant.

Research participants commented on their governance structures. The first quoted fund developed climate decision-making structures across their investment team. Whereas the climate governance practices of the second quoted fund are mainly focused on proxy voting. Both examples below show the pivotal role of the investment committee in their climate-related decisions.

"We've got a Climate Advisory Committee, which is all our heads of, within the investments team. So, in coming up with our roadmap on how are we going to meet our longer-term targets, our investment team - we have an investment team-wide working group that - then recommends to the Climate Advisory Committee - what the roadmap would be. They then endorse to the Investment Committee and the Investment Committee endorses to the board." - Research participant.

"We have an ESG officer. He reports on all our investments from an ESG perspective. We vote our shares. We obviously take proxy advice. He reports to the Investment Committee on all our investments. There's an overlay in respect to ESG. And the investment Committee report obviously goes to the full board every two months and our ESG officer when we get to the investment section and the investment committee report, it's not a tick and flick."

- Research participant.

In order to understand the structures of governance and accountability for Australian superannuation funds a review was done of publicly-disclosed climate governance for the top fifty funds (as measured by AUM). Most details were found in the climate-related policy, which is an essential document to communicate an organisation's approach to reaching net zero (AICD & Pollination, 2024; The Investor Agenda, 2023b). The policy document enables senior leadership and investment, risk, audit and/ or sustainability, committees to determine priorities and time horizons to achieve their interim and long-term commitment. Deciding on who is responsible internally for climate implementation provides accountability for net zero commitments (The Investor Agenda, 2023b). A table of climate governance details by fund can be found in
Appendix G. Publicly available climate governance data for four of the fifty funds was not located.

The majority of trustees had delegated climate governance responsibility to the investment committee with the Chief Investment Officer responsible for its implementation. Exceptions were some of the superannuation funds that were part of a banking group where ESG was instead delegated to the risk, audit and compliance committees. Secondly, trustees for superannuation funds running as platforms had limited climate governance practices, often providing ESG data but typically delegating climate-related investment, engagement and proxy voting to their underlying investment managers. A third observation was that the trustees of

Mercer (2023) and Russell Invesments (2023), both part of multi-national groups also prominent in Europe and the UK, had created sustainability committees and embedded extensive climate governance across their organisations. Given the small sample size, further research would need to be conducted to better understand differing climate governance practices regionally and their correlation with climate policy and regulation for their jurisdictions. It would be reasonable to expect that climate governance practices would be most robust in regions with strong climate regulation.

As there are critical financial implications of net zero transition planning, the investment committee is essential to implementing an entity's commitments (The Investor Agenda, 2023b). Whereas in organisations where climate responsibility is located within their risk or audit function and/ or committees strategic net zero transition and investment opportunities can be limited (AICD & Pollination, 2024; Suetens, 2024). Another approach to oversight is to split climate-related responsibilities across multiple existing committees such as the governance committee for climate policy and training, the audit and risk committee for risk evaluation and disclosure, remuneration committee for climate incentives, nominations committee for climate-aware board appointments (AICD & Herbert Smith Freehills, 2022; The Investor Agenda, 2023b). It is also important that climate strategy is socialised across the full leadership team and joint committee meetings as well as sustainability working groups to improve internal alignment (AICD & Herbert Smith Freehills, 2022; AICD & Pollination, 2024). The use of multiple committee oversight prompts cross organisation ESG awareness but requires strong reporting between these to avoid incongruent outcomes (AICD & Herbert Smith Freehills, 2022) and may be challenging if the committee members do not have sufficient climate expertise and especially if a high existing workload limits their capacity to upskill (Suetens, 2024). These challenges have prompted an increasing number of organisations, including 41% of ASX200 companies, to create sustainability committees (Herbert Smith Freehills & AICD, 2024).

The creation of a sustainability board committee as well as a cross-functional sustainability executive committee enables operational implementation with good oversight and a coordinated structure for escalation from the board as needed (Suetens, 2024). The sustainability committee approach has the advantage of allowing for in-depth climate reporting, compliance and strategy consideration, where an often time-pressured board agenda may not be able to provide for enough climate attention. A dedicated sustainability committee is especially appropriate for governance over a complex topic that relates to value chains across the entire organisation and is experiencing constant scientific, technological and

regulatory development (Suetens, 2024). Commenting on their survey of over 1000 AICD members AICD and Pollination (2024) say "*Climate governance is moving fast, with sustainability-related committees now more common, at least at larger companies, and there is a greater investment in developing boards' climate capability.*" Suetens (2024) asserts the value of a sustainability committee but advises that the entire board must retain climate accountability. Actions such as regular climate reporting on the board agenda and board training encouraged climate action but promoting systems thinking across the whole value chain is also required (WEF, 2022).

This part explained that most Australian superannuation funds had situated climate governance responsibility with their investment committees. That is helpful for positioning net zero as a process of strategic transition, rather than a carbon risk mitigation effort that would be implied by allocating it to a risk committee. There is increasing corporate belief that the use of a dedicated and cross functional sustainability committee is best practice, but this has not been adopted by the Australian superannuation sector.

4.2.2. Climate Leadership and Culture

Understanding decision makers and their influence on the organisations' culture is another critical aspect in internalising net zero commitments. The following discussion in 4.2.2 explores the control and knowledge-related judgements of the board and management, and its effect on organisational culture.

The Board

In addition to their accountability, the board of directors play an important advisory role in the development of a firms' environmental strategy, through understanding environmental risks and emerging opportunities that extend beyond typical business planning horizons and spans all parts of the value chain (Homroy & Slechten, 2019; Mulholland et al., 2020; WEF, 2022). As judgement is central to the Board Directors' responsibilities, their interpretation of net zero and organisational climate momentum, depends on the characteristics of their members. The board influences the urgency and best strategic pace for their organisation; becoming a sector climate leader, joining peers rapidly, or choosing to take later action. In their survey of chairs of the board, WEF (2022) found three stages of climate strategy, 'why?', 'how?' and 'how fast?' Participants affirmed the necessity of board support for net zero progress.

"This really does come from the top. If you've got the chair of the board focused on this, the rest of the organization will be focused on it. And so, I really do think that the responsibility

and the oversight of directors is so important in this space. So, director duties are number one.“ - Research participant.

“This has to come from the top and it has to have board support. And they need to be on board and understand the risks and the opportunities to enable us to then work with particularly the investment team… At the board level, the degree of questions, the sophistication of those questions has stepped up enormously.” - Research participant.

A review of the literature found that factors such as board directors' gender, education and career path were found to have a consistent relationship with the organisation's climate strategy and performance, in particular female directors have greater focus on environmental and social problems, that resulted in improved performance (Aguilera et al., 2021; Al-Qahtani & Elgharbawy, 2020; Rao & Tilt, 2016; Shaukat et al., 2016). The impact of director independence and the effect of previous industry or finance expertise had mixed influence on climate outcomes. The external vantage of board independence is advantageous for providing frank and effective opinions (Aguilera et al., 2021; Dixon-Fowler et al., 2017; Ortas et al., 2017; Rao & Tilt, 2016; Shaukat et al., 2016) but was less powerful in common law jurisdictions (Ortas et al., 2017), as is practiced in Australia. Board members with finance expertise and experience on the audit committee improved environmental performance as they provide management with deeper risk analysis (Shahab et al., 2020; Shaukat et al., 2016; Ting-Ting et al., 2021; Xu, 2021) but the study by Al-Qahtani and Elgharbawy (2020) did not find evidence supporting it. Numerous studies also correlate larger boards with improved environmental performance, due to greater resource availability including environmental committees, expert opinion and legitimacy theory (Aguilera et al., 2021; Albitar et al., 2020). Executive directors with dedicated environmental experience are viewed positively by the market and are immensely helpful in navigating complex environmental science and the long and uncertain horizon of environmental strategies that are often coupled with high capital requirements (Homroy & Slechten, 2019). Additionally, climate-skilled directors with multiple directorships build connections and share knowledge that spreads positive climate practices, 'cross-board socialisation' (Aguilera et al., 2021; Dixon-Fowler et al., 2017; Homroy & Slechten, 2019; Lerner & Osgood, 2023; Rao & Tilt, 2016).

“Some of our directors also serve on public company boards. So, there is a bit of an amplification effect if you educate them on climate change and other areas across the ESG space, they are going to take that knowledge to public company boards that they sit on as well.” - Research participant.

Despite the benefits of appointing board directors with climate expertise, it was not always feasible as their skills were expensive, and limited supply prevented some firms from appointing them if they were already engaged with their competitors. APRA (2022b) found 42% of institutions had a board member with ESG risk experience but noted a likely selection bias given that survey participation was voluntary and may have attracted those with greater experience. Similarly, 47% of firms surveyed by KPMG and Evershed Sutherland (2020) had a climate change expert on their board but 62% stated that their board did not have a good understanding of climate risk. Self-education is the most common way that non-executive directors have built climate competence, with many directors also relying on expert presentations and peer workshops and roundtables (The Investor Agenda, 2023b). AICD and Herbert Smith Freehills (2022) caution though, that over-reliance on a 'designated' ESG expert within the board adds risk that other directors do not have sufficient climate knowledge to properly fulfil their duties.

"We've done formal board and Investment Committee training, where we have brought in people to run it. And then a number of our board directors have also done things such as the AICD climate training, board director training as well. And others have undertaken their own training pathway." - Research participant.

"Trustees by and large, don't have that expertise. They're dependent on advisors, internal and external. So that's a practical issue." - Research participant

Management

In addition to the board, environmental leadership from the most senior staff is key to building an organisation culture that values sustainability (Eccles, 2016; Moktadir et al., 2020). Their guidance is particularly important alongside evidence that the lack of senior management support and cultural resistance to ESG, along with insufficient understanding were seen as the greatest barriers to ESG incorporation by finance professionals (CFA Institute & PRI, 2019). Research participants indicated the major cultural change needed to prioritise climate consideration by executive teams and commented on instances where teams had made excuses rather than proactive climate leadership.

"It's not a natural space for Chief Investment Officers really to think about the role that they have to advocate in a positive manner for a broader economy. But it's the kind of space that superannuation funds are being drawn into as a result of having made some commitments…many of the funds have large internal teams now, so, there's a lot of that

internal education that goes on from the ESG people pushing it up to the CIOs and the portfolio management heads. So, the people who really make the decision around allocation." - Research participant.

"We spend all our time trying to convince CIOs or help them to see it, or investment teams, heads of equity, head of asset classes, that what we need is a real capability built around that. Not just random discussions of ESG people trying to do the best they can and they're not skilled maybe to have those conversations. And they're the unspoken barriers, they're the barriers that are not acknowledged. They're not unpacked, they're not looked at it. We'll just blame government policy, we'll just blame liquidity. We won't look at ourselves."

- Research participant

The literature shows that a CEO's personal, professional and political background are strong indicators of corporate environmental outcomes (Ben-Amar & McIlkenny, 2015; Shahab et al., 2020). environmentally knowledgeable directors and CEOs with more power, such as due to a family connection to the firm, were also found more likely to prioritise climate outcomes (Consuelo Pucheta-Martinez & Gallego-Alvarez, 2021; Karn et al., 2023). Studies have also linked better environmental performance with larger sized firms (Aguilera et al., 2021; Albitar et al., 2020). However, younger CEOs, CEOs who also serve as the chair of the board (CEO duality) and CEOs close to retirement have been found to be negatively correlation with environmental strategy due to their emphasis on short-term profit maximisation (Aguilera et al., 2021; Kang, 2016; Shahab et al., 2020) with the exception of retiring CEOs that were remaining on the board of directors. Aguilera et al. (2021) refers to research that CEOs with a legal background are less supportive of environmental investment. Yet, the research cited is dated 2014, which pre-dates much climate litigation and recent landmark legal opinion so it is questionable whether the same findings would be repeated if the study were replicated now.

"There's a timeframe issue between the nature of the problem and the people who are trying to solve the problem. Like, in corporate world most directors have a tenure of up to 10 years. So, these directors overseeing decisions now, most of them won't be here by 2033, and that's still a long way off 2050. So, where is the motivation, or alignment of interest with really long-term problems. And that flows through to the financial system, where quarterly reporting is very short term. Whereas I guess, for super funds, it's a very long-term investment proposition. So, there's tension between the short term and long-term perspectives." – Research participant

In a survey of 80 finance sector professionals leading sustainability in their organisations, Deloitte (2021) found 32% reported to the CEO and attributed their efficacy to that direct reporting line. Others reported to the Head of Communications and Marketing 13%, HR 9% and Strategy 9%, whilst other reporting lines included risk, legal or public affairs functions, making it difficult to achieve sufficient seniority and influence across the organisation. They also found that 40% of organisations with greater than $100 billion AUM had a Chief sustainability Officer, 35% had a Head of Sustainability and the remainder had a Head of ESG, whereas 50% of firms with less than $100 billion FUM had a Head of ESG, 15% had a CSO and the remaining 35% had no equivalent role. As at October 2024 a search of the executive team of the top 10 Australian superannuation funds who were managing funds ranging from 84 billion to 330 billion, revealed that none had a dedicated CSO, although Aware Super incorporated the role with the Chief Risk Officer title.

Across most sectors the Chief Sustainability Officer (CSO) role, in conjunction with sustainability specialists in specific business units, is the preferred way to rapidly improve internal sustainability capability as those responsibilities have shifted away from a reputational communications role (Deloitte et al., 2022; Eccles & Taylor, 2023; Wang et al., 2024; Zollo et al., 2023). The CSO role is therefore of relevance to the internalisation of net zero for superannuation fund investee companies. 62% of firms had already created, or intended to create, climate-focused roles and 61% had already employed, or intended to employ, a chief sustainability officer (Dujay, 2021). Almost half of the companies surveyed by Deloitte et al. (2022) have a CSO in their firm.

The CSO role entails the need for robust discussion about decisions that require difficult trade-offs and short term costs. Eccles and Taylor (2023) argue that exploring those nuances are an important stage in value-creation and institutional investors are starting to ask companies to share those deliberations with them. The decision to appoint a CSO was found to be motivated equally by peer competition and increased stakeholder scrutiny, often arising following sustainability controversies (Wang et al., 2024). In the most climate-evolved organisations the CSO role is a cross-functional strategic leadership position reporting to the CEO and board, and with responsibilities relating to innovation and cultural change (Eccles & Taylor, 2023; Zollo et al., 2023). Eccles and Taylor (2023) argue that having the CSO report to the CFO is preferable than to the CEO, to best align the organisation's value-creation processes. Importantly the CSO should report to the board to better influence the organisations' sustainability transition, with the future aspiration that when it is fully integrated into organisation, the role would become redundant (Eccles & Taylor, 2023; Strategy& PWC, 2022).

There is a high degree of variance and vagueness in the key responsibilities of CSOs with expectations that are "*both incoherent and grandiose*" (Eccles & Taylor, 2023). Typically the role has been found to involve (Deloitte, 2021);

i. developing insights of the changing external environment,
ii. developing an organisational strategy and
iii. internal thought leadership and climate skills development.

Green Organisation Culture

As well as net zero as a leadership priority, human resource management is a critical function for boosting an organisation's environmental capabilities and internalising a net zero goal (Deloitte et al., 2022; KPMG & Evershed Sutherland, 2020; Maskell, 2021; Shafaei et al., 2020; Shah et al., 2021). Organisations can actively foster a climate-conscious culture through the use of formal sustainability training and green reward systems, as discussed in 0 and 4.2.4. (Afum et al., 2021; Shafaei et al., 2020). In addition to improved financial performance, better efficiency and lowered costs, research also found green organisation culture improved staff retention and employee engagement as staff felt satisfaction from their positive contribution to sustainability (Moktadir et al., 2020; Shafaei et al., 2020; Shah et al., 2021). 81% of North American employees surveyed by Willis Towers Watson agreed that clear climate strategy was important to them, indicating that this factor attracts talent (Dujay, 2021).

Research found that employees were more motivated to take climate action with increased climate awareness and expertise. Their skills were critical as their duties were often technical, but their power was limited to putting pressure on team leaders and management (Karn et al., 2023). A number of studies also showed that employees were most likely to support environmental processes when they felt empowered within the organisation and believed that their actions would make a sufficient difference (Aguilera et al., 2021; Moktadir et al., 2020; Shah et al., 2021). Research participants described a process of deliberate change to prioritise climate at all levels of the organisation,

"We have literally had grassroots conversation with everybody in the investment teams to get their buy-in to the underlying sector targets. Through to the degree of measuring emissions in one of our portfolios of every single one of those portfolio companies. Looking at the trajectory of those emissions moving forward and working out from the bottom up, how are we going to do it? So, we've been having really complex discussions and negotiations at the investment team level." - Research participant

"The huge cultural shift that's needed within large organisations is a very real thing. So, there's the technical part of doing it. And then there's the adaptive/ people and culture element, of making all this stuff happen. And I don't think that that should be underestimated…The real shift to a net zero portfolio will need a whole of organisation uplift and to support the agenda." - Research participant

The demand for climate-skilled staff has surged and about three-quarters of sustainable finance professionals in Australia surveyed by Atherton et al. (2022) said climate skills were in moderate to high demand in their company but they had had trouble finding employees with these skills. Findings from sustainable finance skills surveys in Ireland and Canada yielded consistent results (Deloitte et al., 2022; Sustainable Finance Skillnet & Deloitte, 2019). It is interesting to note that in the four years to 2023, the finance sector has seen a 15% annual increase in climate-skilled recruitment (LinkedIn Economic Graph, 2023) indicating a shift in management support. However, analysis by sector shows that only 1 in 15 finance sector professionals have green skills compared to 1 in 8 workers across all industries (LinkedIn Economic Graph, 2023). LinkedIn Job postings for Sustainability Analyst, Sustainability Specialist and Sustainability Manager roles grew annually by 45%, 42% and 40% respectively in the four years to 2022 (WEF, 2023). The gap in green skills across the workforce is significant and widespread, with 22% of job advertisements across 48 countries seeking at least one climate skill compared to 12% of users possessing a climate skill (LinkedIn Economic Graph, 2023).

"What we haven't done is yet built out the competency. And I think there's a bit of a dangerous view that this doesn't require depth of skills in an organisation. And a transition which is going to take fifteen, twenty years is going to be very, very complex. It's going to be every single asset class, every single investment." - Research participant.

Firms with a genuinely climate-aware organisational culture are encouraged to recognise it across all aspects of the business, including their organisational values, strategy, policies and opportunities to create positive environmental impact (Maskell, 2021; Shah et al., 2021). An underused example proposed by KPMG and Evershed Sutherland (2020) is the idea of default ESG-focused pension funds, where members would need to deliberately 'opt out' if they chose to nominate a conventional fund instead. Yet they found only 3 out of 1095 MNC were doing that. This practice has the potential to improve finance flows to climate-aligned investment significantly. Participants described the way that organisational structure and hierarchy was impactful for building a green organisational culture,

"Climate action is kind of built into our DNA… we've got an investment team and the impact team and basically, the investment team carries a lot of the traditional investment activities and then the impact team sits alongside them with delegations to ensure that all of our investment activities align with the ethical mandates of the relevant funds as well as about investment, philosophy, and purpose. So, we split it out like that, because by having those delegations from a governance perspective – separate - but with equal levels of importance."

- Research participant.

Evidence shows that the finance sector tends to conform to industry conventions (Guyatt, 2023). Some research participants referred to the issue of 'herd mentality' in the industry. Some participants explained that relative performance pressure made investors and advisors reluctant to challenge the status quo. Other participants said that time pressures made it challenging to reflect thoughtfully on norms and everyday practices.

"All of the asset consultants are thick as thieves in all of this as well. It's a brave asset consultant who recommends a wildly different thematic portfolio strategy then then the next one, because if it all goes wrong and you end up, even in the short to medium term fourth quartile for ratings, you've got a problem on your hands. " -Research participant

"I think that there can still be a lack of willingness to change. Like, this is how we've been investing. These are the asset classes that we invest in. And an inability to change the way that you've always done things and really think into the future when you've got all these short-term time pressures as well. Because you've got to meet these milestones for annual returns, and all those sorts of things. " -Research participant

'Herd mentality' and a culture resistant to change can be problematic, however peer relative behaviour can accelerate positive transformation, for example, the scale achieved in net zero commitments.

"When we thought about how we were setting our goal as an organisation, I suppose net zero 2050, to our mind is the business norm. That's where we have to be. So, it was not difficult to come to the conclusion that we, as an organisation needed to support that."

– Research participant

"Then you started to get that groundswell of net zero emissions. And then I think that was when we thought that it could start to also apply to portfolios as well as companies, which are really just an aggregation of both public and private holdings." – Research participant

It is incredibly challenging to question dominant assumptions, but this is the difference between transformation described in SSP1 and maintaining the patterns of SSP2. The deepest leverage point identified by Meadows (1999) requires an individual to rethink their deeply held beliefs.

This section identified characteristics often correlated with executive climate ambition. CSOs are lauded as the way to instil climate leadership in organisations. Their inclusion in C-suites have become more common across companies valued over 100 billion USD globally but are not being used by Australia's largest superannuation funds. Although net zero has moved from a peripheral concern to mainstream dialogue, leaders need to be innovative and courageous to generate a green organisation culture and attract talented staff with climate skills. The vast transformation needed to reach net zero portfolios requires dedicated climate leadership.

4.2.3. Climate Capability and Expertise

The surge of net zero commitments and an increase in mandated climate-related financial reporting has led to demand for climate capability. This section refers to the way that superannuation funds are addressing climate competency across their organisations.

In order to meet the high demand for climate skills, organisations have sought to upskill existing staff with the capabilities needed to understand novel and complex climate considerations (Atherton et al., 2022) (Deloitte et al., 2022; Sustainable Finance Skillnet & Deloitte, 2019). Research participants described climate training across multiple levels of organisations,

"The people and culture team are continuing to see if there is high quality, regular training that they can offer people, or as part of onboarding, particularly when we're hiring somebody that might be selected because they've got really good experience and openness to climate action stuff, but maybe not have deep knowledge." -Research participant.

"We spent the first year developing a framework… and then a huge amount of training and uplift of the front office investment teams." - Research participant

"The issue from a net zero perspective is we jumped into targets, and that's fine. What we haven't done is yet built out the competency." - Research participant

The skills that were in greatest demand were technical analysis skills such as climate-scenario simulation and risk analysis (Atherton et al., 2022; Deloitte et al., 2022) and climate risk management, reporting and disclosure skills (Atherton et al., 2022). However, time-pressures

and a lack of access to training resources have limited upskilling in the finance sector (Atherton et al., 2022). APRA (2022b) noted the resource-intensive commitment that will be needed to build the capabilities necessary to reach net zero portfolios. The intent of the participants distinguished their perspective on addressing climate skills challenges. Planetary emissions participants with the strongest intent to reach net zero, tended to see the imperative to urgently prioritise new skills and practices, whereas other participants emphasised the difficulty of incorporating new ways of working in a time-pressured environment that include many priorities other than net zero.

Developing a culture where iterative climate learning is encouraged will help pilot new processes that will help meet the rising climate expectations of stakeholders in a competitive corporate environment (Arguden, 2020; Zollo et al., 2023). Collaborative industry bodies play an essential role in building and scaling new learnings that are necessary for rapid climate action (AICD & Pollination, 2024). Information-sharing opportunities such as webinars, papers, frameworks and taxonomies to boost sustainable finance knowledge (Deloitte et al., 2022; The Investor Agenda, 2023b).

In their climate risk survey APRA (2022b) found 59% of superannuation board committees had had climate risk training in the last 12 months. Drivers of the need for stronger sustainable finance expertise were increased regulation, development of new sustainable finance instruments such as green bonds, as well as asset manager and asset owner commitments (Sustainable Finance Skillnet & Deloitte, 2019). It is expected that the drive for improved capabilities will be increased by sustainable finance regulation, organisational strategy and external stakeholder demands (Atherton et al., 2022; Sustainable Finance Skillnet & Deloitte, 2019).

In recognition of the sustainable finance skills gap, financial supervisors and governments are investing in research and training such as Sustainable Finance Skillnet in Ireland, the Green Finance Institute in the UK and initiatives by the Monetary Authority of Singapore (Atherton et al., 2022). Skillnet Ireland (2024) provide access and subsidies to a network of upskilling programs customised to sector needs. The Green Finance Institute (2024) is funded and supported by the UK Government and philanthropy, their scope includes the development of green finance skills and capabilities. They are the authors of the Sustainable Finance Education Charter that sets a policy foundation for education and training across the UK finance sector (Green Finance Institute, 2021). Whilst the Singapore government have established a ‘sustainable finance talent development ecosystem’ with three research centres of excellence,

workforce initiatives and training incentives such as the payment of 90% of training costs for approved sustainable finance skills programs (Monetary Authority of Singapore, 2022, 2024).

Atherton and Noble (2023) comment that despite the aspiration to become a green superpower that is articulated in the Australian government's Sustainable Finance Strategy, the document does not reference the skills and competencies that are critical for net zero transition. Company attitudes towards net zero and the novel capabilities required for its implementation are not always sufficiently supportive to accept its costs "*A view remains that taking climate action is always costly and value-destructive. Climate competencies are still seen mostly as a "nice-to-have*"(WEF, 2022, p. 11).

A supportive culture and resource allocation for climate upskilling is core to building the competency to achieve net zero portfolios. Yet, this section showed a need for expansion of climate skills training to meet rapid demand. Government funding as adopted in UK, Ireland and Singapore should also be adopted in Australia. The university sector also has an essential role to play in building climate skills to meet industry demand.

4.2.4. Climate Incentives

Climate incentives have been used to motivate climate-focused investment. This section investigates their adoption and provisions for their use.

Performance incentives are commonly used across the business and finance sector to align the interests of principals and their agents through the use of incentives, also known as 'agency theory' (Siegrist et al., 2020). Conversely, where incentives are based on short-term earnings, agent interests are misaligned with net zero outcomes (Karn et al., 2023). Short- and long-term climate targets can be incorporated into executive remuneration and performance indicators to motivate executives to support net zero outcomes and indicate a company's value for sustainability (AICD & Pollination, 2024; BIS, 2022; Maskell, 2021; Moktadir et al., 2020; PAII, 2024; Shah et al., 2021; Siegrist et al., 2020). Many of the transition plan frameworks suggest the use of climate-linked incentives (GFANZ, 2022c; PAII, 2024; TPT, 2023). Close to half of MNC executives globally expect resistance to the large amount of changes needed to their business models to achieve their decarbonisation targets (KPMG & Evershed Sutherland, 2020). In that context, an increasing number of companies have embedded ESG targets in CEO compensation, in part due to encouragement by institutional investors as part of their own carbon reduction strategies (Winschel, 2021).

The research participants explained their organisation's internal use climate-linked incentives and key performance indicators. One participant said the incentives were at odds with their already climate-focused organisational culture. Other participants were grappling with the most appropriate way to implement them.

"We don't do incentive-based pay because we want to treat people equally and generally, incentive-based pay can tie into certain unconscious biases. So, we try and avoid that side of things and keep things just on a base pay." - Research participant.

"You can measure it in process uplift, or you can measure it in contribution to a working group, or there are other ways. So, that switching, of our STI framework, has been pretty effective. And we've also got a weighted average carbon intensity target for our CIO and our Head of listed assets, that falls down into our portfolio managers for equities as well… the private markets team have been incentivised over the past year and will be incentivized over the next year to find impact investments." - Research participant.

"We have KPIs that include responsible investment integration and progress towards our target broadly. So those KPIs are applied to a range of senior management personnel across the investment team. So, both, the responsible investment team have objectives around meeting the targets, but also those apply to the broader investment management team." - Research participant.

Environmental performance rewards can be individual or group-focused, and may be financial or recognition-based (Maskell, 2021). Some climate performance incentive systems found to be in use by Zollo et al. (2023) were;

- A component of manager bonuses based on emissions reduction performance
- A component of manager bonuses based on a specific environmental target
- A component of long-term incentives based on emissions reduction KPIs
- A score card based on non-financial metrics including climate change

The adoption of climate-linked incentives is increasing rapidly but is most readily adopted when regulatory as well as media pressure for emissions reduction is high or industry peers are influenced by sector trends (Cohen et al., 2023; KPMG & Evershed Sutherland, 2020; Winschel, 2021). The inclusion of environmental and social metrics for executives increased by 60% in Europe and 180% in North America in the four years to 2023 (Ghisolfi & Meche, 2024). Reports on the proportion of executives in Australian companies with environmental or carbon-linked incentives varied from roughly 25%-50% (Cohen et al., 2023; Glass Lewis, 2024; PWC &

National University of Singapore, 2022). These differences are explained by variance in the selected metrics, sectors, regions and company sizes included in the studies but also suggest that there is a need for further research on this.

