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Responding to Climate Change:
A case study

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"Climate change isn't an 'issue' to add to the list of things to worry about next to health care and taxes. It is a civilization wake-up call, a powerful message spoken in the language of fires, floods, drought and extinctions, telling us we need a new economic model – telling us we need to evolve."

Naomi Klein, 2014

1. Introduction

What would you say will be the greatest source of atmospheric CO_2 by 2050? Coal-fired power? Fuel combustion engines? Boreal forest fires maybe? All good guesses, but the answer is probably *none* of these things. In all likelihood, the largest source of CO_2 by 2050 will be the Siberian peat-land bogs. Roughly one-third of all carbon in the earth's land mass is stored in peat-bogs under the arctic permafrost. These frozen wetlands are now starting to thaw and release CO_2 through a process of bacterial conversion. By 2050, it is estimated they will have released more than half this store of carbon, *doubling* the current level of atmospheric CO_2.

The potentially catastrophic impact of thawing arctic permafrost highlights several features of all complex systems – path dependency, feedback loops and the propensity of complex systems to suddenly emerge from a dormant state into a highly charged, *critical state of instability*. The earth's climate is such a system. It would be a mistake to think of climate change as a steady rise in temperature we can model and forecast … and then respond to when the time comes. It would be an even bigger mistake to think deregulated markets will make the requisite adjustments for us. Reaching a critical state in any complex system such as a battlefield, a stock market or the world's ecosystem is like driving your car down a hill and the brakes fail. *By the time you realise they've failed, it will be far too late to do anything about it*.

The aim of this paper is to consider what this means for institutional investors and, specifically, the approach we have taken to managing climate change risk at First State Super. We begin by outlining what climate change is and the key feedback loops likely to compound the risks to investors and to society more broadly. We consider how governments are responding and how pension funds might respond, including a case study of how a portfolio-wide *Climate Change Adaptation Plan* was developed by First State Super in 2015.

2. What do we mean by global warming and climate change?

Global warming is the result of *radiative forcing*. Put simply, this is what happens when more energy enters our climatic system then leaves it, meaning energy is retained somewhere in the system (in fact, over 90 per cent of it is retained in the world's oceans). Many factors affect the balance of radiative forcing – the wave-length of incoming solar energy, ozone levels and cloud formation just to name a few – but the earth is retaining more heat energy and, unfortunately for us, is now retaining it *at an increasing rate*.

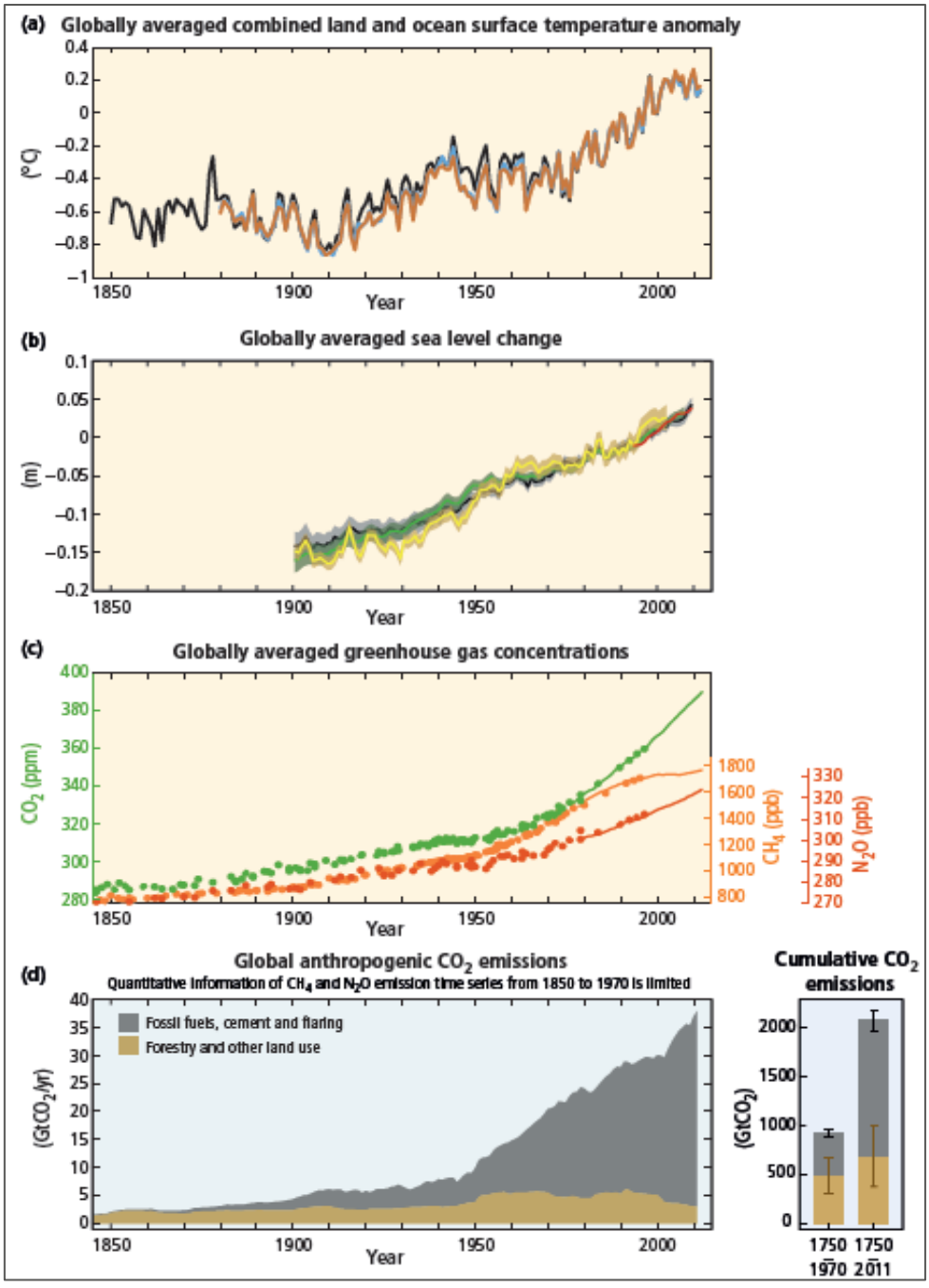
Record temperatures, droughts and typhoons do not, in themselves, represent climate change. Weather patterns can be chaotic and highly episodic, with sequences of unusually hot or cold, dry or wet seasons. When we speak of climate change here, we are talking about a *systemic* change in the interaction between climatic variables that bring the climate to a critical state of instability – the "*we're not in Kansas anymore*" moment.

