

## Minnesota State Board of Investments (SBI)

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### Climate Change Investment Analysis Phase III: SBI Climate Investment Exposures and Policy Options

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## Table of Contents

Preface .....	3
Overview .....	4
I. Asset Manager Approaches to Climate Risks and Opportunities .....	5
II. Asset Manager Approaches to Climate Monitoring .....	15
III. Portfolio Climate Exposures – Introduction .....	20
IV. Public Markets Climate Exposures .....	22
V. SBI Private Markets Climate Exposure .....	28
VI. Climate Scenario Analysis .....	30
VII. Policy Options Discussion .....	35
VIII. Conclusions .....	40
Appendix I .....	42
Appendix II .....	51



## Preface

This report is the third in a series designed to assist the Minnesota State Board of Investments (“SBI”), in its oversight of the SBI investment portfolio. This and previous reports address the potential investment risks and opportunities associated with climate change. Meketa’s Climate Change Investment Analysis project for the SBI provides data, analysis, and options for consideration as the SBI further develops its strategy to address long-term climate investment risks and opportunities. During year one of the project, Meketa addressed these issues in three reports:

- In this Phase III report, we analyze the SBI portfolio’s current exposure to climate risks and opportunities throughout the total portfolio – public and private market investments – and provide options for the SBI to implement a successful climate transition strategy consistent with the SBI’s fiduciary duty and the terms of the Paris Agreement.
- The Phase II report provided results and analysis of a survey of 20 public pension plan climate leaders. The report focused on the manner in which public pension plan thought leaders manage climate-related investment risks and opportunities. The survey results provide the SBI a range of investment strategy perspectives to consider as it determines the best course of action for the SBI.
- The Phase I report reviewed high level global trends that address climate change and related developments in financial markets across asset classes, policy and regulatory frameworks, institutional collaboration, and trends for investment-related climate risk data, metrics, and climate scenario analyses. Those trends are gaining momentum on an almost daily basis.
- The Phase I and II reports found that rapid change in the management of investment risks and opportunities is well underway. Academia, institutional investment firms and providers of analytical tools, databases, and econometric models have and will continue to create resources for institutional investors to assess their investment exposure to climate risks and provide insight in how best to manage that risk and attendant opportunities.
- The Phase II report found trends among public pension plan climate leaders to: 1) improve their climate risk and opportunity monitoring across their entire portfolio, 2) increase investments in climate solutions, and 3) focus enhanced effort on stewardship, including proxy voting and engagement with managers, investee companies, and government regulatory and policy making bodies. A recent trend indicates an increase in public pension funds addressing Net Zero greenhouse gas emissions by 2050. With the attention to Net Zero awareness the need has grown to address climate risks and opportunities in the real economy where the long-term risks to investment portfolios are manifest.
- Although this is the final phase of the year one study, it is just the beginning of an ongoing effort to best manage risk and return in a complex and challenging environment.
- We thank the SBI for engaging Meketa to work on these critical issues and thank the SBI Staff and the SBI’s investment managers for their insights and information.

## Overview

The Meketa Phase III climate report to the SBI concentrates on:

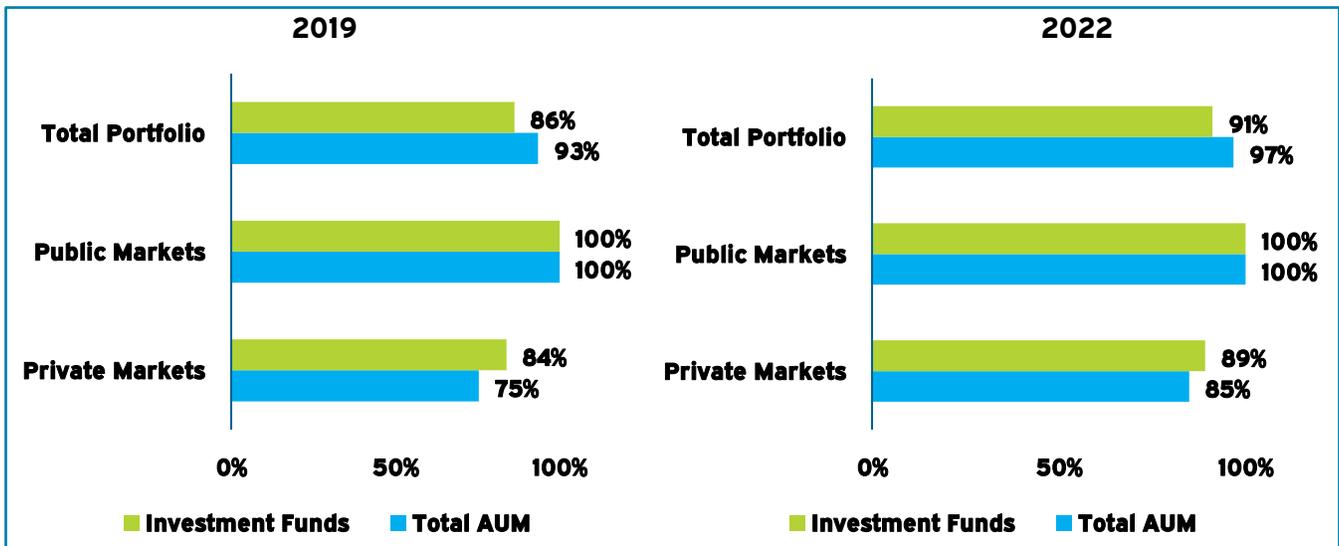
- 1) **Analyzing the SBI portfolio's** current investment manager approaches to managing climate risk through survey responses from public and private markets funds, and quantitative climate analysis of the SBI's public market portfolio companies.
- 2) **Economic modeling of various approaches to managing climate risk and opportunity.** A what if exercise. We use a top-down, statistical approach to give clients a "big picture" estimation of potential impacts to returns and risk that could confront them in a fundamentally uncertain situation.
- 3) **Three distinct approaches to managing climate risk and opportunity.** There is no consensus in the investment community on best practice, and there are many variations within each of these three broad approaches. Seeking to reduce the greenhouse gas (GHG) emissions of the SBI's portfolio is not equivalent to seeking to reduce the real economy systemic climate risks throughout the portfolio. For example, neither broad exclusion of fossil fuel producers, nor hedging the portfolio to become 'carbon neutral', directly address reducing the energy transition risks in the real economy, nor the mounting physical climate risks.
- 4) **Climate Aware Approach (Current).** Continue the SBI's proxy voting on climate issues, exposure to climate transition opportunities in private markets, exclusion of thermal coal producers, manager engagement around climate issues through periodic climate surveys, engagement with regulators, and participation in institutional investor organizations focused on climate.
- 5) **Energy Supply Focused Approach: (exclude all Fossil Fuels).** Exclude all companies with fossil fuel revenues; continue other climate aware available elements of current approach (proxy voting and engagement limited to non-fossil fuels companies).
- 6) **Portfolio-Wide Strategic Net Zero Goal Approach.** Develop an overarching portfolio-wide strategy that seeks to reduce climate risks in the real economy by coordinating and strengthening the use of tools available to address climate issues, including: increased attention to proxy voting; engagement with managers, portfolio companies and governments; increased investments in climate solutions appropriate to each asset class; select exclusions if they the support engagement and investment strategy; and appropriate participation in institutional investor organizations addressing climate.
- 7) **Pros and Cons of the three alternative approaches,** including real economy potential impacts, costs, and complexity of implementation.
- 8) **A recommendation for the SBI's consideration** – Consider a comprehensive strategy across all asset classes that benefits from all three approaches listed above, with the emphasis on A and C, and using elements under B (exclusion of fossil fuels) under certain limited circumstances.

As science and markets continue to provide more and better information which policymakers can rely upon there will be a need to reflect those developments in whatever policy the SBI adopts. This continual evolution is consistent with existing SBI practices of regular and timely review of all aspects of the investment portfolio and is, in our opinion, a best practice.

## I. Asset Manager Approaches to Climate Risks and Opportunities

This section presents the results of the 2022 survey of the SBI’s asset managers on their approaches to managing climate risks and opportunities. The survey asks about general climate risks and opportunities and focuses on energy transition. In subsequent work on each asset class, we intend to analyze more closely both energy transition and physical climate risks and how they are managed.

Figure 1: Climate Risk Survey of SBI Active Investment Funds that Responded<sup>1</sup>



- The great majority of SBI fund managers responded to the 2022 and 2019 survey, including 100% of public markets funds and 89% of private markets funds in 2022, compared to 84% in 2019.
- Managers of 89% of the SBI’s active private market funds responded in 2022 (231 of 259). The 231 responding private markets funds were managed by 65 different managers.
- The 2022 survey enhanced the 2019 survey by requesting that managers supply portfolio level climate metrics on their portfolio companies, such as Scope 1, Scope 2, and Scope 3 emissions.
- Private market responses from managers included some that stated that this was the first time they were attempting to measure such metrics, and that are completing and sending their results. Though some responses were too late to include in this report, the results will be used going forward.

**Managers responsible for investing 97% of the SBI’s Assets Under Management (AUM) responded to the climate survey in 2022, higher than the 93% from the 2019 survey.**

<sup>1</sup> The 2022 survey request went to the 259 SBI active funds of the total 286 private markets funds. The 27 funds that were not sent the survey were funds that had been nearly completely wound down by December 2021. The 2019 numbers have been corrected and updated to provide consistency with the 2022 survey such as excluding Treasury funds in public markets and excluding all inactive funds in private markets.

Climate change material risks and opportunities encompass energy transition and physical climate exposures.

- Attention to stranded assets from the energy transition has often concentrated on larger fossil fuel energy supply companies. Today, the fossil fuel energy supply sector accounts for approximately 4% of the MSCI ACWI index. As the transition proceeds, investment research on a broader range of companies is emerging. For example, a leading fixed income credit rating provider, Fitch, finds that: “Majors, due to their size, asset mix and business diversification, are generally in a stronger position to successfully manage the energy transition. However, mid-caps and juniors will face difficulties as they generally do not have the cash and/or scale and in-house expertise and capacity to develop robust climate strategies, finance decarbonization effects and shift their business model while ensuring ongoing profitability”<sup>1</sup>
- Potentially stranded assets, financial stress, and investment opportunities that arise from the energy transition can be seen in most sectors, including, for example, the transportation and food sectors, as consumer preferences and regulatory regimes shift to support lower carbon alternatives.
- Energy transition risks may also occur in low carbon industries, as new technologies come to commercial fruition. For example, hydrogen is emerging as a key potential opportunity to help shift toward global Net Zero targets. It is being pursued in many industries that are heavy energy users, from transportation to technology. In technology, large companies such as Microsoft are working to move off diesel to support their highly energy intensive data centers with hydrogen. Most hydrogen fuel is very carbon intensive to produce. In July 2022, Australian company, Hysata announced a breakthrough to make green hydrogen cost competitive. This is just one example that may change trends in the types of renewable energies that are produced and used, and potentially raise long-term risks to more established renewable energy technologies and products.

**Energy transition risks and opportunities:**

- **Are occurring in all sectors**
- **Within the energy sector, oil and gas majors are generally in a stronger position to manage the transition than mid-caps and juniors**
- **Transition risks can be material even in renewable energy sectors, due to potentially swift technology changes.**

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<sup>1</sup> Sustainable Fitch, Sustainable Insight | 19 July 2022

The Intergovernmental Panel on Climate Change (IPCC) found in its sixth report, released in February 2022, that human-induced climate change is causing dangerous and widespread disruption in nature and affecting the lives of billions of people around the world, despite efforts to reduce the risks. The report finds that the world faces unavoidable climate hazards over the next two decades with global warming of 1.5° C. The report states that to avoid mounting loss of life, biodiversity and infrastructure, ambitious, accelerated action is required to adapt to climate change, at the same time as making rapid, deep cuts in greenhouse gas emissions.