As at 2023, roughly 80% of large listed US and European energy and infrastructure companies included environmental and social metrics in their executive remuneration, by comparison only about 50% of IT executives in Europe and 20% in North America had these (Ghisolfi & Meche, 2024). Similarly, the rate of climate-linked incentives for executives in the coal and oil and gas sectors was found to be about six times higher than in the finance sector (Cohen et al., 2023). Data also showed differences in the use of incentives within firms where 82% of board directors and c-suite executives at multinational corporations had decarbonisation target incentives but less than 10% of their employees had them (KPMG & Evershed Sutherland, 2020).

Larger companies as well as companies with concentrated ownership were also found to be more likely to adopt carbon-linked CEO compensations. There is also a reasonable link, albeit not specifically climate-related, to incentives to manage non-financial risk in the APRA (2021d, p. 9) requirement for significant financial institutions, including the nineteen largest superannuation funds, to, "*maintain a remuneration framework that (a) aligns with the entity's business plan, strategic objectives and risk management framework; (b) promotes effective management of both financial and non-financial risks, sustainable performance and the entity's long-term soundness."* These arrangements must also be disclosed for oversight and accountability (APRA, 2023d). These factors would suggest that growing superannuation fund size, and increased climate regulation will lead to further adoption of climate-linked performance incentives.

ACSI (2021a), ESG industry body with 34 asset owner members, recommend that remuneration for outsourced asset management is aligned with shareholder interests and long-term value creation. However, Australian Investment consultancy, Frontier Advisers (2022), who service numerous superannuation funds, note that consultant retainer contracts typically last for 3 years and refer to the importance of having short-term staff incentives. Whilst they also recommend that consultants be appraised on their value added over a full market cycle, they will be under scrutiny from asset owners to prove short-term performance.

Whilst most studies reviewed by Aguilera et al. (2021) support a positive correlation between climate incentives, Francoeur et al. (2017) challenges the idea that executives are too self-interested to prioritise stakeholder concerns and questioned the need for climate-linked

incentives in addition to moral value. The high rate of payouts compared to genuine climate progress has also been questioned (PWC & London Business School, 2023). In their study of the 50 largest European companies, all with carbon reduction targets and more than three-quarters with climate-linked executive incentives (PWC & London Business School, 2023). Only seven properly achieved those criteria but methods for accurate calculation raised the issue of ensuring that they are only paid out when they have been achieved. Measuring net zero progress as evidence for incentives payout overlaps with the measurement issues raised in this research such as the challenges and nonlinearity of carbon emissions calculations, refer 4.1.3. Multiple climate-related metrics and the use of standards and assurance for climate-linked remuneration as well as the net zero intention that underlies them must be resolved.

The way that climate-linked incentives are adopted has been found to vary considerably but in order to be effective they must be set and applied robustly (PWC & London Business School, 2023). Four criteria for strong climate-linked incentives were developed by PWC and London Business School (2023);

i. Significant: the incentive should be linked to the organisation strategy and the proportion of pay meaningful to the executives,
ii. Measurable: the incentive should be based on appropriate assessable metrics,
iii. Transparent: The incentives should be clear to stakeholders,
iv. Linked to strategic carbon goals: The incentive should be linked to the organisation's net zero emissions reduction pathway.

This section indicated the benefit of climate incentives to motivate internalisation. The challenge for their implementation is tied to determination of net zero success metrics. Of immense importance is ensuring that their payment is only granted when climate performance is demonstrated.

4.2.5. Outsourcing and Internalisation

Superannuation funds have long relied on outsourcing to external managers, particularly for specialised investment expertise. In relation to CSH, the use of outsourcing, extends the superannuation fund's boundary of accountability. This section considers how outsourcing and internalisation practices affect net zero superannuation portfolios.

The research participants identified the varying degree of power over external managers afforded by the specific investment vehicle. When buying units in a trust superannuation funds could exert limited climate risk control over external manager decisions. On the other hand, a

fund-directed mandate allowed funds to stipulate detailed climate requirements. There are also notable differences in the number of investment options offered by funds. In 2022-23 the profit-for-member sector, which includes industry and public sector funds, offered a median of 14 investment options. In comparison, the retail sector offered a median of 313 (Bell & Warren, 2024). Many retail funds function mainly as a platform, where members supported by financial advisers select from a vast array of externally-managed products. Superannuation funds' influence and control on the net zero actions of external managers is greatest where fund attention can be concentrated on fewer options with more significant FUM.

"It says in those mandates, how much renewable energy / other climate solutions do we need to invest in within this specific asset class? How much reduction in emissions do we need to achieve within this asset class as opposed to others. And essentially, we took those plans that we had to the Investment Committee… We've got key risk indicators to monitor how we're going. - Research participant.

"We'll either run a mandate with the manager where we can be very explicit, or we will go into a pooled fund, where we will buy units in a trust, or we'll have a co-investment style vehicle. Now, with each one of those, there's a spectrum of influence. So, in our mandates, which can be, depending on which asset class, can be more fee-favourable for our members, or less fee-favourable for our members - we can set some pretty key targets. So, for a lot of our new equities mandates we haven't necessarily given them a net zero target, but we give them targets to track 10%, 20%, 30% of carbon emissions below the benchmark. So, a lot of our new, particularly our new, more passive style mandates will have that in them"

- Research participant.

As at September 2022, just four of twenty-eight asset owners surveyed by IGCC (2023b) had included a requirement for most or all of their asset managers to invest in climate solutions in their mandates.

Superannuation funds are ultimately accountable for operational risk and must therefore monitor external managers sufficiently to ensure that their investment decisions and stewardship activities do not expose superannuation funds to financially material climate risk. Some described risk oversight processes to ensure climate-related implementation was sufficiently robust. Whereas other participants, described climate engagement with external managers as a beneficial stewardship initiative.

"Specifically about voting on climate change - there is sometimes a divergence between asset owners and asset managers…we have brought all of the voting in-house. So, all of the proxy voting activity actually sits within the ESG stewardship team." - Research participant.

"We do an ESG review of our external managers and as part of that review process, we are talking to them about their climate change approach, not only from a documentation and governance perspective, but how are they grappling with issues on a live basis, in the portfolios that they're managing on our behalf." - Research participant.

"We are now starting to use a platform, which also then enables us to better connect with our investments and with the fund managers as well. So that they're actually inputting that data, they have access to that data, they can look and think and monitor about what they're doing from an emissions perspective, as well. That's external, as well as internal managers. The credit, PE, infrastructure and property. And it will be fixed income as well at some point in the hopefully, not so distant future." - Research participant.

By July 2025 stronger regulatory oversight and monitoring of operational risk including outsourcing to investment management service providers will come into effect (Allens, 2023; APRA, 2023c). The enhanced regulations in CPS 230 are a response to the Royal Commission's findings (Financial Regulator Assessment Authority, 2023). Additionally, ASIC (2022a) took action against financial 'greenwashing' 35 times in the nine months to March 2023 (ASIC, 2023a) and are continuing to ensure that sustainability claims and disclosures by superannuation trustees are not misleading.

Some participants described a difference in the relative climate capabilities in their organisation compared to their external investment managers. Those with less climate knowledge were reliant on external managers to compensate for their climate deficits whereas others described reciprocal information-sharing and climate expertise.

"[We ran] a session for the first time with our external equities managers focused on issues that matter to us, climate being one of them. So, we shared some of the work that we're doing, so hopefully that helps uplift what they're doing." - Research participant.

"Where we can utilise other investors or fund managers who are doing something specific in the space or where we can cross share knowledge, we always look for smart partnerships...We are working together with our investee companies. They're guiding us, we are guiding them - and we get these outcomes." - Research participant.

The diverse breadth of asset management makes it difficult to generalise on their climate skills, which vary significantly. Participants also noted that investment style and asset class affected the level of external manager climate capability, as well as their ability to most effectively implement their organisations' net zero objectives. The onus then is on superannuation trustees to ensure they have monitoring processes to ensure all of their external manager climate practices are adequate.

Fund size also affects superannuation fund control over the climate actions of external investment managers is fund size. Six megafunds each manage more than 100 billion AUD and control of assets is highly concentrated, with the top twenty funds managing 89% of all APRA-regulated funds (APRA, 2024a). Increased fund size amplifies the power and ability to have substantial stewardship power over external managers. However, that is not a guarantee of superior fund operations or control used for "*good"* (Lawrence & Warren, 2023). Fund size growth has also lead to an increase in international investment including the establishment of offshore offices for internal management of international investments (Korporaal, 2023).

The rise of megafunds would imply an increase in the size of superannuation funds outsourced to investment managers. However, superannuation funds have simultaneously increased internalisation of some parts of their asset management to gain investment control, manage capacity issues and reduce third party fees (Mercer Consulting (Australia), 2024) (J.P. Morgan, 2022; Paparo & Jani, 2022). Fund-level data on the proportion of funds under management that is outsourced to external managers compared to managed internally is not easily accessible, however, Bradley (2023) notes the rise of internalisation in megafunds with Unisuper managing 70% and AustralianSuper managing 58% internally as at June 2023.

"As more funds, including us, have gradually internalised, more and more of that is being done internally…we've developed up those capabilities internally to integrate climate into our CMAs [capital market assumptions]" - Research participant.

Building expertise is a recognised challenge of internalisation as it is difficult for asset owners to attract and retain internal asset manager talent due to lower remuneration and organisational culture differences (Gallagher et al., 2019; Investor Strategy News, 2023). Yet, internalisation enables further climate-related investment control and could be used to enable greater product customisation and overcome short-term performance competition of external managers (Gallagher et al., 2019).

4.2.5 showed that outsourcing requires careful monitoring to ensure that net zero processes are aligned. This also depends on the investment style of an external manager and at times the relationship has benefits for shared climate knowledge. Internalisation can overcome cultural differences between organisations but requires significant internal capability.

Section 4.2 revealed that internalisation of a net zero commitment requires superannuation funds to make changes across all levels of their organisation. Climate governance must expand beyond the board risk committee into a strategic and cross-functional board priority. Climate leadership at a CSO level is advantageous and being adopted by the most climate progressive corporations. With deep climate governance and leadership funds can uplift internal climate competency and incentivise climate-focused decisions. Interest groups have been pivotal in building awareness of climate skills and supporting collaborative learning. Yet government support is needed to immediately boost climate training. The emphasis on industry-driven climate knowledge and expertise places a financialisation bias on selected knowledge at the expense of challenging established norms. Internalisation rests on net zero interpretation at multiple levels including the net zero success metrics on which performance incentives are measured and the extent of alignment in outsourced investment mandates.

4.3. Implementing a Net Zero Commitment

In CSH, decisionmakers have control over the system enablers and resources (Ulrich, 1994). Control over the elements and knowledge needed for portfolio carbon reduction, investment in climate solutions and carbon neutralisation requires cooperation from other system stakeholders beyond superannuation funds. This section considers the complexity of net zero implementation. In this system, knowledge and control depend firstly on the judgement of superannuation trustees. However, congruent with the theory by Meadows (1999) they are simultaneously constrained and incentivised by the Australian government-controlled system design, which is subject to vast and dynamic global pressures. All of which, are merely a function of intent.

4.3.1. Climate-related Information

This section highlights two recurring issues raised by participants in relation to climate-related information: mandatory reporting and scenario analysis. These considerations show the importance of intent and judgement at this formative time for climate-related disclosure.

Almost all research participants commented on problems with the quality of climate-related financial reporting and data. Those issues are outlined in 2.7. Two climate information issues that are particularly revealing of system dynamics and boundary judgements are mandated reporting and forward-looking climate information, particularly scenario analysis.

Mandatory Reporting

Many research participants referred to the expected data improvements that would result from mandatory reporting.

"Once you've got a mandatory regime, and it sits in your balance sheet, in your financial statements. I just think that's it's a real game-changer. It's going to really uplift, the quality of disclosure." – Research participant

"We've been a really big supporter of the ISSB standards, creating a taxonomy and having globally consistent reporting standards. We are a global investor, so the ability to compare any assets in different jurisdictions would be hugely beneficial. It also means that things like the TCFD, that has been voluntary here, with climate reporting becoming mandatory, companies can no longer hide. It means ASIC will be able to review and have more of a view on these disclosures." - Research participant

Improvement of climate-related financial information has been a big focus for policymakers globally. Policy makers typically focus on system change at shallower places, but change is constrained by deeper places of leverage (Abson et al., 2017; Meadows, 1999). Climate related-reporting and data in the system of net zero superannuation portfolios is an example of that.

As at September 2024, twenty-five jurisdictions, representing 50% of global emissions, were in the process of phasing in climate-related reporting that responds to the international standards developed by the ISSB (Lloyd, 2024). This progress in highly commendable and is expected to improve the quality, comparability and interoperability of current climate data. Yet, the ISSB prioritise financial materiality and proportionality. In Australia, disclosure requirements will be introduced gradually from January 2025 in stages according to entity size. Similarly, incorporation of scope 3 information will be delayed to the second year of reporting and must only include information that can be found, "without undue cost or effort" (Commonwealth of Australia, 2024a, p. 2). Therefore, mandatory reporting standards have been developed in a way that meets the intent of portfolio emissions commitments. The ISSB standards and their gradual adoption do not reflect the urgency of data, extent of information

or impact materiality of climate risk that is needed to properly address the intent of a planetary emissions goal. In CSH terms, the boundary judgements of relevant knowledge are limited to financialisation and a short-term perspective of fiduciary duty.

Scenario Analysis

Another data issue that remains challenging and relates to a deeper place of intervention in the system, is the production of novel forward-looking information. Research participants reasoned that reliance on past information was not sufficient for climate knowledge. They explained the difficulty of anticipating future Government policy decisions, entity actions and climate impacts.

"How much you can rely on the forward-looking view that an ESG provider gives us? This is actually a very big challenge, and nothing is really best practice at this stage. …There is a lot of forecasting that relies on assumptions of growth and on technology that is unknown at this stage. As well as regulation in each country. So, it makes that component very tricky to manoeuvre around." – Research participant

"Almost all of investment history has been backwards looking, and all of our systems and processes and ways of thinking about the world is based on - this is what's been true about the past…and this is how we can predict the future, or attempt to predict the future. All of those conditions are about to massively change, very dramatically." – Research participant

As discussed in 2.3.5, scenario analysis is a risk modelling tool used to identify forward looking portfolio risks and opportunities. It involves anticipating climate risk based on a conceivable set of assumptions. It provides important climate risk insights for investment level decisions, financial stability analysis, and global capital market risk-return expectations used by superannuation funds in their strategic asset allocation (SAA).

Although assumptions and simplifications are necessary, widely-used climate models used for scenario analysis have been criticised for lacking the latest science, ignoring tipping points and therefore underestimating catastrophic climate risk (Trust et al., 2023). Trust et al. (2023) suggest defining a temperature limit and then reverse stress-testing a 100% GDP loss. Using that method, risk projections as early as 2070 suggest a 50% GDP loss. This is highly relevant to superannuation funds given that the youngest members are unlikely to retire before 2070. Judgement on the temperature goal and remaining emissions budget by region and sector will also differ (Bingler & Colesanti Senni, 2022). Fair share principles are related to this issue and are discussed later in this section.

The investment horizon of a physical asset is very sensitive to scenario settings, a 1.5^{o} pathway requires decarbonisation twenty years before a 2^{o} scenario. Another consideration participants referred to, is whether the emissions pathway has temperature overshoot. That would favour negative emissions technology (NET) and carbon capture and storage (CCS) investment. Scenario analysis methods should be explored transparently to ensure that they have been designed to represent an explicitly agreed desired net zero future.

"It's a very complex area, as we all know. And I wouldn't begin to sort of suggest that I understand tipping points. And we know that a lot of scenarios used for example, don't really cater for tipping points, and so there's too much complex information."

– Research participant

Scenario analysis methods are nascent and are expected to improve through increased climate data, methodological development, and use and evaluation (ACSI, 2023; GFANZ, 2022c; The Investor Agenda, 2023b) (Kurian et al., 2023). A summary of the recommendation by main net zero framework providers can be found in Table 17 in Appendix H. APRA (2021b, p. 16) cautions that, "*expectation of future improvements in approach is not a justification for delaying its use*." Many research participants commented on the need for its refinement,

"I just think there needs to be greater education and sophistication. The modelling is, like most modelling, so sensitive to assumptions. And there's so much variability about going forward and change. That's not to say you shouldn't have models and be ready to change them, even on a monthly basis, because things are going so quickly." – Research participant

"Close to 50 different scenarios are being used [across the ASX200]. And for different purposes. So, not all companies are doing scenario analysis, those that are…some are doing it for physical risk. Some are doing it for transition risk. Some are doing either of those across all of their business, or part of their business. Then within those using the RCP type scenarios, or the IEAs. Or they're making up their own, which are a combination."

– Research participant

Iteration on forward-looking climate information capabilities requires a supportive organisational culture and leadership. A survey of 63 institutional investors by IGCC (2024b) found that only 16% had conducted physical risk analysis, and just 32% had implemented scenario analysis overall. The UK Government have convened the industry group, 'Climate Financial Risk Forum' to develop a scenario analysis implementation guide and online tool. They note that "*there has been a marked increase in the proportion of firms being required to*

undertake climate scenario analysis for regulatory purposes" (Climate Financial Risk Forum, 2022, p. 3). Participants discussed the way that they were beginning to adopt scenario analysis processes internally and apply the forward-looking portfolio climate risk information it generated into their SAA,

"When we develop up an SAA, we will stress test that SAA against a range of scenarios… We also stress test our portfolio for range of forward-looking climate scenarios… it used to be an external process, now we've developed up those capabilities internally through working with a consultant." - Research participant

In addition to innovative methods for its preparation, the use of forward-looking information is essential. It is the basis for net zero-focused investment decisions and impactful stewardship that influences future company and policy decisions. This is discussed in 4.3.5 and is an example of a deeper leverage point and complexity in control within the system.

The way that climate-related information is developed is critical to net zero superannuation portfolios. Section 4.3.1 showed the control of the Australian government in defining financial materiality in mandatory reporting and emphasising proportionality in the preparation of information and phasing-in of regulation. The participants were interviewed prior to adoption of mandatory reporting but they said they anticipated improvement following regulation. Further research once phase-in is complete would be beneficial to understand how government definition of materiality and proportionality affects climate outcomes. Similarly, scenario analysis methods will evolve but will ultimately depend on interpretation of materiality in forward looking modelling and perspective on appropriate net zero scenario pathways.

4.3.2. Emissions Reduction and Fossil-Fuel Phase Out

This part analyses fossil fuel phase out and emissions reduction and is closely linked to observations in 2.3.4 questioning the decisions on appropriate climate scenario pathways.

Emissions reduction requires decreased energy and resource use across an entity's value chain and may need sector-wide intervention and stewardship (Axelsson, 2024). High intensity sectors are most essential to planetary net zero outcomes; however it is recognised that actions will need to be region-specific given differing socio-economic conditions (PAII, 2024).

Fossil fuel phase-out is a crucial component in net zero pathways and was a major outcome of the COP28 global stocktake (UNFCCC, 2023a). This section comments on the necessary challenges of transitioning away from fossil fuels. The process of fossil fuel phase-out is

immensely complex and has caused great uncertainty for superannuation fund investors. This discussion refers to the various approaches to investment in the phase-out of coal, oil and gas in differing regional situations. The much-debated issues of subsidies, carbon capture and stranded assets are included in this segment.

The Energy Trilemma

Since the 19th century, Western development has been powered by and orientated around the intensive use of fossil fuels. "*Everything from productive activities through to the layout and design of our cities, not to mention the way of living imposed on working families, is shaped by the dynamics of fossil capital*" (Garzon Espinosa, 2022). 70% of all human-caused GHG emissions are the result of the fossil fuel industry and its products (Griffin, 2017). Dependency on, and the damage caused by fossil fuels, have led to a "trilemma" in their phase-out. Energy security, affordability and environmental impact must all be considered (NZAOA, 2023b). The trilemma is central to stakeholder judgements in fossil fuel phase-out. A portfolio emissions perspective reduces environmental impact in a way that will not threaten economic stability and energy security. Energy affordability occurring from fossil fuel phase-out for members and national beneficiaries is also considered by portfolio emissions. However, energy affordability and environmental impact in EMDE is outside of their boundary judgement and net zero commitment.

Although there is general agreement on a necessary transition from fossil fuels to renewable energy, approaches to this are divergent (GFANZ, 2022c; United Nations, 2022). Comparative benchmark performance, especially relative to YFYS which includes fossil fuel equities, adds further difficulty to fossil fuel investment decisions. Investment in an asset to facilitate a managed phase-out is considered important in net zero-aligned finance by some stakeholders (GFANZ, 2023; NZAOA, 2023b). Research participants commented on the tension between removing fossil fuel exposure and the risk of stranded assets, compared with active ownership to enable transition. Part of their struggle is strong encouragement from NGOs and other stakeholders to divest. At the same time, the superannuation sector is under pressure from governments and industry interest groups for active ownership and stability in net zero transition.

"***Do we consider it a good or a bad thing if a government with clear commitments to wind down assets, picks up some of these fossil fuel assets, and then winds them down in a controlled manner. Is that positive or negative? Would we want that exposure? Would our members expect that exposure?...***" – Research participant

"A big challenge is the fact that super funds are clearly failing to understand that net zero by 2050 means no new fossil fuels. Or if they do understand that, then they're certainly failing to act on it. And as we've discussed as well, regulators are failing to pull them up on that point."

– Research participant

"You need to keep fossil fuels going until you get the scale on the wind and solar… But they both suffer from the issue of intermittency. So you need some, some reserve source, where they can fill in those moments where the wind's not blowing, and the sun's not shining. And people don't even know those basic concepts, in the investment world, at least."

– Research participant

A more granular consideration of fossil fuel phase-out below provides more clarity on the topic.

Determining Fossil Fuel Power Thresholds

Most main net zero transition models rely on phase-out of coal for energy use by 2030 in advanced economies (PAII, 2024; United Nations, 2022). Yet there are different views on oil and gas production and the use of emissions removal technologies. Whereas the UN HLEG exclude the financing of oil and gas activities altogether, the IEA sees a role for abated oil and gas production using carbon capture utilisation and storage (CCS). The differences between models are helpfully summarised by SBTi (2023b) and have been adapted into the table below.

Table 8. Approaches to Fossil Fuel Phase Out across Key Models Adapted from SBTi.

	IEA	IPCC	NGFS	OECM	UN HLEG
Coal	Coal power plants phased out in 2030 for advanced economies and 2040 globally	Reduced coal for energy to <5% by 2050	Reduced coal for energy to 7% by 2030 and 0% by 2050	Coal power plants phased out in 2030 for advanced economies and 2040 globally	Coal power plants phased out in 2030 for advanced economies and 2040 globally
Oil	Unabated oil-fired power	Reduce use of oil by 40-75% by 2050	Oil for energy to be reduced	Reduce use of oil by 8.5% annually. No	End exploration, expansion and

	plants phased out by 2040. No new power plants.		to 18% by 2050	new power plants.	production financing.
Gas	No new plants	Reduce use of unabated gas by 80% by 2050	Use of gas for energy to be <9% by 2050.	Reduce use of gas fields by 3.5% annually.	End exploration, expansion and production financing.
Emissions removal	Coal and gas relies on CCUS	Mainly LULUCF	Limited use of removal technology	Use of natural carbon sinks	No overshoot

Net zero transition plan frameworks advise funds to develop phase-out policies including thresholds for their exposure to fossil fuel investments (The Investor Agenda, 2023b).

Thermal Coal

Despite relative consensus on thermal coal mining and power generation phaseout, financial institutions have different acceptable investment thresholds. GFANZ (2022c) found most entities they surveyed considered 11-20% and 21-30% to be the highest acceptable range for investment in coal-related activities.

"When we think about stranded assets we as a fund screen out companies with more than 10% thermal coal revenue. We're probably one of the strictest. I think some other superannuation funds have it up at like 30%. So, we're quite strict when we apply thermal coal. That's an industry where we can't see how they would transform and we view that it will structurally decline so long term we have that cap to ensure that we don't have long-term stranded asset risk." – Research participant

"Since writing that part of the policy we have a thermal coal mining screen for companies with 10% revenue. So, we were really trying to shift away from that reliance on coal, which is arguably a stranded risk." – Research participant

Battiston et al. (2017) note that 82% of global coal and almost half of global gas assets will be stranded in a 2-degree economy. Additionally, a new renewable energy-generated electricity plant is now cheaper than a new coal-fired one over its economic life (Atholia et al., 2020). In 2020, Australia ranked second globally for thermal coal exports (Australian Government Geoscience Australia, 2022), indicating the high level of national exposure to carbon transition risk. There are limited opportunities to re-purpose coal-fired plants. They could be fitted with Carbon Capture, Utilisation and Storage technology (CCS) or co-fired with biomass or ammonia, but most are likely to become sites for battery storage centres (IEA, 2021).

Oil and Gas Power

Some stakeholders considered all oil and gas investments unacceptable whereas others just excluded unconventional fossil fuels. For example, unconventional coal seam gas has higher emissions intensity including fugitive methane emissions. Deepwater oil and gas drilling in areas such as the Arctic are also especially damaging (GFANZ, 2022c; NZAOA, 2023b). A further concern for investors in oil and gas is their involvement in the petrochemical and plastic value chain (NZAOA, 2023b; The Investor Agenda, 2023b). The effects of oil and gas-related investment are wide-reaching and require a systematic approach and sectoral pathway guidance that includes detailed timelines for phase-out (GFANZ, 2022c; NZAOA, 2023b). Further guidance is anticipated (European Parliament, 2022a; GFANZ, 2023).

Carbon Capture Utilisation and Storage (CCUS)

In CCUS, CO_2 is captured, compressed and stored geologically in a location close to refineries (IEA, 2023b). The use of CCUS technology is questioned due to its cost, leakage and lack of permanence, low public acceptance and difficulty standardising and scaling. Ketan (2021) cautions that "*techno-optimists*" are too reliant on the "*false comfort*" of CCUS. Ketan noted that in 2019, 36,440 megatons of fossil fuel-related emissions were released globally and only 0.1% of those were captured. However, it is increasingly understood by some stakeholders as a necessary component in reaching net zero (IEA, 2023a; Monaghan, 2024) and Yang et al. (2023) observe that most 1.5^{o} and 2^{o} IPCC pathways will require 10.5 Gt of carbon dioxide removal annually after reaching net zero. Investment in CCUS is an area of confusion for investors. Research participants expressed sceptical views on it,

"There's no carbon capture technology, which is going to help you at the moment"

"The NGO community hates negative emissions because it's going back to 2005 when CCS was seen as a way to give the fossil fuel companies an easy ride. But I think that things have

moved on from there. The NGO community hasn't. CCS will be needed. It will be developed…the capture side of it in power." – Research participant

A distinction should be made between the use of CCUS as a negative emissions technology for offsets that occur outside of the value chain, and its use for abatement in production processes without a viable substitute, including cement production. The former is discussed in 4.3.5.

To date, expertise in CCUS technologies is primarily in oil and gas companies which account for 90% of CCUS in operation globally (IEA, 2023b). Exxon Mobil, Occidental, Petrobras, and Chevron represent more than half of global CCUS (IEA, 2023c). One research participant commented on the dilemma of being invested in a company innovating on CCUS but whose core business is gas.

"Santos, so it's a gas company, right? And probably you say, 'Well, should we be investing in gas companies? Not sure… Yet, if you take another view of Santos, it's Carbon Capture Use and Storage, they're probably the leaders in that, and they need capital to develop that part of their business…However, what I suspect is that a lot of funds wouldn't invest in it because it's gas. And at a simplistic level, that's fair. Therefore, they [Santos] don't get the capital to invest in net zero gas and we lose both the opportunity as Australia to have a leader in that space… if we're over simplistic in the pursuit of legislation or transparency here, we probably miss the nuances of how we can develop the industries of the future." – Research participant

Government support of CCUS projects is mixed. The Victorian government has been involved in CCUS developments and projects, such as CarbonNet and The Federal Australian Government has allocated approximately 50 billion AUD to carbon sequestration (Monaghan, 2024). On the other hand, the Queensland government is planning to ban CCUS in the Great Artesian Basin (Monaghan, 2024). In the US, incentives through the Inflation Reduction Act are supportive of CCUS (US Department of Energy, 2022). CCUS is also included as an activity that offers a substantial contribution to climate change mitigation within the EU sustainable finance taxonomy (European Parliament, 2020b).