In defining such a tipping point, climate scientists have settled on a rise in surface temperatures, on average, of 2°C from pre-industrial levels. Whether it should be 1.5°C, 2°C or even 3°C is a moot point – it is only relevant *when* we reach it under current pathways, whether it's us, our children, or our grandchildren that suffer most.

As shown in Display 1(a), the latest UN Inter-Government Panel on Climate Change (IPCC) Synthesis Report (IPCC Report) based on data to 2012, shows that average temperatures have so far increased 0.8˚C since the Industrial Revolution, *of which 0.5˚C has occurred in just the last 30 years*. Given the lifespan of most greenhouse gases and the latency of global warming, even if we did not produce a single ounce more CO_2, average temperatures will still rise another 0.5˚C, bringing the total increase eventually to *at least* 1.3˚C.

The IPCC Report also shows average sea level rise of 15-20cms over the past century – see Display 1, graph (b). The main protagonist in all this, of course, is the accumulation of CO_2 and other greenhouse gases (GHG) in the atmosphere, reported as reaching concentrations of 380ppm by 2010 (see Display 1, graph (c)). As Display 1, graph (d) illustrates, this accumulation of GHGs is almost entirely anthropogenic, i.e. man-made.

Display 1. Charts from the IPCC 2014 Synthesis Report (Base year for a, b = 2000)



Unfortunately, the world is still producing 50GtCO_2e a year and, in the absence of coordinated global action, is projected to breach the 2°C limit (900GtCO_2e) within 20 years and record temperatures 4-5°C higher in 50-70 years. Indeed, last month, CSIRO's Cape Grim station recorded GHG concentrations over 400ppm and recent IPCC data shows that post-industrial warming may now have hit 1°C. If there is a criticism to be made of the IPCC's climate models, it is that they consistently *under-estimate* just how quickly the climate is changing.

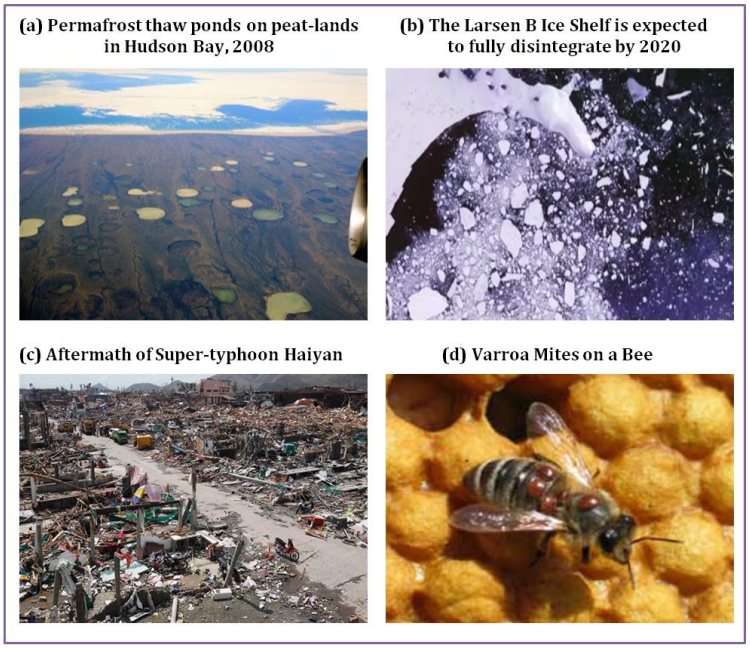
3. Positive (reinforcing) feedback loops

We began with stories of thawing arctic permafrost, unlocking a subterranean *methane ocean*. What we didn't explain was that recent studies of arctic peat-bogs have made a worrying discovery. Not only is the rate of thaw increasing, but the bacterial conversion process releasing CO_2 from the peat-bogs is accelerated by the presence of CO_2 in the air around it, causing the peat to emit as much as 10 times more CO_2 than normal. This process has been blocked for thousands of years by the bog's frozen barrier … until now. Having now thawed, *GHG emissions from the peat-bogs have become self-perpetuating*.

Another feedback loop is emerging as rising ocean temperatures melt polar ice. From above, ice caps are white and reflect heat energy – when they melt, they turn blue-black and absorb it. The melting of ice therefore increases the rate of heat absorption, while melt-water draining through cracks in an ice sheet or glacier softens it from the inside, also causing the process to accelerate. Moreover, as ice melts, it *expands* and so rising sea levels are not just due to a displacement effect (like sitting down in a bath tub), but also the more expansive molecular behaviour of melt-water. As a guide, the Larsen B ice shelf in the Antarctic acts as a 625m^2 stopper preventing the much larger Western Ice Sheet slipping into the sea. NASA now predicts the Larson B may collapse by 2020. If the larger Western Ice Shelf subsequently collapses over the next ~50 years, it is estimated *this will raise sea levels by up to three metres*.

Melting ice is also responsible for the reversal of the Beaufort Gyre. Bound by Greenland, Russia and Canada, this dominant circular current is driven by a permanent high pressure system over the Arctic. Its normal clockwise motion forces melted (fresh water) ice back to the centre, trapping it in a dome where it re-freezes. But the increasing spread of this dome, as more ice melts, is now causing a reversal in the direction of the current, allowing fresh-water to flow back through the Fram Strait into the North Atlantic

Display 2. Examples of climate change feedback loops



and Gulf Stream, where it has already had a major effect on weather patterns for the United States.

In yet another feedback loop, it is well understood that warmer oceans create more intense wind speeds. Greater heat energy is also leading to greater *nutrient matter* in the upper layers of the ocean which, in turn, traps more heat. Scientists at the Scripps Institution of Oceanography have found the greater intensity of typhoons, such as super-typhoon Haiyan which tore through the Philippines in 2012, are due to higher ocean surface temperatures, compounded by higher nutrient levels. The warmer south-eastern Pacific, they concluded, caused typhoons to start further out to sea, essentially giving them *a much longer runway* before making landfall.