- For 2021, a total of \$343 billion in economic losses from catastrophic events world-wide were reported by large insurance provider, Aon, \$329 billion of which resulted from weather and climate -related events, making 2021 the third costliest year on record, after adjusting for inflation. Of the 2021 losses, only 38% were covered by insurance.<sup>1</sup>
- Physical climate risks already take a financial toll and create stranded assets in agriculture, which, after energy, is the second largest sector responsible for GHG emissions. For example, a recent study in *Environmental Research Letters* by Stanford University climate scientists examined the global warming impact on the U.S. crop insurance program, which Congress established in the 1930s to revive domestic agriculture in the wake of the Dust Bowl. Recent research shows a new dust bowl is twice as likely today due to climate change. Between 1991 and 2017, climate-fueled temperature increases generated an estimated \$27 billion in insurance payments to U.S. farmers, the study found. Those losses accounted for nearly 20% of the program's total payouts over that period.
- Financial losses from physical climate risks in traditional agriculture are expected to rise as climate change intensifies and be geographically more severe in different geographies. The agricultural sector represented approximately 0.16% of the MSCI ACWI IMI index, with total food products industry representing approximately 1.9% of the index as of March 2022. Food production financial stress can have repercussions throughout the economy, including for example through inflation.
- Warming may bring physical climate opportunities. For example, in Canada global warming may open new agricultural opportunities because warming starts from a relatively colder base.

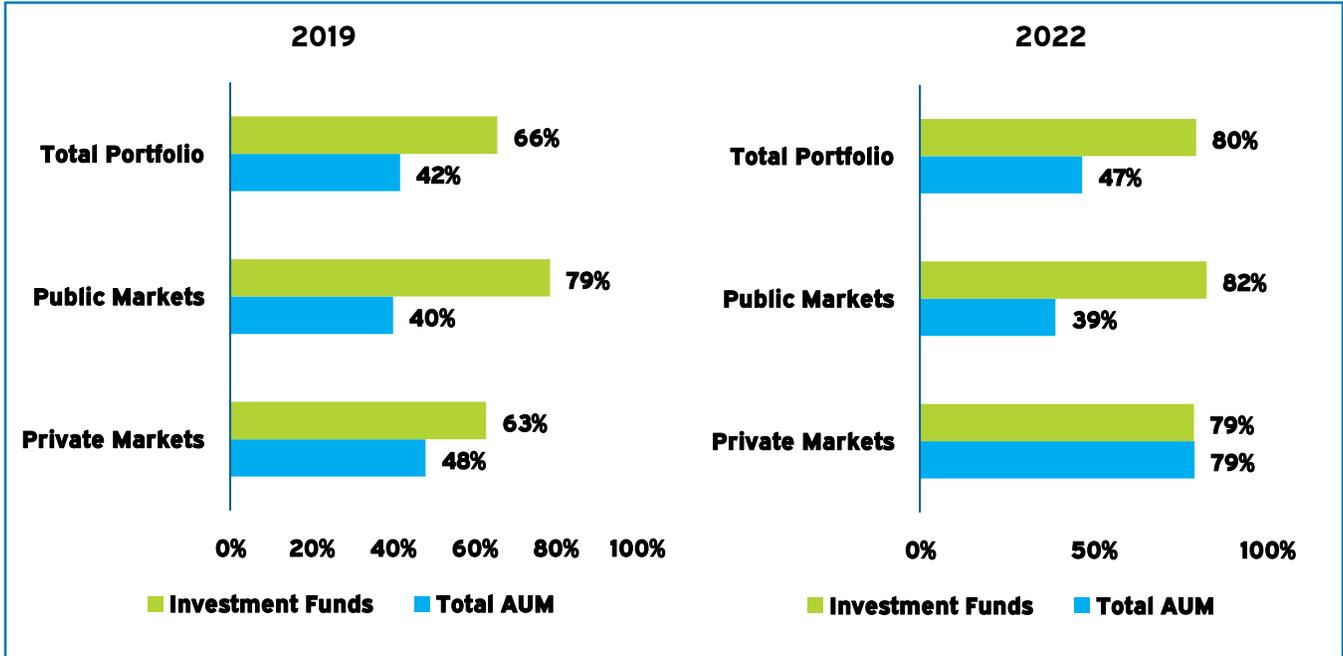
**The modeled physical climate impacts that have been assumed to be decades away are already happening today in some cases.**

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<sup>1</sup> January, 2022, [2021 Weather, Climate and Catastrophe Insight report](#)

A large majority (80%) of SBI funds that responded to the survey account for material climate change risks in their management of the SBI funds.

Figure 2: SBI Funds that Account for Climate Change Material Risk

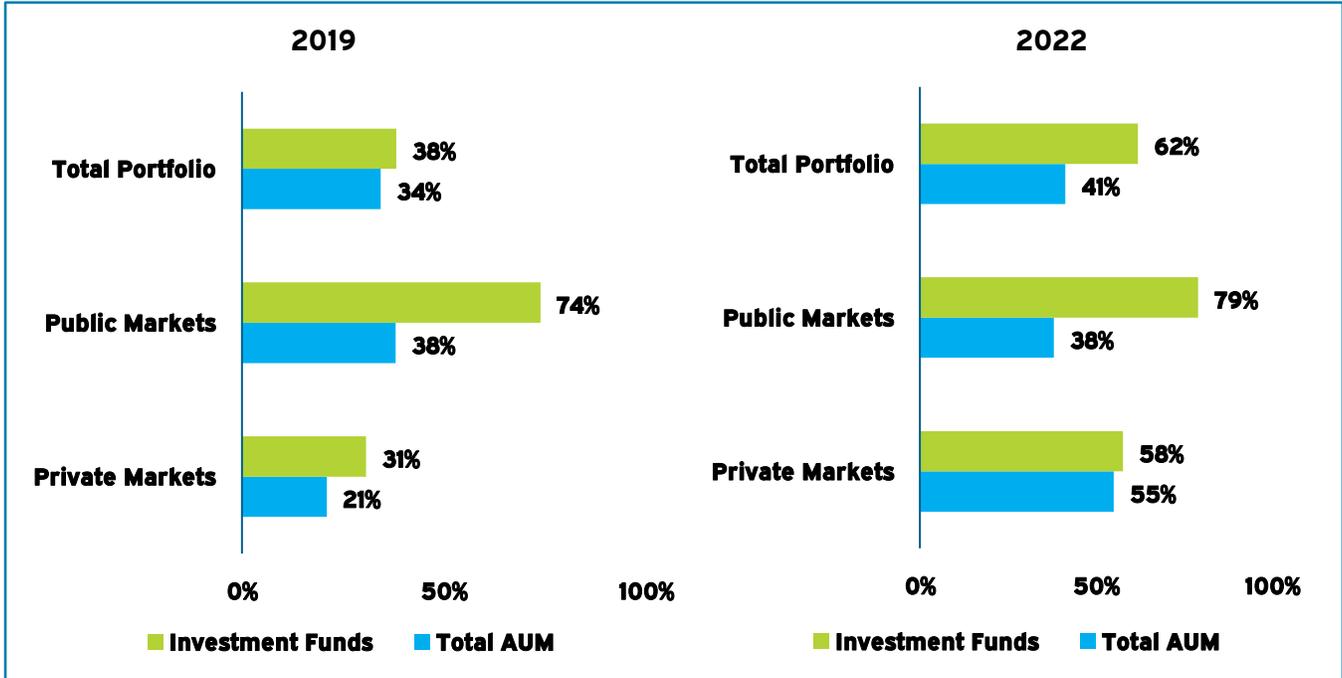


- In 2022, 80% of SBI’s public and private markets investment funds that responded to the survey indicated that they account for climate change material risks, compared to 66% in 2019.
- Public market equities include a few funds that passively manage a large portion of the SBI’s assets. By design these passively managed equity funds invest based on market cap weights only.

The SBI’s large passive equity investments reduce the percent of the total portfolio AUM where the SBI’s managers account for climate change risk in investments.

In 2022, 62% of the SBI funds that responded to the survey indicated that they account for low carbon economy opportunities compared to 38% in 2019.

Figure 3: SBI Funds that Account for Low Carbon Economy Opportunities

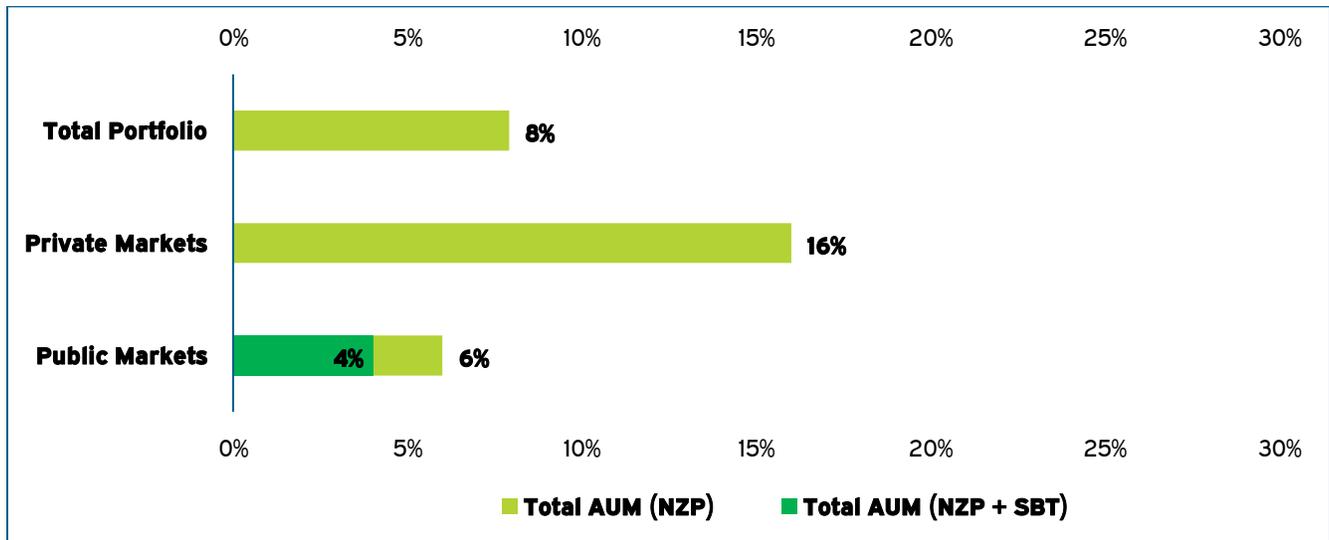


- In 2022, 62% percent of SBI funds responded that they account for low carbon economy opportunities, compared to the 80% that account for material climate risks.
- The percent of the SBI’s private markets funds that is managed to account for low carbon economy opportunities nearly doubled in 2022 from 2019 (58% up from 31%) and more than doubled the percent of SBI’s private markets AUM (55% up from 21%).

The SBI’s public and private markets active managers are increasingly accounting for low carbon economy opportunities in their investment strategy, along with material climate risks.

SBI public and private markets are adopting Net Zero pledges. To achieve Net Zero goals, asset managers are often encouraging, supporting, and setting criteria for portfolio companies to transition their businesses to meet Net Zero targets, rather than implementing broad exclusions for higher risk industries, and/or types of companies.