On the other hand, leading climate scientists have united to alert society on the failure to operationalise about 70% of CCUS projects. They also warn that storage vastly undersatisfies carbon storage demand and has been banned in many jurisdictions including Germany and the Netherlands due to the dangerous risks it poses to human health (Lethal Humidity Global Council, 2024a).

Subsidies

The fossil fuel industry has enjoyed a long history of government subsidies and these were ongoing well after the Paris Agreement, despite the G20's phase-out agreement that commenced in 2009 (NZAOA, 2023b). Fossil fuel subsidies remain higher than G20 funding for clean energy (The Investor Agenda, 2023b). In the ten years to Dec 2022, Australian Government provided 110.3 billion AUD in fossil fuel support (OECD, 2023a). Net zero frameworks urge investors to lobby governments to end fossil fuel subsidies (NZAOA, 2020). In their report The Australia Institute (2024) provide a breakdown of the 14.5 billion AUD spent on fossil fuel subsidies by Federal and State governments in the 2023-2024 financial year in Australia. They comment that the total amount was sixteen times higher than the 'Disaster Ready Fund.' The detrimental climate impacts of the 11 billion AUD spent on the Fuel Tax Credits Scheme to offset costs for businesses using fossil fuels for machinery and vehicles over 4.5 tonnes on private roads are clear. However, there are a small number of instances, such as the Hydrogen Hub, where the use and climate impact of the subsidies is unclear. The hub combines green hydrogen with fossil fuel-based hydrogen developments. Some research participants commented that government subsidies would be needed to support the transition to net zero.

"Would my fund invest in a coal-powered station or a gas-powered station right now? We wouldn't, because it's a sunset industry. The risks are too great. The Government would have to provide significant subsidies, which they are actually thinking about, because some of the power stations can't be closed too early." – Research participant

"There's a role in government helping to subsidise some carbon intensive or fossil fuel industries, because we don't want to pull the rug out from everyone. What we're trying to not have, is a disorderly transition, or where you have the kind of abrupt changes to industries and sectors and communities and regions. So, we need to be able to help and provide help to companies that ultimately have to change or over time, wind down. But everyone would point to subsidies and tax breaks for large fossil fuel companies probably are not the ideal settings." – Research participant

An example of government support is the NSW Government agreement with Origin Energy to keep the Eraing coal Power station open until August 2027. The NSW government would claim up to 80% losses of 225 million AUD per year risk and share up to 40 million AUD per annum profits (NSW Government, 2024). The agreement also includes a clause that the 220 employees of the Eraing plant are to be retained until closure. Government subsidy of fossil

fuel phase-outs is distinct from subsidies that have been used by governments for energy security and economic growth. Total global fossil fuel subsidies are estimated to be $10.5 trillion USD annually (Iyke, 2024). In addition to explicit fossil fuel subsidies, Iyke (2024) refers to the lack of carbon pricing as an implicit subsidy. That is the negative impact of fossil fuel emissions is a cost to global stakeholders rather than producers.

A consistent directive from commonly-used net zero frameworks is the importance of investor lobbying to governments for 1.5^{o} aligned policy that supports fossil-fuel phase-out (GFANZ, 2022c; NZAOA, 2023b; PAII, 2024). Their lobbying recommendations are for carbon pricing and other fiscal incentives to support GHG emissions reduction, the removal of fossil fuel subsidies, restriction measures to limit the supply and demand of activities derived from the fossil fuel value chain and enhanced disclosure requirements (NZAOA, 2023b). The Powering Past Coal Alliance (2022) Principles are a helpful resource. PPCA is also part of the GFANZ alliance and according to their PPCA Timeframes, OECD countries should have exited from coal power by 2030. The principles also explain that members should avoid financing new unabated coal projects or new equity or debt investment in companies that will be generating unabated coal power beyond the PPCA timeframes

A Just Transition

The phrase, 'a just transition' is used to refer to fair share principles due to inequities between countries. Challenges relate to affordable energy supply where EMDE have a high level of relatively new carbon-intensive infrastructure that poses a financial transition risk in the event of early retirement. Additionally, 750 million people globally have no energy access and have been disproportionately harmed by climate change (NZAOA, 2023b).

The term is also used to describe communities suffering from the economic effects of workforce changes in the transition to net zero (IEA, 2021; NZAOA, 2020). The latter is pertinent to Australia where there are regions that are dependent on thermal coal and other industries that will experience concentrated unemployment as these are phased out (ACSI, 2022). A just transition is especially relevant to industry superannuation funds that were established for members in industries now affected by net zero transition. The research participant quoted below referred to economic transition costs,

"In some particular regions, there is likely to be quite a lot of disruption to communities and employees, as old industry shut down, new ones are born or relocated…it goes back to the universal investor concept again. Where with super funds being diversified and exposed to all sectors of the economy, you don't really want to have one part of that fall over. Because

even if you're not a direct investor in this particular asset which is shutting down and its workers displaced, there will be flow on effects to other areas of the economy which will flow through indirectly." – Research participant

Whilst costs to transition are inevitable, there are expectations on companies to support communities and workers within their planned transition. Through consultation with investors, companies, unions and other stakeholders ACSI (2022) developed guidance and principles to support a just transition;

- Disclose, consult and engage on the expected impacts of the transition strategy on workers and communities. Ensure these are tailored specifically to each local community.
- Develop timelines, plans and funding for retention, retraining, redeployment or redundancies for affected workers. This should be accompanied by financial advice and counselling services.
- Seek opportunities to increase economic diversity in affected regions.

Fossil fuel phase-out is laden with complexity. Judgements on a just transition depend on who is seen as the intended beneficiary of the net zero commitment. For planetary emissions participants who seek to focus on global beneficiaries of net zero, it is challenging to address energy affordability in EMDE as well as environmental impacts. Fossil fuel phase-out remains an area for urgent research. Conclusions from the German Coal Commission found that to phase-out coal-fired power by 2038 or earlier in a way considered to be equitable, the cost would be 69 to 93 billion euros including 40 billion euros in regional aid and 16 to 32 billion euros for electricity price compensation to companies and consumers (Agora Energiewende und Aurora Energy Research, 2019). The German Coal Commission strategy has been criticised for its compensation provision to coal producers and limited ambition in pace. Arguments also centred on a lack of inclusiveness in stakeholder consultation with under-representation from environmental advocates and from the public in affected regions (Radtke & Löw Beer, 2024; World Resources Institute, 2021). Research to inform coal-power phase-out in other jurisdictions such as Korea and Canada has built on lessons from the German Coal Commission (Binz et al., 2024; Honnen et al., 2023) and is shared on platforms such as Coal Transitions (2020) to promote knowledge sharing for coal phase-out in the EU and beyond.

A summary of fossil fuel phase-out guidance from key net zero transition plan frameworks is found in Table 19 in Appendix H.

This discussion presented several strongly argued issues underpinning the net zero transition. How to meet energy demand without compromising climate goals, especially in EMDE where affordability is paramount. Energy security is also a concern heightened by global conflict. The intermittency of renewable energy poses a further issue and the subsidy of fossil fuels in transition is another point of contention. SFTs have been central to articulating these decisions. These are especially fraught in Australia where regional communities are suffering the economic effects of climate transition and the Government has long benefited economically from emissions-intensive exports.

4.3.3. Passive Investment Funds

This section builds on the discussion on ESG ratings in 2.7.2 and benchmarks in 2.6.3. From that foundation, 4.3.3 considers the impact of passive investment funds on net zero superannuation portfolios.

Passive investment strategies track a portfolio or an index. They represent a rising share of superannuation fund assets (Parliament of Australia, 2022). The reasons for this are outside the scope of this thesis, however, it may be explained by the YFYS performance test and fee pressure (Australian Government, 2024b). Whilst the average fee for active funds in Australia in 2023 was 0.53%, passive funds fees were 0.23% (St Anne, 2023). Given their prominence, it is important to examine the decisions that have been made in constructing passive funds. Such as the determination of an investable universe for EMDE and the methodology used for climate-related indices. Some superannuation funds develop proprietary indices, whilst others invest in a generic wholesale index.

For passive investment in equities, a market-capitalisation-weighted index is commonly followed. Unless a screen or an additional set of rules has been applied, all companies in the particular sector or region will be included in the passive fund based on their market value and there is no possibility of divesting from selected constituents. Market valuations do not properly incorporate carbon risk so passive funds may have high exposure to unvalued carbon risk. A current concern for some research participants is their belief that certain industries were no longer viable due to high physical and transition carbon risks. For example, an extreme weather event or a policy change to encourage decarbonisation could cause a company to experience a sudden devaluation. Passive index investors would be exposed to the fall because the index and holdings are only rebalanced quarterly.

"As we start to see the stranded asset risk increasing in sectors or certain companies, there is going to be this real dilemma of companies and their place in the index which, we are

basically forced to, not track, but track very closely to. That risk is going to become greater, and greater. And so, you're going to find a lot of regulated entities would not be in a position to fully divest. There are obviously those that are, ethical options, pure ethical options. And people are self-selecting into those super funds. But I think that this is going to be a real risk to the value of retirement savings for members unless it's changed." - Research participant

Index rules

To counter the short-term risk of exposure to high-emissions companies but still invest with passive indices, some funds apply a screen and rules to the index. Yet, if they screened the energy sector out of their portfolio and it were to rally, they would risk relative underperformance. The use of sector screens also removes capital from high emissions sectors needing capital for fossil fuel phase-out and transition, refer to section 4.3.5. It is an especially challenging issue for superannuation funds to manage given that the YFYS performance test is built on market-capitalisation weighted indices and the decision of the legislated benchmark is controlled by the government.

Index providers have developed passive climate-related indices to help investors manage carbon risk as well as invest in climate-related opportunities at a low cost (S & P Global, 2022c). These are mostly systematic strategies built on information developed by ESG data and rating providers. Yet, the index construction method for climate-focused passive funds varies significantly and labelling can be ambiguous (Baselli, 2023). In addition to inaccurate labelling, there are concerns about ESG data and rating quality, as discussed in 2.7.

An example is MSCI Climate Action Indices, designed to include companies who are considered to be leading in their climate transition activities (MSCI Inc., 2024) and have a Science Based Targets Initiative approved target (MSCI Inc, 2023b). The index begins with all Index companies included in the region, then screens out companies that are involved in thermal coal mining, oil sands activities, weapons or tobacco production or that MSCI has found to be involved in very severe ESG controversies. MSCI provides companies with an emissions intensity rating based on their scope 1, 2, and 3 GHG emissions. Despite this admirable methodological intention, insufficient data availability poses a challenge to the accuracy of this rating. MSCI also determines a climate risk rating for companies. This is based on their view of the way that the company is managing emissions, biodiversity and land use, their vulnerability to climate change and their opportunities in renewable energy, clean tech and green building. Whilst the areas for climate risk evaluation include important concerns, finding adequate information to determine the company's performance on these parameters is difficult and would require

forward-looking judgment of unknown future circumstances. MSCI determine the index constituents by aggregating the company emissions intensity and carbon risk ratings and ranking these within their GICS sector. Whilst the index label and methodology in this example are well-aligned, there are important boundary judgements and information gaps that should be understood by investors.

Whilst there are numerous climate-related equity and corporate bond index products there are fewer climate-related sovereign bond index products. This is due to the challenge of determining a country's climate performance. An example of a climate-related passive sovereign bond index family is the Bloomberg Government Climate Tilted Index (Bloomberg Professional Services, 2024) launched in April 2024. Constituents from the parent index are selected based on a Government Climate Score determined by Bloomberg. The methodology assesses a country's performance on climate policy and a current and forward outlook of the country's power and carbon transition (Bloomberg Professional Services, 2023). Their score aggregates thirty underlying data inputs. For example, the carbon transition score includes current and expected absolute carbon emissions, as well as current and expected carbon emissions per GDP and capita. These emissions metrics combine data from several "orderly" transition scenario models available on NGFS (2024b) and then uses NGFS estimates to attribute emissions to individual countries. The additional data inputs that inform the Government Climate score are similarly well-considered and detailed. Yet, it is again necessary to acknowledge the numerous assumptions and unknowns that exist in their index methodology, as discussed in 4.3.1.

EMDE Investable Universe Determination

A point of difference between planetary emissions and whole portfolio research participants is the emphasis of the former group for investment in EMDE to enable climate change mitigation and adaptation, refer to 4.1. Some participants referred to climate solutions in EMDE as 'uninvestable' and beyond the domain of their fiduciary duty due to high political and country risk. Less regulated markets have led to fewer providers of capital in developing countries. Conversely, that limitation strengthens the stewardship potential of investors who are present (Caldecott, 2019). The boundary judgements made by passive index providers about emerging market indices are clearly articulated. An example is key ESG data provider is MSCI Inc (2023a) whose emerging markets index is benchmarked by large passive funds together representing over 1.3 trillion USD under management as at 2023, this includes Vanguard Emerging Markets Index Fund and iShares Emerging Markets Index Fund. The index is also the emerging markets index that is included in the legislated YFYS benchmark (Australian Government, 2024b).

MSCI Inc (2024a, p. 14) claim to define the Global Investable Market according to "*transparent and objective rules*." Table 9 shows the emerging markets countries deemed investable by MSCI Inc (2023a, p. 4) as at April 2023. It is interesting to note that just ten countries were allocated more than 90% of the capital, with most investments in China, Taiwan, India and Korea. The market capitalisation threshold for companies in emerging market countries to be included in the index was 323 million USD with further minimum liquidity and trading rules (MSCI Inc, 2024a). Index providers offer a range of overlays on their defined universe including the climate methodologies discussed above. There is a distinction between the EMDE countries and companies considered to be within the universe of passive index investors and a comprehensive definition of the global economy. Superannuation funds should be aware of these boundary judgements and align their net zero intent with the full universe they are seeking to invest in.

Table 9. MSCI Emerging Markets Index Region and Country Allocation by Weight as at 30 April 2023

China	31%	
Taiwan	15%	
India	14%	
Korea	12%	
Brazil	5%	
Saudi Arabia	4%	
South Africa	4%	
Mexico	3%	The remaining index allocations are across Malaysia, UAE, Qatar, Kuwait, Poland, Philippines, Chile, Turkey, Greece, Peru, Hungary, Czech Republic, Egypt and Colombia.
Thailand	2%	
Indonesia	2%	
Total	**91.5%**	

Regulatory pressure to lower fees and reduce active portfolio risk has boosted the appeal of passive investment in superannuation portfolios. This section makes explicit the limitations of ESG ratings and judgement of investability for climate outcomes.

4.3.4. Climate Solutions

Climate solutions are the technology and services that support climate mitigation and adaptation. This section discusses their implementation and strong link to SFTs.

Execution will require broad system cooperation, particularly in energy and hard-to-abate industries (GFANZ, 2022c; OECD, 2022d; UNEP FI & PRI, 2024b). For a 1.5 ^{o} pathway by 2050, up to 275 trillion USD will need to be invested in climate solutions (IIGCC, 2023a). Of the total sum estimated, a 'historic surge' of 5 trillion USD annually will be needed for global energy and infrastructure (IEA, 2021).

This section examines the research participant assumptions and experience with investment in climate solutions. Their comments revealed the control and knowledge boundaries affecting climate transition judgment. The obstacles to their investment in climate solutions are also probed. Conversely, Government incentives and the use of sovereign bonds to attract private capital for national comparative advantage are also explored. The most polarising difference between portfolio and planetary emissions perspectives is seen in fair share principles and investment in climate solutions in EMDE.

Defining Climate Solutions with Sustainable Finance Taxonomies

Research participants referred to the need for a sustainable finance taxonomy for guidance on whether an economic activity would be deemed a climate solution. They also wanted proof to show that their net zero investments were credible.

"What we've done is developed our own criteria or taxonomy that anyone, whether it's an external manager or an internal team, need to comply with in order to say, 'well actually, this can be defined as a climate investment." – Research participant

"I think a lot of people find it difficult to work out whether a company's aligned or not aligned…sector pathways will identify both the sort of direct infrastructure, but also the support infrastructure that's needed to support net zero..." – Research participant

"I think the taxonomy will help…we're trying really hard to be as transparent as possible. But it is a challenge because you can look like you're contradicting your goals by being exposed to particular sectors or assets." – Research participant

Regulator taxonomies and sectoral pathways can prioritise national interests in their judgements, such as the reference to Australia's agenda to become a 'renewable energy superpower' in the development of its taxonomy (ASFI, 2023a). This would imply that net zero

outcomes advance alongside the pursuit of national comparative advantage. On the contrary, the voluntary Australian sustainable finance taxonomy is ambitious and Paris-Aligned. The use and export of Australian green products including green iron and green aluminium could reduce Australian and global emissions by about 10% (Sims, 2024). Yet these judgements should be considered in terms of net zero interpretation. Is the period for which an activity is classified as transitional also in the best interests of global beneficiaries? How long is it acceptable to invest in a project that is not aligned to a long-term net zero future? Additionally, what activities are considered acceptable and necessary for net zero transition? Would portfolio and planetary emissions participants agree on it?

The Australian government identified twenty-six critical minerals such as lithium as potential opportunities that were essential for global decarbonisation (Parliament of Australia, 2023a). Research participants noted the opportunity presented by investment in critical minerals but also noted the issues caused by mining and finite resources. They further questioned how critical minerals mining would affect their emissions metrics. They suggested that it would be necessary to differentiate between emissions associated with investment in critical minerals and other mining emissions. Carbon attribution is discussed in 4.1.3.

"I think something that lots of superannuation funds are grappling with is how you differentiate between the emissions from your portfolio - if you're investing in for example, critical minerals, mining, which will be a huge enabler for the global transition. But your investment will mean your portfolio emissions will go up. So how do we be a bit more sophisticated about what a net zero portfolio is, that's not just portfolio emissions? That thinks about the contribution to global decarbonisation." – Research participant

I think Australia, being a source of critical minerals is essential, because we're powered by the money sector in many ways, and the financial sector. And I think we can be in the fortunate position that we will still be in a great mining country and just mine different things. And people will want different things. And if we can help the world decarbonise that's great. But yes, we need to understand that mining is still mining. There's still emissions. There are still problems that come along with digging things up from the from the ground. – Research participant

"We have all those critical minerals and other things here, so for at least the next, whatever this reindustrialisation looks like, for the next 20 or 50 years. And there'll be other things in the future when we run out of lithium and we move to different types of storage."

– Research participant

It was important to the participants to have an independent 'source of truth' that affirmed their investment credibility. As outlined in 2.7, determinations of sustainable finance taxonomies are underpinned by stakeholder judgements and are based on the assumptions and values of system architects. In Australia, ASFI (2023b) have assembled a cross-section of experts in sustainable finance, climate and environmental science, circular economy, human rights and indigenous views. However, they emphasise the importance of 'useability' to ensure it is adopted. Arguments of proportionality and balance are discussed by IPSF (2023) and International Sustainability Standards Board (2023). The judgement on an acceptable pace for transition is essential to net zero outcomes but is weighed against its acceptability to a sufficient proportion of stakeholders to affect change. The most powerful leverage point to accelerate net zero outcomes is individual intent.

From Emissions Reduction to Climate Investment

Many of the research participants described a phase of rapid portfolio emissions reduction following net zero commitment. Funds that divested from fossil fuel or other high emissions industries without engagement were criticised (Robin, 2021) and this remains a contested topic, discussed in 4.3.2 and 4.4.1. The participants referred to the next stage of net zero implementation as more difficult, as it entailed investment in climate solutions. Their description of the stages they had taken in net zero transition divides emissions reduction from climate solutions investment. This differentiation is well-articulated by Caldecott (2022a) who separates climate risk management, where a company reduces its GHG emissions exposure from the provision of finance for alignment with climate outcomes. Using the example of divestment to an actor with no climate-aligned objectives, Caldecott explains that whilst emissions reduction and climate solutions investment might overlap they should not be confused or interchanged.

"The areas where funds tend to be able to move most quickly is setting the target and building out their policy and setting their commitment and their strategy. And then the stumbling blocks come when, after that process of dealing with the low-hanging fruit… they're managing not just the number that comes with decarbonisation, but looking at…nature, water, all of those things that feed into it."

– Research participant

"It's not just enough to think about where you want to avoid putting your emissions. But actually, really, what we want to see is a significant transition of Australia's energy and

other processes. And really, in order to do that, we really noted that we needed to be investing in climate solutions. – Research participant

Energy Sector Exposure

Superannuation funds are restricted by sector allocation requirements or comparison with performance benchmarks, such as in the Your Future, Your Super performance test. However, there are structural differences between the oil market and other energy subsectors that make it hard for institutional investors to substitute their energy sector exposure into renewable energy equity (Ameli et al., 2020). Unlike the powerful and mature oil market whose standardised commodity has enjoyed historic support of government finances, the renewable energy industry is localised and immature, with differentiated products produced by small companies that do not meet minimum market capitalisation criteria, liquidity or volume trading limits for large investors. Further, the young companies operating in emerging and uncertain sectors create risks that reduce their feasibility for institutional investment. Renewable energy operating models may also influence investor interest. Ameli et al. (2021) explains the revenue risk of floating feed-in tariffs compared with fixed-price tariffs. These issues are problematic for investors requiring a sufficient allocation to energy equities.

"***On the one hand, you have a government saying we should all be good citizens. And on the other hand, you have a benchmark by which superannuation funds are measured. And the benchmarks are all at this point in time, inclusive of many things that are non-ESG…that would include fossil fuels, etc. …I would not want to take that basis risk. So, in very simple terms, every single ESG fund in the country has lost in an opportunistic sense a lot of money for its members, because energy prices have risen, and they didn't have any energy stocks. Now, that's a very simplistic argument to just measure, but at the moment, you have a government that measures the performance of the index with energy stocks, but those people who took the decision to be ex. energy are losing and will be treated harshly accordingly when they should be congratulated. "*** – Research participant

Regulatory Barriers to Climate Solutions Investment

Research participants were supportive of investment in climate solutions but were deterred by the risk of failing the YFYS performance test.

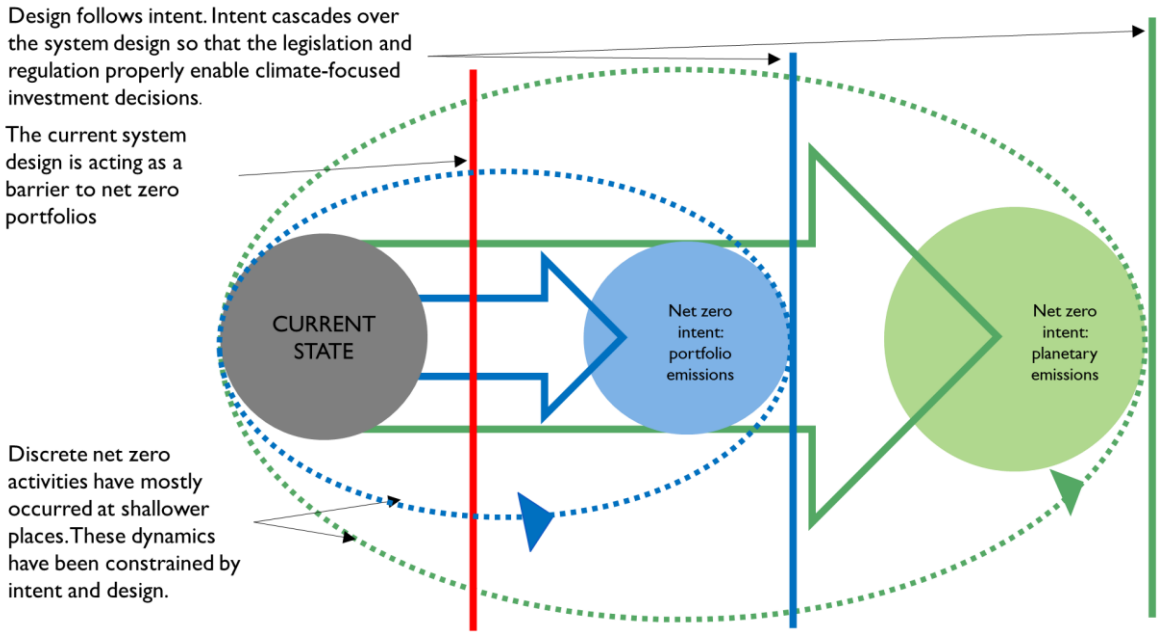
"There's an APRA performance test that you may have heard about. And I think that that's not allowing a fast tilt of a portfolio. It is allowing a steady, risk-budgeted approach to

portfolio transition. So, a solution would be having a higher risk budget that is not necessarily correlated with the budgets in the performance test." – Research participant

The Australian Government (2024b, p. 8) review into the YFYS performance test found evidence of the unintended regulatory obstacle. Trustees felt the test incentivised passive benchmark hugging and were "*discouraging investment in assets that are not well-represented in the benchmark indices, including emerging asset classes such as those associated with the climate and energy transition.*"

The Places to Intervene model by Meadows (1999) can be used to explain the design of the net zero superannuation system. This is shown diagrammatically in Figure 22.

Figure 22 Superannuation System Design Responds to Intent



In 'places to intervene', Meadows (1999) explains that intent is the strongest driver of system change. The inner most arrow in the diagram, coloured blue, represents a net zero transition according to a portfolio emissions interpretation. Whereas the outer arrow, coloured green, shows a planetary emissions intent. The superannuation system is controlled by the Australian Government through legislation and regulation. The 'intent', of the Australian Government, is the critical leverage point to the sectors' transition.

Abson et al. (2017) argues that realms of leverage are interacting and that deeper places constrain shallower realms. Similarly, intent informs perspectives of fiduciary duty and materiality, as examined in 2.5. The portfolio emissions interpretation of net zero requires fiduciaries to address financial materiality. Whilst the planetary emissions interpretation of

duty is global impact materiality. In the diagram, the intent constrains the design and dynamics of the system. As the intent of net zero planetary emissions is greater, the design and dynamics expand.

The red vertical line in the diagram shows how the existing system design has acted as a barrier, limiting superannuation portfolios from climate-focused investment, and reaching to net zero. The current system design is built on an intent that is inconsistent with the Government's net zero ambition as stated in the Climate Change Act 2022. The Australian Government has acknowledged the financially material risk of climate change to superannuation portfolios and to financial stability. They have expressed the national importance of reaching net zero by 2050 in the 2022 Climate Change Act, and have indicated the need for private sector investment in order to achieve this goal. However, net zero intent has not been contextualised for superannuation. Of particular note, is the legislated objective of superannuation, which remains undefined in relation to sustainability and net zero outcomes.

Climate Solutions Targets

In addition to the regulatory constraints, investors are concerned about other factors that counteract climate solution investment. These include policy uncertainty, illiquidity of assets and investment risk. Research participants referred to the often longer payoffs and less attractive risk-reward profile of climate solutions compared to other investment opportunities. Some funds had self-nominated a 'climate solutions' target. Their allocation was low so as not to alter the risk-return settings of the portfolio or their YFYS performance.

"We have a 1% allocation to climate investments... That allows us to invest in investments that don't fit within the existing risk-return profiles of our existing portfolios, but creates learning opportunities for the teams…there is a risk if the allocation is really large and if it wasn't as successful returns-wise as other investments, that it could impact how we're performing in Your Future, Your Super." – Research participant

In a survey of twenty-five superannuation funds, Investor Group on Climate Change (2023) found that 28% have adopted a defined climate solutions investment target. Some funds stipulate a climate solutions allocation internally. However, IGCC is supportive of funds that have quantified their climate solutions allocation publicly and encourage them to report annually on their progress. Most commonly used frameworks encourage investors to set climate solutions investment targets (PAII, 2024; UNEP FI & PRI, 2024b). It is recommended that investment is focused on parts of the portfolio where the greatest climate impact can be

achieved (SBTi, 2023a). According to Corbell et al. (2018), the Australian superannuation sector could finance Australia's complete transition to renewable energy by 2030 with the use of just 7.7% of superannuation savings. Investment can be prioritised in energy-intensive sectors such as grid and renewable energy infrastructure, automotive, steel, cement and chemicals (SBTi, 2023a; UNEP FI & PRI, 2024a).

It is believed that asset owners, such as superannuation funds, are the group best positioned to increase climate solutions investment through unlisted funds and direct investment (OECD, 2020). Caldecott et al. (2024) caution that real economy impact requires more than just holding green assets. Instead, they find that institutional investors achieve the greatest influence when they affect a firm's cost of, and access to capital, as well as their stewardship practices on corporate practice. Their study found that loans offer the most impact potential across all three dimensions. As discussed in 2.7.5, lenders are now willing to accept a lower return to encourage climate outcomes and can encourage these further with an SLL overlay. Caldecott et al. (2024) reason that impact is especially strong where the pool of lenders is smaller and where firms are most reliant on that financing source. Their analysis provides insights across other asset classes to understand the enabling factors for the greatest climate impact. Their findings are useful for the implementation of net zero superannuation portfolios through their SAA but are also directly relevant given the increase in internalisation of asset management.