Finally, rising temperatures are leading to more specie extinctions. Dirty Harry once said "*there's nothin' wrong with shootin' … as long as the right people get shot*." Similarly, most of us seem to feel there's nothin' wrong with extinction, as long as the right species become extinct. And so, we have stood idly by and watched the declining population of polar bears, Queensland bats and the final passing of the Oriole and the American Goldfinch. However there is one extinction story-in-the-making that may bring this into sharper relief. While our food arrives packaged up on supermarket shelves, at its heart, our food system remains dependent upon the natural process of pollination and, ergo, on *bees*.

Over the past 15-20 years, bee populations have fallen in Europe and North America by greater than one-third. This phenomenon, known as *colony collapse disorder*, is often attributed to the concoction of pesticides used in modern farming. New research however, shows that bees are under siege from more than just chemicals. Many have been stricken by the Varroa Mite. Specifically, the mite found on dead bees is the Asian *nosema ceranae*, not normally found in northern regions due to the cold. According to researchers at Belfast's Queens University, this is changing – as the planet warms, the mites are *migrating*. The decline in the number and productivity of bees presents a feedback loop that may ultimately threaten human beings' ability to withstand climate change.

4. How long do we have?

The IPCC projects average temperature and sea levels under different future Representative Concentration Pathways (RCPs). The most benign of these, RCP2.6, is a scenario in which GHG emissions are steadily reduced to levels 90 per cent below current levels by 2050, with atmospheric carbon peaking at 800GtCO_2e vis-à-vis current levels of 500GtCO_2e. Under RCP2.6, temperatures would peak at 1.8°C above pre-industrial levels. Under a scenario where there is no reductions in emissions however, RCP8.5, temperatures may be 4-5°C higher by 2100 with accumulated CO_2 rising to 1,500GtCO_2. Under this scenario, we will blow through the 2°C limit in 15-20 years.

Display 3. Projected temperature and sea level rises relative to 1986-2005 levels under Representative Concentration Pathways (IPCC, 2014) (add 0.8°C and 0.17m respectively to give rises from pre-industrial levels)

		2046–2065		2081–2100	
	Scenario	Mean	*Likely* range [c]	Mean	*Likely* range [c]
Global Mean Surface Temperature Change (°C) [a]	RCP2.6	1.0	0.4 to 1.6	1.0	0.3 to 1.7
	RCP4.5	1.4	0.9 to 2.0	1.8	1.1 to 2.6
	RCP6.0	1.3	0.8 to 1.8	2.2	1.4 to 3.1
	RCP8.5	2.0	1.4 to 2.6	3.7	2.6 to 4.8
	Scenario	**Mean**	***Likely* range [d]**	**Mean**	***Likely* range [d]**
Global Mean Sea Level Rise (m) [b]	RCP2.6	0.24	0.17 to 0.32	0.40	0.26 to 0.55
	RCP4.5	0.26	0.19 to 0.33	0.47	0.32 to 0.63
	RCP6.0	0.25	0.18 to 0.32	0.48	0.33 to 0.63
	RCP8.5	0.30	0.22 to 0.38	0.63	0.45 to 0.82

5. How are governments responding?

If climate change reflects a colossal form of market failure, the lack of action at the United Nations Framework Convention on Climate Change (UNFCCC) 2009 Conference of the Parties summit (COP15) in Copenhagen represented a colossal *failure of government*. Having promised so much, the summit delivered little in terms of real policy action, confirming people's worst fear - *no one was coming to save us*. The despair this caused however, set in motion a massive, world-wide mobilization of climate activists, scientists, asset owners and other concerned citizens. By 2015, elected leaders and climate authorities were back at the negotiating table ahead of the COP21 summit in Paris with a new global imperative for coordinated policy action.

The two week COP21 summit came to a close on 12 December 2015 with 196 countries committing to a universal pledge to reduce GHG emissions (the Paris Agreement). While the full effects of the summit will take time to ripple through, the key outcomes were as follows:

1. *New goal of 1.5°C to 2°C*

Leaders agreed they should aim to limit global warming to less than 2°C, and possibly even 1.5°C, with a longer-term goal of net zero emissions by the second half of the century.

2. *Intended Nationally Determined Contributions (INDCs)*

Prior summits were criticised for infringing national sovereignty by pushing individual countries to commit to targets they were not ready to deliver, notably China and India. The Paris Agreement allowed countries to pledge their own intended nationally determined contributions (INDCs) to emissions reduction. The INDCs of major countries are set out in Display 4. As of April 2016, 55 countries had formally signed off on their INDCs.

Display 4. Select countries' INDCs to the Paris UNFCCC

Country	GHG Emissions (2012, $GtCO_2e$)	Base Year	Reduction Target	Target Year	2030 v 1990 Equivalent
United States	5,546.3	2005	26-28%	2025	~26%
Europe Union	4,240.7	1990	>40%	2030	>40%
Japan	1,266.1	2005	25%	2030	~18%
Switzerland	50.4	1990	50%	2030	50%
Norway	26.1	1990	>40%	2030	>40%
Russia	1,755.1	1990	25-30%	2030	25-30%
Canada	739.5	2005	30%	2030	~13%
New Zealand	49.4	2005	30%	2030	~8%
Australia	558.4	2005	26-28%	2030	5-20%
China	7,045.0 (2005)	Aim to peak emissions by 2030			+400-500%

3. *Five-year reviews*

Notwithstanding the progress at the COP21 summit in Paris, the pledges remain well short of what is required to keep global warming below the 2°C limit. Accordingly, leaders acknowledged that national

pledges will need to ratchet up over time, with countries resubmitting their INDCs and reporting on progress every five years.

4. Climate financing

To provide financial support to poorer countries, the agreement has a climate finance goal of $100 billion per year by 2020. This goal, first established at the 2010 UNFCCC summit in Cancun, seeks to lift the level of state and private funding for renewables and other climate-related projects in developing countries. In 2014, the level of financial commitments was $62 billion.