Figure 4: SBI Funds with a Net Zero Pledge (NZP) and Funds that Follow a Science Based Target (SBT)



- In public markets, 6% of the SBI’s public markets AUM (nine funds) are investing with a Net Zero pledge, of which five funds, representing 4% of public markets assets are managed in line with a GHG target approved by the Science Based Target Initiative (SBTi).
- In SBI’s private markets, 16% of the private markets AUM of the managers that responded is managed against a Net Zero pledge, including 24 funds managed by eight different asset managers.
- Among private markets funds managed to Net Zero, the range of commentary varied from, for example, a manager noting that they are just starting to put together their program to achieve a Net Zero goal by 2050, to a manager stating that their target is to have all portfolio companies achieve Net Zero status by 2040.

Across the SBI portfolio, 8% of the SBI’s AUM is currently managed against a Net Zero pledge among the managers that responded.



# Minnesota State Board of Investments

## Phase III: SBI Climate Exposures and Policy Options

The SBI's passive equity assets account for a large percentage of assets where climate risks and opportunities and Net Zero pledges are not considered, by design.

Figure 5: 2022 Climate Survey Results from all SBI Funds by Asset Category

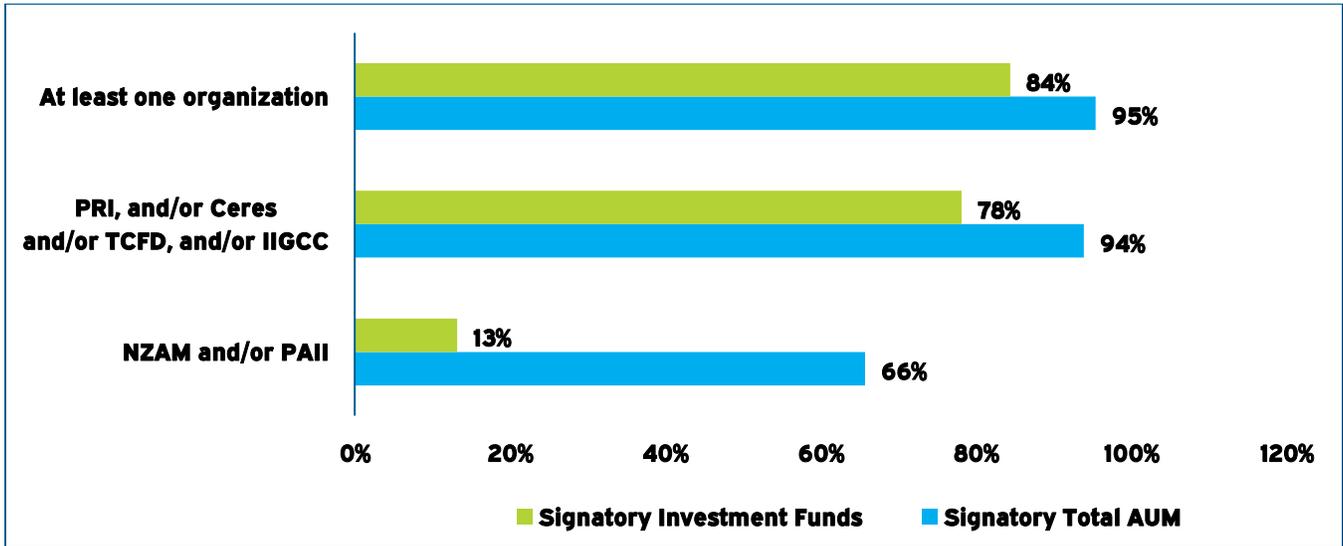
Asset Class	All Funds that Responded											
	Total # of SBI Funds	# of Funds	Total SBI AUM of responses (\$M)	Funds that responded YES to:								
				Account for climate change material risks?		Account for low carbon economy opportunities?		Net Zero Pledge		Net Zero Pledge + Science Based Target		
				# of funds	Percent of AUM (%)	# of funds	Percent of AUM (%)	# of funds	Percent of AUM (%)	# of funds	Percent of AUM (%)	
<b>Total Portfolio</b>	316	288	82,468	229	47	178	41	33	8	5	3	
<b>Total Public Markets</b>	57	57	66,676	47	31	45	31	9	5	5	3	
<b>Total Private Markets</b>	259	231	15,792	182	15	133	11	24	3	N/A	N/A	
<b>Total Public Markets</b>	57	57	66,676	47	39	45	38	9	6	5	4	
<b>Domestic Equity</b>	18	18	32,303	14	10	13	10	1	0.3	0	0	
Active	13	13	3,658	12	5	11	5	1	0.3	0	0	
Semi-Passive	2	2	3,376	2	5	2	5	0	0	0	0	
Passive	3	3	25,269	0	0	0	0	0	0	0	0	
<b>International Equity</b>	18	18	14,123	14	8	14	8	3	2	1	0.7	
Active	15	15	6,002	14	8	14	8	3	2	1	1	
Passive	3	3	8,121	0	0	0	0	0	0	0	0	
<b>Global Equity</b>	3	3	1,155	3	2	3	2	2	1	1	0.7	
<b>Fixed Income</b>	16	16	12,662	16	19	15	19	3	3	3	3	
<b>Private Markets-Uninvested</b>	2	2	6,432	0	0	0	0	0	0	0	0	
<b>Total Private Markets</b>	259	231	15,792	182	79	133	55	24	16	N/A	N/A	
<b>Private Equity</b>	158	138	11,265	105	55	81	39	12	12	N/A	N/A	
<b>Private Other</b>	101	93	4,527	77	24	52	16	12	4	N/A	N/A	

→ The SBI's 24 private markets funds that implement a Net Zero pledge encompass private equity (12 funds), real estate (8), private credit (2), and real assets funds (2).

**Public Markets Net Zero pledges are currently being implemented in SBI active international equity (3 funds) and fixed income (3 funds) more than in active domestic U.S. equity (1 fund).**

Additional insight into manager attention to climate issues can be seen in their participation in institutional investor organizations that focus on investor climate risks and opportunities.

Figure 6: SBI Total Portfolio Funds that are Signatories to Climate-Related Investment Organizations



- Ninety-five percent of the SBI’s assets were managed by firms that are signatories to at least one institutional investor organization that addresses climate change investment issues.
- These include the PRI, Ceres, TCFD, and IIGCC, where 78% of SBI funds, representing 94% of the SBI AUM, are signatories to at least one of these organizations.
- A significantly smaller number of funds (13%) are managed by signatories to either the Net Zero Asset Management initiative (NZAM) or to the Paris Aligned Investment Initiative (PAII).

Sixty-six percent of the SBI’s assets are managed by firms that are signatories to NZAM or PAII. This represents 13% of the SBI’s funds that responded to the survey and includes managers of passive equity assets, where the specific funds in which the SBI invests with a given manager are managed based on market cap weighted indexes that by design do not include Net Zero criteria.

Firms that manage publicly listed assets for the SBI are taking advantage of collaborative efforts as they seek best practices and education to mitigate investment climate change risks and increase climate opportunities that can affect their long-term investment performance.

Figure 7: SBI Public Markets Funds that are Signatories to Climate-Related Investment Organizations

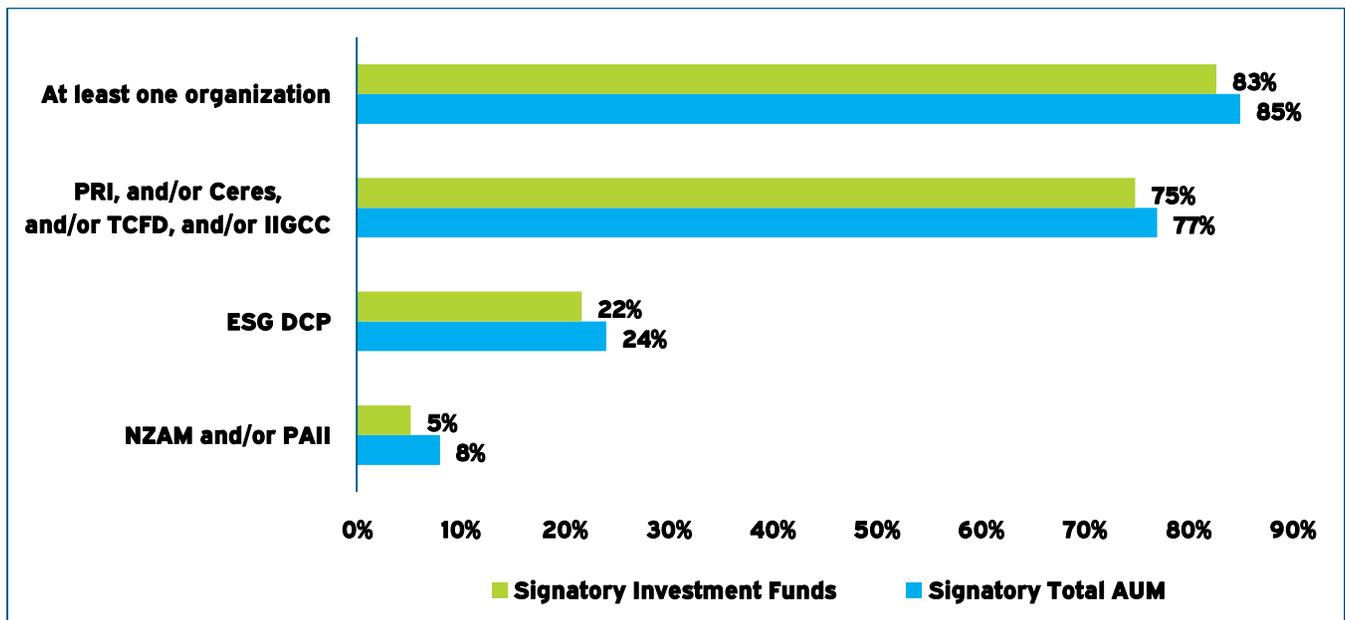


- In the SBI’s Public Markets investments, 91% of the funds reported their firm being a signatory to at least one climate-related institutional investor organization, accounting for 98% of the SBI’s public markets AUM.
- Slightly less than half (46%) of the SBI’s public markets funds report that their firm is a member of NZAM and/or PAIL, representing 79% of the SBI’s public markets AUM of the survey respondents, which includes managers of the SBI’s passively managed funds.
- Managers of the SBI’s passive equities, that, by design those specific funds do not account for climate change in their investment mandate, are more frequently making important contributions to long-term stable energy transitions through their proxy voting and engagement. The largest managers, such as BlackRock, SSGA, and Vanguard, are the largest global investors in many publicly listed companies.

**Managers of 56% of the SBI’s of public markets funds, representing 87% of SBI public markets AUM, are members of Climate Action 100+, an organization that focuses on climate proxy voting and engagement with the largest corporate emitters of greenhouse gases.**

Some widely supported institutional investor organizations such as Climate Action 100+ focus primarily on publicly listed companies. For investors, reliable comparable data is a critical component to managing risks and opportunities. For private markets managers, recent developments directly address private markets managers and companies, such as the ESG Data Convergence Project (EDCP). The EDCP was launched in 2021 to provide a vehicle for common sustainability reporting among private equity GPs and LPs, in the absence of regulated disclosures.