A powerful lever would be a regulatory mandate as proposed by Stewart (2020) to increase capital allocation in a Canadian context by mandating a climate solution target proportionate to assets under management. Caldecott (2022a) also argues that climate targets, alongside transition plans, must be mandated for financial institutions by governments to rapidly scale progress on climate outcomes.

Guidance for investment in climate solutions is provided by the interest groups and is found in Table 18 in Appendix H.

Incentives for Climate Solutions Capital

The Australian Government (2023e) has clarified the need for private investment to finance Australia's transition to net zero. "*It is important that financial markets are well placed to finance this transition and therefore support the Government's emissions reductions target*" (Australian Government, 2023e, p. 4). Many participants emphasised that investors were willing to provide capital but were limited without government action for incentivising and de-risking climate solutions. Governments can attract capital through projects and initiatives such

as securitised infrastructure vehicles to increase investor appeal (OECD, 2020). Public-private partnerships are important to encourage and de-risk investment. Caldecott (2022b) urged Governments to introduce sustainability-linked loans using an ESG score KPI into all government stimulus to incentivise transition finance. This efficient idea has the potential to rapidly align finance with environmental and social outcomes.

"We have more conversations about the barriers, the inability to invest domestically in climate investments. " -Research participant

"I think that it's really now up to governments and regulators to be creating the right policy frameworks, the right policy settings to be able to take us to the next level and turbocharge things...I think investors have signalled that they will invest under the right conditions."

-Research participant

"I think we actually need to have a larger drive towards investment in solutions and that includes adaptation…private markets can try to go there, but without government incentives, it will be very hard to have investments being driven and pushed in those areas that we require to achieve net zero by 2050." – Research participant

The Clean Energy Finance Corporation (CEFC) aims to attract and invest private capital on behalf of the Australian government. It is used for investment in the "*clean energy sector and to facilitate the achievement of Australia's greenhouse gas emissions reduction targets*"(Commonwealth of Australia, 2023a). The Investment Mandate 2023 stipulates the government's expectations of how the CEFC board will invest funds and the minimum rates of return it should target across its various funds. One of the ways it uses and attracts capital is through its Clean Energy Innovation Fund. The CEFC will provide up to 200 million AUD, and seek private investment, in emerging research and development projects that are not yet commercially viable (Commonwealth of Australia, 2023a). Hydrogen-powered electricity is an example of an early-stage industry needing private investment (IIGCC, 2023a). Superannuation funds have provided significant capital and co-invested alongside the CEFC (CEFC, 2023a, 2023b, 2023c). The rates of return and level of allocated investment are examples of system dynamics that can be easily adjusted but are constrained by the system intent of net zero and design.

Deglobalisation and National Comparative Advantage

The research participants remarked on the US Inflation Reduction Act that improved the risk-adjusted return settings for climate solutions and attracted Australian investment. Their

comments should be considered in the context of rising government intervention, 'deglobalisation' and economic nationalism in the transition to net zero (Bordoff & O'Sullivan, 2022). The participants noted the need for domestic governments to increase capital flows to climate solutions in Australia by capitalising on Australia's opportunities for comparative advantage and ambition to become a green superpower. It should be noted that from on taking office President Trump revoked the Inflation Reduction Act and a suite of other climate policies established by the former Biden Administration (The White House, 2025b).

"One of the biggest things that we're seeing is the IRA in the US. So, I think the US is taking the carrot approach. And obviously we're seeing more investment going offshore. That's not necessarily good for Australia…I think we can be in the fortunate position that we will still be in a great mining country and just mine different things. And people will want different things. And if we can help the world decarbonise that's great. But yes, we need to understand that mining is still mining. There's still emissions. There are still problems that come along with digging things up from the from the ground". – Research participant

Australian Government Incentives

The thesis interviews were conducted prior to the 2024 Federal Budget that included planning and funding for 'Future Made in Australia' (Australian Government, 2024e, 2024h). The policy outlines a suite of concessions, incentives and other measures to scale private capital. The Australian Government has highlighted the net zero transition as an opportunity to capitalise on national economic interests. So as to, *"secure Australia's place in a changing global economic and strategic landscape*" (Australian Government, 2024e). The strategy aims to attract investment and profit from renewable energy and critical minerals production (Parliament of Australia, 2023a, p. 3).

"apart from being a supplier of natural resources, or as a green energy superpower… certainly the Australian finance sector funds, the asset managers, the banks and so on, can see the way forward to becoming a green finance superpower. Because the services side of this, the matching of capital to technology, to opportunity, to all the rest of it, is only going to get bigger." – Research participant

The Future Made in Australia strategy acknowledged the current challenges for institutional investment in climate solutions including project approval delays, the lack of carbon pricing and early-stage investment risk. It seeks to overcome these issues with ideas such as a "front door" to streamline and facilitate investment. The plan also sets out a strategy to scale and attract private funding for five net zero industries. These have been selected for national

comparative advantage and include renewable hydrogen, green metals and low-carbon liquid fuels.

There is a strong overlap between the Future Made in Australia Treasury National Interest Framework paper and the ideas proposed by the Superpower Institute (Sims, 2024). It is interesting to note that the Superpower Institute raises the problematic issue of a lack of carbon pricing and recommended the adoption of a Carbon Solutions Levy (CSL) on fossil fuel extraction sites and fossil fuel imports. The CSL was not included in the Future Made in Australia plan. As discussed in 2.3 the politics of climate change have been heavily debated in Australia and carbon pricing has been especially contentious. The political intent and feedback loop described in 4.1.2 shows how support for net zero outcomes can accelerate. Yet, political support for net zero has not reached the level where carbon pricing has been reinstated or a CSL adopted. Other nations that have carbon pricing have sought fair methods for global trade. Carbon border taxes are supported by the European Commission and under the former Biden Administration were being considered by the US. These would have financial implications for Australian companies in the current policy environment as 70% of Australian trade is with nations such as China, S. Korea, Japan and the USA each of whom made large decarbonisation announcements in 2021 (Investor Group on Climate Change, 2020).

Sovereign Bond Investment

Sovereign bond issuances are another way that governments can attract private investment. By the end of December 2023 Climate Bonds Initiative (2024a) had enabled governments in 22 Developing and 28 Emerging markets to issue 486 billion USD in sovereign sustainability bonds, of which more than three-quarters were green bonds. Investor coalitions such as IIGCC (2024b) have urged investors to set sovereign bond targets.

"Governments hold the biggest economic, powerful areas. Investors are going to be hostage to what governments do and therefore should be encouraging governments go harder and faster. And then governments can better enable investors to utilise the tools that they've got to manage their exposure to the risks and opportunities they need to carve an orderly transition to net zero in their portfolio." -Research participant

The Australian Government (2023c, p. 2) developed a Green bond framework in December 2023. With the first green bond issue launched in June 2024 with 10-year maturity and an issuance size of 7 billion, further Australian green bonds with other maturities are expected to follow (Australian Government, 2024i). This progress occurred after the thesis interviews were

conducted. The bonds, "*mobilise additional climate-aligned capital, deepen sustainable finance markets and signal the Government's commitment to climate, energy and other environmental goals*." The emphasis of the use of proceeds will be Australian climate mitigation, adaptation and resilience. The framework also mentions the Australian Government goal to contribute to climate adaptation in developing countries. It is unclear what proportion of proceeds would be allocated to EMDE.

Sovereign bonds can focus on EMDE climate solutions exposure (IIGCC, 2024b; OECD, 2022b). Although many of the countries that would benefit most from this do not satisfy the investment criteria for inclusion in the universe of bonds (IIGCC, 2024b). Weak local regulation, lack of industry standards, unmet international credit rating criteria and regulatory delays in large projects can make these investments risky (OECD, 2022b). Improved standards-setting and international stock exchange listing can reduce the level of risk (OECD, 2022b). In order to improve data issues, a coalition of institutional investors including Ceres, AIGCC, IIGC, IIGCC, PRI and NZAOA, created an open-source database for Assessing Sovereign Climate-related Opportunities and Risks ASCOR (2024). As at May 2024, the coverage includes 25 countries coverage expected to expand. Other country-level climate-related policy data is available from organisations such as Climate Action Tracker (2024) covering 39 countries as at May 2024 and CCPI (2024) tracking 63 countries as at May 2024

Investment in Climate Solutions in Emerging Markets and Developing Economies (EMDE)

Only the research participants in the planetary emissions group discussed the essential need for investment in climate solutions in emerging markets. They emphasised that emissions permeated national boundaries and therefore climate solutions needed to include EMDE. Participants commented on the importance of overcoming challenging investment conditions to facilitate investment in EMDE.

"We might build all the things that we need here in Australia and in Europe, we will meet our targets, etc. But if that doesn't happen in India, if that doesn't happen in a lot of the developing world, well, the climate problem is not solved." -Research participant

It is estimated that climate solutions in EMDE will need 94.8 trillion USD to transition to net zero by 2050 (Standard Chartered, 2023). The intergovernmental central bank organisation NGFS (2023c) believe that climate mitigation investment in EMDE will require 80-90% private investor funding but to date, just 4% of global climate investment funding has come from the private sector. GFANZ (2021) support a 7x increase in EMDE private capital. Therefore there is

a significant discrepancy between the EMDE climate solutions investment sought by NGFS versus the amount considered feasible by GFANZ. A key consideration for climate solutions investment is ensuring it has been sufficiently de-risked, especially through the use of public-private partnerships, guarantees, grants, and first loss capital from development banks and agencies (The Investor Agenda, 2023b).

The proportion of Australian superannuation funds with climate investments in EMDE is low. Investor Group on Climate Change (2023) suggests the potential for direct superannuation fund investment in blended finance structures including alongside the Australian Government's Emerging Markets Impact Investment Fund. Andersen et al. (2019) explain that blended finance offers 'additionality', where the investment would not otherwise be possible without the funding or the technical capability. Further, the project provides sustainable development benefits that justify the use of public funds or even concessions to entice investors with improved risk-adjusted financial returns.

However, many research participants commented that investment in EMDE climate solutions was limited or outside of scope for them. The investable EMDE universe is discussed in section 4.3.3.

"The inequity that a number of non-OECD countries are going to experience because of climate change is devastating. But I think we are so bound by our fiduciary duty, that it's going to be really hard for huge amounts of investment dollars to flow too far outside the OECD when we're thinking about climate solutions." -Research participant

Industry interest groups including PRI believe that the grave risk of climate change requires the finance sector to take further responsibility in investing in solutions. GFANZ also called for greater attention and development of standards related to the just transition, referring to climate-vulnerable populations and the relationship with UN's Sustainable Development Goals. IIGCC (2024b) advocate for principles of fair share and indicators to operationalise them.

Yet, there is a lack of clarity on investment in EMDE climate solutions in relation to fiduciary duty (NGFS, 2023c). In order to understand the legal view PRI engaged Freshfields Bruckhaus Deringer (2021) to evaluate the extent to which institutional investors should and can 'invest for social impact'. Freshfields Bruckhaus Deringer (2021, p. 164), found variance across jurisdictions and investor classifications but noted that legislation for APRA-regulated funds "*restricts their capacity to design and offer investment options that have objectives other than financial return*." Amundi's global pension survey found that about a third of pension funds

globally were investing for impact and had an average 5% portfolio allocation growing at a CAGR of 5% (Rajan, 2023).

There is no clearer example of divergent judgement on net zero intent than investment in EMDE climate solutions. A planetary emissions interpretation of net zero cannot be achieved without that investment. Superannuation portfolio investments do not typically include EMDE climate solutions as they do not satisfy risk-return criteria. A minor EMDE climate solutions target will not significantly affect the portfolio returns and is undoubtedly beneficial for mitigation and adaptation. However, scaling adequate capital to reduce global emissions requires the net zero intent of a system to be synonymous with planetary emissions. That capital could be scaled through the combination of a sizeable impact-motivated allocation to EMDE climate solutions, or government climate incentivises or regulatory requirements. Capital for EMDE climate solutions can also be equated to the SSP1: Sustainability. There, economic growth in advanced economies is slower to support equality and growth in developing economies (O'Neill et al., 2017).

This part revealed participant consensus on existing regulation acting as a barrier to climate solutions investment. This view was also supported by submissions to government consultation on that topic. Participants commented on the need for climate solutions investment, some also stressed the need for these in EMDE, but emphasised the challenge of investment without sufficient derisking and incentives. The Australian SFT and Future Made in Australia strategy shows that national economic interests are prioritised in climate solutions budgets. The document affords little attention to global decarbonisation beyond the justification that Australia's green superpower ambition is beneficial to supplying critical minerals and materials for global decarbonisation.

4.3.5. Neutralisation and Credits

This section builds on 2.7.6 and explores the use of carbon credits in net zero portfolios.

Entities may use credits to offset their scope 1,2 and 3 emissions in reaching their net zero commitment. Opinion on carbon neutralisation and credits depends greatly on how they are being used. Offsets are either used in lieu of decarbonisation, or to counter remaining residual emissions. The Oxford offsetting principles recommend that entities regularly update their processes to ensure they are using the most current technology to reduce the most possible emissions (Axelsson, 2024). Offset of only residual, hard-to-abate emissions is encouraged by many of the net zero frameworks (GFANZ, 2022b; The Investor Agenda, 2023b). As discussed in 2.7, the use of offsets instead of feasible emissions reduction is unsustainable and likened to

net zero greenwashing (SBTi, 2023a). Most research participants referred to the excess use of offsets to reach a net zero goal as a disingenuous accounting calculation. Judgements on the acceptable use of offsets are a reflection of net zero intent. The use of offsets for net zero trickery affirms the need for multiple metrics to measure net zero progress. Some participants indicated extensive use of offsetting and queried how to interpret the use of offsets by investee companies.

"When people use things like, I will buy carbon offsets to achieve our net zero commitment. They haven't actually shifted anything. They've just done a series of accounting tricks to look good… and a willingness to turn a blind eye to junk credits." – Research participant

"There's a lot of scepticism around offsets…We're really trying to encourage more credibility in everyone's approaches because the endgame is actually real-world emissions reductions - not just having columns in your balance sheet that equal zero. It's actually got to devolve into real things happening in the economy. Not just for reporting wizardry."

– Research participant

"If you take into account our equities, portfolios and emissions, and our investment strategy, particularly in the unlisted space, we do have a lot of offsetting. There are carbon credits that are technically associated with that stuff. So, it depends on what you consider in and out of scope, of the [portfolio emissions] accounting method." – Research participant

Disclosure of emissions measurement, CO2 conversion, verification and the use of credits ensures transparency (Axelsson, 2024). To provide clarity for stakeholders, most of the net zero frameworks advised that offsets should be excluded from portfolio emissions calculations until the investee company has reached the deep decarbonisation level stipulated in the corporate net zero standard (SBTi, 2023b). A summary of the guidance on offsets and neutralisation by key net zero frameworks is found in Table 20 in Appendix H. An additional use of offsets is to demonstrate climate integrity in addition to a net zero goal, termed in the Oxford offsetting principles as, 'beyond value chain mitigation' (Axelsson, 2024). The use of voluntary carbon removal is needed to counteract net zero overshoot, which is anticipated by an increasing number of stakeholders (Andreoni et al., 2024; Axelsson, 2024; Fulton, 2023).

"There will be a place for offsets in the future… they should be absolutely a last resort - when you've done everything within your means to make real world emissions, reductions. But

yeah, there will be some things that cannot be reduced, and that is when they are needed."

– Research participant

"I think funds have to understand that we are going to overshoot on current settings, even with an acceleration in policy. There is going to be a need for some kind of offsets… they're not going to be able to run away from the implications of overshoot, and then the use of offsets. And then the debates about the various forms of offsets within that. So, getting prepared for that because there's going to be significant debate within climate and environmental and civil society over this issue. And they're not going to be able to hide from it."

– Research participant

In addition to debates on their over-use, offsets have been critiqued for a lack in credibility in their creation (Climate Integrity, 2024). As discussed in 2.7, past offsetting practices have been misleading and sullied their reputation. Offsets can be achieved as part of an entity's operations or through the purchase of credible offsets. If the carbon avoidance or removal project would have occurred for a separate reason, such as regulation, then it cannot be considered to be a legitimate offset (Axelsson, 2024). The Oxford offsetting principles refer to the urgent need to increase carbon removal credits. Carbon removal credits use negative emissions technologies (NETS), such as CCUS and nature-based solutions. Yet, NETS are not fully developed or scalable. Overreliance on offsets such as CCUS and natural carbon sinks alongside insufficient and delayed fossil fuel reduction are a grave concern that has prompted the release of a statement seeking 'Real Zero' (Lethal Humidity Global Council, 2024b). The statement, signed by renowned climate scientists, argues that a net zero commitment is not enough and businesses must fully remove fossil fuels from operations. Net Zero Australia (2023) comments that there are no viable permanent or negative emissions technology alternatives to CCUS and seeks Australian government subsidies and other large-scale assistance to attract private capital for these. Some of the research participants also indicated their concern with CCUS technology,

"One of my most concerning aspects of this, is the reliance on carbon capture and storage. I think the best solution is reduction. We just need to reduce emissions."

– Research participant

Noting that the technological readiness level of more than half of known carbon dioxide removal using conventional (using natural carbon sinks) and novel (using technological solutions) methods are unproven and hindered by economic and geophysical constraints

Caldecott and Johnstone (2024) calls for rapid policy attention and investment into research, development and innovation. They argue that a carbon removal budget is needed to make transparent the amount of CDR that will be required to reach global decarbonisation goals and which are already assumed in IPCC scenarios. The method would require the determination of a temperature goal alongside estimation of region and sector dependence on CDR to achieve it. They emphasise the mitigation hierarchy where reduction is the first step but argue that residual emissions are poorly quantified and the carbon budget process demonstrates "*our ability to reduce CO2 is far less constrained than our ability to remove it*" (Caldecott & Johnstone, 2024, p. 3).

The carbon removal budget would importantly enable the currently unmanaged and unconstrained use of CDR to be better defined, negotiated and allocated in net zero transition planning. Currently, carbon removals are conceptualised to meet demand, yet Climate Integrity (2024) assert that instead they should be understood as a finite supply, limited to avoid causing socio-environmental harm. They call for the Australian Government to develop clear targets and guidelines for their national use.

As with remaining carbon emissions budgets, decisions are politically charged with competing views on historic emissions responsibility and fair share principles (Caldecott, 2018; Caldecott & Johnstone, 2024). Depending on the economic conditions under which CDRs are developed and regulated these could add to global inequality (Andreoni et al., 2024). Yang et al. (2023) analyse countries' physical conditions and apply equity principles to calculate their fair carbon dioxide removal liability and storage capacity. Applying these factors in their fair share model, they found a significant gap, where about 40% of countries with do not have insufficient geological capacity to meet their assigned liability using Afforestation, Bioenergy with Carbon Capture and Storage (BECCS) technology.

Efforts have also been taken to improve the integrity of carbon credits and address the lack of agreement on issues such as appropriate use of credits, accounting for credits purchased by investee entities, credit integrity, registration of credits, insufficient supply of credits (GFANZ, 2022d). Voluntary stakeholder-led ICVCM (2024) developed an assessment framework and a set of principles to indicate voluntary carbon offset credibility with;

- Transparent, effective governance and independently assured verification
- Additionality, permanence and robust accounting
- Impactful for sustainability and decarbonisation.

ICVCM (2024, p. 7) will be launching Core Carbon Principles (CCP)-labelled credits by the end of 2024 and propose the use of voluntary credits, "*as a complement – not a substitute – to rapid emissions reductions within their value chains*." Non-profit organisation VCMI (2023, p. 5), was established alongside ICVCM in order to develop a code of practice for the credible use of carbon credits, "*alongside broader decarbonization efforts*". They established a Carbon Integrity Claims system to provide evidence of their genuine credit use. To achieve one of their Claim badges the entity must have and demonstrate, progress on a net zero goal with interim targets and also prove Paris-aligned policy advocacy. According to Axelsson (2024) most current offsetting lacks integrity.

The determinations of VCMI and ICVCM imply a planetary emissions interpretation of net zero where, offsets are additional and provided in the manner of an impact investment. None of the participants referred to the intention to purchase credits for beyond value chain mitigation. As identified by Freshfields Bruckhaus Deringer (2021) YFYS and BFID, limits the scale to which superannuation funds can invest without a financial first rationale.

Discussion on neutralisation and credits is ultimately a dialogue about net zero intent. This part demonstrated that integrity measures improve the credible use of credits but the deeper issue is deeming when use is appropriate. Some participants indicated concern over their use in lieu of decarbonisation. Efforts have been made to improve VCMs and develop verification processes although this happened after the period when interviews took place. The use of voluntary credits outside the portfolio value chain is likened to impact investment and does not meet BFID criteria.

Analysis of superannuation fund net zero implementation in 4.3 revealed the critical role of SFTs and sector pathways. Participants indicated uncertainty and were seeking policy guidance on climate solutions investment and emissions reduction especially fossil fuel phase out, CCUS and other topics without consensus or straight forward answers. Given the dynamic nature of the topic, work on the SFT at the time of the interviews was not well progressed. Climate reporting and ESG data and ratings are similarly core to net zero implementation and are strongly affected by definition of materiality. Fiduciary duty was also found to be the enabler to the flow of capital to climate solutions. Unless government incentives sufficiently derisked these investments they did not meet risk-adjusted criteria. Capital flow to EMDEs and VCM credits were out of scope due to existing regulatory settings.

4.4. Influencing Net Zero: Stewardship and Advocacy

The previous section analysed the elements that superannuation funds need to implement to reach net zero portfolios. 4.4 is an analysis of superannuation fund net zero influence, the scope of elements that are within and outside decision maker control and the methods that can be used to affect these. There is a hierarchy of ownership and power – asset owners, including superannuation funds, are at the top of that chain and their pressure demands action from asset managers who subsequently put pressure on companies (Eccles, 2016). A powerful part of stewardship practice is collaborative engagement and the role for industry interest groups is significant. A further aspect of influence is lobbying to governments and regulators.

4.4.1. Direct Stewardship

The next discussion covers stewardship, a valuable tool that asset owners can use to hold their investee entities to account and influence their transition to net zero.

Superannuation funds can use their power in proxy voting decisions, filing shareholder resolutions, board appointments, litigation, as well as the credible threat of reputational damage or even termination of contract or ownership if the entity were not meeting expectations. The leverage of asset owners over external asset managers is considerable and their corporate engagement practices extend over those agreements too.

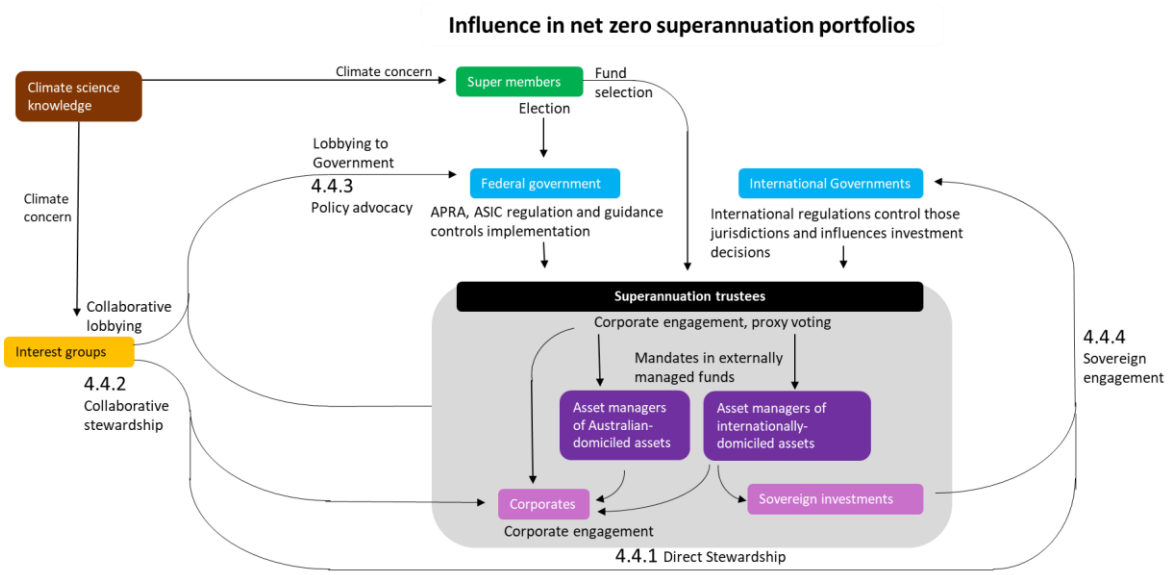
Table 21 in Appendix H compares the corporate engagement recommendations of five-commonly used net zero frameworks. They explain that stewardship practices aim to align investee companies with net zero 1.5 low overshoot pathways. They recommend a process where funds first influence their investee entities to commit, then monitor and support them in their plans to meet their disclosed targets. Funds should also use their proxy vote in alignment to net zero and disclose their voting decisions. The frameworks also suggest that superannuation funds create and disclose a corporate engagement policy including engagement priorities and targets within their portfolio and time-bound escalation steps when their influence does not affect change in the investee entity.

"They've got the expertise to vote their shares. The proxy advisers advise them and that's been a big shift, too, because it's effectively armed them. The owners are now exercising greater scrutiny over the operations of the businesses they own. And that's very important in the ESG environment." -Research participant

Figure 23 is an influence diagram, that shows the cascading flow of influence across the system. Superannuation trustees are at the top of the investment chain (shaded grey). Interest

groups play an amplifying role in supporting collaborative lobbying and engagement. Control by members and governments outside of the shaded box is also a critical influence on net zero superannuation portfolios. The discussion that follows examines the system of influence as numbered.

Figure 23. Influence in Net Zero Superannuation Portfolios



As captured in the quote below, there is vast complexity in stewardship for net zero superannuation portfolios. Superannuation funds are centrally positioned to influence systems change.

"There are a lot of intersecting levers that need to be put into play for this to work effectively in actually affecting systems-wide change…for example, facilitating collaboration amongst investors in how they engage with companies and businesses on the transition to net zero. Also facilitating collaboration between investors…And to also encourage Governments to increase their ambition in that regard." – Research participant.

Research participants were all involved in stewardship activities at some level. Stewardship codes in Australia have been developed by interest groups such as ACSI (2024) who has twelve superannuation fund signatories to their voluntary stewardship code. The code requires funds to disclose their stewardship and voting policies and direct and collaborative activities and encourages engagement extended to asset owners and in public advocacy. The UK's Financial Reporting Council (2020) have provided a stewardship code with principles for asset owners and managers that include the requirement to report on their direct and collaborative engagement approach and outcomes, and any necessary escalation actions and outcomes.

Superannuation funds have called for Australian regulatory guidance to improve understanding of stewardship expectation and efficacy (Australian Retirement Trust, 2023b; Aware super, 2023b; Future Super, 2023; HESTA, 2023b; PRI, 2023e).

There was a notable distinction between the way 'planetary emissions' and 'portfolio commitment' participants considered stewardship. Research participants in the 'planetary emissions' group indicated a stronger duty and took the view that superannuation funds needed to exert more forceful engagement over their holdings. Similarly, global interest group PRI refer to the need for an enhanced and urgent stewardship and calls on superannuation funds as universal investors to opt into their 'active ownership 2.0' programme for real-world climate outcomes (Peres da Costa & Chandler, 2019). Likewise, CA100+ (2023) released phase 2 goal enhancements and stressed the need for urgent action on climate change. Their enhancements have an emphasis on implementation beyond simple emissions reduction.

The planetary emissions participants also discussed the importance of engagement with time-bound consequences to deliver more rapid and significant climate engagement outcomes. To satisfy their criteria SBTi et al. (2023) require companies and superannuation funds to set engagement targets for at least 2/3 of their scope three emissions and investee companies that must meet within five years. Their engagement aim is to have whole portfolio alignment to their own net zero goal (SBTi, 2022). The need for effective stewardship with oil and gas companies was also a recurring theme across planetary emissions participants. Caldecott (2019) comments that large listed oil and gas companies have been a focus for stewardship activities, yet they are difficult to transition and have tactical investor relations teams. Fossil fuel phase-out is discussed in section 4.3.2.

"A lot of funds will say that engagement doesn't happen overnight, and these things take time, but, like the reality is, we don't have the time when it comes to climate change. And the Paris Agreement was signed nearly 8 years ago now, and so companies in their portfolios have had plenty of time to demonstrate that they're willing and able to change."