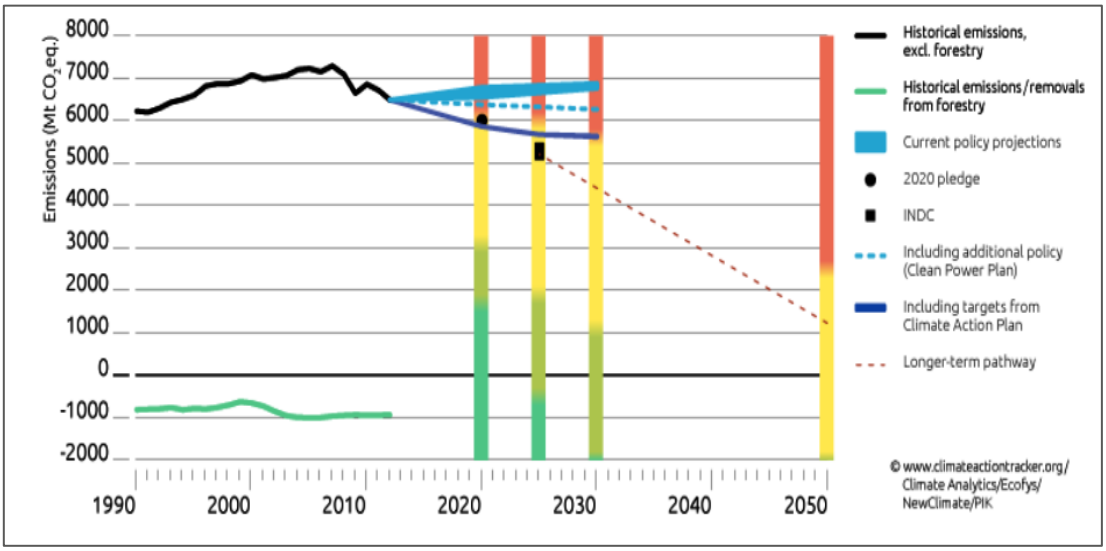
More generally, the COP21 summit in Paris provided fresh impetus for the transition to a low-carbon global economy, albeit this will likely occur at a different pace in different regions and still requires real policy action to ensure *the targets are met*.

Some implications for investors and corporations include:

- new sector initiatives in renewable energy, aviation and other sectors;
- an increasing risk of stranded assets, notably in the fossil fuels sector;
- greater pressure for carbon disclosure including stronger internal data systems and reporting processes.

Display 5 shows how the INDCs apply for the United States. The black line shows the path of CO_2 emissions since 1990, peaking in 2008 after the financial crisis. The blue line shows the projected future path based on prior policies, including tax credits for wind and solar and vehicle fuel-economy standards. The dotted blue line shows reduction due to the *Clean Power Plan* while the dark blue line projects further cuts from the more recent *Climate Action Plan*. The INDCs are shown by the black square in 2025 and the red dotted line shows future reductions needed to meet the 2°C limit (yellow shading).

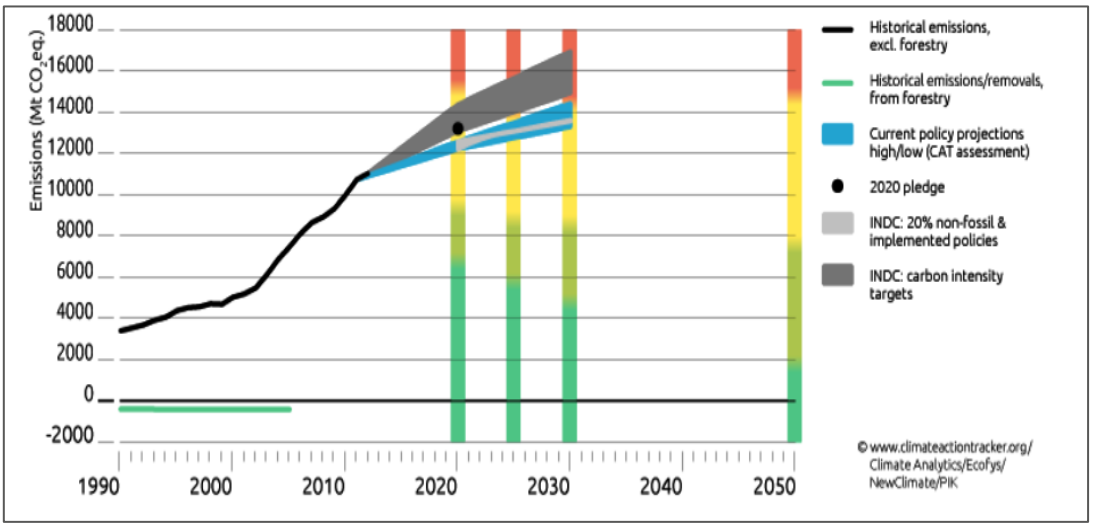
Display 5. INDCs for the United States



Source: Climate Action Tracker

Countries at an earlier stage of industrialisation, such as China and India, were unwilling or unable to commit to emission *reductions*. China did however, commit to a target date for *peak* emissions (2030 or sooner) and a range of projects to reduce carbon intensity and pollution. In its latest Five Year Plan, China set a target of 700GW of renewable energy capacity in 2020 and is expected to reach total renewable capacity of 1100GW by 2030.

Display 6. INDCs for China



Source: Climate Action Tracker

The Australian government has committed to reducing emissions by 26-28% from 2005 levels by 2030, equivalent to around 5-20% from 1990 levels (depending on whether we exclude land use and forestry from calculations). Australia's total emissions are currently ~560MtCO_2e, of which one-third comes from electricity generation and another one-third from transport. For reference, in the absence of further policy action, emissions are projected to rise to over 720MtCO_2e by 2029-30 (more than 30% above current levels).