**Figure 8: SBI Active Private Markets Funds that are Signatories to Climate-Related Investment Organizations**



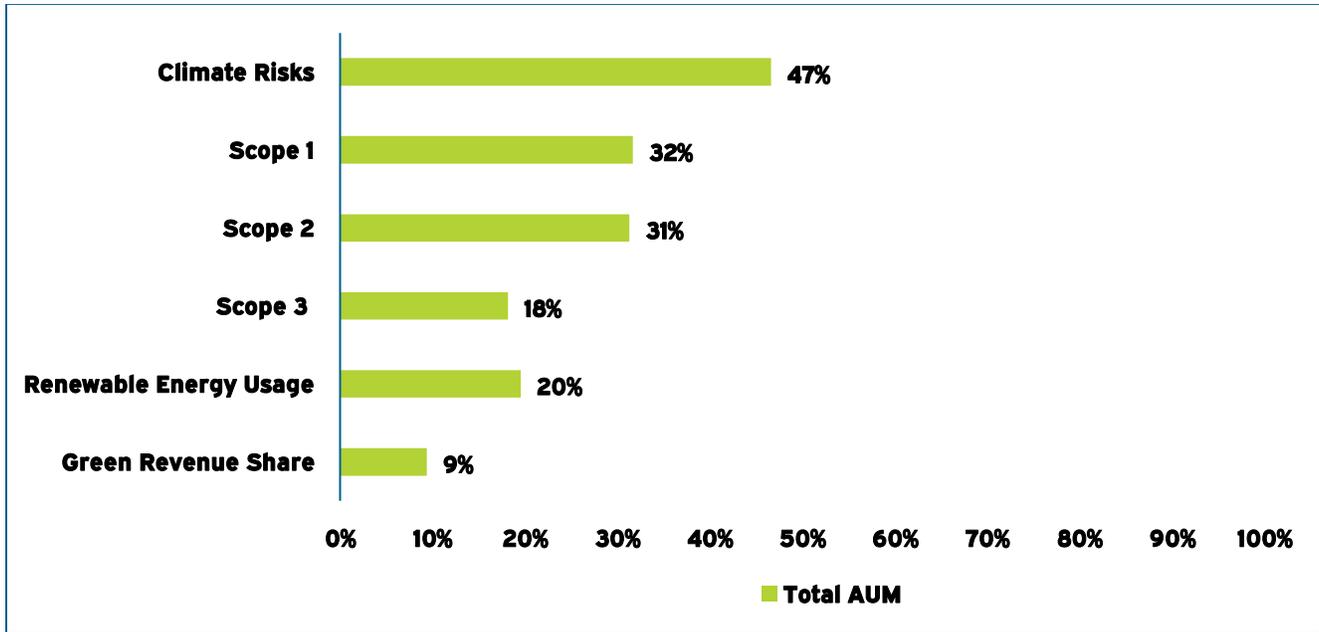
- In the SBI Private Markets, 83%, 191 of the 231 active private markets funds that responded to the survey. These funds were managed by 50 of the 65 responding managers, are signatories to at least one climate-related investment organization, and accounted for 85% of the SBI’s private markets AUM from survey respondents.
- Seven SBI private markets funds, from four different managers (representing 5% of private markets AUM of survey respondents), reported that their firms are a member of the NZAM, compared to the total 24 SBI private markets funds reported that they manage to a Net Zero pledge. This difference indicates that Net Zero asset manager implementations are occurring in addition to those that are official members of NZAM or PAII.

The ESG Data Convergence Project (EDCP), launched in October 2021 to aggregate ESG metrics using comparable data across private equity funds, already has 17 different firms as signatories that manage 50 SBI funds. The 50 funds represented 24% of SBI’s private markets assets from the survey.

## II. Asset Manager Approaches to Climate Monitoring

Investment manager monitoring of climate is growing, as institutional investors such as the SBI request better disclosure and information on how managers are addressing climate risks and opportunities.

Figure 9: SBI Total Portfolio Monitoring Results

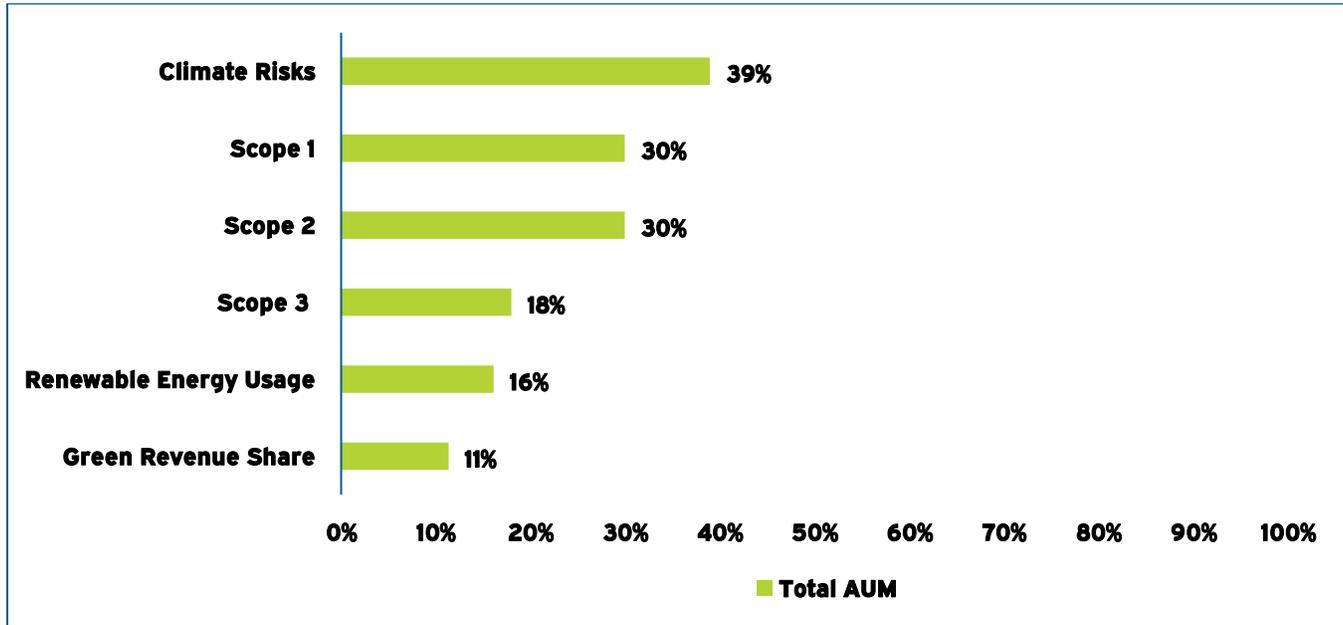


- A total of 229 of the 288 SBI public and private markets funds reported that they account for climate risks. These funds account for 47% of the total portfolio AUM of the reporting companies.
- The approaches vary widely. For example, one respondent disclosed that the company-level climate analysis explicitly incorporates a climate change section that breaks down transition and physical risks, as well as target setting.
- Funds managing 18% of the SBI’s total portfolio AUM of the responding firms measure Scope 3 emissions. The lack of reliable data was often cited as a hurdle to measuring Scope 3 emissions of portfolio companies.
- SBI funds that measure the renewable energy use of their portfolio companies, account for 20% of the total portfolio AUM among those managers that responded to the survey, while 9% of the Total portfolio AUM is managed by funds that track green revenue shares.

**Managers that track climate risk data, such as Scope 1 and 2 emissions, had reached 39% of the SBI’s total portfolio. Attention to climate opportunities was lower, such as green revenue share (9%) and renewable energy use (18%). Scope 3 emissions, which are the most difficult to measure, were also tracked by a relatively small percent of the SBI’s AUM (18%).**

The SBI’s total public markets portfolio reflects the high percentage of public markets funds in passive, market cap weighted equity index funds that are by design managed without regard to climate or other metrics.

Figure 10: SBI Total Public Market Funds Monitoring Results

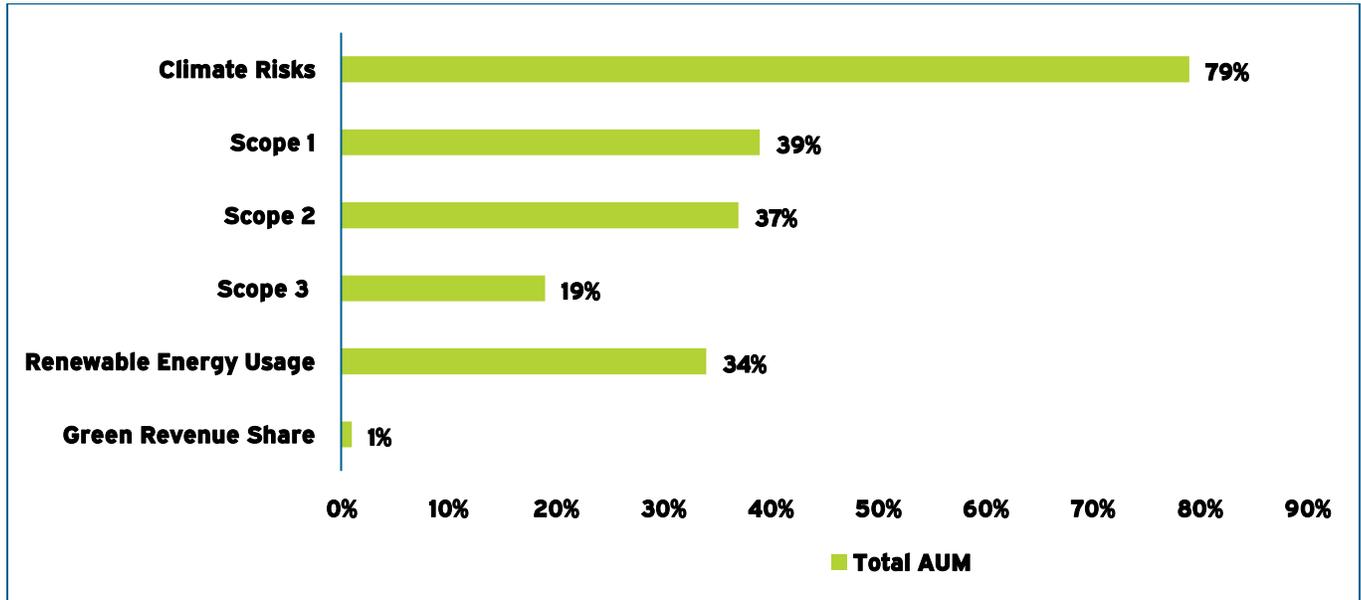


- Funds managing 30% of the SBI’s public markets AUM measure Scope 1 and 2 emissions. Eighteen percent measure Scope 3 emissions. The lack of reliable data was often cited as a hurdle to measuring Scope 3 emissions of portfolio companies.
- Nineteen SBI public markets funds measure renewable energy use of their portfolio companies, accounting for 16% of the total public markets AUM among those managers that responded to the survey.
- Twelve SBI public markets funds (11% of public markets AUM) keep track of green revenue share of portfolio companies, reflecting the lack of standardized measurement of green revenues.

Within the SBI’s public markets investments, 30% of the public markets AUM (36 of 57 funds) measure Scope 1 and 2 emissions of portfolio companies, while less than 20% measure renewable energy use, green revenue share, or Scope 3 emissions.

Private market investments represent a smaller share of the SBI’s total investment portfolio than public markets. Figure 11 reports the shares of private markets AUM from respondents that measure emissions and climate opportunity metrics.