– Research participant

"They need to stop taking a knife to a gunfight and start working out [that] engagement isn't enough. If we want that capex slowed, if we want that lobbying stopped, well, we have to start not just having a replacement of a couple of people on the board, and leaving it at that … no more tea and bikkies on the engagement front with the oil & gas sector."

– Research participant

Whereas other research participants were sympathetic to the extent and time required by companies to transition. Their sentiments align with a sample of Australian investors who were surveyed by UN PRI to assess their consideration of active stewardship (House et al., 2023). They found that the investors avoided forceful engagement, shareholder resolutions and proxy voting in order to maintain 'collegiate relationships' and not antagonise portfolio companies. Further, they noted that investors felt their ability to take forceful action was constrained by Australian regulatory settings.

"We don't necessarily expect all companies to have the answers for everything today… a lot of people seem to think it's a twelve-month process, and there's bright lines that you either go through or you don't. And that's not it…If a company requires quite a fundamental change, their industry faces a structural decline. What do you actually expect from them? I suppose where I'm going with that is that if I think of an oil and gas company, a lot of the time, what you might be pushing them towards, can't be done in the sense that it's just not a commercially viable option for them to do today…new energy is not necessarily economic or commercially viable. There are no customers for it. So, I think there is some uncertainty around what we should expect from those companies in this decade. " – Research participant

The complexity of net zero transition from the company perspective was identified by all research participants who commented on several issues. They referred to the difficulties that companies found in getting investor support for significant capital investment towards climate solutions when the 'role' of the company in the superannuation portfolio was to deliver yield.

"They want the investors to say, 'we realise that your payout ratio is going to go from 80% of cash flow as dividends, to now it's 40%. But we're fine. We support that because we can see that instead of share price growth, your returns will actually be higher in the longer term'... these investors do hold growth stocks too, but a lot of these big industrial stocks, they're holding more for yield because they have been yield-oriented investments in the past."

– Research participant

Initial emissions reductions were simpler for entities but increased decarbonisation requires greater investment (NZAOA, 2022b). This has led to tension as new climate solutions expenditure affects short-term profits. There is a body of evidence from companies that asset owners and managers are engaging with them for investment in climate resilience, which unavoidably requires capital expenditure and they are simultaneously pressuring them to sustain short-term dividends (AICD & Pollination, 2024; WEF, 2022). Demand for low-carbon

products would increase scale and lower prices but these have not been achieved as flow-on prices have reduced their appeal and therefore caused a reluctance to invest in these (AICD & Pollination, 2024).

Corporate engagement has been effective in increasing climate awareness and commitments for some investee companies, especially listed companies, however, it's limitations have also been recognised and have led to an evolution in engagement practices (NZAOA, 2022a; PRI, 2023e).The engagement conversations were often impeded by the realisation that certain issues were common in a sector but were outside the scope of a single company's control. Therefore there has been a shift to looking for solutions by sectors and value chains (NZAOA, 2022b).

Some examples of sector engagement work bringing together investors, companies and sector experts is across the food and beverage food chain (Climate Action 100+ et al., 2021) and net zero steel production steel (IIGCC & Climate Action 100+, 2021). The former identified emissions sources from production to consumption across their value chain and found that fertilisation emissions, methane emissions and land use change, as well as developed economy demand for Indonesian and Brazilian palm oil and soy were key challenges. Most companies in the sector need to address these issues to meet their net zero goals. Therefore, collaborative efforts on the use of fertilizer, no deforestation and encouraging diet shift away from high-emissions ingredients can be more effective than direct engagement with a single company. The latter provided detailed guidance for investors needing practical engagement actions and expectations such as finance for lower emissions production (hydrogen-based direct reduction iron ore and scrap production methods), the increased use of scrap in steel-making, as well as carbon capture and storage utilisation. Asset owners can also influence sector trends through deeper understanding of common challenges.

Another recognised corporate engagement challenge has been the fact that company commitments are voluntary and without policy settings across all markets, they can be at a competitive disadvantage. For example, company *"directors noted that in highly competitive industries, an effective shadow price on carbon can lead to decisions which put the company at significant economic disadvantage. This is particularly the case where companies compete against imports for the same product*."(AICD & Pollination, 2024, p. 43). Certain sector-wide changes such as market failures or fragmentation also require regulation (The Investor Agenda, 2023b) and lobbying for government policy is discussed in section 4.4.3.

Most corporate engagement has been centred on publicly listed companies, however this is expanding to other asset classes and stakeholders where prospects differ (NZAOA, 2022b). An opportunity for bondholders is engagement directly with firm management at investor roadshows and alongside other investors (Caldecott et al., 2024). Sovereign bond engagement is discussed in 4.4.3. Engagement with other financial sector participants, including data providers on aligning market tools, data and advice to net zero is encouraged (PAII, 2024). Direct real estate investors could engage with tenants to improve energy use, retrofit buildings or take other net zero-aligned actions (PAII, 2024). Another strong level of engagement can be achieved in smaller, less liquid asset classes such as private equity and private credit (Caldecott, 2019; Caldecott et al., 2024). The extent of this influence depends on the investment structure and their role. Venture capital investments and private equity buyouts where their substantial holding affords them the most power over corporate practice (Caldecott et al., 2024). PAII (2024, p. 56) defines the investor's 'band of influence' noting that a sole-lending general partner or lead debt arranger has the most control. A limited partner who invests at launch also has moderate control, whereas minority partners usually have less influence. Some research participants described the way that they had used that power for climate-aware board appointments,

"Another dimension that's really important in the unlisted space is the governance mechanisms that we have, as well. So, as part of the governance rights as direct investors in the large property and infrastructure assets, we get the ability to appoint a director to the [investee company] board. And it's very important that once through the selection process, the individual is very much aware and aligned to how we look at responsible investment as part of the process. So, they can take that mindset and that concept into the boardroom"

– Research participant

Engagement or Divestment

As discussed in 4.3.2, there is debate about the decision to divest from or engage with fossil fuel companies (Ameli et al., 2020; Anthony & Ranina, 2021; Fink, 2022; Gocher & Australasian Centre for Corporate Responsibility, 2021; Pearce, 2021). Chevron, Exxon, BP and Shell are together accountable for 10% of all global emissions since 1965 (Taylor & Watts, 2019). Stewardship advocates say that divestment will not starve fossil fuel companies of capital, instead, it will just see a different ownership, one that lacks stewardship as a force for internal change (GFANZ, 2022d). An example of ineffective divestment is Rio Tinto, who sold their coal mines to Yancoal and Glencore, EMR Capital and Adaro Energy in 2018. However, all the mines

that were sold, remain operational (Gocher & Australasian Centre for Corporate Responsibility, 2021). Stewardship supporters believe rapid fossil fuel divestment by institutional investors without sufficient engagement and demand for change does not allow for a company to respond and support its transition to net zero. SBTi (2023b) Recommends that investors should phase out support for any projects or companies that are not transitioning according to those set criteria within two years. Engagement was favoured over divestment by the research participants in most instances. They reasoned that divestment removed their stewardship power and that the asset could be bought by an investor who was uninterested in climate change issues.

"Let's assume, we said, we'll disinvest from coal mines in Australia... Someone else would come and buy the asset at a knockdown price, probably have no particular concern about ESG, and they'd make the money. They'd make more money because they wouldn't at all care about these environmental ESG issues. And we would have sold our asset at a knockdown price, and we'd have no influence." – Research participant'

"We want to make sure that we are not shying away from making investments in hard-to-abate sectors. We want to be part of the transition. We want to be contributing to the transition. And we know that there are going to be some companies in our portfolio, and some companies that we may even buy between now and 2030, that will not be able to get that 45%, emissions intensity reduction. And probably won't be able to get to net zero by 2050, either. But we still want them to be part of our portfolio mix, because we want to be contributing to it. To the transition of that industry, company, sector, whatever it is."

– Research participant

"If the way you get to net zero is just by divesting the things that have the bad measurements, then you're just pushing the can down the road to somebody else. In other words, if you end up with a world where the regulated super funds, own all the green companies, and all the private investors own all the energy polluters, well, you haven't changed anything have you?" – Research participant

On the other hand, some participants took the view that a company in an 'unviable' industry posed a stranded asset risk and so they divested and/ or applied a thermal coal screen over their portfolio.

"***There is no amount of engagement you can do that changes an oil exploration company into something that is viable for the future. That business model is dead on its feet – it is not realistic anymore…in those situations, we think that actually, collective divestment is a really useful tool, both for social change, and signalling to regulators that they should start to move into this space and take action.***" – Research participant

Global divestment campaigns, run by climate interest groups such as 350, have been in place for more than a decade. The NGO, 350, is named for the amount of carbon dioxide parts per million (ppm) in the atmosphere that is needed for a safe liveable planet (350, 2022). As at January 2024, there are 423 ppm (NASA, 2024), a concerning 20% above the safe upper CO2 limit. According to 350 (2022) more than 1500 organisations valued at over $40 trillion have divested from fossil fuels, 12% of these are pension funds. Australian climate advocacy group, Market Forces (2020) identifies eight large super funds that divested from thermal coal mining. They also manage a database that helps superannuation members find the coal, oil and gas policy and investments disclosed by the largest Australian funds. The site also assists members in contacting their funds and lobbying for divestment. Market Forces (2022) also identifies 22 ASX300 companies that are high emitters in the campaign called, "*Tell your Super Fund to Get Your Money Out Of These Climate-Wrecking Companies*" (Market Forces, 2022). Advocacy organisations such as 350 and Market Forces put reputational pressure on superannuation funds to divest from fossil fuels and other high-emitting companies.

There was little correlation between participants' views on divestment and the grouping that reflected their net zero intent. The tension between divestment and engagement is essentially an argument over who is the beneficiary of the net zero goal. The Head of Responsible Investment at Aware Super agrees that a strategy relying only on divestment will not achieve global decarbonisation but emphasises that the fund's responsibility is to deliver member returns as their reason for divestment of fossil fuel companies, *"I think if everyone was to divest everything, no it's not going to contribute to real-world outcomes in terms of emissions reductions. But as an investor and looking at how we are going to achieve returns for members, we believe that there are some high-emitting companies that we don't want to own in terms of their long-term value, and we are long-term investors"*(McDonald, 2022). Gocher and Australasian Centre for Corporate Responsibility (2021) reported that none of the superannuation funds that divested from thermal coal in 2020 took the powerful step of signalling this to the companies in advance of their action and allowing for a response. On the other hand, Aware Super stated that they had already had "extensive engagement" with coal mining companies and were unable to announce their plans to divest from 60 companies

globally for commercial reasons (Anthony & Ranina, 2021). When Aware Super (2021) reported an emissions reduction of 45% across their listed equities they exceeded the target they set themselves in 2020. Even though Aware see divestment as their last step in engagement (Cox, 2022), their early exit from high-emission companies avoids the transition risk of stranded and/ or devalued assets. Conversely, an early exit from large energy companies is a deviation from the benchmark and a tracking risk if that sector rallies in the short term.

The decision to divest remains unclear and challenging for superannuation funds and further research would be useful to improve understanding. Two recent academic publications add to existing knowledge and would be interesting topics to explore further in an Australian context. An academic study by Zink (2024) published in 2024, provides insights into the voting and divestment practices of US investment funds. Signatories to Climate Action 100+ voted mostly in favour of climate-related shareholder proposals. However, membership to PRI showed no significant correlation with climate voting, except for those who joined PRI in its founding year, 2006. Zink suggests that PRI should consider stronger criteria and verification processes. Relatedly,

Table 3 revealed that 25 of the top fifty superannuation funds are PRI members and 8 of these did not have net zero commitments. In contrast 18 of the top fifty superannuation funds were Climate Action 100+ members and just one of those had not made a net zero commitment. Further research that also included other stewardship practices in addition to voting for shareholder proposals would help reveal the extent of greenwashing by signatories.

Filing shareholder proposals in Australia is more complicated than in the US and UK (PRI, 2023a; Sheehan, 2017). In Australia, a shareholder resolution is a constitutional decision that needs 75% of voters to agree for it to pass (Sheehan, 2017). By comparison in the US and UK resolutions can be non-binding but enable dialogue in the public domain and a vote of 50% in favour passes in the US and in some cases in the UK. PRI (2023a) comment on an alternative method that has been occasionally used to overcome the Australian legislative barrier. A binding resolution seeking to enable an ‘advisory resolution’ to be filed is accompanied by an advisory resolution on the climate issue. This enables public engagement but is a cumbersome process. It is infrequently used in Australia and still requires a high voting threshold for the advisory resolution to even be considered (Sheehan, 2017).

Zink (2024) found evidence that the largest US asset managers including J.P.Morgan, T.Rowe Price and Fidelity have gradually reduced their carbon exposure and increased their climate-

supportive voting since 2019. The findings relate to Australian superannuation fund investment where a growing proportion of assets are invested outside of Australia. Zink (2024) commented on the major limitation that the regression data did not include scope 3 emissions due to availability. A separate study by McDonnell (2024) evaluated the stewardship practices of the three largest US and EU Pension funds. Evidence showed that fossil fuel divestment had been used to remove the highest emitters from their portfolios due to pressure to meet their own net zero commitments. The study questioned the efficacy of ownership transfer but also contested the strength of the pension funds' engagement practices. McDonnell found that shareholder resolutions typically focused on corporate disclosure practices rather than meaningful or ambitious climate plans.

These recent studies suggest that fossil fuel investment stewardship is complex, uncertain and a fertile area for greenwashing.

Participants agreed on the significant influence of the superannuation sector and saw the importance of stewardship as part of a net zero goal. Stewardship was seen to be a viable way to demonstrate net zero commitment in contrast with certain climate solutions investments that were obstructed by regulation. Although given the resource-intensity of stewardship this practice was also limited by BFID. This section also showed that a systems thinking approach to stewardship is useful for understanding the sector-wide issues that are beyond the control of a single entity. Opinion on divestment and phase-out of fossil fuels is very divided across all participants and indicates the need for further research in that area.

4.4.2. Collaborative Stewardship

4.4.2 considers collaborative stewardship including the role of interest groups.

Participants stressed the resource-intensity of stewardship and the importance of interest groups for information-sharing on stewardship topics, collaborative platforms to strengthen their engagement activities,

"I suppose resourcing those direct engagement meetings, all those collaborative engagement meetings where we have a lead role, is really significant."

– Research participant

"We leverage off them. Both of them [CA 100+ and ACSI] are also really good for bringing in what's developing internationally. It's not always relevant for Australia and I think a lot of stakeholders don't necessarily understand that…Australia is such a specific region that it's

not always transferable…we use them mostly where our exposure is smaller but also to get those global insights and direction of travel, and also in the policy and advocacy space. We use them a lot for that again, because they've got the additional resources, the expertise and the kind of relationships, too, that we can leverage" – Research participant

Collaborative engagement is now prioritised over direct engagement as it leverages the number of investors and their expertise and amplifies their power. Collaborative engagement offers the additional benefit of resource-sharing and improved time efficiency both for asset owners and entities. SBTi et al. (2023) refers to the benefit of collecting emissions data from a collection source such as CDP to reduce survey fatigue for companies. In addition to duplicate requests for information, company boards and senior leadership had to attend numerous engagement meetings, where at times asset owners had competing demands of them. Other engagement processes could include letters, workshops, interviews, focus groups and stakeholder surveys. Superannuation funds also devoted significant resources to engagement with numerous investee companies. This is especially beneficial in Australia where PRI (2023e) found cost and insufficient climate skills to be barriers to effective stewardship.

The frameworks call for participation in collaborative engagement in industry initiatives such as Climate Action 100+ (2024a), PRI (2024a) collaboration platform, IIGCC (2023b) engagement initiative and CDP (2024) campaigns. For example Climate Action 100+ (2023) engages with 170 high-emissions corporations on progress in reduction. Say On Climate (2023) guides investor expectations on climate transition plans and provides tools for resolutions and voting when these are not met. Australian Council for Superannuation Investors has a domestic emphasis on collaborative engagement, voting and lobbying. GFANZ (2022d) recommend the development of a plan that summarises the fund's engagement objectives and details their progress and the outcomes of their engagement on these including the use of industry networks to achieve greater collective influence over portfolio companies and lobbying to government for policies that align with net-zero goals.

A cross-section of participants currently or previously working in climate-focused interest groups participated in this study. These included global and domestic climate-focused industry groups and NGOs. The participants referred to the sustainable finance leadership and support provided by their organisation and industry group peers globally and in Australia. For example, more than two decades ago, interest groups challenged the boundary of fiduciary duty and introduced the concept of financially-material climate risk. In Australia, the Australian

Sustainable Finance Roadmap by interest group ASFI (2020), developed a set of sustainable finance recommendations, including steps for the effective transition of the finance sector to net zero, was initially led by finance industry participants and later attracted government involvement. They noted the important role they had played especially prior to, and in lobbying for, the establishment of the Australian government climate agenda. Research participants from superannuation funds were complimentary about the research, tools, frameworks and opportunities for information sharing and collaborative engagement provided by interest groups. They commented that sometimes frameworks were overly ambitious but acknowledged how this helped articulate the direction of change.

"These industry interest groups offer research and sometimes support. They are also very helpful in dealing with the regulator. They help us with basically unpacking what is coming, when things happen and how to read it. So, they are also quite supportive in that aspect...It has led us, for instance, to have a greater awareness and put in place a certain level of framework. So, it has helped us build up our framework, and to evolve."

– Research participant

Some research participants noted the duplication of work occurring across organisations and felt that this impeded their funding opportunities. Others believed the groups collaborated well and did not consider the overlap to be problematic. Some research participants felt that the interest group momentum was not delivering outcomes at the pace needed to achieve net zero goals.

"I think a lot of the industry groups have done the heavy lifting in the early part when no one was really doing any work on the on these issues, and we had governments that weren't listening. But now in Australia, we do… I think there's too many (industry) groups. There's a lack of coordination between them. There's duplication of work and effort. And I've seen this with very firsthand experience, that people who work in these organisations in particular, can get very proprietorial about what their work stream is and their bit of work."

- Research participant

PRI (2023e) conducted a roundtable with institutional investor signatories who stated that they rarely filed shareholder resolutions because the process required onerous constitutional amendments and anti-competition legislation was unclear in relation to stewardship practices. Dutch and United Kingdom regulators overcame similar claims of collusion in collaborative climate engagement with guidance that enables climate outcomes (Hale et al., 2024). The

Australian Competition and Consumer Commission (2024) has prepared supportive draft guidance that is in consultation phase at the time of writing. Whereas, shareholder resolutions were not an arduous process in UK, US, Canada or South African (PRI, 2023e).

A further deterrent to shareholder resolutions found by PRI (2023e) was the view that escalation was seen as hostile and detrimental to company relationships. They reasoned that this might be overcome if the practice was encouraged by regulators. In contrast, they found that collaborative engagement was the most popular form of engagement. A recent study by Slager et al. (2023) affirmed the confrontational nature of shareholder resolutions where power and control are used to assert change. Slager et al. (2023) commented that in contrast, collaborative engagement is consensual and preferred by corporates. They analysed 553 collaborative engagement processes in 35 countries to find criteria to improve their success rate. They found that successful engagement was highly dependent on tailoring the appropriate combination of coalition experience, coalition size, shareholding value and knowledge of local conditions to suit the target firm. For success, the four criteria needed to be adjusted depending on the size, environmental track record and profitability of the target firm.

This section highlighted the importance of interest groups in facilitating collaborative stewardship. It offers the advantage of increased leverage, shared resources and costs. It is also seen to be consensual in contrast with stewardship practices such as shareholder resolutions that are perceived to be hostile. Collaborative stewardship is most effective when a bespoke approach addresses the specific conditions of the target entities.

4.4.3. Policy Advocacy

The influence of government on the net zero actions of superannuation funds is immense. Many research participants discussed the need to engage more broadly than corporates and referred to the importance of lobbying for effective climate policy. This section analyses the policy advocacy practices by superannuation funds to encourage policy and regulatory settings that support and incentivise net zero portfolios.

Research participants consistently referred to the difficulty of achieving a net zero superannuation portfolio given existing legislation and regulation. Despite regulation that is supportive of climate-aware investment as a fiduciary duty, its application alongside Australian legislation has been challenging for trustees.

"Considering ESG is not inconsistent with the sole purpose test because we are looking at the impact on beneficiaries in the long term and superannuation funds are long term investors. How that works out on a technical basis, that's probably something, that is still the ongoing work of regulators, together with industry associations over the coming years ahead."

-Research participant

Findings from Treasury discussions with 100 stakeholders and 66 submissions noted that climate actions were hard to apply alongside best financial interests duty (BFID) (Australian Government, 2023f). The literature also finds that the interpretation of 'best interests' made trustees hesitant to take climate-aware decisions unless the profit incentive is clear (Pryor et al., 2021; Sigel, 2021).

Fund and interest group research participants affirmed the importance of overcoming underperformance yet all perceived the test to be a hindrance on net zero superannuation portfolios. It was a recurring and key topic across all interviews.

"Well, the number one priority for every single Superfund is the Your Future, Your Super performance assessment benchmark. Because if you fail that, your fund dies."

- Research participant

"I still see that the Your Future Your Super performance test is a hurdle for greater action. And I think that is because that is not really incentivising you to take on new risks and to look at new areas because you all have to look the same basically. Have to look the same as anybody else, and you cannot afford to fail that performance test." - Research participant

"It's debilitating in all honesty, absolutely debilitating. It is completely incentivising the wrong behaviour. And I understand that this is probably a huge frustration for APRA, that on one hand they are really stepping up their requirements and discussions and conversations with super, all their regulated entities, on climate risk, understanding, climate risk, reporting climate risk being transparent about your climate risk, managing that climate risk, getting your boards up to speed on climate risk. And then, on the other hand, they're having to endorse and roll out Your future, Your Super. And it's logical, it's contradictory. And it is a detractor from what every super fund is trying to do." – Research participant

The common problem in the YFYS and BFID legislation is interpretation of time horizon. In CPG229 APRA (2021b) refer to the distinguishing and "unprecedented" features of climate risk, including "extended and uncertain horizons" and advising entities to consider both short-term climate risks as well as longer-term risk scenarios "extending to 2050 or beyond" (APRA,

2021b, p. 17). Prior to the BFID, the Productivity Commission Report on the superannuation system (Australian Government, 2016a, p. 63) recommended that best interests must "*encourage long-term investing*" and allocative efficiency would, "*maximise members' wellbeing to the greatest extent possible*." In the UK, The House of Commons Environment Audit Committee (2018, p. 10) noted that *"the 'fiduciary duty' of pension scheme trustees is misinterpreted as a duty to maximise short-term returns."* They reasoned that the long-term risk of climate change must be accounted for, given the long-term investment horizons of pension beneficiaries.

However, YFYS encourages short-term decision-making by trustees (Australian Government, 2023f; Bell, 2022). Short-termism runs counter to the need for investment in new decarbonisation technologies that can have high capital costs and longer payback times (Hafner et al., 2022). Some research participants commented that investors were reluctant to make climate-aware decisions without clearer policy settings but argued that at times the funds used the argument as an excuse for inaction,

"It is much more sitting back, expecting other agents like the government, and companies and other actors to make sure that all the risk has been taken out for investors and that they can then invest in net zero. As opposed to what to invest - thinking about it in a different way, which is, what we have to do to help achieve net zero. - Research participant

Research participants commented on a dramatic evolution of climate policy and advocacy. Much of this action was led by interest groups.

"I think it's interesting to look at how superannuation in particular, is thinking about their role in policy. And that's changing really rapidly. They recognise that to achieve the impact they want to in the world. It's very difficult to do that, or to achieve their portfolio targets without having good policy coming in to back that up…these organisations are now taking a bigger systems view of what needs to happen to support the climate." - Research participant

[we are] "…a voice of advocacy for the net zero transition to be able to do that in an orderly manner. And to also encourage governments to increase their ambition in that regard. An orderly transition cannot happen without government levers and enablers. So, we view that as a very important part of the puzzle. And I think a lot of these things are common across most industry organisations, many have policy arms. We work together with them, certainly at the local level here in Australia, we have regular meetings with them. To check in on areas where we have areas of common interest. And we can have joint supporting statements and

positions that we can bring to government. And it works in a similar way with company engagement as well. Whether it's the associations engaging directly with the companies, or whether it's the investors that work through the association." - Research participant

Key transition plan frameworks also include policy advocacy into their guidance. Table 22 in Appendix H summarises their recommendations.

A direct way that funds can advocate for net zero supportive policy is through submissions to government consultation. In 2023 Treasury sought stakeholder opinion on the Sustainable Finance Strategy (Australian Government, 2023e) and received 140 submissions where 15 were confidential. Whilst many interest groups that include superannuation fund members responded to the submission, direct submissions were received only by seven superannuation funds; ART, Australian Super, Aware Super, Future Super, Hesta, Rest, Unisuper. Their responses were generally supportive raising concerns with interdependencies such as:

- the need for transition plan guidance
- conflicting requirements of YFYS performance test
- climate skill-building
- cost of compliance with regulation
- improved regulatory guidance on stewardship practices
- broader consideration of climate change that includes biodiversity and nature, just transition and climate change adaptation in the broader Asia Pacific region
- structures and incentives for investment in climate solutions

The consultation submissions emphasised that the Australian government needed to learn from sustainable finance strategies already implemented in other jurisdictions. However, there was some divergence in their views on those teachings, for example concerning taxonomies Future Super (2023) commented that the EU taxonomy included unsustainable nuclear and gas activities whilst Australian Super (2023) recommended consistency with the EU taxonomy. Unisuper (2023c) commented that labelling should be gradually phased in and not overly prescriptive whereas Future Super (2023) believe that labelling must be unambiguously enforced and noted that that has not been done in the EU, UK and US. This level of active engagement in policy development is an important responsibility for asset owners to ensure they have the right policy settings to be able to meet their fiduciary duty in climate risk mitigation and finance flows for net zero alignment (NZAOA, 2023a).

Other approaches to public advocacy are meetings with government officials such as through investor roadshows, roundtables or advisory groups. In 2023, Parliamentary Friends of Clean Investment was launched, the non-partisan net zero investment group includes six superannuation fund CIOs (Parliament of Australia, 2023b). A recent example of their work has been a panel event with parliamentarians to discuss rapid scaling up investment for climate resilience and adaptation and ensuring policy settings including mandatory climate disclosure to support that (ASFI, 2024c). An investor roundtable event on net zero transformation in December 2023 also involved superannuation funds and other finance industry experts (Chalmers, 2023b). In addition to other lobbying efforts, their policy advocacy which took place over three roundtables, was impactful in raising the detrimental effect of the YFYS Performance test on climate investment and the need for reform, emphasising opportunities for investment with the Australian sovereign green bond framework, attracting funding and participation for the development of the sustainable finance taxonomy.

In their member survey IGCC (2024b) found that about half of the respondents had participated in public events on climate change, supported investor statements for action on climate change, met with policymakers at roundtable discussions and made submissions to climate-related policy consultations. Research participants commented on the need for strong policy advocacy and pointed to competing activities by anti-ESG or fossil fuel interests that act as a counterforce to their efforts.

"Large investors also need to be looking very hard at what their activities are to help influence that policy. What their activities are to work against negative policy-making. Because that's what's in the long-term interest of their members." – Research participant

"I don't think it's any surprise for anyone who works in climate to say that industry lobby groups have had a huge and generally negative influence on the progress on climate change across multiple markets. It's not a surprise too, that those industry groups are mostly connected to fossil fuel interests. Some are connected to other corporate interests, heavy industry, and at times finance. And they have not been a force for good over multiple decades. Anyone who says otherwise is lying. And that is why you've seen investors in recent years, spend a bit more time in their corporate engagement in particular, focusing on how companies are both lobbying governments directly themselves, and also how their industry bodies are acting in markets as well… investors know that that's also a system risk for them. And are trying to address what is ultimately been a negative influence over time."

– Research participant

"They [the pension funds] should also be taking an extremely active stance on probably one of the biggest handbrakes to global action, which is the intense lobbying efforts in the US at a political level to slow and stymie climate action and at the same time, in the EU. "

– Research participant

Investors lobby for overarching cross-government climate policy that is robust and effective but also sector-specific policy to show national priorities and provide credible details (The Investor Agenda, 2023a). Investors also advocate for long-term climate policy certainty and longevity with interim targets so they can confidently plan their investment payoff (The Investor Agenda, 2023a). Climate solutions such as renewable energy typically have higher risk and longer payoff profiles than other investment options so superannuation funds also lobby for incentives to overcome these (The Investor Agenda, 2023a). The context for policy advocacy is dramatically evolving as governments are realising the need to rapidly scale private capital to limit the impacts of climate change (The Investor Agenda, 2023a). Governments have also recognised the need for system-wide policy to enable GHG emissions reduction and climate solution investment.