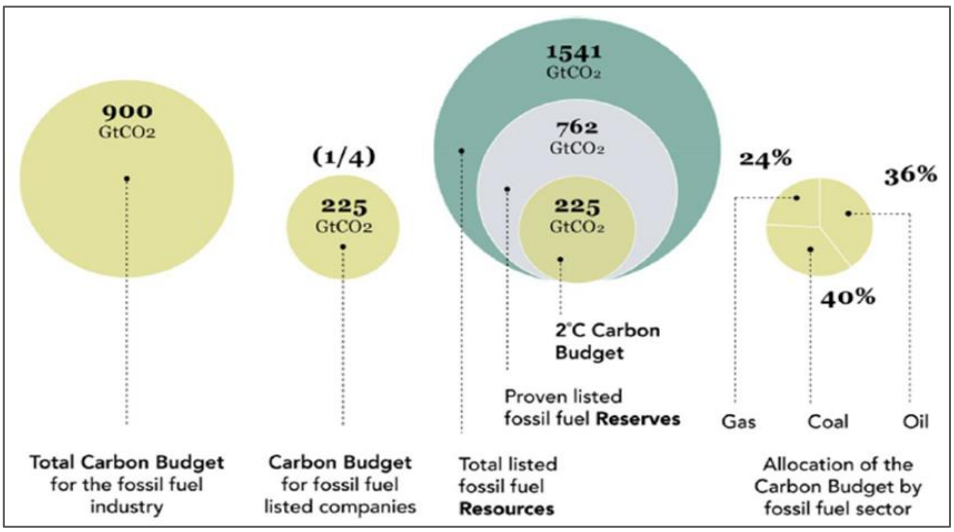
At the end of the day, the INDC pledges are just that – pledges. To ensure real cuts to emissions, real changes will need to be made. These changes may be price-based, e.g. an emissions trading system (ETS) or volume-based, e.g. safeguard mechanisms or energy efficiency standards. Either way, they will only be successful if backed by a proactive, enlightened approach to capital allocation by investors.

6. What are the main risks from climate change for pension funds?

Like all risks, climate change risk is multi-dimensional. For instance, there are *direct risks* to portfolios from more frequent, catastrophic weather events via physical damage or loss of earnings. There are already many real examples of this – damage to Aurizon's rail lines in the Queensland floods; the flooding of Yallourn coal mine which threatened power supply to Victoria; a $500mn class action settlement by SP Ausnet following the Black Saturday fires. In recent years, insurance companies have repeatedly downgraded earnings due to 'extreme catastrophe activity'. More generally, research groups estimate over $US2.2 trillion in damage has been incurred as a direct result of some 15,000 extreme weather events over the past 20 years.

The possibility of *policy action* to reduce emissions introduces a different type of risk. A carbon price, for instance, that adds to the cost of carbon-intensive industries such as thermal power generation or steel production may erode the profits of such firms and diminish demand for fossil fuels. International competitiveness may be impacted in the instance that policies are enacted in some countries but not others. Similarly, *technological changes* (supported by public policy or otherwise) may be highly disruptive to established fossil fuel businesses. This potential loss in value is referred to as '*stranded asset risk*'.

Display 7. The 'Carbon Budget' - estimating the level of unburnable carbon



The scale of stranded asset risk was highlighted by the Carbon Tracker Institute in a 2011 report entitled *Unburnable Carbon*, which raised the spectre of a '*carbon bubble*'. The Carbon Tracker thesis, illustrated in Display 7, goes something like this:

1. if the world is to limit global warming to 2°C, it must limit cumulative emissions to ~900GtCO$_2$e;
2. listed companies' share of this is roughly one-quarter, or ~225GtCO$_2$e;
3. this represents just one-third of all listed companies' *proven* fossil fuel reserves and just one-seventh of their total *known* reserves; and so
4. two-thirds (six-sevenths) of all proven (known) reserves are thus *unburnable*.

Add in the growing public awareness of climate change, a growing divestment movement and given the propensity of markets to price in future expectations, stranded asset risk is not a long-term risk – it is impacting assets now, most notably in thermal coal and other fossil fuels. This has been compounded by a proliferation of rooftop solar generation 'behind-the-meter'. In the most potent example, the world's largest coal company, Peabody Inc. in April 2016 filed for Chapter 11 protection in the US with over $US10 billion in outstanding debt.

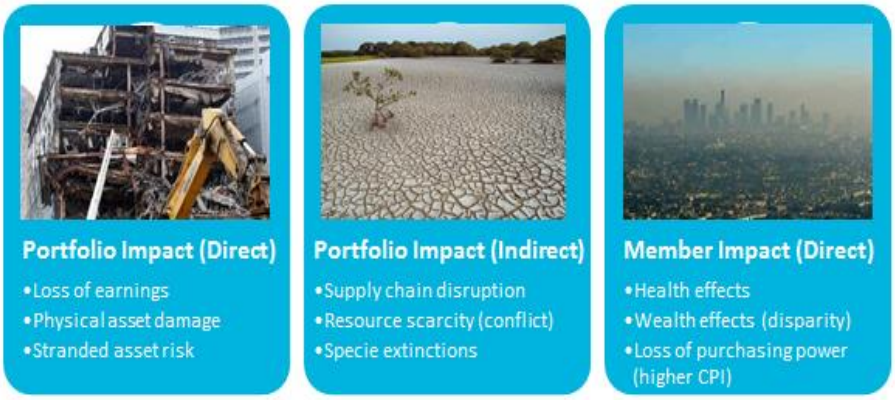
Display 8. Peabody Inc. share price

Source: YCharts

Climate change may also have *indirect* impacts via disruption to supply chains or shortages of raw materials. It can also alter the competitive landscape by changing the cost of energy, as documented by Citi in a recent study with the beguiling title, *Energy Darwinism II*. Finally, it can impact fund *members* directly. Indeed, several studies suggest the greatest impact will fall on low income groups including pensioners, for instance, due to health effects or an inability to adapt (relocate, insulate homes) or afford higher food and energy bills.

The different dimensions of climate change risk are illustrated in Display 9. It should be noted these risks can be hard to disentangle from other factors. For instance, is the fall in coal prices due to climate change, divestment campaigns, policy change, solar technology or the shale gas boom?

Display 9. Different dimensions of climate change risk for pension funds



7. What is our fiduciary duty?

The prospect of either a globally coordinated policy response, or continued inaction, raise serious questions for the world's pension funds. For instance, the OECD forecasts that, in the absence of policy action, the costs of climate change will be ~$72 trillion in lost GDP over the next 40 years. Even based on current policy commitments, it projects global GDP will still be $44 trillion lower due to climate change over this period, a drag of 1-2% p.a. Either way, the likelihood of a significant economic transformation appears inevitable.

Naturally, the first thing Trustees should ask is: What is our fiduciary duty to members? Historically, climate change was regarded by most Trustees as a separate, *ethical* issue. Often, fiduciaries considered that climate change meant having a 'double bottom line', possibly breaching the so-called 'sole purpose test' (which obliges fiduciaries to be solely focused on the provision of financial benefits to members in retirement). In other cases, more proactive 'responsible investing' policies have been developed to serve investors' obligations to United Nations Principles for Responsible Investment (UNPRI) or the Asset Owners Disclosure Project (AODP) or simply in response to pressure from a larger cohort of their members.