Figure 11: SBI Private Market Funds Monitoring Results



- Private markets funds that measure Scope 1 emissions (39%) or Scope 2 emissions (37%) represent a similar percent of the SBI’s private markets AUM, as that of the SBI’s public markets AUM that measure Scope 1 and 2 emissions (39%).
- SBI private markets funds that manage one percent of private markets AUM monitor the green revenue share of portfolio companies. The much lower tracking of green revenue share compared to renewable energy usage reflects the lack of readily available, comparable data regarding green revenue share.

A significantly greater percent of private markets AUM (34%), compared to that of public markets AUM (16%) is managed by funds that track the renewable energy use of portfolio companies.



Figure 12: 2022 Climate Survey Results from all SBI Funds by Asset Category

Asset Class	All Funds that Responded										
				Funds that responded YES to:							
	Total # of SBI Funds	# of Funds	Total SBI AUM of responses (\$M)	Account for climate change material risks	Measure Scope 1, and/or Scope 2, and/or Scope 3 gas emissions	Measure Renewable Energy Consumption	Measure the Share of Green Revenues Generated				
				Percent of # of funds	Percent of AUM (%)	Percent of # of funds	Percent of AUM (%)	Percent of # of funds	Percent of AUM (%)	Percent of # of funds	Percent of AUM (%)
Total Portfolio	316	288	82,468	229	47	105	32	87	20	16	9
Total Public Markets	57	57	66,676	47	31	36	24	19	13	12	9
Total Private Markets	259	231	15,792	182	15	69	7	68	7	4	0.3
Total Public Markets	57	57	66,676	47	39	36	30	19	16	12	11
Domestic Equity	18	18	32,303	14	10	10	6	4	2	1	1
Active	13	13	3,658	12	5	9	4	4	2	1	1
Semi-Passive	2	2	3,376	2	5	1	3	0	0	0	0
Passive	3	3	25,269	0	0	0	0	0	0	0	0
Int'l Equity	18	18	14,123	14	8	11	6	7	5	6	4
Active	15	15	6,002	14	8	11	6	7	5	6	4
Passive	3	3	8,121	0	0	0	0	0	0	0	0
Global Equity	3	3	1,155	3	2	3	2	2	1	1	1
Fixed Income	16	16	12,662	16	19	12	15	6	9	4	6
Private Markets-Uninvested	2	2	6,432	0	0	0	0	0	0	0	0
Total Private Markets	259	231	\$15,792	182	79	69	39	68	34	4	1.5
Private Equity	158	138	11,265	105	55	44	28	47	27	0	0
Private Other	101	93	4,527	77	24	25	10	21	7	4	1.5

- Most of the SBI's fixed income funds track GHG emissions (12 of 16 funds).
- Within public markets, domestic equity had the fewest actively managed funds and the lowest percent of public markets AUM measuring renewable energy and green revenue share.
- Within private markets, the four funds (1 manager) that measure the green revenue share of their portfolio companies were in real assets and private credit.

Survey results indicate that some managers in each sub-asset class track climate metrics despite the newness and current constraints on climate data availability.



Manager engagement with portfolio companies on climate risks and opportunities can be an essential element to managing transition risks and enhancing transition opportunities.

Figure 13: 2022 Climate Survey Results from all SBI Funds by Asset Category

Asset Class	All Funds that Responded			Funds that Responded YES to:					
	Total # of SBI Funds	# of Funds	Total SBI AUM of responses (\$M)	Engage on Scope 1, and/or Scope 2, and/or, Scope 3 gas emissions		Engage on Renewable Energy Consumption		Engage on the Share of Green Revenues Generated	
				# of funds	Total AUM (%)	# of funds	Total AUM (%)	# of funds	Total AUM (%)
Total Portfolio	316	288	82,468	84	28	52	15	12	7
Total Public Markets	57	57	66,676	33	23	16	12	8	7
Total Private Markets	259	231	15,792	51	5.3	36	4	4	0.3
Total Public Markets	57	57	66,676	33	28	16	14	8	9
Domestic Equity	18	18	32,303	9	6	3	1	0	0
Active	13	13	3,658	8	4	3	1	0	0
Semi-Passive	2	2	3,376	1	3	0	0	0	0
Passive	3	3	25,269	0	0	0	0	0	0
Int'l Equity	18	18	14,123	10	6	6	4	4	2
Active	15	15	6,002	10	6	6	4	4	2
Passive	3	3	8,121	0	0	0	0	0	0
Global Equity	3	3	1,155	3	2	2	1	0	0
Fixed Income	16	16	12,662	11	15	5	8	4	6
Private Markets-Uninvested	2	2	6,432	0	0	0	0	0	0
Total Private Markets	259	231	15,792	51	28	36	19	4	1.5
Private Equity	158	138	11,265	35	22	28	17	0	0
Private Other	101	93	4,527	16	6	8	2	4	1.5

→ Fewer SBI funds engage portfolio companies on climate, than monitor climate metrics.

More SBI funds (84 funds) engage portfolio companies on carbon emissions, than on climate opportunity metrics such as renewable energy use (52 funds) or green revenue share (12 funds).

### III. Portfolio Climate Exposures – Introduction

In sections I and II we reported survey findings on how the SBI's asset managers are addressing climate risks and opportunities. Sections III-V assess the SBI's exposure to climate risks and opportunities based on metrics for portfolio companies, and top-down total portfolio climate scenario analysis.

The metrics and analytic tools available for investors to analyze climate risks and opportunities is rapidly evolving. Today, for public markets, a growing number of companies provide reported data such as Scope 1, 2 and 3 greenhouse gas emissions, green revenue share and renewable energy use. For public markets companies, ESG data providers gather company level metrics that are reported and provide modeled estimates for companies that do not report. Private market company climate data is not widely available today.

We expect continued growth in reported data, particularly in geographies where policy regulators require such data, and continued evolution and refinement of climate key performance metrics, and in climate scenario analysis.

For this report, Meketa relied on a leading ESG data provider – ISS – to look at some key performance metrics for the SBI's Public Markets portfolio companies, including Scope 1 + 2 emissions intensity (emissions generated directly from a company's business and emissions generated from purchased energy), and Scope 3 emissions intensity (emissions generated by a company's suppliers, and by its customers' use of its products and services). Emissions intensity measures the carbon emissions of a company compared to its revenues, and is a measure supported by the TCFD. The SBI's exposure is the emissions intensity weighted by the SBI's investment exposure to a given company.

Emissions intensity provides an indication of the emissions efficiency of a company. Another useful metric is the carbon footprint, which weights the absolute emissions by investment exposure. Measuring the carbon footprint is important because of the need to reduce overall emissions. However, a carbon footprint does not distinguish the efficiency of an entity's use of resources, and whether total emissions are due to positive or negative economic growth. For future climate implementation reports, we anticipate looking within each asset class at both carbon emissions intensity and carbon footprints.

We also include metrics that can indicate a company's exposure to climate opportunities, and ability to succeed during the energy transition away from fossil fuels. These include information such as Board oversight of Climate Risks, >5% green revenue share, GHG target approved by the Science Based Target initiative (SBTi), renewable energy used by the company, and renewable energy generation as a share of revenues.



For the SBI's private markets climate exposures, we relied on the information provided through the survey, because currently no comprehensive private markets climate database is available. Through our survey of the SBI's private markets managers, we found only a handful that supplied the resulting data, even though a somewhat larger percent responded that they track such data. With this limitation, for this report we focus on the percentage of each private markets asset class that indicated that they track climate data, and which supplied data. Over time, we expect private markets data to become more widely reported on comparable metrics.

To complement the bottom-up understanding of the SBI's exposure to climate risks and opportunities through such metrics, Meketa employed a top down, macro assessment of the potential performance of the SBI's portfolio, with its current asset allocation, under different climate scenarios – consistent with a 3.0 degree warming globally, and consistent with the current scientific conclusion that to avoid warming that has irreversible catastrophic effects globally, warming must be kept to 1.5 degrees above industrial levels.

**Meketa analyzed the SBI's portfolio with public markets company-level climate metrics and complemented the bottom-up findings with a top-down assessment of the SBI's portfolio over the next twenty years under different climate scenarios.**



## IV. Public Markets Climate Exposures

Figure 14 shows how much Scope 1, 2 and 3 emissions data is reported by publicly listed companies in the SBI portfolio, as collected by ISS. Emissions data is modeled by ISS for companies that don't report.

Figure 14: SBI Public Markets: Reported Scope 1, 2 and 3 Emissions

	# Of Companies	AUM (\$M) <sup>1</sup>	% Of Asset Class	% Of Total Public Market	Reported Scope 1+2 Emissions			Reported Scope 3 Emissions		
					# Of companies	% Of Asset Class	% Of Total Public Market	# Of companies	% Of Asset Class	% Of Total Public Market
<b>Public Markets</b>	<b>6,623</b>	<b>56,958</b>	<b>100%</b>	<b>100%</b>	<b>2,725</b>	<b>73%</b>	<b>73%</b>	<b>996</b>	<b>44%</b>	<b>44%</b>
<i>Benchmark<sup>2</sup></i>	<i>5,884</i>	<i>-</i>	<i>100%</i>	<i>-</i>	<i>2,718</i>	<i>74%</i>	<i>-</i>	<i>1,042</i>	<i>44%</i>	<i>-</i>
<b>Public Markets Asset Classes</b>										
<b>Domestic Equity</b>	<b>3,096</b>	<b>32,123</b>	<b>100%</b>	<b>56%</b>	<b>917</b>	<b>81%</b>	<b>46%</b>	<b>305</b>	<b>52%</b>	<b>30%</b>
Passive	3,016	25,173	78%	44%	900	85%	38%	294	56%	25%
Active	1,492	6,951	22%	12%	603	66%	8%	228	39%	5%
<i>Benchmark</i>	<i>3,038</i>	<i>-</i>	<i>100%</i>	<i>-</i>	<i>904</i>	<i>82%</i>	<i>-</i>	<i>295</i>	<i>53%</i>	<i>-</i>
<b>Int'l Equity</b>	<b>2,568</b>	<b>13,792</b>	<b>100%</b>	<b>24%</b>	<b>1,695</b>	<b>91%</b>	<b>21%</b>	<b>632</b>	<b>49%</b>	<b>11%</b>
Passive	2,159	7,933	58%	14%	1,408	91%	13%	548	51%	7%
Active	1,204	5,859	42%	10%	878	77%	8%	369	39%	4%
<i>Benchmark</i>	<i>2,254</i>	<i>-</i>	<i>100%</i>	<i>-</i>	<i>1,502</i>	<i>90%</i>	<i>-</i>	<i>573</i>	<i>47%</i>	<i>-</i>
<b>Global Equity</b>	<b>222</b>	<b>1,125</b>	<b>100%</b>	<b>2%</b>	<b>89</b>	<b>84%</b>	<b>2%</b>	<b>49</b>	<b>52%</b>	<b>1%</b>
<i>Benchmark</i>	<i>2,873</i>	<i>-</i>	<i>100%</i>	<i>-</i>	<i>1,960</i>	<i>89%</i>	<i>-</i>	<i>796</i>	<i>55%</i>	<i>-</i>
<b>Fixed Income</b>	<b>1,586</b>	<b>9,921</b>	<b>100%</b>	<b>17%</b>	<b>874</b>	<b>29%</b>	<b>5%</b>	<b>377</b>	<b>13%</b>	<b>2%</b>
<i>Benchmark</i>	<i>2,216</i>	<i>-</i>	<i>100%</i>	<i>-</i>	<i>728</i>	<i>23%</i>	<i>-</i>	<i>362</i>	<i>11%</i>	<i>-</i>

→ A large minority of companies 41% (2,725 of 6,623 companies) of the SBI's public markets investee companies, reported Scope 1+2 emissions as of December 31, 2021.