IFM Investors (2023) in conjunction with eight large industry super funds lobbied for improved policy settings for investment in climate solutions. They note that Australia will require an enormous 12 billion AUD annually for energy transition as well as 40 billion AUD annually for investment in other sectors. They set out the policy settings that could facilitate their investment for national decarbonisation including transmission infrastructure, batteries, electric vehicle charging and aviation fuel projects.

In Australia, this climate policy change is significant against a historical context of fossil fuel subsidy discussed in section 2.3 and aggressive climate politics. Politicising climate remains topical in Australian Federal leadership (O'Malley, 2024). Noting that background, policy advocacy should be done with accountability and transparency to show that democratic and public interests have not been abused (Hodgson & Witte, 2020; NZAOA, 2023a). Stewardship requires superannuation funds to ensure that the political contributions of investee companies are aligned to a 1.5^{o} net zero pathway. Similarly, investors have urged policymakers for regulation that improves climate-related and transition planning disclosures by investee companies (The Investor Agenda, 2023a).

A collaborative and broad policy advocacy action is the use of investor statements. The Investor Agenda (2022a) coordinated 602 investors in a Global Investor Statement to Governments on the Climate Crisis requesting stronger NDC commitments, stronger domestic

climate policy, support for the global methane pledge, improved consistency in global climate risk disclosure regulation, scaled-up climate finance. An example of an investor policy statement in an Australian context is the Safeguard Mechanism Reforms: Joint Finance Industry Statement which recommended transition plan disclosure by large firms, sector pathway and target development and the alignment of the safeguard mechanism with 1.5^{o} decarbonisation (IGCC, 2023a). The statement coordinated by IGCC represented 29 Trillion USD of AUM and signatories included major sustainable finance interest groups, ASFI, ACSI, RIAA and PRI, as well as Aware, CBUS and HESTA superannuation funds. As a result of the advocacy, the Safeguard Mechanism Amendment Bill was passed and sector pathways are in development (IGCC, 2024a).

4.4.3 yet again showed the essential role of interest groups in effective and collaborative policy advocacy. Policy advocacy is a critical leverage point where superannuation funds can put pressure on governments for greater national climate ambition and appropriate regulatory settings to enable the sector to reach net zero. Current settings do not align with a portfolio emission interpretation of a net zero commitment let alone a planetary emission goal.

4.4.4. Sovereign Bond Engagement

This part explores the nascent area for investor stewardship, sovereign bond engagement.

Some participants also discussed the opportunity to engage with foreign governments on their climate policy and the credibility of their transition to net zero. This included providing investor expectations of appropriate climate actions and setting priorities and timely milestones. Sovereign (or sub-national) bond issuers who do not meet investor expectations could result in reputational consequences, or in the most severe situation, divestment. Few of the research participants interviewed had participated in sovereign engagement. Those who did comment on it, discussed the positives of increased investor attention to sovereign bond engagement, they also emphasised the ethical challenge of setting expectations in EMDE where capital may be less available and engagement conditions may be difficult to achieve. Issues on fair share principles and EMDE investability in section 4.3.3 and are pertinent to those ethical considerations.

The transition frameworks recommend that investors engage with sovereign issuers for improved labelling (PAII, 2024) and stronger climate policy (IIGCC, 2024b). These are summarised in Table 23 in Appendix H. PRI (2020) note that bondholders already engaging with foreign governments can request improved climate-related disclosure and conduct engagement on their Paris Agreement progress.

"Investors are starting to ask about sovereign risk with regard to sovereign bonds. Because I think governments have seen it as a company issue - and it won't necessarily impact us."

– Research participant

"It's much more sensitive when you're in capital-hungry, developing economies. And the dynamics of European investors going into those economies who have less options for capital and telling them what to do starts to prompt thought about the kind of issues that are raised from both moral and just a governance point of view. It has to have guard rails."

- Research participant

"We have been engaging with domestic governments about regulation in the climate space and what we need from them. But it has typically been around disclosures, transition plans, the need for taxonomies, the need for sector pathways, unlocking barriers so that we can invest domestically - as opposed to sovereign bonds." – Research participant

PRI report that climate-related sovereign engagement with developed countries is infrequent however they commenced a pilot initiative in Australia in 2022 (Cox & Wescombe, 2023). The pilot involved 25 asset owners and asset managers who will seek dialogue with the Australian government on stronger climate action, establishing an economy-wide net zero transition plan, climate adaptation programs and disclosure to international standards with reporting expected in July 2024 (PRI, 2023b). According to the terms of reference, "*a central message of each engagement should be that inaction or a lack of progress by the overall sovereign system may be adverse for the countries' standing in debt and other global markets. This may be reinforced in public statements or other activities if required*." (PRI, 2023b, p. 11).

Sovereign bond engagement offers investors the potential for discourse on national climate expectations. Its use for engagement with EMDE countries is dependent on the fund net zero interpretation and portfolio inclusion or exclusion. For planetary emissions interpretations sovereign bonds facilitates the allocation of capital to climate solutions in EMDE. If that is perceived to be out of scope and 'uninvestable' there will be no interest in sovereign bond advocacy. Sovereign bond advocacy can be likened to the 'excluded' in CSH, in this case, global beneficiaries in uninvestable economies.

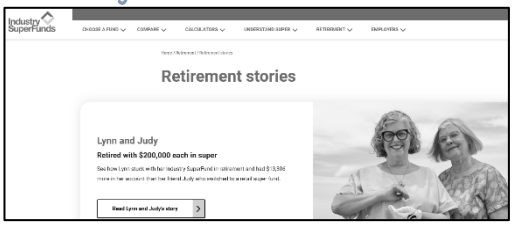
The key role of interest groups in facilitating collaborative stewardship and advocacy is made clear in 4.4. This part also exposed that the extent of influence exerted by superannuation

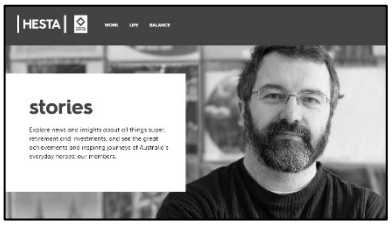
funds is dependent on their net zero interpretation. Their ambition informs the forcefulness of stewardship and willingness to devote resources to those activities, albeit within the constraints of BFID. Similarly, their perspective on designated beneficiaries of net zero superannuation portfolios affects their stewardship and advocacy goals. There is a reasonable alignment between the Australian government sponsoring and controlling the superannuation sector and the view that the nation should be nominated alongside members as beneficiaries of net zero portfolios. Yet, the Australian government emphasised national comparative advantage in their climate policy and sustainable finance policy strategy. Given that position, advocacy for domestic regulation and policy that enables planetary emissions implementation of net zero superannuation portfolios is challenging. Opportunities for advocacy to international governments are available through sovereign bond engagement. Superannuation funds are global investors who directly or through interest groups can participate in meaningful global stewardship.

Chapter 5.

Conclusions and Contributions

As shown below, superannuation funds often use 'storytelling' in member outreach and marketing.





Throughout this thesis I pondered what the 2050 member story would tell. My hope is that it will be a message from a more sustainable future. I believe net zero superannuation portfolios have immense potential to limit the impacts of climate change and ideallistic as it may be, I prepared the member story I would most like to read in 2050.

This chapter synthesises the thesis findings and answers the overarching research problem, 'How will Australian superannuation portfolios reach net zero? The implications of the research findings discussed in this section will be of interest to policy and practice. These are presented in 5.2 in a succinct format that will be usable for practitioners. This is also designed to meet the transdisciplinary research aim of providing knowledge that supports the sectors' transition. I then reflect on the research limitations. In the final part of the chapter, I identify possible opportunities for further research.

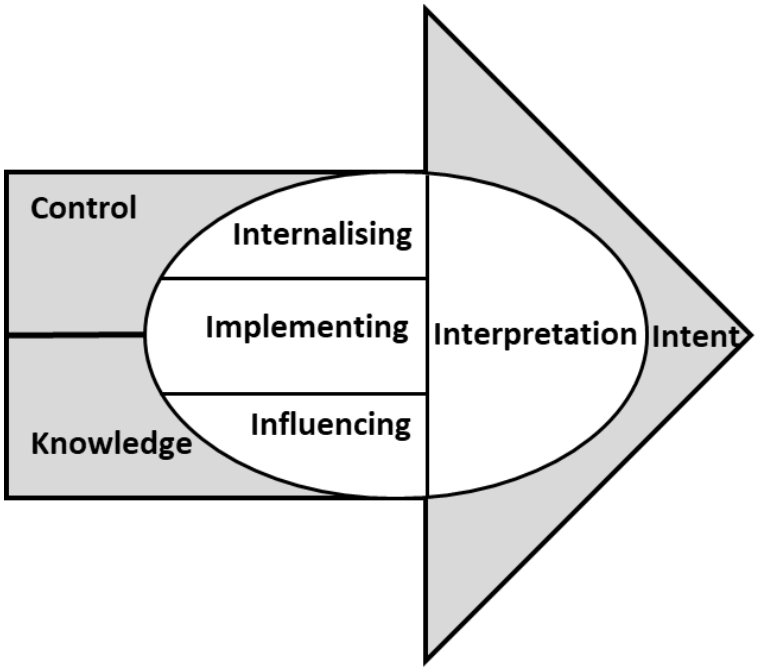
5.1. Research Findings

5.1.1. A Model for Net Zero Transition for Financial Institutions

This doctoral research focused on the transition of the Australian superannuation sector to net zero, but it is generalisable to other financial institutions (FI).

Figure 24 below distils the thesis findings into a generalisable framework for FI net zero transition in other contexts. It draws from Ulrich's (2010) CSH framework and Meadows' (1999) Places to Intervene in a System theory.

Figure 24 The Transition Arrow: A Model of Financial Institution Transition to Net Zero



The shaded outer areas of the transition arrow depict the system in which the FI is applying their net zero commitment.

Intent of a system is the most powerful leverage point for a net zero goal and is therefore shown at the driving point of the transition arrow.

Intent is founded on the deep-set beliefs and overarching ideology of a system. It determines:

i. The extent and urgency of the net zero ambition
ii. Which beneficiaries are prioritised in its application and,
iii. Which net zero measurements will be used to demonstrate progress and success.

These judgements propel but also constrain all other net zero actions.

Control over who decides the intent of a financial institution's net zero goal differs according to the jurisdiction and finance sub-sector of the system in which the FI operates and interacts. Control is shown at the top of the transition arrow as this is a power hierarchy that flows down through the system.

Decision-makers control:

i. The rules of the net zero system, such as carbon fiscal mechanisms.
ii. The conditions for FI net zero actions as permitted by legislation and regulation. They could require the adoption of mandatory transition plans or compliance with national sustainable finance taxonomies.
iii. The incentives, subsidies, and prioritisation in climate-related investment and fossil fuel phase-out.

Knowledge reflects a system's intent. It is situated at the bottom of the arrow, underpinning the system.

Decision-makers determine:

i. Which types of expertise will be deemed relevant.
ii. How climate-related information must be prepared and assured, including proportionality and materiality.
iii. The competency requirements and availability of resources for capability building.

The inner ellipse in the transition arrow describes the FI net zero actions. These are located within, and confined by the system conditions.

Interpretation shapes how the FI internalises and implements its net zero commitment and uses its influence for stewardship activities.

As with intent, interpretation sets the level of ambition and scope for all the FI net zero practices.

i. If the FI interpretation of a net zero goal is more ambitious than the intent defined by the system, the FI can try to influence the system with policy advocacy or other activities.
ii. The FI net zero interpretation of net zero must meet the minimum standards enforced by the system controls.

Internalising a net zero commitment requires FI:

i. To develop governance, leadership, capabilities and a culture that supports their net zero interpretation.
ii. Internalisation must meet minimum standards enforced by the system controllers such as climate governance regulation.

Implementing a net zero commitment requires FI:

i. To incorporate and produce climate-related information that informs their investment decisions. Judgment on the rules for the production of relevant information is determined at the system control level.
ii. FIs determine investment in climate solutions, phase out, and neutralisation according to their net zero interpretation, within the intent articulated in legislation and regulations.
iii. FI Investment decisions respond to the net-zero related rules, incentives and subsidies set in the system.

Influencing the net zero transition of countries and companies and other FI stewardship actions:

i. Reflects the way that FIs interpret the extent of their net zero duty and which beneficiaries they are acting for.
ii. The extent, forcefulness and resources that a FI devotes to stewardship is constrained by the system conditions, including legislation and regulation.

The transition arrow model for FI net zero implementation is derived from the adaptation and application of the CSH and Places to Intervene theories to this study. It is useful for making the forces affecting net zero transition explicit and seeking the leverage points for system intervention. It could be revealing for understanding and comparing net zero implementation in other FI contexts.

5.1.2. Which are the Most Effective Places to Intervene in the System to Support Net Zero Superannuation Portfolios?

This section brings together the analysis to answer the first research sub-question, seeking the most effective place to intervene in the system for net zero superannuation portfolios.

The research supports Meadow's theory that intent is the most effective place to intervene in a system. As the Australian Government sponsors and controls the superannuation system through legislation and regulation, their intent is the most critical leverage point to the sectors' transition.

The Australian Government has Failed to Contextualise Net Zero Intent for the Superannuation Sector

The Australian Government has acknowledged the financially material risk of climate change to superannuation portfolios and to financial stability. In the 2022 Climate Change Act, they expressed the national importance of reaching net zero by 2050 in accordance with the Paris Agreement. They also documented the need for private sector investment to achieve this goal in the Sustainable Finance Strategy.

However, in the context of superannuation, net zero intent is lacking. Research participants emphasised that existing legislation and regulation have acted as a barrier, limiting superannuation portfolios from net zero implementation. Superannuation trustees must comply with best financial interests' duty (BFID) legislation and manage the existential threat of failing the YFYS performance test. Of note is the legislated objective of superannuation, which remains undefined in relation to sustainability and net zero outcomes. The most significant finding in this inquiry is that the current system design is unclear on its net zero expectation, and at times, its narrow financialisaton definitions are inconsistent with the Government's net zero ambition as stated in the Climate Change Act 2022.

The Absence of a Net Zero Commitment is a Litigation Risk

Superannuation trustees have a fiduciary duty to protect member retirement savings from financially material risks, including climate risks, as outlined in APRA's prudential guidance. They also have the duty to meet the reasonable expectations of beneficiaries. Hutley and Hartford-Davis' legal opinion states that companies are expected to have a net zero commitment and intent to deliver it. Therefore, superannuation funds without one could be at litigation risk.

The Interests of Future Members and Global Beneficiaries are Not Recognised in the System Intent

Some superannuation funds' have lobbied the Australian government for the policy settings to reach their net zero commitments. Their net zero goal has also found alignment, as in most developed economies, with the domestic government's need for private capital to reach national climate commitments. The Australian Government plans to address climate change with an economic plan to become a renewable energy leader and green superpower. National economic benefit is being highlighted in sector pathways and sustainable finance strategies.

Whilst domestic effort is important, the Paris Agreement stipulates a duty to meet the interests of global beneficiaries. Despite the Australian Government's claims that the national decarbonisation strategy also provides essential support for decarbonisation globally, this is a subordinate objective. Assistance is required so that the investment universe includes the most vulnerable global beneficiaries and is deemed viable for portfolio holdings.

Fair share principles in carbon budgets and carbon removal budgets for residual emissions will enable transparency and dialogue on their planned use. These agreements are absent from existing domestic policies and documents related to net zero intent. In addition to global beneficiaries, Paris-aligned net zero portfolios must recognise future members. Financial materiality, incorporating a ten-year horizon, is embedded in decision-making at the expense of longer-term consideration of future generations. Their interests must be served with impact materiality measurements and intergenerational well-being frameworks.

Net Zero Measurements Must Demonstrate Progress and Socio-Environment Benefits along an Ambitious Climate Scenario Pathway

Carbon equivalent GHG emissions were adopted as a metric that was customisable with less risk of failure, its verifiable and quantifiable methodology claimed to bypass politics. On the contrary, this metric is strategically imbued with political intent. Emissions metrics appeal to the dominant objectivist theoretical stance and aim to streamline with existing financial processes. This study supports the literature that carbon accounting is increasingly being recognised as a lagging indicator and an oversimplified metric that alone does not adequately signify net zero portfolio alignment or transition. Instead, forward-looking net zero metrics to show alignment to an ambitious climate pathway are a more sophisticated indicator of progress.

This research also finds that scenario analysis models also contain value judgements. They should include fair share principles and transparent carbon and carbon removal budgeting. Taken together, these findings indicate that existing metrics have not been sufficiently interrogated to ensure they are meeting Paris-aligned sustainability objectives. Instead, they reflect the judgement of the system decision-makers whose policies and legalisation to date have an intermediate climate scenario intent.

Transforming Individual Intent

Meadow's argued that transformation could occur by shifting individual mindsets. It is recognised that individuals may play multiple roles in the net zero superannuation system, as voters, members, industry participants, investors and so on. Individual intent drives political pressure and industry norms and is therefore a deep and powerful place to intervene in a system. Unlike the tangible process of policy advocacy and legislation, transforming individual beliefs may occur through various lived experiences or emotive narratives. Given the heterogeneity of superannuation members and Australian voters, this was not in the scope of the thesis research.

The most effective place to intervene in the system for net zero superannuation portfolios is through the intent of the Australian Government, the system's regulators and sponsors. Evidence shows that this intent is fragmented, intermediate and not Paris-aligned. Superannuation funds need to advocate actively for policies to support their net zero goal. Firstly, the Climate Change Act must be contextualised for the sector, so that the barriers caused by YFYS Performance Test and BFID are addressed. Secondly, incentives and subsidies for climate solutions and fossil fuel phase-out are essential to attract private capital for the transition. In particular, allocation to EMDE must be increased to reach the objectives of the Paris Agreement. Thirdly, Paris-aligned transition plans need to be mandatory. These need to include forward-looking progress metrics, such as portfolio alignment to the national sustainable finance taxonomy and to economic activities for EMDE transition. Scenario analysis must be devised with consideration to fair share carbon emissions and carbon removal budgets. Fourthly, carbon fiscal mechanisms are needed to expedite the pace of transition.

5.1.3. How are Actors Interpreting Net Zero Superannuation Portfolios?

This section answers the next research sub-question, how are actors interpreting net zero superannuation portfolios?

In the absence of a defined net zero intent for superannuation portfolios, the interpretation of a net zero commitment by superannuation funds is ambiguous. Two distinct interpretations emerged from the research, 'planetary emissions' and 'portfolio emissions'.

The more ambitious category, 'planetary emissions' argues that as portfolios are highly diversified with deeply complex supply chains, a sustainable net zero portfolio is synonymous with net zero planetary emissions. Whereas the 'portfolio emissions' perspective intends to reduce all significant and measurable emissions. Participants who took that view also emphasised the role of superannuation funds as aggregators of capital where their control over whether the goal could be reached was limited and reliant on investee companies.

The investigation showed clear parallels between net zero intent and net zero interpretation, and the Shared Socioeconomic Pathway scenarios. This is significant for situating the research findings within widely understood climate future narratives.

The portfolio emissions interpretation signifies net zero ambition but with caveats to reaching net zero in a way that does not fundamentally alter existing patterns. It corresponds with the intermediate Shared Socioeconomic Pathway scenario SSP2: "Middle of the Road" where "*social, economic, and technological trends do not shift markedly*" but "*there are some improvements and overall the intensity of resource and energy use declines*" (O'Neill et al., 2017, p. 173). In SSP2 there are moderate challenges to mitigation and adaptation with good progress made in advanced economies compared to EMDE countries. The similarity between SSP2 and a portfolio emissions future can be seen in the judgements and exclusions that exist in the interpretation of a net zero portfolio emission commitment. Firstly, in this perspective, large portions of portfolios have been omitted from net zero measurements because existing emissions calculation methods are considered too imprecise to meet industry standards or the cost of its preparation is considered disproportionate. Secondly, portfolio emissions are judged according to enterprise value and financial materiality horizons are restricted to typical business sector timeframes. Thirdly, this category sees superannuation portfolios as aggregators, so the onus for net zero transition is not their ultimate responsibility. Therefore, influencing activities are less urgent and forceful. Fourthly, this interpretation described an investment universe as global so far as the confines of 'invest-ability', where satisfactory economic conditions must be met to be deemed relevant to their goal. Finally, by limiting their ambition to the boundary of their holdings there remains scope for their portfolio in 2050 to avoid certain entities and still achieve net zero. This is analogous to SSP2 where decarbonisation is mainly progressed in advanced economies.

The second normative net zero interpretation is synonymous with planetary emissions. Where future success requires deep system transformation across the complex system. That future is likened to SSP1:" Sustainability – Taking the Green Road" where "*Investment in environmental technology and changes in tax structures leads to improved resource efficiency, reducing overall energy and resource use and improving environmental conditions over the longer term…assumes that policy changes are driven by changing attitudes. The focus on equity, and the de-emphasis of economic growth as a goal in and of itself in high-income countries, leads industrialised countries to support developing countries in their development goals, including green growth strategies*" (O'Neill et al., 2017, p. 172).

The sustainability of a scenario where a net zero portfolio emission commitment was 'successful' but planetary emissions had not been achieved is questionable. Similarly, SSP2 results in improvement but ongoing environmental degradation makes its long horizon sustainability doubtful too. This candidate therefore takes the view that planetary emissions should be stated as our normative goal and similarly favours an SSP1 future and cooperation towards improved management of global commons. Successfully reaching net zero planetary emissions portfolios will require vast and urgent system change and cooperation for which we are all accountable as the self-interested imperative of human sustainability.

Net zero interpretations are not being made transparent. Most research participants were found to hold either a "planetary" or "portfolio" view on net zero superannuation. This research identified a parallel between these interpretations, and the IPCC's climate futures narratives SSP1 and SSP2, respectively. Whilst a planetary view and SSP1 are Paris-Aligned, the portfolio view and SSP2 are not and will not reach net zero by 2050. SSP2 is expected to result in a 2.8-degree temperature increase by 2100 with severe and compounding climate impacts. Many superannuation funds have linked their net zero commitment to the Paris Agreement. In order to achieve that, they need to find a way to implement it in a way that is more ambitious than the current system's intent.

5.1.4. How are Superannuation Funds Implementing their Net Zero Commitments?

This section considers the third research sub-question, 'How are superannuation funds implementing their net zero commitments?'

The evidence from this study shows that superannuation funds are implementing their net zero commitments within existing industry governance and organisation structures, rather

than altering these for optimal net zero progress. For example, most of the top fifty Australian superannuation funds had located climate governance responsibilities with their investment committee. This governance structure is preferable to the risk committee and implies that net zero is seen as a strategic intent rather than merely a risk, also identified in SPS530 Investment Governance. Yet none of the top fifty funds had a sustainability committee or CSO for maximal organisational transformation. Another finding is that high demand for climate skills is prevalent across the finance sector and the gap extends over all levels of the organisation. Nevertheless, funds commented that the time they could devote to training was limited due to competitive pressure. This skills shortfall requires regulator intervention and Australian government funding, as has occurred in the UK, Ireland and Singapore. The superannuation funds with a presence in international markets such as the UK or Europe where climate policy is more stringent, also tended to have stronger climate governance practices. This strengthens the essential role that governments and regulators play in progressing net zero implementation.

Many research participants from superannuation funds acknowledged that net zero implementation requires significant effort alongside competitive business pressures and had considered adopting climate incentive schemes. Some research participants believe intent on climate action should be intrinsic and they criticised incentives as a symbol of financialisation over socio-environmental benefit. However, a pragmatic view supports the use of incentives under the right conditions to boost transition. During the interviews, research participants were unsure which KPIs and progress metrics would be effective for climate incentives. This is also symptomatic of the challenges in measures of net zero progress.

A further finding of the thesis is that retail funds operating mainly as platforms did not have a net zero commitment. They also outsourced most net zero investment decisions and/ or stewardship processes to external managers or consultants. Their limited net zero control was consistent with their third-party business model, meaning that the extent to which investments were climate-aligned was instead delegated to members, financial advisers and asset managers. This indicates a gap in net zero implementation for APRA-regulated superannuation portfolios.

The research also showed that funds first implementing their net zero commitment tended to focus only on emissions reduction. That initial effort however was now seen to be overly simple, and more impactful implementation, as stipulated in the transition plan frameworks, is now understood to entail investment in climate solutions, fossil fuel phase-out, and

neutralisation of remaining hard-to-abate emissions through offsets. This deeper understanding further reinforces the need for mandatory transition plans.

The transition plan frameworks also encouraged beyond value chain voluntary carbon credits. Whilst these would enable faster net zero progress, they are unambiguously out of scope for superannuation portfolios due to BFID.

Although there was consensus on the obstacle posed by BFID and YFYS legislation, research participants differed on the extent of control they perceived to have in overcoming this barrier. All participants acknowledged the need for policy reform to achieve net zero superannuation portfolios, but those with a planetary emissions net zero interpretation emphasised the urgency and vast change required. They were critical of those with a portfolio emissions view who they believed were more acceptant of the obstacles and used them as an excuse for inaction. Similarly, in corporate engagement, those with a planetary emissions view argued that funds needed to be more assertive in stewardship. They emphasised the need for ambitious pathways to portfolio companies with time-bound consequences for inaction.

Sustainable finance interest groups were recognised for their important role in facilitating collaboration and amplifying superannuation fund power. Although research participants commented that the pace for transformation encouraged by the interest groups differed, with some groups seen as overly ambitious, particularly the science-aligned NZAOA which did not have Australian superannuation fund members. This thesis finds that net zero implementation is a function of net zero interpretation.

The identified challenges in net zero implementation require support at a system level. Supportive ideas include the need for competency regulation, skills funding by the Australian Government, mandatory climate transition plans, and climate solutions allocation requirements as a % of FUM, particularly for EMDE. Superannuation funds can undertake policy advocacy for these and use their broad-reaching influence to engage in more assertive collaborative and sector-wide corporate engagement to implement net zero. Net zero interpretation affects the perceived urgency and motivation needed to overcome identified obstacles to implementation and stewardship.

5.1.5. How Will Australian Superannuation Portfolios Reach Net Zero?

For superannuation portfolios to reach net zero by 2050 the Australian Government must contextualise the 2022 Climate Change Act with net zero-related legislation and regulation specifically for the sector. This will clarify the superannuation sectors' duty to transition to net

zero, increase the adoption and implementation of commitments and enable the existing system barriers to be overcome.

If the net zero intent is consistent with the comparative advantage emphasis in the Australian Government in the National Interest Framework, 'Future Made in Australia' net zero investment will progress the national climate transition but not address the needs of global beneficiaries. The financial materiality emphasis in the Australian climate-related reporting standards phased in from January 2025 have an intermediate intent. Should this narrow and intermediate intent be echoed in the contextualisation of net zero for the sector, an SSP2 socio-economic climate future would result. Similarly, a net zero portfolio interpretation, limited to the boundary of significant and measurable portfolio holdings, signifies immense emissions reduction but will not achieve planetary decarbonisation and long-horizon sustainability for future generations.

Emissions do not obey borders and investment in hard-to-abate sectors in all regions, including 'uninvestable' EMDE is needed to reach net zero planetary emissions and SSP1. The environmental and humanitarian risks that could occur if global warming is not limited to well below 2^{o} over pre-industrial levels by 2050 are profound. Stakeholder power is not spread evenly and future generations, as well as EMDE actors outside the investible universe that stand to be most affected by the impacts of climate change cannot exert any control over net zero superannuation portfolios or the flow of global capital and its subsequent impacts.

This study sheds new light on net zero Australian superannuation portfolios and contributes to our understanding of the sector's contribution to global finance flows in relation to the Paris Agreement. The insights from this research may be of assistance to understanding net zero interpretation and implementation by FI in other contexts. This work adds to the body of research confirming the need for urgent, transdisciplinary systems transformative to limit the impacts of climate change.

5.2. Implications for Policy, Practice and Members

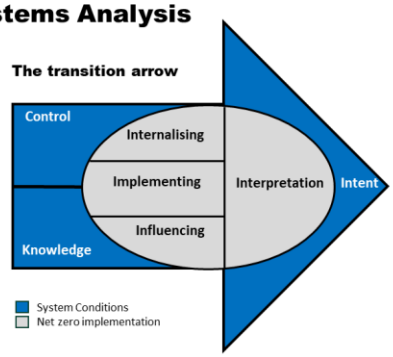
This section has been designed to deliver a succinct thesis summary and usable knowledge to practitioners. For readability, the text is shown below.