However, as the climate science becomes clearer, as the frequency of catastrophic weather events increases and as the push for global policy action grows, climate change is emerging as one of the key systemic financial risks facing Trustees.

The *Superannuation Industry (Supervision) Act 1993 (SIS)* in Australia holds Trustees to the standard of the 'prudent superannuation Trustee' and APRA's prudential guidelines require Trustees to exercise a duty of care, skill and diligence in acting in the best interest of members. This does not drive Directors to any specific action, e.g. divestment of coal stocks, but it does mean Directors need to ensure a diligent process of risk management is followed. *Neither a passive response on one hand, nor a knee-jerk reaction on the other, will discharge Trustees' duties.*

Other key questions that then arise for Trustees include:

- Do the Trustee, Chief Investment Officers and investment team members receive up-to-date briefings on financial and other risks associated with climate change?
- Has a review been conducted on current portfolio exposures of climate change risk, including emissions, insurances and stranded assets?
- Does the Fund's Statement of Investment Beliefs recognise the financial risks of climate change? How are said beliefs and other commitments to sustainability reflected in policies, mandates and processes; and
- Are fund managers/advisors well informed of the Fund's beliefs and commitments to United Nations Principles for Responsible Investment (UNPRI), AODP and Environmental-Social-Governance (ESG) more generally?

Not surprisingly, many large funds are now seeking to develop a more focused climate change response.

8. Developing a climate change adaptation plan

In 2015, the Board of First State Super signed off on an ambitious, portfolio-wide *Climate Change Adaptation Plan*, now being implemented by its internal investment team. The key considerations and steps taken by First State Super are set out below as a guide for other investors.

Philosophical Underpinning - Universal Ownership

First State Super is a large, profit-for-members superannuation fund with more than 750,000 members. A key principle enshrined in First State Super's Statement of Investment Beliefs is the principle of *Universal Ownership*. Universal Owners are the beneficiaries of pension funds, like First State Super, that are so large they become an integral part of the market architecture and, as such, their investment decisions have real consequences for prices, the environment, corporations and communities. We might think of this as the 'footprint' left in their investment wake.

Universal Ownership is where such funds take responsibility, on behalf of their members, for managing the risks and opportunities this presents. Similar concepts exist such as '*Fiduciary Capitalism*' or '*Better Beta*'. A critical aspect of such concepts is the lengthening of time horizons, recognizing that what is most important to members are *sustainable* returns, over 30-40 years or more (and that pursuing short-term returns at the expense of the environment or companies' social licence to operate can undermine long-term returns).

> While First State Super recognised its response to climate change should not be driven solely by the notion of Universal Ownership, its size and the resources available to it, place it in a privileged position to play a leadership role in Australia on climate change adaptation which, if followed by others, could potentially lift the long-term return on risk capital per se, for the benefit of all.

Initial Steps - Carbon foot-printing

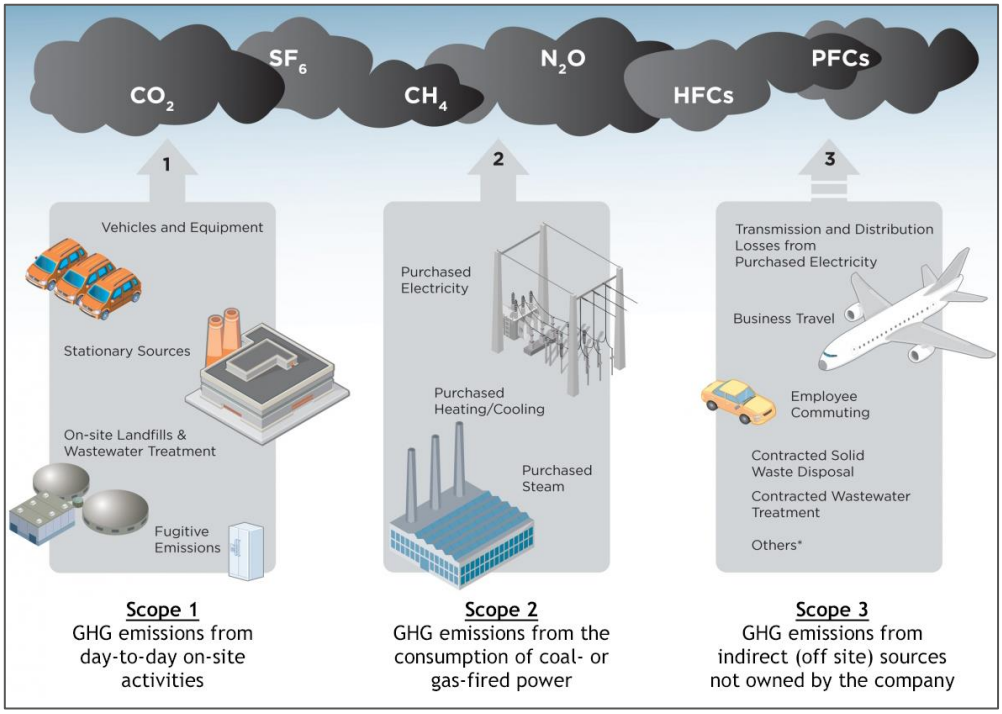
In 2014, the Board of First State Super approved a broad Environmental-Social-Governance (ESG) Policy. As part of this, and specifically under the 'E' piece, the First State Super Investment Team undertook an extensive modelling exercise to estimate its own contribution to GHG emissions, i.e. its own *carbon footprint*.

A fund's carbon footprint is the level of attributable CO_2e emissions calculated by aggregating, across all its portfolio holdings, one or more of the following:

- Total emissions (in CO_2e, terms);
- Carbon intensity (CO_2e emissions per dollar of revenue) – this shows how productive, or wasteful, a companies use of carbon is; and
- Fossil fuel reserves (proven and probable) – this captures companies which are not necessarily high-emitters today, but may be in the future.