→ Fewer companies (996 of 6,623) reported Scope 3 emissions, as of December 31, 2021.

**Companies that report carbon emissions today tend to be larger market capitalization companies. Thus, the 41% of companies that reported Scope 1+2 emissions comprised 73% of the SBI Total Public Markets portfolio.**

<sup>1</sup> Public Market Data as of 12/31/2021, excluding Cash and Treasury Protection. 5.8% (or \$3.3 billion) of the remaining market value was missing securities unique identifiers, 4% of which belonged to the Fixed Income portfolio. These securities were included in the AUM calculation but not included in the count of # of companies.

<sup>2</sup> Consists of asset class benchmarks by their respective weight: 56% Russell 3000, 24% MSCI ACWI ex. US, 2% MSCI ACWI and 17% SSGA US Agg.



Emissions intensity measures the carbon emissions of each issuer per million USD of revenues. This metric offers a proxy for the carbon efficiency per unit output, a measure endorsed by the TCFD.

Figure 15: Scope 1, 2 and 3 Emissions Intensity by asset class

	# Of Companies	AUM (\$M)	% Of Sector	% Of Total Public Market	Scope 1+2 Emissions Intensity <sup>1</sup>		Scope 1, 2 + 3 Emissions Intensity <sup>1</sup>	
					Average	Weighted Average	Average	Weighted Average
<b>Public Markets</b>	<b>6,623</b>	<b>56,958</b>	<b>100%</b>	<b>100%</b>	<b>228</b>	<b>129</b>	<b>1,604</b>	<b>1,007</b>
<i>Benchmark</i>	<i>5,884</i>	<i>-</i>	<i>-</i>	<i>-</i>	<i>252</i>	<i>134</i>	<i>1691</i>	<i>993</i>
<b>Public Market Asset Classes</b>								
<b>Domestic Equity</b>	<b>3,096</b>	<b>32,123</b>	<b>100%</b>	<b>56%</b>	<b>175</b>	<b>121</b>	<b>1,667</b>	<b>1,005</b>
Passive	3,016	25,173	78%	44%	178	122	1,652	1,005
Active	1,492	6,951	22%	12%	169	118	1,705	1,235
<i>Benchmark</i>	<i>3,038</i>	<i>-</i>	<i>-</i>	<i>-</i>	<i>181</i>	<i>123</i>	<i>1,740</i>	<i>1,049</i>
<b>Int'l Equity</b>	<b>2,568</b>	<b>13,792</b>	<b>100%</b>	<b>24%</b>	<b>272</b>	<b>168</b>	<b>1,635</b>	<b>1,247</b>
Passive	2,159	7,933	58%	14%	337	159	1,540	1,191
Active	1,204	5,859	42%	10%	189	157	1,757	1,148
<i>Benchmark</i>	<i>2,254</i>	<i>-</i>	<i>-</i>	<i>-</i>	<i>376</i>	<i>208</i>	<i>1,728</i>	<i>1,298</i>
<b>Global Equity</b>	<b>222</b>	<b>1,125</b>	<b>100%</b>	<b>2%</b>	<b>82</b>	<b>70</b>	<b>577</b>	<b>548</b>
<i>Benchmark</i>	<i>2,873</i>	<i>-</i>	<i>-</i>	<i>-</i>	<i>340</i>	<i>154</i>	<i>1,659</i>	<i>1,011</i>
<b>Fixed Income</b>	<b>1,586</b>	<b>9,921</b>	<b>100%</b>	<b>17%</b>	<b>268</b>	<b>124</b>	<b>1,528</b>	<b>676</b>
<i>Benchmark</i>	<i>2,216</i>	<i>-</i>	<i>-</i>	<i>-</i>	<i>304</i>	<i>66</i>	<i>1,488</i>	<i>396</i>

- The SBI's total public markets weighted average emissions intensity was roughly in line with the total public markets benchmark (129 and 134 weighted average emissions intensity).
- Among actively managed domestic, international, and global equities, global equities exhibited the lowest weighted average emissions intensity compared to its benchmark (70 vs 154).
- The SBI's fixed income assets indicated a higher-weighted average emissions than the benchmark, however, these numbers may be skewed by a lower exposure to corporates in the benchmark, and by lower availability of CUSIP identifiers in the benchmark due to ETFs, compared to the actual holdings by the SBI.

The SBI's public markets investments and benchmark are skewed somewhat to lower carbon emissions intensity companies, compared to the simple average emissions intensity of companies in the economy: The SBI's public markets portfolio and its benchmark show an investment weighted average emissions intensity that is lower than the unweighted average emissions intensity of the portfolio companies.

<sup>1</sup> Carbon intensity is expressed as the issuer's total carbon emissions per million USD of revenue as a proxy of the carbon efficiency per unit of output.



Forward-looking energy transition metrics can help assess how/if companies might successfully transition to a low-carbon economy. There are multiple and growing approaches to climate transition metrics. For this report we include three:

- 1) Board oversight of climate risks,
- 2) the percentage of green revenues, and
- 3) Greenhouse Gas (GHG) targets approved by the Science-Based Target initiative (SBTi).

Board oversight of climate risks reflects company responses to the question: does the company's Board of Directors exercise oversight of climate-related risks and opportunities?

We used the ISS measure of green revenue share that includes products and services throughout the economy that have a (significant or limited) contributing impact on the achievement of mitigating climate change. Examples range widely and include renewable energy production, power utilities using renewables, vehicles that increase use of renewable energy, concrete made with less or zero fossil fuel energy, products that reduce the use of energy, which can range from laundry detergent that works well in cold water (avoids energy used to heat water), energy efficiency in buildings, to food products with reduced emissions.

Large corporate users of energy are beginning to generate clean energy solutions. For example, large technology companies such as Microsoft and Google are transitioning to use clean energy to support the data storage needs of their businesses. A large consumer retail company, Walmart, has added jobs in U.S. Midwest through its support for offsite wind energy generation to support the clean energy needs of its facilities.

SBTi approved GHG targets are clearly defined pathways for companies and financial institutions to reduce greenhouse gas (GHG) emissions which have been validated by the SBTi. Targets include near-term targets, next five to ten years targets, and long-term (2050, and 2040 for the power sector) targets needed to achieve Net Zero GHG emissions.

**Forward-looking transition metrics can help assess how/if companies might successfully transition to a low-carbon economy.**



Figure 16: Board Oversight of Climate Risk, Green Revenue Share and Approved Science Based Targets

	Board Oversight of Climate Risks			>5% Green Revenue Share <sup>1</sup>			GHG target approved by Science-Based Target Initiative (SBTi)		
	# Of companies	% Of Asset Class	% Of Total Public Market <sup>4</sup>	# Of companies	% Of Asset Class	% Of Total Public Market	# Of companies	% Of Asset Class	% Of Total Public Market
<b>Public Markets</b>	<b>1,637</b>	<b>62%</b>	<b>62%</b>	<b>594</b>	<b>24%</b>	<b>24%</b>	<b>312</b>	<b>23%</b>	<b>23%</b>
<i>Benchmark<sup>5</sup></i>	<i>1,508</i>	<i>63%</i>	<i>-</i>	<i>572</i>	<i>24%</i>	<i>-</i>	<i>301</i>	<i>23%</i>	<i>-</i>
<b>Public Markets Asset Classes</b>									
<b>Domestic Equity</b>	<b>920</b>	<b>79%</b>	<b>45%</b>	<b>322</b>	<b>34%</b>	<b>19%</b>	<b>136</b>	<b>29%</b>	<b>17%</b>
Passive	910	83%	37%	318	40%	16%	131	31%	14%
Active	618	65%	8%	186	27%	3%	109	21%	3%
<i>Benchmark</i>	<i>919</i>	<i>80%</i>	<i>-</i>	<i>318</i>	<i>34%</i>	<i>-</i>	<i>131</i>	<i>30%</i>	<i>-</i>
<b>Int'l Equity</b>	<b>711</b>	<b>60%</b>	<b>14%</b>	<b>248</b>	<b>15%</b>	<b>4%</b>	<b>179</b>	<b>21%</b>	<b>5%</b>
Passive	573	65%	9%	220	15%	2%	164	25%	3%
Active	478	44%	5%	117	13%	1%	116	13%	1%
<i>Benchmark</i>	<i>583</i>	<i>57%</i>	<i>-</i>	<i>236</i>	<i>16%</i>	<i>-</i>	<i>159</i>	<i>21%</i>	<i>-</i>
<b>Global Equity</b>	<b>55</b>	<b>58%</b>	<b>1%</b>	<b>25</b>	<b>29%</b>	<b>1%</b>	<b>30</b>	<b>34%</b>	<b>1%</b>
<i>Benchmark</i>	<i>1,030</i>	<i>74%</i>	<i>-</i>	<i>352</i>	<i>29%</i>	<i>-</i>	<i>274</i>	<i>28%</i>	<i>-</i>
<b>Fixed Income</b>	<b>403</b>	<b>18%</b>	<b>3%</b>	<b>108</b>	<b>3%</b>	<b>0%</b>	<b>76</b>	<b>4%</b>	<b>1%</b>
<i>Benchmark</i>	<i>405</i>	<i>16%</i>	<i>-</i>	<i>91</i>	<i>4%</i>	<i>-</i>	<i>89</i>	<i>4%</i>	<i>-</i>

→ >5% Green Revenue Share: The SBI's Total public markets actively managed funds that held portfolio companies with greater than 5% green revenue share (594 companies), was slightly more than those held in the SBI total public markets benchmark (572 companies).

→ GHG Target Approved by the SBTi: The SBI's total public markets investments includes 312 companies with an approved GHG target, slightly more than the benchmark (301).

Sixty-two percent of the SBI's public markets portfolio AUM (1,637 companies) indicate there is Board oversight of climate risks at portfolio companies; 24% of AUM (594 companies) show a green revenue share >5% and 23% (312 companies) were identified as having GHG emissions targets approved by the SBTi.

<sup>1</sup> MSB assets data, SBI; climate metrics, ISS.



Energy transitions are occurring throughout economy, both within the traditional energy sector, and in sectors that require large amounts of energy. Within the energy sector, integrated oil and gas majors Total Energy and BP are among the top 100 producers of renewable energy globally. Peabody Energy, a large U.S. coal mining company announced in 2022 that it was converting two old coal mines in Missouri and Illinois to solar power and noted that because the sites were already connected to the energy grid, getting the solar energy to the grid was much less costly and less time consuming than solar energy sites not already connected.