HOW WILL AUSTRALIAN SUPERANNUATION PORTFOLIOS REACH NET ZERO?

A Systems Analysis

Summary of doctoral thesis findings for practitioners - Donna Lopata - December 2024

The transition arrow



Under the current system conditions most superannuation funds will not reach Paris-aligned net zero. Firstly, because BFID and YFYS must be adapted to encourage net zero implementation. Secondly, if net zero is contextualised in a way that is consistent with most of Australia's sustainable finance policy and legislation, then it will be intermediate and correlate with SSP2.

SSP2 is not sustainable and will likely result in a 2.8-degree temperature increase by 2100, causing severe and compounding climate impacts in the lifespan of existing members.

For impact and alignment with the Paris agreement and Australia's Climate change Act, we need to enable Superannuation funds to be more ambitious in their net zero commitments. They must also be incentivised to provide private capital for climate solutions in EMDE.

Interest groups and the legal system are helping funds to influence the system and strive for more ambitious action.

Some encouraging developments have taken place, but the voluntary aspect is limiting net zero progress. It is essential for net zero intent to be legislatively contextualised for the superannuation sector in a way that takes a global view of beneficiaries and limits the impacts of climate change for a sustainable future.

SYSTEM CONDITIONS

INTENT

- Intent is the most powerful leverage point in a system, driving or constraining it. It is derived from the beliefs and ideology of the system.
- In the Climate Change Act the Australian Government have stated a net zero intent for global benefit in accordance with the Paris Agreement.
- Yet, they have failed to contextualise it for the superannuation sector.
- The intent for superannuation trustees to protect member assets from financially material climate risk has been declared by APRA.
- In financial materiality, climate risk is only relevant if it could affect enterprise value.
- Financial materiality is consistent with Best Financial Interests Duty (BFID) that requires decisions to be made in the best financial interests of members.
- Judgement on the timeframe for assessment of BFID and financial materiality is unclear but is typically applied using conventional finance horizons where long-term is seen as 10 years at most, therefore excluding the most severe and compounding impacts of climate change.
- The youngest superannuation members are unlikely to retire before 2075.
- The SIS Act ensures trustees manage retirement savings responsibly and meet the reasonable expectations of members.
- In 2021 Hutley and Hartford-Davis provided a legal opinion that there was now an expectation for companies to have a net zero commitment, and if they did not demonstrate an intention to implement their commitment, they would be at an acute risk of litigation.
- Then surely it is reasonable for members to expect superannuation funds to have a net zero commitment, and without one, wouldn't funds be at risk of litigation?
- However, the Your Future, Your Super (YFYS) Performance test is acting as a barrier to funds fulfilling both their fiduciary duty to manage financially material climate risk and the arguable obligation to implement a net zero commitment.
- The legislated objective of superannuation is to preserve savings...*in an equitable and sustainable way.*
- The word 'sustainable' refers to fiscally sustainable – although interest groups RIAA & PRI prepared submissions to the bill arguing that it should refer to environmentally sustainable on the basis that you can't separate fiscal sustainability from environmental sustainability.
- The RBA and NGFS recognise the risk that climate change could pose to fiscal stability.
- The Sustainable Finance Roadmap, Future Made in Australia and Australian Green Bonds use of proceeds have noted the need to scale private capital to reach national commitments. The strategies state the intent to make Australia a renewable energy superpower and maximise national comparative advantage.
- The Paris Agreement emphasises that developed countries need to provide financial assistance to developing countries who are more vulnerable and have less capital to adapt to climate impacts.
- Yet, finance for global, and especially EMDE benefit, is a very subordinate objective in the strategies.
- The research found that instead of contextualising net zero intent for the superannuation sector in accordance with the Paris Agreement, intent is fragmented and intermediate. It enables superannuation funds to implement it in the interests of members over a 10-year horizon at most but only within the constraints of the YFYS performance test.

CONTROL

- The Australian Government sponsors and regulates the superannuation sector.
- They determine the rules of the net zero system including carbon fiscal mechanisms, incentives or subsidies for climate-related investment and fossil fuel phase out.
- They could boost sector net zero progress with mandatory Paris-aligned transition plans.
- Funds should advocate for system conditions to support their net zero commitments.

KNOWLEDGE

- The Australian Government decides which information is relevant, which experts can provide assurance, and what level of climate competency is necessary.
- The incoming climate related reporting standards prioritise financialisaton in materiality and proportionality.
- The immense demand for capability building has seen UK, Ireland and Singapore governments provide funding for climate skills training. The Australian government could similarly provide funding to boost net zero competency.

Summary of doctoral thesis findings for practitioners - Donna Lopata - December 2024

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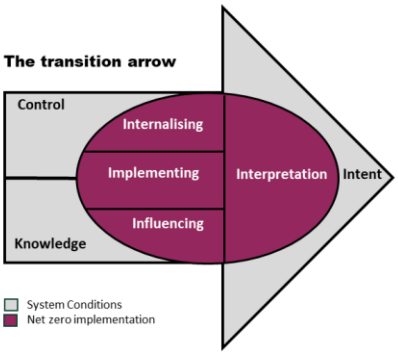

"We can decarbonise our entire portfolio. We could do that and yet if the rest of the economy is burning around us - what good are we really?" Research participant

"If a government with clear commitments to wind down assets, picks up some of these fossil fuel assets, and then winds them down... Is that positive or negative? Would we want that exposure? Would our members expect that exposure?" Research participant

"The inequity...is devastating. But I think we are so bound by our fiduciary duty, that it's going to be really hard for huge amounts of investment dollars to flow too far outside the OECD when we're thinking about climate solutions." Research participant

"We have a 1% allocation to climate investments...there is a risk if the allocation is really large and if it wasn't as successful returns-wise as other investments, that it could impact how we're performing in Your Future, Your Super." Research participant

NET ZERO IMPLEMENTATION BY SUPERANNUATION FUNDS

INTERPRETATION

- Interpretation affects the ambition and pace of a fund's net zero implementation
- In the absence of a contextualised intent for superannuation portfolios net zero, interpretation of commitments is ambiguous and not transparent.
- Two distinct net zero interpretations emerged in the research:

1. 'Planetary emissions' - this view argues that because portfolios are highly diversified with complex supply chains, they are synonymous with net zero planetary emissions. This interpretation is Paris-aligned and analogous to 'the green road' shared socio-economic scenario (SSP1-2.6) in the 6th IPCC report. Just and rapid transition will need to be accompanied by significant policy change to improve the global commons. Advanced economies urgently support EMDE in reaching their development goals.
2. 'Portfolio emissions' reduces all feasibly measurable portfolio emissions, including financially material supply chains emissions. This interpretation views superannuation funds as aggregators of capital, where their control in reaching net zero is reliant on investee companies. Whilst the intent is genuine, there are caveats to achieving net zero and the portfolio boundary theoretically allows funds to successfully reach net zero by divesting from laggard investee entities at the very last minute. This perspective is comparable to 'The Middle of the road' scenario (SSP2–4.5) where growth is unequal, and advanced economies gradually transition away from fossil fuels but progress in EMDE is limited.

- SSP2 is not Paris-aligned and exposes Australia to severe and compounding climate impacts.
- Where superannuation funds have linked their net zero commitment to the Paris Agreement, they need to find a way to implement it in a more ambitious way than the current system intent.

INTERNALISATION

- Climate competency must be uplifted across organisations to ensure their capability to implement transition plans. Much of the existing guidance is beyond current fund skills.
- Climate incentives can motivate net zero progress in a time pressured context, yet even its measurement will require new skills so that payout only rewards genuine climate action.
- Emissions accounting is not sufficient for net zero measurement, nuanced carbon attribution and portfolio alignment to an ambitious climate pathway is also needed.

IMPLEMENTATION

- Net zero is a non-linear emissions reduction process that requires investment in climate solutions, fossil fuel phase-out and neutralisation of remaining hard to abate emissions.
- To reach their net zero commitments, funds can advocate for governments to allow climate investments to be excluded from the YFYS performance test or for a % of assets to be invested in climate solutions.
- Funds can also advocate for government incentives to include EMDE climate solutions too.

INFLUENCING

- The pace for stewardship activities depends on net zero interpretation. Planetary emissions participants sought time-bound consequences for inaction, whereas the portfolio emissions interpretation tended to prioritise collegiality in stewardship.
- Collaborative stewardship enables resource-sharing and amplifies superannuation fund power.
- Sector-based engagement is helpful for addressing the challenges that are common across an industry and cannot be solved by a single company.
- Engagement and policy advocacy objectives differ depending on net zero interpretation
- Superannuation funds can influence their investee entities but also external asset managers, service providers, sovereign bond issuing governments and most importantly, the Australian government.

HOW WILL AUSTRALIAN SUPERANNUATION PORTFOLIOS REACH NET ZERO?

Under the current system conditions, most superannuation funds will not reach Paris-aligned net zero. Firstly, because BFID and YFYS must be adapted to encourage net zero implementation. Secondly, if net zero is contextualised in a way that is consistent with most of Australia's sustainable finance policy and legislation, then it will be intermediate and correlate with SSP2.

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Some encouraging developments have occurred, but the voluntary aspect limits net zero progress. It is essential for net zero intent to be legislatively contextualised for the superannuation sector in a way that takes a global view of beneficiaries and limits the impacts of climate change for a sustainable future.

INTENT

- Intent is the most powerful leverage point in a system, driving or constraining it. It is derived from the beliefs and ideology of the system.
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- The intent for superannuation trustees to protect member assets from financially material climate risk has been declared by APRA.
- In financial materiality, climate risk is only relevant if it could affect enterprise value.
- Financial materiality is consistent with Best Financial Interests Duty (BFID) which requires decisions to be made in the best financial interests of members.

- Judgement on the timeframe for assessment of BFID and financial materiality is unclear but is typically applied using conventional finance horizons where long-term is seen as 10 years at most, therefore excluding the most severe and compounding impacts of climate change.
- The youngest superannuation members are unlikely to retire before 2075.
- The SIS Act ensures trustees manage retirement savings responsibly and meet the reasonable expectations of members.
- In 2021 Hutley and Hartford-Davis provided a legal opinion that there was now an expectation for companies to have a net zero commitment, and if they did not demonstrate an intention to implement their commitment, they would be at an acute risk of litigation.
- Then surely it is reasonable for members to expect superannuation funds to have a net zero commitment, and without one, wouldn't funds be at risk of litigation?
- However, the Your Future, Your Super (YFYS) Performance test is acting as a barrier to funds fulfilling both their fiduciary duty to manage financially material climate risk and the arguable obligation to implement a net zero commitment.
- The legislated objective of superannuation is to preserve savings…*in an equitable and sustainable way.*
- The word 'sustainable' refers to fiscally sustainable – although interest groups RIAA & PRI prepared submissions to the bill arguing that it should refer to environmentally sustainable on the basis that you can't separate fiscal sustainability from environmental sustainability.
- The RBA and NGFS recognise the risk climate change could pose to fiscal stability.
- The Sustainable Finance Roadmap, Future Made in Australia and Australian Green Bonds use of proceeds have noted the need to scale private capital to reach national commitments. The strategies state the intent to make Australia a renewable energy superpower and maximise national comparative advantage.
- The Paris Agreement emphasises that developed countries need to provide financial assistance to developing countries who are more vulnerable and have less capital to adapt to climate impacts.

- Yet, finance for global, and especially EMDE benefit, is a very subordinate objective in the strategies.
- The research found that instead of contextualising net zero intent for the superannuation sector in accordance with the Paris Agreement, intent is fragmented and intermediate. It enables superannuation funds to implement it in the interests of members over a 10-year horizon at most but only within the constraints of the YFYS performance test.

CONTROL

- The Australian Government sponsors and regulates the superannuation sector.
- They determine the rules of the net zero system, including carbon fiscal mechanisms, incentives or subsidies for climate-related investment and fossil fuel phase-out.
- They could boost sector net zero progress with mandatory Paris-aligned transition plans.
- Funds should advocate for system conditions to support their net zero commitments.

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- The incoming climate-related reporting standards prioritise financialisaton in materiality and proportionality.
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INTERNALISING

- Climate competency must be uplifted across organisations to ensure their capability to implement transition plans. Much of the existing guidance is beyond current fund skills.

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5.3. Research Limitations

Despite best efforts to achieve the research objectives in the most robust and impactful way possible there were inevitable limitations. These are identified in this section.

There are many ways to explore the superannuation sectors' transition to net zero. Whilst the benefits and justification of a TDR approach are presented in the thesis, I am aware of the limitations of that theoretical perspective.

Firstly, whilst TDR aims to provide socio-environmental benefit to a complex situation, complexity is unpredictable so positive outcomes cannot be guaranteed. What is intended as a solution may become a problem. Research impact is notoriously hard to assess and tends to occur over a horizon beyond the span of a study. In recognition of those limitations, I have drawn on the research outcome goals of the Institute for Sustainable Futures in seeking to contribute towards change in policy and practice.

Secondly, a challenge in researching a complex topic is determining the boundary of relevance. Whilst I made my judgements transparent in the context diagram, my positionality is finance sector oriented, and I privileged sustainable finance knowledge. This is also a research limitation because other valid knowledge perspectives would have generated different findings. Due to language constraints, all selected literature sources were in the English language which means that relevant content will have been incidentally omitted. Additionally due to the breadth of the topic and the narrative literature approach I will not have included all relevant content and may have missed valuable ideas.

Thirdly, there is an inherent tension between disciplinary perspectives as well as between practitioner and scholarly knowledge. This study has tried to respect and incorporate all approaches. Yet, this topic is evolving and, on some themes, had limited academic sources so therefore drew heavily on grey literature. Whilst the selected sources tended to be well-reputed organisations, the criteria and review of knowledge production is more relaxed than academic outputs. TDR also emphasises knowledge co-creation and this research would have benefited from more practitioner input. However, due to limitations of participant recruitment and doctoral time constraints, primary inputs were limited to interviews.

Fourthly, TDR aims to incorporate the perspectives of stakeholders across the defined system. However the perspectives of superannuation members were not included given the heterogeneity of the group and the time limitations of a doctorate. Similarly, other system actors, such as policy makers were not included in the interviews and were instead represented by policy documents. The thesis also refers to EMDE stakeholders as vulnerable and excluded however all sources of information that inform that view are not of EMDE origin. Further, the research scope did not attempt to understand the region-specific needs of that heterogeneous group.

There are also research limitations owing to the selection of the interview participants who are either members of superannuation fund ESG teams or in industry-related roles. This was a practical decision to permit dialogue on technical content. On the other hand, those who participated had an obvious sustainability bias evident from their career choice. A further limitation was that the ethical approval and participant agreement required that the transcript deidentified any content that would cause fund recognition. It also allowed organisations to check the interview transcript and redact any content they believed would be commercially sensitive. Therefore, some parts of the interview had to be removed, additionally, participants would have avoided presenting their organisation negatively. Further, due to participant time constraints, the interviews had to be limited to 45 minutes at most, which meant a large amount of content needed to be covered in a short time span. Lastly, the selection of industry participants adds a finance sector bias to the research.

The evolving and dynamic nature of the topic presented a large research challenge. As identified in the thesis, the interviews were conducted prior to the release of numerous government documents which would have been relevant dialogue. Currency was a key issue, and large parts of the literature review were updated and rewritten to include new articles. Thematic analysis was included in chapter four to add currency and triangulate the interview findings.

Another research limitation owing to the nascence of the topic is the emphasis on GHG emissions and limited reference to nature and biodiversity. The latter are becoming more prominent in topics within the sustainable finance sector but were not widely discussed at the time of the interviews.

5.4. Recommendations for Further Research

The TDR approach and study of an evolving complex situation opens many opportunities for future research. These are presented in three categories: refinement, advancement and expansion of research ideas.

Refinement

In recognition of the identified limitations in TDR doctoral research, further research could seek greater stakeholder involvement. Focus group input on the superannuation system net zero context diagram could test and develop the boundary judgement of relevant knowledge, which would affect research outcomes. Dialogue on system conditions and implications for implementation could benefit from knowledge co-creation. The involvement of different system participants would enrich understanding and provide shared learning opportunities. The use of futures thinking methods may give insight into a desirable future and encourage policy outcomes that lead to it.

Advancement

The dynamic nature of climate change knowledge and societal responses to it presents numerous opportunities for further research. Rich areas for further research are anticipated due to; greater net zero commitment and implementation, climate change impacts, political influence, legislation and regulation. These elements are complex, interacting and rapidly changing and will all affect net zero superannuation portfolios.

In addition to evaluating these developments and their impact on net zero progression, further research will be enabled by improvements in understanding. Specific areas that are quickly evolving, fascinating topics for further research are: Climate science pathways and socioeconomic scenario development, Climate-related financial reporting, ESG data, sustainable finance taxonomies, fund labelling and investment products, sustainable debt, compliance and voluntary carbon credit markets and sustainable derivatives and transition plans.

Net zero measurement is a topic that is not well refined and requires more research on carbon metrics, carbon attribution and exploring other suitable net zero measures such as portfolio alignment. The concept of active and passive emissions reduction would also be an interesting area for further exploration as it relates to system-wide net zero intent.

At the time of the thesis interviews, biodiversity and nature were not widely seen as a topic that intersected with finance. Future research on its implementation in net zero portfolios would be beneficial given the rise of awareness and attention to this topic.

Additionally, stewardship on sector-wide enablers to transition and on fossil fuel phase-out do not have consensus in practice or in the literature. These topics require further research and will be impactful for net zero influence and investment.

Research from the context of Australian superannuation could support policymakers and policy advocacy activities to overcome barriers to net zero implementation due to existing legislation. Ideas on climate solutions targets and climate-related benchmarks would be worthy of further investigation.

Another contested area that would benefit from further research relates to carbon budgets, carbon removal budgets and fair share principles. Dialogue on these is related to emissions pathways and socioeconomic scenarios and it is expected that these would evolve concurrently. This knowledge is important for the assumptions in superannuation fund scenario analysis and would benefit from future research.

Expansion

There is scope for further research in topics related to net zero superannuation portfolios that were not investigated due to the timing and resource constraints of doctoral research. These suggested topics for further research are also based on the thesis findings.

i. Comparison between net zero implementation by other finance sectors in Australia as well as between other pension funds in other jurisdictions would be useful knowledge. This would also enable refinement of the transition arrow proposed in the generalisable thesis findings to other FI contexts.
ii. Research on superannuation members is limited and member disengagement and member education may be a factor in the low uptake of climate fund selection. Further studies find evidence that superannuation members could be mobilised to support net zero outcomes by selecting climate choice options or making climate-aware decisions within available platform selections.
iii. The low level of net zero implementation by retail funds with member platforms has important implications for a large segment on APRA-regulated superannuation funds.
iv. Exploring the correlation between industry interest group membership with net zero commitment and implementation. This could be informative of greenwashing practices, as well as best allocation of resources to interest groups and choice of interest group membership by funds.
v. The boundary and conditions for investability in relation to EMDE universe could be a topic for further research that would facilitate more climate finance.

vi. The link between net zero intent, interpretation and climate future scenarios would benefit from deeper research. Research participants were identified as having a portfolio or planetary emissions perspective of net zero based on their interview comments, but more explicit research would enable improved testing.

The further research ideas are not exhaustive, and net zero superannuation portfolios do not have a precise point of completion. Instead, they should be seen as steps within an impact continuum for a dignified retirement in an equitable and sustainable way. That can only be a reality if urgent action is taken to limit the impacts of climate change.

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Appendix A: Articles by Year on CSR, ESG and Sustainability Reporting

Table 10. Articles on CSR, ESG and Sustainability Reporting/ Disclsoure

Year	"Corporate Social Responsibility (CSR)" AND "Reporting" or "Disclosure"				"Environmental Social Governance (ESG)" AND "Reporting" or "Disclosure"				"Sustainability" AND "Reporting" or "Disclosure"			
	Proquest peer reviewed articles	Change (%)	Factiva articles	Change (%)	Proquest peer reviewed articles	Change (%)	Factiva articles	Change (%)	Proquest peer reviewed articles	Change (%)	Factiva articles	Change (%)
1990 - 2000	24		7756		0		1,349		17		14,660	
2000 - 2010	731	+ 2946	64,869	+736	20		8,246	+511	1206	+6994	230,394	+1472
2010 - 2015	1705	+ 133	83,782	+ 29	74	+ 270	12,031	+46	2574	+113	363,369	+58
2015 - 2020	3371	+ 98	89,594	+ 7	300	+ 305	104,900	+772	4461	+ 73	533,649	+47
2020 – 2022* As at 16/3/22	1604		48,942		284		227,565		2059		435,863	

Appendix B: Key Climate-related Financial Reporting Frameworks

Table 11. Key Climate-Related Financial Reporting Frameworks Prior to the Establishment of ISSB

Framework	Established	Orientation	Focus
(Task Force on Climate-Related Financial Disclosures) (TCFD)	2015	Financial materiality	Established by the Financial Stability Board, this framework for climate-related disclosure has become the most widely used globally. As at October 2021, TCFD represented $194 Tr Assets across more than 2600 supporters and has been officially adopted for reporting in 8 regions including the EU, UK and NZ. TCFD guidelines are now widely used by more than 1500 organisations globally, an increase of 85% from 15 months prior (TCFD, 2020). Growth of TCFD- aligned reporting has benefited from the support of more than 110 regulators globally. This includes ASIC, who in August 2019 and APRA, who in April 2021 cited TCFD as their preferred standard (ASIC, 2019b, APRA 2021). NZ have approved mandatory climate-related reporting in accordance with TCFD guidelines, becoming effective for NZ companies in 2023 (NZ Ministry for the Environment, 2021). Increased investor demand, particularly via powerful 2017-launched investor group, Climate Action 100+, has also boosted TCFD support. This group collectively manage more than $50 Tr USD and use their influence to navigate the shift to a low carbon economy through engagement with focus companies and demand for improved carbon disclosures. The TCFD is also endorsed by the G20 Sustainable finance roadmap.

			The TCFD framework provides guidance for company disclosure along four pillars; Governance, Strategy, Risk management and Metrics with TCFD providing targets for investors and further recommendations for tangible scenario analysis. The TCFD was disbanded in October 2023 and stated that the organisation had completed its objective and future work would be continued by IFRS.
Global Reporting Initiative (GRI)	1997	Impact materiality	GRIs growth coincided with the rise of CSR reporting. Their information caters to broad stakeholder concerns and is aligned with impact considerations. GRI developed the Global Sustainability Standards Board (GSSB) to set sustainable reporting standards.
(Value Reporting Foundation) including **(SASB) (SASB)** **(Integrated Reporting Framework) (IRF)**	Formed in 2021 SASB founded in 2011 IRF founded in 2013	Financial materiality	Value Reporting Foundation was formed with the merging of IIRF and SASB. Both organisations are orientated to investors. SASB's framework aims to provide sector-specific information that is comparable and useful for making investment decisions. Integrated Reporting Framework is principles-based guidelines for financial reporting that includes non-tangibles such as natural capital, human capital and social and relationship capital. Their approaches have been joined by using the SASB methods to identify financially material risks

			and by using the IRF guidelines to consolidate this information with company reporting.
(Climate Disclosures Standards Board) (CDSB)	2007	Financial materiality	US-based CDSB was a group aiming to improve environmental reporting standards. It offered a technical framework with recommendations for reporting material risk within existing financial reporting. It ceased operation on 31 January 2022 when it was consolidated into the IFRS Foundation (refer 5.9).
(Greenhouse Gas Protocol) (GHG)	2001	GHG Emissions Accounting Standard	GHG Corporate Accounting and Reporting Standard method is very widely used and underpins many of the disclosure standards mentioned above. Its framework helps users identify and calculate direct and indirect emissions where; scope 1 refers to all direct emissions of operations, scope 2 refers to indirect emissions from purchased production energy and scope 3 emissions refer to other upstream and downstream emissions relating to business activities.
(CDP) Formerly known as Carbon Disclosure Project	2000	Financial materiality and impact materiality	The first carbon disclosure standard CDP, faces both investors and stakeholders. Data is voluntarily self-reported by companies and cities and fact-checked by CPD. Members include 590 asset managers who together manage more than $110 trillion USD. CDP launched Science Based Targets Initiative (SBTi) as a commitment mechanism for companies to set and achieve a climate target. As of January 2021, CDP have acknowledged the prominence of TCFD in the process of

			mainstreaming climate-related disclosure and have amended their disclosure process to better align with TCFD (CDP, 2021). This is an important collaborative step that will serve to better standardise carbon disclosure.

Appendix C: ESG Data and Rating Providers

Table 12. Dominant ESG Data and Rating Providers

ESG Data and Rating Provider	Aquisitions	Parent	Scope	Estimated revenue year ended 31 Dec 2020	Business Orientation	Investor perspective as commented in (Wong & Petroy, 2020, pp. 33-35)
MSCI ESG Research	KLD, Innovest, IRRC, GMI Ratings	MSCI Inc.	Analyses 8500 entities globally	$111.4 million USD (MSCI Inc, 2020)	General Data provider	Positives: -one of the most widely used -broad coverage -good data set -easy to integrate with Barra risk system. Negatives: -Don't like the scoring
S & P Global ESG Research & Data	RobecoSAM Trucost Ethical Corp The Climate Service	S & P Global	Analyses 7500 entities globally (S & P Global, 2020)	Unknown – Ratings revenue overall is $3.6 billion USD Subscription revenue overall is $177 million	RobecoSAM Asset manager S & P Global General data provider	Positives: -Robeco SAM data is well regarded Negatives: -Little attention is paid on which companies are included in Dow Jones

				USD note these are not ESG specific (S & P Global, 2020).		Sustainability Index (DSJI) as it is not transparent enough
ISS ESG		Deutsche Borse Genstar Capital ISS Management		$280 million USD (ISS, 2020)	ESG Data Specialist	"Multiple investors noted ISS has the best research on proxy reporting… and good data… but low usefulness for the score."(Wong & Petroy, 2020, p. 34)
Moody's ESG Solutions Group	Vigeo-Eiris Four Twenty Seven MioTech	Moodys Corp	5000 + entities globally	Estimated $47 million USD but it is unclear how much of Moody's Investor Services Other Revenue Line of business revenue is generated from ESG revenue, data and assessments (Moody's, 2020).		
Bloomberg ESG		Bloomberg Finance	11,800 entities globally. Data only	Unknown – Privately held company	General Data provider	Positives: -Bloomberg terminal is widely used for data

						Negatives: -Low use of ESG data scores
Sustainalytics and Morningstar	Sustainalytics	Morningstar	Analyses 13,000 companies globally	Unknown – Organic Licence-based revenue overall $934.9 million USD where Sustainalytics revenue is for Q1 and Q2 only .	Sustainalytics ESG Data Specialist, Morningstar General Data Provider Morningstar Investment Management asset manager	Positives: -one of the most widely used -broad coverage -good data set -good materiality emphasis -carbon risk product is well regarded Negatives: -many instances of missing data.
Refinitiv ESG Data and Scores FTSE Russell ESG Ratings		LSEG	10,000 + entities globally	Unknown – $6.25 Billion USD	General Data provider	Positive: -Green revenues data is highly regarded Negative: Not often mentioned

Appendix D: Media Attention on Climate Change

Table 13. Media Attention on Climate Change

Year	Number of articles			
	USA	Australia	United Kingdom	Canada
1975	1	0	0	0
1976	0	0	0	0
1977	8	0	0	0
1978	8	0	0	0
1979	10	0	0	0
1980	17	0	0	0
1981	23	0	0	0
1982	25	0	0	0
1983	37	0	1	0
1984	20	0	0	0
1985	23	0	2	0
1986	36	0	6	19
1987	48	3	9	32
1988	395	69	149	174
1989	818	165	776	368
1990	1058	129	1107	467

Appendix E: Semi-Structured Interview Discussion Guide

Semi-structured Interview Discussion guide – Superannuation Fund participants (45 minutes)

1. Can you tell me how your organisation went about setting your net zero target?
2. What changes have happened in your organisation as a result of setting the target? *For example Team, Policies.*
3. How does your organisation view stewardship in relation to your net zero goal?
4. To what extent is your net zero commitment incorporated in your investment processes?
5. What will be the greatest challenges and solutions to reach your net zero commitment?

Semi-structured Interview Discussion guide – Interest group participants (30 minutes)

1. How are industry interest groups influencing the transition to net zero superannuation portfolios?
2. What do you see as the role of government and regulators in superannuation funds transitioning to net zero?
3. What net zero-related regulation are you seeing internationally that could impact Australian superannuation portfolios?
4. What is your view on the opportunities and challenges for regulation related to net zero superannuation portfolios?