In measuring a fund's carbon footprint, it is important to consider three levels of emissions ranging from those a company is directly responsible for in its day to day activities, e.g. fugitive emissions, to those it contributes to indirectly through its use of coal- or gas-fired power, and finally those it contributes to indirectly through other (off-site) activities, e.g. air travel.

Display 10. Capturing Scope 1, 2 and 3 emissions



First State Super's attributable Scope 1 and Scope 2 emissions for its listed shares portfolios in 2014 was $4.11MtCO_2e$, of which $1.46MtCO_2e$ was in Australian shares (~0.3% of Australia's national CO_2e emissions) and $2.65MtCO_2e$ in International shares. The relative results are set out in Display 11 and show that First State Super's aggregate carbon footprint was 8.7% less than the benchmark.

Display 11. Results from 2014 study (Carbon Footprint)

Carbon Intensity	Portfolio tCO_2e/$Revenue	Index tCO_2e/$Revenue	% Difference
Australian Shares	268.5	279.3	-3.8%
International Shares	302.6	318.0	-5.0%
Aggregated Portfolio	289.6	317.0	-8.7%

On one hand the results are positive and consistent with First State Super's efforts to integrate its ESG policies and practices into its manager-selection process over recent years. However, they need to be interpreted carefully. For instance, the results reflect a home bias to Australian shares where carbon intensity is lower on average (notwithstanding our large mining sector) due to a higher share of financials. Some companies' carbon-intensity score is also distorted by short-term factors affecting revenues (a denominator effects).

It should also be noted the results can fluctuate over time due to active managers' stock selection. In Australia for instance, the results reflect a -4.8% sector allocation effect (managers being overweight in more carbon-intensive sectors) and a +8.7% stock selection effect (managers being underweight the most carbon-intensive stocks within each sector) at the time of the study.

The analysis also identified a number of potential stranded assets in the portfolio where such assets:

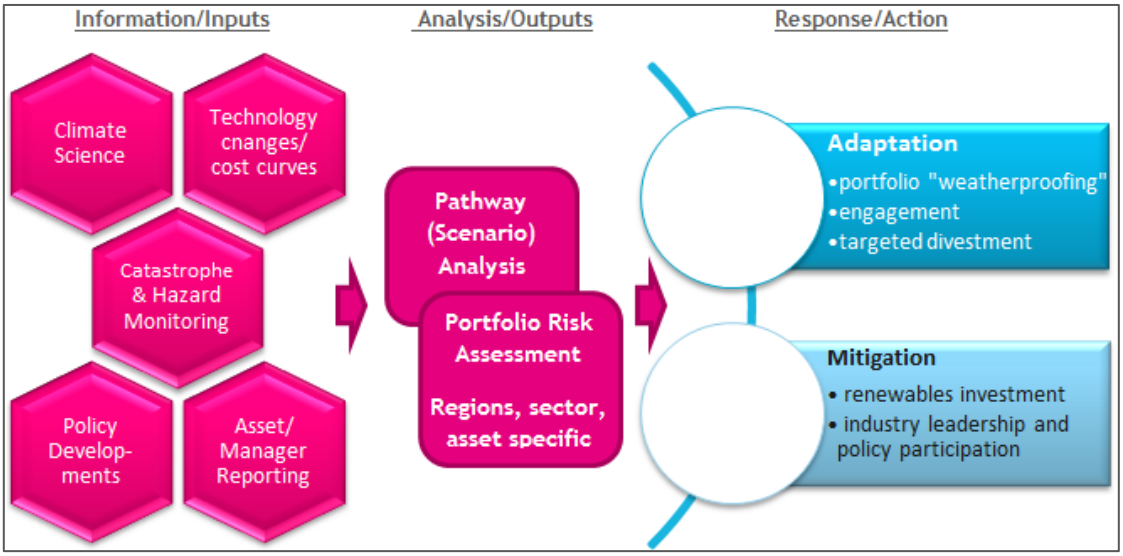
- are dependent on fossil fuel exploration, production or transmission (especially where the asset's value is based on reserves given the long *duration* of such assets and greater difficulty attracting project finance);
- are highly exposed to a loss of competitiveness from carbon pricing or tougher emission standards, especially in competitive markets with little scope to pass on cost increases to customers; or
- operate at a high point on the cost curve and may be loss-making if new technologies reduce the cost of low-carbon alternatives.

Developing a broader risk framework

Having measured and reviewed the fund's carbon footprint and stranded asset risks, the Board then sought research to be done by the investment team on the assessment of climate change risks to the Fund (and therefore to members) and the best approach to managing those risks. As a result, a broader framework for assessing and managing climate change risk was developed. This framework, illustrated in Display 12, has three key parts – information and monitoring (inputs), scenario analysis and portfolio risk assessment (output) and, finally, a response plan.

The information used by First State Super as inputs in this risk framework have been discussed above – our understanding of the climate science and modelling, (economic) post-mortems of catastrophic weather events and our reading of policy initiatives and the transformation to a low-carbon global economy, among other things.

Display 12. Risk framework



In developing the key outputs, First State Super established a scenario-based framework for identifying plausible future scenarios and assessing the impact on specific regions, sector and assets under each one. Initially, four scenarios were defined, corresponding roughly to the RCPs modelled by the IPCC, as follows:

- Scenario 1: Transformation (~ICPP RCP2.6)
- Scenario 2: Policy Coordination (~ICPP RCP4.5)
- Scenario 3: Policy Fragmentation (~ICPP RCP6.5)
- Scenario 4: Inaction (~ICPP RCP8.5)

A high-level summary of these scenarios is set out in Display 13.