Figure 17: Energy Supply: Fossil Fuel and Renewable Energy Generation Exposure

	Renewable Energy Generation Revenue >5%			Fossil Fuel Revenue >20% <sup>2</sup>			Fossil Fuel Revenue >20% and Renewable Energy Generation Revenue >5%		
	# Of companies	% Of Asset Class	% Of Total Public Market	# Of companies	% Of Asset Class	% Of Total Public Market	# Of companies	% Of Asset Class	% Of Total Public Market
<b>Public Markets</b>	<b>99</b>	<b>1.11%</b>	<b>1.10%</b>	<b>557</b>	<b>6.03%</b>	<b>6.03%</b>	<b>75</b>	<b>1.04%</b>	<b>1.04%</b>
<i>Benchmark</i>	<i>100</i>	<i>1.21%</i>	<i>-</i>	<i>502</i>	<i>5.87%</i>	<i>-</i>	<i>77</i>	<i>1.09%</i>	<i>-</i>
<b>Public Markets Asset Classes</b>									
<b>Domestic Equity</b>	<b>22</b>	<b>1.02%</b>	<b>0.57%</b>	<b>205</b>	<b>5.40%</b>	<b>3.07%</b>	<b>19</b>	<b>1.01%</b>	<b>0.57%</b>
Passive	21	1.07%	0.47%	200	5.31%	2.35%	18	1.06%	0.47%
Active	13	0.83%	0.10%	113	5.89%	0.72%	13	0.83%	0.10%
<i>Benchmark</i>	<i>21</i>	<i>1.14%</i>	<i>-</i>	<i>206</i>	<i>5.48%</i>	<i>-</i>	<i>18</i>	<i>1.05%</i>	<i>-</i>
<b>Int'l Equity</b>	<b>53</b>	<b>1.52%</b>	<b>0.34%</b>	<b>194</b>	<b>8.03%</b>	<b>1.83%</b>	<b>34</b>	<b>1.23%</b>	<b>0.28%</b>
Passive	52	1.75%	0.24%	155	8.01%	1.12%	34	1.55%	0.22%
Active	14	0.99%	0.10%	92	6.93%	0.71%	9	0.63%	0.06%
<i>Benchmark</i>	<i>57</i>	<i>1.71%</i>	<i>-</i>	<i>192</i>	<i>8.36%</i>	<i>-</i>	<i>37</i>	<i>1.46%</i>	<i>-</i>
<b>Global Equity</b>	<b>2</b>	<b>1.45%</b>	<b>0.03%</b>	<b>3</b>	<b>2.20%</b>	<b>0.04%</b>	<b>2</b>	<b>1.45%</b>	<b>0.03%</b>
<i>Benchmark</i>	<i>66</i>	<i>1.33%</i>	<i>-</i>	<i>243</i>	<i>6.43%</i>	<i>-</i>	<i>46</i>	<i>1.23%</i>	<i>-</i>
<b>Fixed Income</b>	<b>33</b>	<b>0.94%</b>	<b>0.16%</b>	<b>234</b>	<b>6.28%</b>	<b>1.09%</b>	<b>29</b>	<b>0.92%</b>	<b>0.16%</b>
<i>Benchmark</i>	<i>33</i>	<i>0.71%</i>	<i>-</i>	<i>165</i>	<i>3.58%</i>	<i>-</i>	<i>32</i>	<i>0.71%</i>	<i>-</i>

→ Today, in the SBI’s total public markets portfolio, there are many more companies that generate fossil fuel revenues >20% of total revenues (557 companies) than there are companies that generate renewable energy revenues >5% of total revenues (99 companies). One indicator that the global economy and companies are in transition is the number of companies that have over 5% renewable energy revenues and >20% fossil fuel revenue share.

**Seventy-five of the SBI portfolio companies with >20% fossil fuel revenues also generate >5% renewable energy revenues, with 77 such companies in the total public markets benchmark.**

<sup>1</sup> Average recent-year revenues (>5%) for the issuer’s involvement in the generation of electric power using renewables.

<sup>2</sup> Average recent-year revenues (>20%) for the issuer’s total involvement in fossil fuel, including any exposure in Production, Exploration, Distribution, and Services.



There is evidence of the energy transition among large coal, and oil and gas reserves owners in SBI benchmarks and in its portfolio holdings. Large fossil fuel companies may exhibit a small percent of renewable energy generation, or of green revenue share, but, because they are large global companies, they may represent a large share of today's global renewable energy generation.

Figure 18: Top 200 Fossil Fuel Reserves Companies and Energy Transition Indicators

	ISS Top 100 Coal and Top 100 Oil & Gas Reserves			ISS Top 100 Coal or Top 100 Oil & Gas Reserves and Top 200 Renewable Energy Generators			Top 100 Coal and Top 100 Oil & Gas Reserves and GHG targets Approved by Science Based Target Initiative		
	# of companies	% of Sector	% Of Total	# of companies	% of Sector	% Of Total	# of companies	% of Sector	% Of Total
			Public Market			Public Market			Public Market
<b>Public Markets</b>	<b>109</b>	<b>2.81%</b>	<b>2.81%</b>	<b>16</b>	<b>0.45%</b>	<b>0.45%</b>	<b>1</b>	<b>0.020%</b>	<b>0.020%</b>
<i>Benchmark</i>	114	2.70%	-	20	0.49%	-	1	0.024%	-
<b>Public Markets Asset Classes</b>									
<b>Domestic Equity</b>	<b>23</b>	<b>1.74%</b>	<b>0.98%</b>	<b>1</b>	<b>0.01%</b>	<b>0.0047%</b>	<b>0</b>	<b>0%</b>	<b>0%</b>
Passive	23	1.79%	0.79%	1	0.001%	0.0003%	0	0%	0%
Active	19	1.54%	0.19%	1	0.036%	0.0044%	0	0%	0%
<i>Benchmark-R3000</i>	26	1.79%	-	1	0.01%	-	0	0%	-
<b>Int'l Equity</b>	<b>60</b>	<b>6.24%</b>	<b>1.42%</b>	<b>13</b>	<b>1.89%</b>	<b>0.427%</b>	<b>1</b>	<b>0.100%</b>	<b>0.020%</b>
Passive	55	5.70%	0.80%	13	1.63%	0.226%	1	0.120%	0.015%
Active	35	6.01%	0.62%	8	1.97%	0.201%	1	0.054%	0.005%
<i>Benchmark-ACWI-ex-US</i>	65	6.06%	-	18	1.79%	-	1	0.096%	-
<b>Global Equity</b>	<b>1</b>	<b>0.32%</b>	<b>0.01%</b>	<b>1</b>	<b>0.32%</b>	<b>0.006%</b>	<b>0</b>	<b>0.0%</b>	<b>0%</b>
<i>Benchmark-ACWI</i>	75	3.46%	-	18	0.70%	-	1	0.037%	-
<b>Fixed Income</b>	<b>54</b>	<b>2.30%</b>	<b>0.40%</b>	<b>4</b>	<b>0.07%</b>	<b>0.012%</b>	<b>0</b>	<b>0%</b>	<b>0%</b>
<i>Benchmark-US Agg</i>	24	0.90%	-	4	0.21%	-	0	0%	-

→ Compared to the SBI's domestic equity benchmark, the international equity, global equity, and fixed income benchmarks each held more companies that were both top 200 fossil fuel reserves companies and Top 200 renewable energy generators globally.

Twenty companies in the SBI total public markets benchmark (16 in the portfolio) are both top 100 Oil and Gas reserves companies and among the Top 200 global renewable energy generation companies. This includes integrated oil and gas majors such as Total Energies (82<sup>nd</sup> largest global renewables producer), BP (95<sup>th</sup>), Repsol SA (140<sup>th</sup>), Eni (141<sup>st</sup>), Shell (144<sup>th</sup>), and Equinor (180<sup>th</sup>).

## V. SBI Private Markets Climate Exposure

Among the SBI’s private markets funds, some reported that they track climate metrics of their portfolio companies. We first review by sub-asset class the overall number of managers and percent of SBI private markets funds being monitored using climate metrics, and then present information on the number of funds that provided results of their measurements for funds in which the SBI invests.

Figure 19: SBI Private markets sub-asset class measure climate exposures

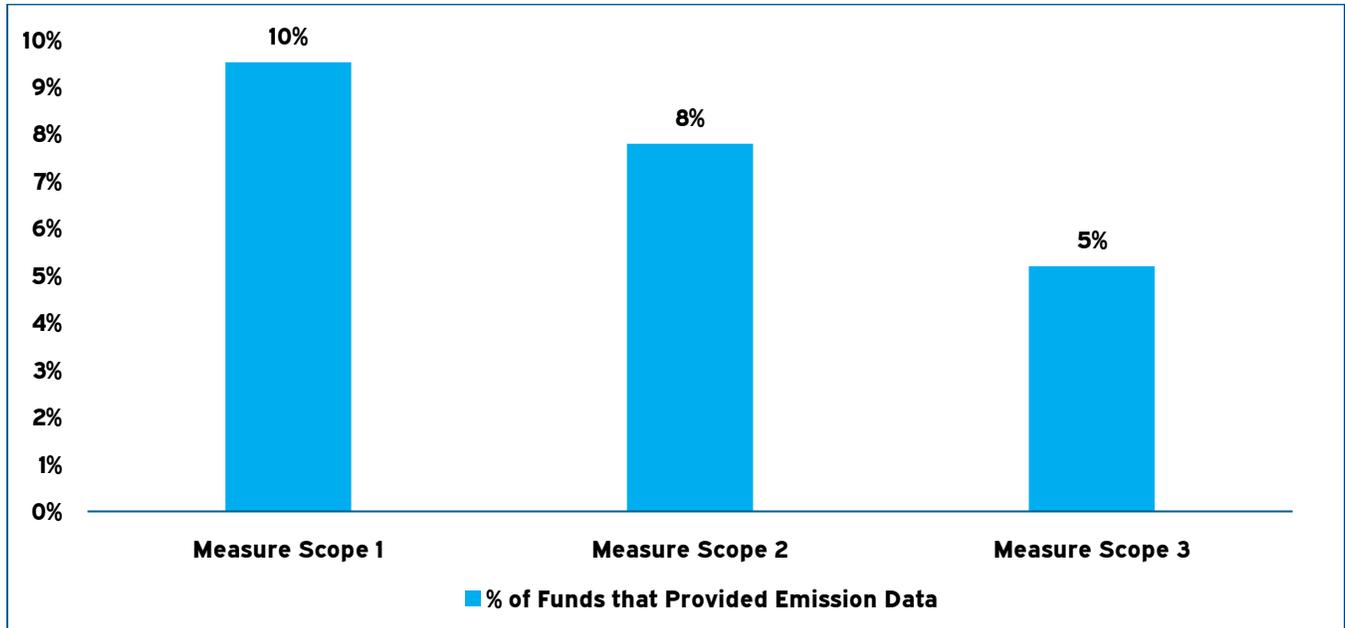
	Number of Funds that Responded		Monitor Climate Risks		Measure Scope 1, 2, and/or 3		Measure Renewable Energy usage		Measure Green Revenue Share	
	# of Funds	% AUM	# of Funds	% AUM	# of Funds	% AUM	# of Funds	% AUM	# of Funds	% AUM
Total Private Markets	231	100%	182	79%	69	39%	68	34%	4	1%
Private Equity	138	71%	105	55%	44	28%	47	27%	0	0%
Real Estate	30	10%	22	7%	3	1%	10	3%	0	0%
Real Assets	27	9%	25	9%	19	8%	7	3%	3	1%
Private Credit	36	10%	30	8%	3	1%	4	1%	1	0%

- Among the SBI’s 231 private markets funds that responded to the climate survey, by sub-asset class, more Private Equity and Real Estate funds reported that they measure Scope 1, 2 and/or Scope 3 emissions, than measure renewable energy use. No SBI Private Equity or Real Estate funds measured green revenue share, largely due to lack of clear definition of metrics.
- Private Credit fund managers that measure Scope 1,2, and/or 3 emissions also measure renewable energy use.
- The four SBI private markets funds (one manager) that track the green revenue share of portfolio companies include three Real Assets funds and one Private Credit fund.

Slightly more than one third of the SBI’s private markets assets are managed by funds that measure Scope 1,2 and/or 3 emissions (39% of private markets AUM) and/or measure renewable energy usage (34% of private markets AUM).

Private markets investment funds are in the early stages of collecting GHG emissions data on portfolio companies.