Appendix F: Carbon Emissions Portfolio Metrics

Detailed working of Bouchet (2023) analysis of three carbon emissions portfolio metrics

Hypothetical portfolio	A portfolio has 5m USD each of two companies. Both are valued at 20m USD and earn 10m USD revenue. Company A emitting 100 TCO_2/ m USD and company B emitting 10 TCO_2/ m USD	The market capitalisation of company A doubles.	Some of company A is sold to buy company B so that the portfolio holdings of each are again equal

WACI (TCO_2/ m USD)	a. 55	b. 70	c. 55
WAAC (TCO_2/ m USD)	d. 27.5	e. 18.4	f. 14.5
Absolute portfolio emissions (TCO_2)	g. 275	h. 275	i. 225

The weighted average carbon intensity formula (WACI) is shown as,

$$\text{Weighted average carbon intensity} = \sum_{\text{Sum of}} \left(\text{Financed emissions intensity} \times \frac{\text{Value of portfolio holding}}{\text{Value of portfolio}} \right)$$

Calculation a.

= [(100 TCO_2 per million revenue x 0.5) + (10 TCO_2 per million revenue x 0.5)]

= 50 TCO_2 + 5 TCO_2

= 55 TCO_2

If the first company's market capitalisation were to double, the value of the portfolio and the value of the portfolio grow too.

= [100 TCO_2 per million revenue x 0.67 + 10 TCO_2 per million revenue x 0.33)]

Calculation b.

= 67 TCO_2 + 3.3 TCO_2

= 70.3 per million USD revenue

If the portfolio is rebalanced by selling some of the first company and buying more of the second so that the weight of the two companies are equal again then the emissions intensity lowers to the previous weighted portfolio average.

Calculation c.

= [100 TCO_2 per million revenue x 0.5 + 10 TCO_2 per million revenue x 0.5)]

= 50 TCO_2 + 5 TCO_2

= 55 TCO_2

Bouchet (2023) compares the WACI portfolio metric with weighted average absolute emissions (WAAC) for the portfolio.

$$\text{Weighted average absolute emissions} = \sum_{\text{Sum of}} \left(\frac{\text{(Emissions intensity x Sales)}}{\text{Market capitalisation}} \times \frac{\text{Value of portfolio holding}}{\text{Value of portfolio}} \right)$$

Calculation d.

= [(0.5 x (100 TCO_2 per million revenue x $10 million)) + (0.5 x (10 TCO_2 per million revenue x $10 million))]

= (0.5 x 1000/20) +(0.5 x 100/20)

= 27.5 TCO_2 per million USD revenue

Again, the market capitalisation of the first company doubles so that now the WAAC is now

Calculation e.
= [(0.67 x (100 TCO_2 per million revenue x $10 million)) + (0.33 x (10 TCO_2 per million revenue x $10 million))]
= (0.67 x 1000/40) +(0.33 x 100/20)
= 16.75 + 1.65
= 18.4 TCO_2 per million USD revenue

This time if the portfolio is rebalanced by selling some of the first company and buying more of the second so that the weight of the two companies are equal again then the WAAC lowers again

Calculation f.
= [(0.5 x (100 TCO_2 per million revenue x $10 million)) + (0.5 x (10 TCO_2 per million revenue x $10 million))]
= (0.5 x 1000/40) +(0.5 x 100/20)
= 12.5 + 2.5
= 14.5 TCO_2 per million USD revenue

Then Bouchet (2023) compares these to the absolute portfolio emissions. Shown as,

$$\text{Absolute portfolio emissions} = \sum_{\text{Sum of}} \left(\text{Company Emissions} \times \frac{\text{Value of portfolio holding}}{\text{Market capitalisation}} \right)$$

Calculation g.
= [(100 x 10) x (5/20)] + [(10 x 10) x (5/20)]
= 250 + 25
= 275

Calculation h.
When the market capitalisation of the first company doubles then absolute emissions are
= [(100 x 10) x (10/40)] + [(10 x 10) x (5/20)]
= 250 + 25
= 275

Calculation i.
If the portfolio is rebalanced by selling some of the first company and buying more of the second so that the weight of the two companies are equal again then the then absolute emissions are
= [(100 x 10) x (7.5/40)] + [(10 x 10) x (7.5/20)]
= 187.5 + 37.5
= 225

Appendix G: Climate-Related Organisation Structure

Table 14. Publicly Disclosed Climate-related Organisation Structure - Funds Ranked by AUM as at May 2023.

Fund	Climate policy delegated to	Primary responsibility for implementation	Further roles with disclosed climate responsibilities
AustralianSuper (2023)	The Investment committee	The investment team	
Australian Retirement Trust (2023a)	The Investment committee	Chief Investment Officer	Head of responsible investments, investment and investment risk team representatives
Aware Super (2023a)	The Investment committee	Chief Investment Officer	Head of Responsible investments, Risk & Compliance – Investments, Finance, Strategy & Transformation team, Head of Public Market Equities, Investment Operations & Service Delivery team, Income & Markets team
Unisuper (2023b)	The Investment committee	The investment team	
CSC (2023)	The board	The investment team	
Hostplus (2024)	The board	Chief Investment Officer	Head of responsible investing Investment Strategy Team External asset consultant
Colonial First State FirstChoice Superannuation AIL (2023)	The Investment Committee	Chief Investment Officer	External investment managers Risk management Investment Governance
CBus Super Fund (2023)	The Investment Committee	The investment team Responsible investment team	
Military Superannuation and Benefits Fund No 1 CSC (2023)	The board	The investment team	

MLC Super Fund Nulis (2024)	The Investment Committee	GM Investment Governance	Risk management Member Office Portfolio Managers Insignia Legal Asset consultant
HESTA (2023a)	The Investment Committee	Chief Investment Officer	Responsible investment team Investment execution, Legal, Risk and Compliance teams
REST (2023)	The Investment Committee	Chief Investment Officer	Head of responsible investment Risk management
Westpac Group (2023)	ESG Reputation Committee	CEO Chief risk officer Group general counsel	Board Risk Committee Board Audit committee Board remuneration committee Stakeholder Advisory Council Climate change financial Risk committee ESG council Divisional risk committees
Mercer (2023)	The board	CIO	Risk committee, portfolio exec committee, head of compliance, investment risk management committee, Global SI forum, ESG coordination group, sustainable investment consulting team, client management teams, sustainable investment solutions team, portfolio management teams.
CSS Fund CSC (2023)	The board	The investment team	
AMP (2023)	AMP Ltd board AMP Risk and compliance committee	CEO	AMP ESG and Sustainability Advisory Group Audit committee

Wealth Personal Superannuation and Pension Fund	AMP Ltd board AMP Risk and compliance committee	CEO	AMP ESG and Sustainability Advisory Group Audit committee
Brighter Super (2022)	No specific reference to ESG in the governance statement (Brighter Super, 2023)	Ambiguous, implies external manager	
Macquarie Superannuation Plan Macquarie Group (2023), MAM Public Investments (2023)	Board Governance and Compliance Committee	Risk Management Group	MPI Sustainability Team, Risk Management Group Environmental and Social Risk team, MPI Global Proxy Voting Committee, MPI Global ESG Oversight Committee
OnePath Inisignia Financial (2023), Insignia Financial (2024)	Group risk and compliance committee	Superannuation Trustee Investment Committee, 2nd Risk management function	CIO Head of ESG External Managers Head of responsible investment Insignia Legal
IOOF Inisignia Financial (2023), Insignia Financial (2024)	Group risk and compliance committee	Superannuation Trustee Investment Committee, 2nd Risk management function	CIO Head of ESG External Managers Head of responsible investment Insignia Legal
Equip Super (2024)	The investment committee	CIO	Head of responsible investment The investment team
Spirit Super (2023)	The investment committee	CIO	External advisors
Telstra Super (2024)	The investment committee	CIO	

HUB24 Super Fund (Hub 24, 2020) Equity Trustees Limited (2024)	Equity trustees for HTFS Nominees Where EQT is investment manager Internally managed listed aus equities only Management investment committee	Chief risk officer Typically delegated to the external investment manager Proxy voting advisor	Proxy voting policy only - platforms
MLC Superannuation Fund			
Netwealth Superannuation Master Fund Netwealth (2022)	Corporate sustainability Board Committee (Netwealth Group Ltd, 2023)	CEO, Executive Director, The Executive	
Public Sector Superannuation Accumulation Plan CSC (2023)	The board	The investment team	
Care Super (2024)	The investment committee	CIO	Asset consultants
Vision Super (2023)	ESG Working group	CIO	ESG Manager Investment Team
NGS Super (2023)	The investment committee	CIO	
Active Super (2023)	The investment committee		
Mine Superannuation Fund	-		
Commonwealth Bank Group Super (2023)	Merged with Australian Retirement Trust		
Avanteos Superannuation Trust AIL (2023)	The Investment Committee	Chief Investment Officer	External investment managers Risk management

			Investment Governance
Russell Invesments (2023)	Investment strategy committee and Global Risk Management Committee	CEO	
Qantas Super (2024)	The board	The Investment team	Chief Impact Officer Investment governance framework Active ownership Screening
Australian Ethical (2023)	The investment committee	CIO, Head of Impact and Ethics	Ethics research team
Prime Super	"being updated" as at 11/6/2024		
TWU Super (2023)	The investment committee	CIO	External Investment Adviser and External Investment managers
BUSSQ (2023)	No reference to climate governance policy – annual report refers to ESG investment and risk activities		
Maritime Super	Merged with hostplus		
National Mutual Retirement Fund Resolution Life Equity Trustees Limited (2024)			
LegalSuper (2023)	The investment committee (LegalSuper, 2024)	External investment managers Screens ACSI proxy voting for Australia equities Investment advisors	
Smart Future Trust Equity trustees			

Essential Super	Avanteos		
First Super (2022)	The Investment committee	CEO	Analytics and Investment Officer
Praemium (2023) (Diversa Trustees)			Platform, managed accounts, model portfolios Proxy voting by underlying managers
(Diversa Trustees); ING Superannuation (2023)	Investment managers Mercer Investments Australia		Proxy voting by underlying managers
Oasis Superannuation Master Trust Inisignia Financial (2023), Insignia Financial (2024)	Group risk and compliance committee	Superannuation Trustee Investment Committee, 2nd Risk management function	CIO Head of ESG External Managers Head of responsible investment Insignia Legal

Appendix H: Comparing Transition Plan Guidance

Table 15. Comparing Scope 3 Requirements of Net Zero Frameworks

Framework	Scope 3 (S3) requirements and recommendations
NZIF2.0	Baseline S3 to be calculated separately. a S3 management strategy to be developed. Material S3 emissions are disclosed on a dashboard Engagement with investee companies and service providers to disclose their S3 emissions.
ICAP	*recommends* Track S3 emissions. Include S3 in sector targets where possible Material S3 targets and disclosure to be phased in, 'material' is >40% of emissions of underlying assets.
GFANZ-NZ	*recommends* Material S3 emissions are disclosed. 'material' is >40% total company emissions or where scope 3 emissions are higher than 10 Mt CO2e as could be likely in sold oil and gas goods and services, electrical utilities, use of sold automotive, consumer staples and chemical sectors (GFANZ, 2022b)
SBTi-NZ in consultation phase	*Proposed requirement* S3 emissions for automotive, oil and gas, forest, land and agriculture shall be included and S3 emissions shall be estimated for all other sectors where possible. Where materiality of scope 3 emissions are below 5% they can be excluded.

	Any offsets or carbon credits used by investee entities cannot be included. Financed and facilitated emissions should be reported separately (SBTi, 2023a)
NZAOA-TSP4	*Recommends* Track S3 emissions, targets will not be required until data is more reliable. Set targets and report where possible (UNEP FI & PRI, 2024b)
EU-CS	Develop S3 target Report S3 emissions where relevant. Notes the priority for reporting standards to specify required S3 emissions disclosure.
UK-TPT	Explain which S3 are included in target or the reason for their exclusion and explanation of any steps for improved S3 monitoring and reporting. Scope 3 should be disclosed where they are including in the target.

Table 16. Comparison recommended Baseline, Included and Recalculated Emissions in Commonly-used Net Zero Plan Frameworks

Framework	Baseline, included and recalculated emissions recommendations and requirements
NZIF2.0	**BASELINE EMISSIONS:** Disclose baseline calculation method and separate scope 3 and sovereign-related emissions. **INCLUDED EMISSIONS:** Disclose ratio and methodology for asset alignment and excluded assets and provide an inclusion timeline

	RECALCULATION: Entities should disclose a policy for baseline recalculation.
ICAP	**INCLUDED EMISSIONS:** Minimum 70% coverage in material sectors to be net zero, aligned or subject to stewardship, to be increased to 90% by 2030
GFANZ -NZ	**BASELINE EMISSIONS:** Select a baseline year that is recent and representative. They note the data challenges affecting accurate calculation. **INCLUDED EMISSIONS:** Entities should disclose a policy on their scope and timeline for emissions inclusion and portfolio exclusions **RECALCULATION:** Entities should disclose a policy for baseline recalculation.
SBTi -NZ	*Proposed requirement* **BASELINE EMISSIONS:** A starting baseline for emissions is preferably an annual time-weighted average of portfolio holdings. An alternative proposal is holdings dated as per the annual financial statement. **RECALCULATION:** An attribution approach should explain; changes in emissions due to changes in corporate structure, emissions reduction of underlying assets, portfolio composition, availability of emissions data and new calculation methods. **INCLUDED EMISSIONS:** All financed and facilitated activities must be included where a suitable alignment method exists, and updated within maximum of 18 months of their availability.
NZAOA-TSP4	**BASELINE EMISSIONS:** A base and target year should be set and updated in 5-year cycles. Adjustments on pre-existing targets is allowed if it is in line with a scientific pathway **INCLUDED EMISSIONS:** Phase-in targets should be disclosed **RECALCULATION:**

	Portfolio emissions calculation should be disclosed and can be dated in correspondence to the annual financial statement or to the most recently available data
EU-CS	**BASELINE EMISSIONS:** Global baseline standards to be developed by the ISSB
UK-TPT	**INCLUDED EMISSIONS:** Strategic ambition and implementation strategy in relation to roadmaps.

Table 17. Recommendations and Requirements Scenario Analysis

Framework	Recommendations and requirements for scenario analysis
NZIF2.0	Use scenario analysis to inform capital market assumptions and return expectations Use scenario analysis to stress test portfolios Define how scenario analysis will be used in investment decisions Use scenario analysis to demonstrate how the transition plan can be reached
ICAP	*Recommends* Conduct 1.5^{o} and 2^{o} scenario analysis and stress testing to identify risks and opportunities With increased familiarity, scenario analysis should be incorporated in investment decision making, methods, assumptions and findings disclosed and scenario analysis should be used to set climate solutions targets.
GFANZ -NZ	*Recommends* Use scenario analysis to set a baseline for climate solutions investment. Ensure model and scenarios are peer-reviewed. Identify its current use – eg. net zero alignment or risk?
SBTi -NZ	*Proposed requirements*

	Climate risk modelling should determine the extent of portfolio alignment with a 1.5^{o} low overshoot pathway, with required thresholds to be set by SBTi. Sector-level and baseline alignment will also need to be disclosed.
NZAOA-TSP4	*Requirements* Select and apply a sector pathway scenario analysis model to set sector level decarbonisation targets, NZAOA recommends using either the OECM or IEA sector data as well as a regional or country-level data
EU-CS	*Requirements* Prudential scenario analysis has been mandated for the European Supervisory Authorities and European Central Bank and (European Comission, 2021), this has lead to the-Fit-for-55 one-off scenario analysis that includes 110 EU Banks (Martyniuk, 2024).
UK-TPT	*Recommends* The use of UK Climate Financial Risk Forum's Scenario Analysis Guide.

Table 18. Recommendations and Requirements for Investment in Climate Solutions

Framework	Recommendations and requirements for investment in climate solutions
NZIF2.0	Climate solutions metrics and classifications should be used: TSC aligned, Taxonomy aligned for 'standardisation' and 'transparency'. Climate solutions mandates should be set for third party service providers and custodians. Lobbying should aim for the inclusion of fair share principles in national assessments Nuanced reporting should be used to explain necessary emissions increases due to transition and climate solutions Use custom and climate-tilted performance benchmarks for increased climate solutions investment.

	Add net zero goals to standard indicators including forward-looking metrics "*eg. Proportion of companies with clean energy commitments*" Develop a deforestation and energy investment policy Disclose fair share global emissions reduction contribution
ICAP	*Recommends* An increasing <10 year goal for climate solutions investment based on EU taxonomy mitigation criteria Engagement with investee companies to ensure their capital allocation decisions are climate-aligned Investors should become involved in climate solutions taxonomy and disclosure improvement
GFANZ -NZ	*Recommendation* Expand global GHG emissions reduction with investment in climate mitigation technologies and services. Disclose the entity approach to climate solutions investment. Lobbying governments for public capital for climate solutions investment Notes that regional sectoral decarbonisation paths and taxonomies are important for credible climate solutions investment Use climate solutions metrics for decision-making, for example, green-asset ratio and green capital weighting.
SBTi -NZ	*Proposed requirements* Tilt SAA to generate climate impact such as grid and renewable energy infrastructure, energy efficient building and private equity for renewable energy technology.

	Adopt sector specific positions in sectors where the greatest impact of solutions can be achieved such as power utilities, automotives, steel, cement and chemicals.
NZAOA-TSP4	*Requirements* Set climate solutions investment targets such as % green investment, % green assets, % green revenue. Annual disclosure on progress against these targets. Consider reporting on the split of climate solutions investment in OECD/ non-OECD countries. Contribute to industry guidance on climate solutions They acknowledge the asset and liability management constraints that will exist for different entities wishing to provide climate-positive capital.
EU-CS	*Requirements* Taxonomy guidance from the EU framework to facilitate sustainable investment (European Parliament, 2020b).
UK-TPT	*Requirements* Define objectives, climate solution targets and disclosure of strategic ambition including climate solutions financing or enabling entities and activities that develop and scale climate solutions. Consider stakeholder engagement to attract climate solutions capital Consider increasing capital allocation in climate solutions, nature-based solutions and other forms of adaptation and transition finance Reference to IIGCC (2023a) climate solutions guidance

Table 19. Recommendations and Requirements on Phasing-out Fossil Fuels.

Framework	Recommendations and requirements for sovereign-related emissions
NZIF2.0	Phase out unabated fossil fuels to align with a 1.5^{o} pathway Lobby governments to ensure subsidies do not inhibit net zero goals
ICAP	*Recommends* Formal thresholds are undefined, phase-out all fossil fuel investments that are inconsistent with a 1.5^{o} pathway. Apply region-specific advice Publish policy that affirms phase-out of unabated fossil fuels through engagement or divestment. Stewardship activities to shift entity behaviour Just transition planning Recommends a systematic focus on fossil fuel value chains including petrochemicals and plastic waste. Engagement on fossil fuels Lobby governments to phase out fossil fuel subsidies and introduce carbon pricing
GFANZ -NZ	*Recommends* Accelerated phase out of fossil fuel energy financing consistent with a 1.5^{o} pathway Notes the role of forests in CO_2 storage and notes the need to stop deforestation. Lobby governments as fossil fuel subsidies create market distortions Further guidance to be provided on oil and gas especially in relation to natural gas that is seen as a transition fuel in some markets.

SBTi -NZ	*Proposed requirements* (SBTi, 2023b) timeframe for these criteria differ by country income. All exposure to fossil fuel must be disclosed including scope 1,2 and 3 emissions and their transition plans A policy must be created to ensure no financial support of new or unabated fossil fuel activities across the fossil fuel value chain, that is entities with > 5% revenue in coal, unabated oil and gas and projects Engagement with existing fossil fuel entities to align with 1.5^{o} low overshoot transition in accordance with set criteria including no expansion and clear commitments to abate emissions by >90% direct emissions, carbon capture must have a lifetime> 100 years and cannot be used for continued production, entities and projects must phase down production Phase out support for any projects or companies that are not transitioning according to those set criteria within two years. Fossil fuel commodities and future trading should be disclosed, specific targets will be set in the future.
NZAOA-TSP4	*Requirements* Policies should be adopted in alignment with NZAOA (2020) thermal coal position that is no new coal, all existing unabated coal fired electricity should be phased out by 2030 in advanced economies and by 2040 globally. Alignment with NZAOA (2023b) position on oil and gas that is no new investments in upstream oil or gas fields or oil-fired power, oil and gas pipeline investments should be

	limited to brownfield projects, no new unabated gas-fired power, align infrastructure investments with 1.5^{o} pathways, invest in carbon solutions and removal technology. Engagement with companies to set scope 1,2 & 3 targets, reduce emissions through their value change especially fugitive methane emissions and transition away from unconventional oil and gas. Adapt engagement for EMDE entities. Lobby policymakers for carbon pricing, and public-private investments in zero emission infrastructure.
EU-CS	*Requirements refer to disclosure* Specific directive to investors has not been issued Guidance can be found in the EU taxonomy criteria for determining whether an investment qualifies as environmentally sustainable; that specifies that power generation from solid fossil fuels is not environmentally sustainable (European Parliament, 2020b) and major EU climate policies; EU Carbon border adjustment mechanism EU Emissions trading system with clean technology required for energy intensive industries (European Commission, 2021b), Energy taxation directive, 36-39% binding energy consumption emissions reduction target by 2030, European Action Programme 8 includes setting a deadline for phasing out fossil fuel subsidies (European Parliament, 2022a)
UK-TPT	*Recommends*

	Entities may consider developing policy and phasing out oil and gas utilities, thermal coal mining and coal-fired electricity generation Disclosure of managed phase out plans

Table 20. Recommendations and Requirements for the use of Offsets

Framework	Recommendations and requirements for use of offsets
NZIF2.0	Purchased offsets should not be used to offset portfolio emissions unless there is no viable solution.
ICAP	*Recommends* Alignment with GFANZ-NZ and also disclose the use of neutralisation credits separately. For performance at the highest tier, ICAP only recommends the use of credible portfolio emission offsets after 2030 in line with NZIF and NZAOA carbon removal criteria.
GFANZ -NZ	*Recommendation* Allows for the neutralisation of remaining GHG emissions through the purchase of quality credits either within the value chain or by the entity. In acknowledging known debates over the use of offsets they recommend that offset emissions are separated from net zero progress and information on the credits is disclosed. Aligns with recommendations from the Integrity Council for the Voluntary Carbon Markets (ICVCM) and the Voluntary Carbon Markets Integrity Initiative (VCMII).
SBTi -NZ	*Proposed requirements* Carbon credits purchased by investee companies cannot be counted

	"Residual GHGs released into the atmosphere when the FI has achieved their long-term targets must be counterbalanced through the permanent removal and storage of carbon from the atmosphere. FIs must ensure these residual emissions are neutralized to reach net-zero emissions at the portfolio level and achieve a state of zero impact on the climate from GHG emissions."
NZAOA-TSP4	*Requirements* Carbon removal offsets must not detract from decarbonisation progress. Carbon removals must not be used to reach a portfolio target prior to 2030 but voluntary use is strongly recommended as a way of contributing to planetary emissions reduction. Offsets must be disclosed separately.
EU-CS	*Requirements* EU Carbon Removal Certified carbon offsets are permitted for an entity's residual emissions after all possible reduction has taken place (European Parliament, 2024a).
UK-TPT	*Requirements* The use and details of carbon offsets must be disclosed annually

Table 21. Corporate Engagement

Framework	Recommendations and requirements for corporate engagement
NZIF2.0	Set an increasing engagement target in relation to the proportion to of assets 'achieving or aligned' to a credible net zero pathway. Start from 70% of scope 1 & 2 financed emissions in material sectors that increases to 90% by 2030.

	Develop and disclose an engagement policy including priorities, milestones and time-bound escalation steps Disclose voting policy and actions Participate in collaborative engagement such as Climate Action 100+ and IIGCC Net zero engagement initiative
ICAP	*Recommends* Engagement for climate-related disclosure, transition plans, climate targets, decarbonisation strategies and capital allocation to aligned investment. Align all rights including resolutions, proxy voting, director appointment or removal, with net zero pathways Participate in collaborative engagements such as Climate Action 100+ and CDP campaigns
GFANZ -NZ	*Recommends* Share net zero plan with investee companies Engagement, Support, monitor and advise portfolio companies for net zero alignment with stewardship including proxy voting, shareholder resolutions, lending conditions, escalation processes with divestment as a last resort. Participate in collaborative engagement to magnify effort. Encourage new transition-related networks Become a signatory to climate-transition commitments Peer comparison and cross-sector initiatives Develop or publicly support industry initatives and thought leadership in low carbon tools and solutions
SBTi -NZ **SBTi et al. (2023)**	Supplier targets should be aligned with SBTi criteria. Develop an engagement target

	eg. 67% of scope 3 emissions to meet SBTi criteria. Determine entities for engagement by ranking investee companies by their total emissions and engaging with enough of them to represent 67% portfolio emissions or greater. Engagement targets should outline expectations and consequences and must be achieved within 5 years of setting. Engagement decisions should include senior leadership, sustainability and finance teams Provide training such as workshops, coaching and webinars
NZAOA-TSP4	Engagement with investee companies on alignment to 1.5^{o} low overshoot climate risk expectations including target and business plan. Align with CA100+ expectations Clear escalation steps Engagement activity should be with 20 entities where decarbonisation impact is greatest or at least 65% of financed emissions. Participate in collaborative engagement especially across sectors or value chains
EU-CS	Companies with turnover > $450 million Euro and/ or 1000 employees should use their power to influence and do due diligence to avoid adverse environmental and human rights in their own operations, their subsidiaries, their direct and indirect business partners through their upstream chain of activities such as sourcing and supply of material and downstream such as distribution

UK-TPT	Engagement and disclosure of current and planned activities for entity and across value chain to respond and contribute to a low carbon, climate resilient economy. Collaborative engagement and disclosure of current and planned activities with industry bodies.

Table 22. Policy Advocacy Recommendations

Framework	Recommendations and requirements for policy advocacy
NZIF2.0	Direct and collaborative engagement with policymakers and regulators to overcome policy barrier to net zero and climate solutions investment Develop and disclose policy monitoring and advocacy processes Also encourage interoperability
ICAP	Advocate for policy to scale capital flow to decarbonisation, adaptation and a just transition. Ensure political contributions are aligned to 1.5^{o} low overshoot goals. Lobbying can be to intergovernmental and international groups such as G20, ISSB and IOSCO as well as domestic policy makers and regulators.
GFANZ -NZ	Influence policy and regulation for an accelerated and orderly transition to net zero Engage on national net zero targets, net zero-aligned regulation, carbon pricing instruments, high integrity voluntary carbon markets and incentives to scale up investment in low carbon solutions Seek dialogue with government leaders Provide consultation feedback individually or as part of an industry body

	Share research and reports calling for climate policy
SBTi -NZ	SBTi (2022) refers to the opportunity for asset owners to lobby for improved climate-related disclosure regulation, climate-related tax, fiscal and incentive policies and lobbying to central banks for climate-related developments. It notes that public lobbying is an area SBTi are yet to develop.
NZAOA-TSP4	Disclose and support the development of net zero policy and regulation. Contribute to climate reports
EU-CS	Not included as these are government initiatives
UK-TPT	

Table 23. Recommendations and Requirements on Sovereign-related Investment and Engagement

Framework	Recommendations and requirements for sovereign-related investment and engagement
NZIF2.0	Disclose sovereign-related assets consumption emissions separately. Define a decarbonisation objective for sovereign bonds, for use on a best effort basis eg. tCO2e/$mn invested Update 5 yearly Recommends the use of PCAF sovereign consumption accounting method. Any fair share principles used should be disclosed Portfolio tilt towards aligning countries Engagement with issuers for improved labelling SOEs should be treated as per corporate fixed income Suggests using ASCOR, CAT and CCPI data sources
ICAP	*Recommends* Sovereign bond engagement
GFANZ -NZ	*Recommends* Sovereign bond engagement

SBTi -NZ	*Proposed requirements* Sovereign debt is in scope for net zero portfolio emissions
NZAOA-TSP4	*Requirements* Sovereign emissions target should be set by end 2024. Disclose (scope 1) sovereign bond production emissions annually When data can be reasonably assessed disclose consumption emissions Disclose land use and forestry Sub-sovereigns, supra nationals and municipal debt will be considered at a later date Requests that investors pilot the ASCOR scores in 2024 Provide a market value-weighted portfolio average score for all sovereign debt
EU-CS	*Requirements* European Green bond standard provides standardised requirements for issuers including sovereigns (European Parliament, 2023)
UK-TPT	*Recommends* Sovereign bond engagement