Display 13. Climate change pathways (scenarios) and high-level portfolio risk assessment

Scenario	Description	Ave. Projected Rise in Temperature		Ave. Projected Rise in Sea Level		Key Short-Term Risks (0-5 Years)	Key Medium- to Long Term Risks (5-25 years)
		2046-65	2080-99	2046-65	2080-99		
Transformation (~RCP2.6)	Adaptation involves a rapid market/investor driven transition to a low-carbon economy, including major investment in renewable energy technology	1.8°	1.8°	0.41m	0.57m	**Stranded asset risk** from both policy change and technology (Energy, Transport, Industry) More frequent extreme weather events	**Muted impact on returns** Major **divergence in returns** between high- and low-carbon assets and **isolated losses** from extreme weather events
Policy Co-Ordination / Regulation (~RCP4.5)	A co-ordinated global policy response following the 2015 UNFCCC, including real measures to achieve targeted GHG emission reductions	2.2°	2.6°	0.43m	0.64m	**Stranded asset risk** (policy driven) mainly in fossil fuels **Higher volatility** from market reaction to extreme weather events	**Lower long-term returns** due to rising costs and lower productivity, but ... **Greater certainty** for investment in renewables
Policy Fragmentation (~RCP6.5)	A fragmented policy response leading to lower GHG reductions in some countries but large variance across countries, e.g. strong adaptation in Europe but limited action/inaction in China, India and developing countries	2.2°	3.0°	0.42m	0.68m	**Variable earnings losses** by industry and region **Higher volatility** from market reactions to more extreme weather events Significant losses from **physical asset damage** **Escalation in regional conflict** and refugee crisis (mid-East, Nth Africa, SE Asia)	**Lower long-term returns** due mainly to weak growth/ productivity and economic dislocation **Increased strain on public finances** from urban re-building, humanitarian relief Lower real incomes from **higher inflation** (stagflation)
Inaction (~RCP8.5)	No clear agreement at UNFCCC leading to continue high levels of new investment in fossil fuel development and consumption around the world, i.e. limited variation from current emission pathways	2.8°	4.5°	0.47m	0.75m	**Widespread earnings losses** from a fall in productivity, resource shortages and supply chain disruptions **Rise in risk premium** for equities and illiquid assets Major losses from **physical asset damage** Greater regional conflict and **global contest for resources**	**Global economic contraction and loss of capital** **Significant loss of life and poor health** - greatest impact on the poor and elderly Global **sovereign debt crisis** **Major loss of purchasing power** for retirees from a significant rise in inflation, (food, healthcare and power)

Developing a Climate Change Adaptation Plan

The final step was to develop a clear plan of action. First State Super took the view that there is no one silver bullet to manage climate change risk, but there is a wide range of options and actions available that can be taken as part of a portfolio-wide Climate Change Adaptation Plan. As illustrated above, possible actions can be classified as either 'adaptation' or 'mitigation'. Adaptation and mitigation have been discussed at length by climate authorities for building socioeconomic and resilience or for climate-proofing cities, but they can also be applied by investors to build portfolio resilience.

Adaptation means responding, in advance, to climate change risks to avoid or lessen future losses. It is not about saving the world or trying to avert climate change. It involves future-proofing portfolios to withstand the impact on asset values and returns over time from extreme climatic events, policy changes, divestment campaigns/capital strikes or new technologies.

Mitigation, on the other hand, is a more aspirational goal of slowing down or preventing climate change. At a public policy level it means reducing GHG emissions through price- or volume-based measures. For

investors, mitigation may take the form of investment in renewable energy and related technologies that support the transformation to a low-carbon economy, e.g. battery storage.

First State Super's Climate Change Adaptation Plan comprises three elements as follows:

1. **Portfolio weather-proofing**

   This is seen as the first line of defence and involves a technical asset-by-asset review of the portfolio to assess asset-specific climate change risks and options to build resilience. These reviews go beyond basic carbon foot-printing to assessing exposures to plausible climatic events, supply chains, policy or technological change and public activism. The reviews are conducted by First State Super in collaboration with its asset managers and advisors over a two year cycle.

   It should be noted that many risks are interdependent and difficult to assess – such risks may not always present themselves in the way we anticipate.

2. **Engagement**

   A key part of First State Super's ESG Policy is proactive engagement with senior executives and boards of the companies we hold, even where our percentage of share-holdings is small, e.g. listed shares. The second part of our Climate Change Adaptation Plan involved upgrading the 'E' piece in our engagement to ensure:

- suitable reporting of emissions and (more generally) climate change risk assessment and management;
- stress testing the impact of a carbon price on long-term business plans, including the development of each firm's own Adaptation Plan, including a review of energy efficiency and scope for embedded generation; and
- (in some cases) a return of capital over time rather than reinvestment in new exploration/development of fossil fuel reserves.

> **Divestments** are possible under First State Super's engagement model, but are the last line of defence, considered only where: 1) assets have high levels of stranded asset risk; and 2) engagement fails or is unlikely to succeed. First State Super acknowledges that divestment may be ineffective in climate change *mitigation* as it simply transfers ownership of capital that has already been deployed and to which management will be largely indifferent. But there may still be a case for divestment to reduce excessive asset-specific risk. Moreover, when many pension funds divest *en masse*, this can increase the cost of capital for new projects, and may have real signalling effects that change corporate attitudes.

3. **Investing in Renewable Technology**

   The third plank in First State Super's Climate Change Adaptation Plan is the proactive assessment of investment in renewable energy generation, notably in wind and solar farms. Globally, renewables accounted for two-thirds of all new capacity in recent years. In Australia, investment in large-scale renewable generation came to a standstill in 2013 due to uncertainty around the government's Renewable Energy Target (RET) policy. The reset of the RET to 33,000GWh by 2020 however, is estimated to create the need for 5-6GW of new large scale capacity, estimated to require ~$10 billion in capital over the next 3-4 years.

   A key aspect of climate change mitigation in Australia is for this renewable capacity to displace a large part of our coal-fired generation capacity. In practice, the level of coal-fired capacity is likely to decline anyway as ageing coal-fired plants are decommissioned over the next 15-20 years. Around 1.5GW of coal-fired capacity was retired and another 500MW mothballed in recent years and other

large coal plants such as Liddell (2GW) and Vale's Point are scheduled for decommissioning over the next decade.

As a back-of-the-envelope exercise, $600 million (<1% of First State Super's total assets) in new renewables capacity over the next 3-4 years, would create 350-400MW of capacity – 6% of new capacity needed under the RET. Assuming this displaced an equivalent level of coal-fired capacity; this would reduce emissions by ~3MtCO_2e in emissions, or ~0.5% of Australia's current total emissions and reduce the Fund's net carbon footprint virtually to zero, i.e. 'carbon neutrality'.

First State Super has prepared this paper to share with other investors how we are thinking about climate change and how we are responding to the very significant and multi-dimensional risks climate change presents. We firmly believe that large institutional investors not only have a fiduciary responsibility to manage these risks, but through shared insights and action, can actually support more sustainable returns to portfolios over time. We welcome any feedback and requests for further information.

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