Figure 20: SBI Private Markets Carbon Emissions Scope 1, 2 and 3 Measurements Provided



- Among the 231 private markets respondents, 22 funds (10% of respondents), representing nine distinct managers, provided data for Scope 1 metrics tons of CO<sub>2</sub> emitted by the 502 portfolio companies.
- Eighteen funds (8% of respondents), representing seven distinct managers, provided data for Scope 2 metric tons of CO<sub>2</sub> emitted by 469 portfolio companies.
- Twelve funds (5% of respondents), representing four distinct managers, provided data for Scope 3 metric tons of CO<sub>2</sub> emitted by 436 portfolio companies.

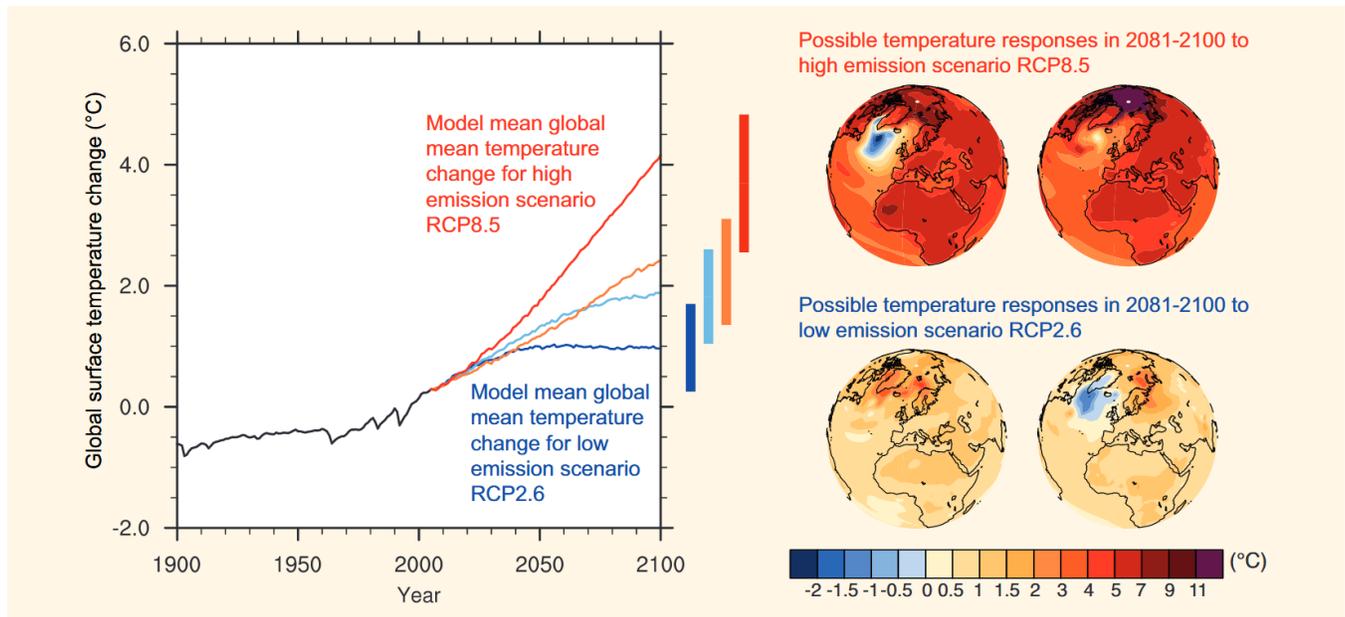
The small number of SBI private markets funds that reported emissions of their portfolio companies reflects the fact that market wide, private markets managers are in the very early stages of collecting and reporting emissions data of their portfolio companies in the absence of regulatory disclosure requirements.

We anticipate that the availability of reported climate metrics by private markets funds will increase in coming years.

## VI. Climate Scenario Analysis

Global temperatures have been rising along with various industrial greenhouse gas emissions, most notably (but not limited to) carbon dioxide (CO<sub>2</sub>) and creating significant increases in material physical climate risks.

Figure 21: What Are We Dealing With?<sup>1</sup>



→ Currently average world temperatures are slightly less than +1.5°C above the pre-industrial baseline.

**Increases of the average temperature from 2.0° C to 4.0° C above industrial levels by the end of the 21<sup>st</sup> century, are not only possible, but arguably likely without broad changes in human behavior.**

<sup>1</sup> Source: IPCC Fifth Assessment Report, FAQ 12.1, Figure 1, [https://www.ipcc.ch/site/assets/uploads/2018/02/WG1AR5\\_Chapter12\\_FINAL.pdf](https://www.ipcc.ch/site/assets/uploads/2018/02/WG1AR5_Chapter12_FINAL.pdf).

### Meketa's Climate Scenario Approach

Our clients are often seeking to mitigate risks across their entire investment portfolio over 20 to 30-year periods. As a result, we use a top-down, statistical approach to give asset allocators a “big picture” estimation of potential impacts to returns and risk that could confront them in a fundamentally uncertain situation. However, such an approach should not be viewed in isolation and has unique benefits and drawbacks.

A top-down model illustrates broader relationships at the expense of specificity; bottom-up models can make more specific assumptions.

Our statistical approach relies on demonstrated historical relationships to explain causality.

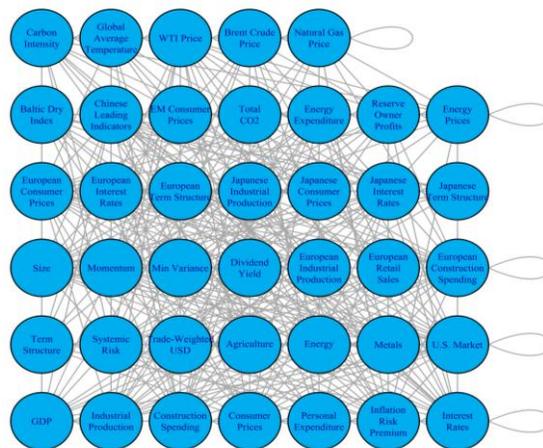
As a financial model, our results show observable monetary impacts from transition risks better than from physical climate risks, and its results are affected by capital market conditions.

→ We start by using information from our fundamentally driven asset study and our quantitatively driven modelling of economic and financial factors.

- This information provides us with a foundation of what we know but leaves an honest assessment of our uncertainty.

This uncertainty leads us to define future scenarios in terms of their probability of occurrence and presents a range of possible outcomes.

**Figure 22: The Meketa Climate Scenario Analysis Model**



We take historical factor definitions and their past behaviors to generate direct and indirect relationships among factors. We then use these relationships to generate “simulations” that forecast these factors into the future.

→ Each simulation can be thought of as a way the world *could* look in the future.

→ We then review the simulations with characteristics that are of interest.

The SBI Current Portfolio Climate Scenarios

For the SBI’s current portfolio target asset allocation (based on December 31, 2021), Meketa analyzed two climate change scenarios compare to the base case where climate change is not taken into account. We selected simulations where:

- Global warming was constrained consistent with 3.0°C warming by 2100.
- Global warming was constrained consistent with 1.5°C warming by 2100.

Figure 23: SBI Current Target Portfolio: Climate Scenario Analysis Model

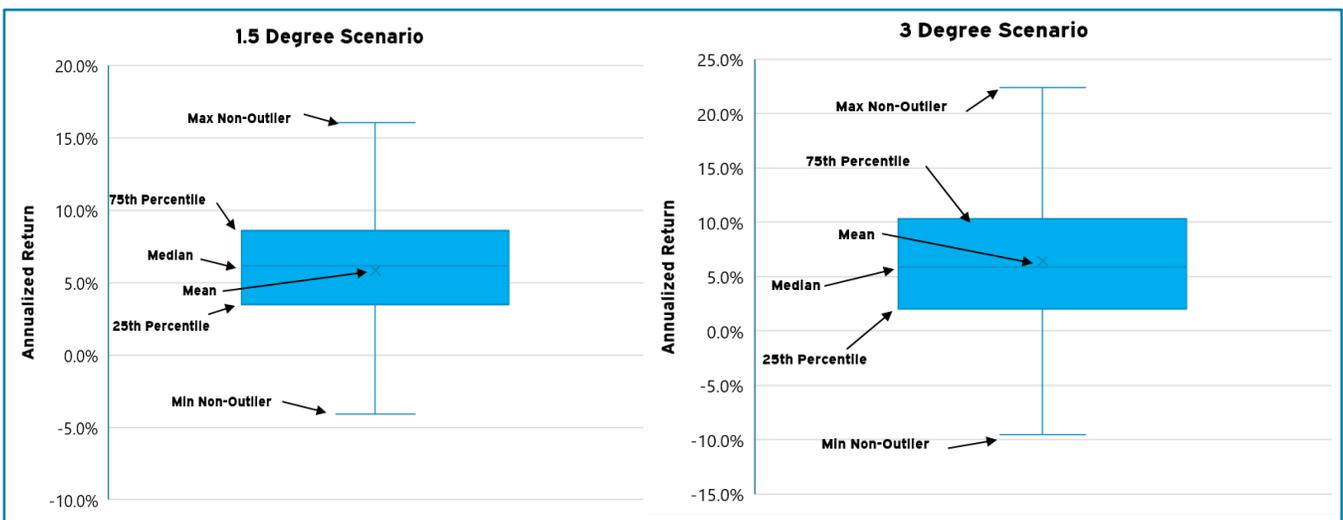
SBI 20-Year Climate Scenario Analysis: Average Target Portfolio (As of December 31, 2021)			
	Base: No temperature effect included (%)	1.5 Degree (%)	3 Degree (%)
<b>Long-Term Expected Return (annualized)</b>			
Current	6.9	6.0	6.7
<b>Standard Deviation</b>			
Current	14.7	15.5	15.1
<b>Sharpe Ratio</b>			
Current	0.35	0.28	0.33

- The lower long-term return expectations for scenarios with climate included, relative to the base case where climate is not accounted for, presumably reflect the greater societal efforts to curtail carbon emissions and incentivize climate-friendly economic initiatives, and/or the impacts of ignoring climate change.
- The 1.5° C long-term expected return is nearly a full one percentage point lower than the expected return that does not include any anticipation of climate change.
- For the SBI’s current portfolio, the lower relative return of the 1.5° C scenario versus the 3.0° C scenario likely stems in part from the SBI’s relatively somewhat high allocation to alternative asset classes, including private equity, and reflects the start date of December 31, 2021, when private equity was relatively highly valued. Alternative assets historically display a positive relationship with temperature, and more sensitivity to changes in climate forecasts, thus increasing the asset class variability while decreasing average returns.

**Under either a 1.5° C or 3.0° C climate change scenario, the SBI’s portfolio would be expected to reduce future returns and increase portfolio volatility, to become less risk efficient compared to estimates that do not include climate.**

- Our analysis begins in December 2021, a period characterized by low interest rates, a dramatic recent increase in equity prices including private equity, and somewhat higher prices for energy relative to historic lows in 2020. Our modeling incorporates 1) extrapolation of recent market trends and 2) reversion to mean expected long-term returns when generating simulations for analysis. If the starting point of the analysis were shifted, particularly in volatile markets as we have experienced in recent years, we expect the relation between the mean expected return of the base and climate scenario portfolios would differ.
- Modeling a 4.0° C or higher scenarios could result in potentially even lower performance as the global economy grapples the possible enormous destruction of capital and greater volatility from unmitigated physical climate risks.

Figure 24: Point versus range Estimates = 1.5 and 3.0 (December 31, 2021)

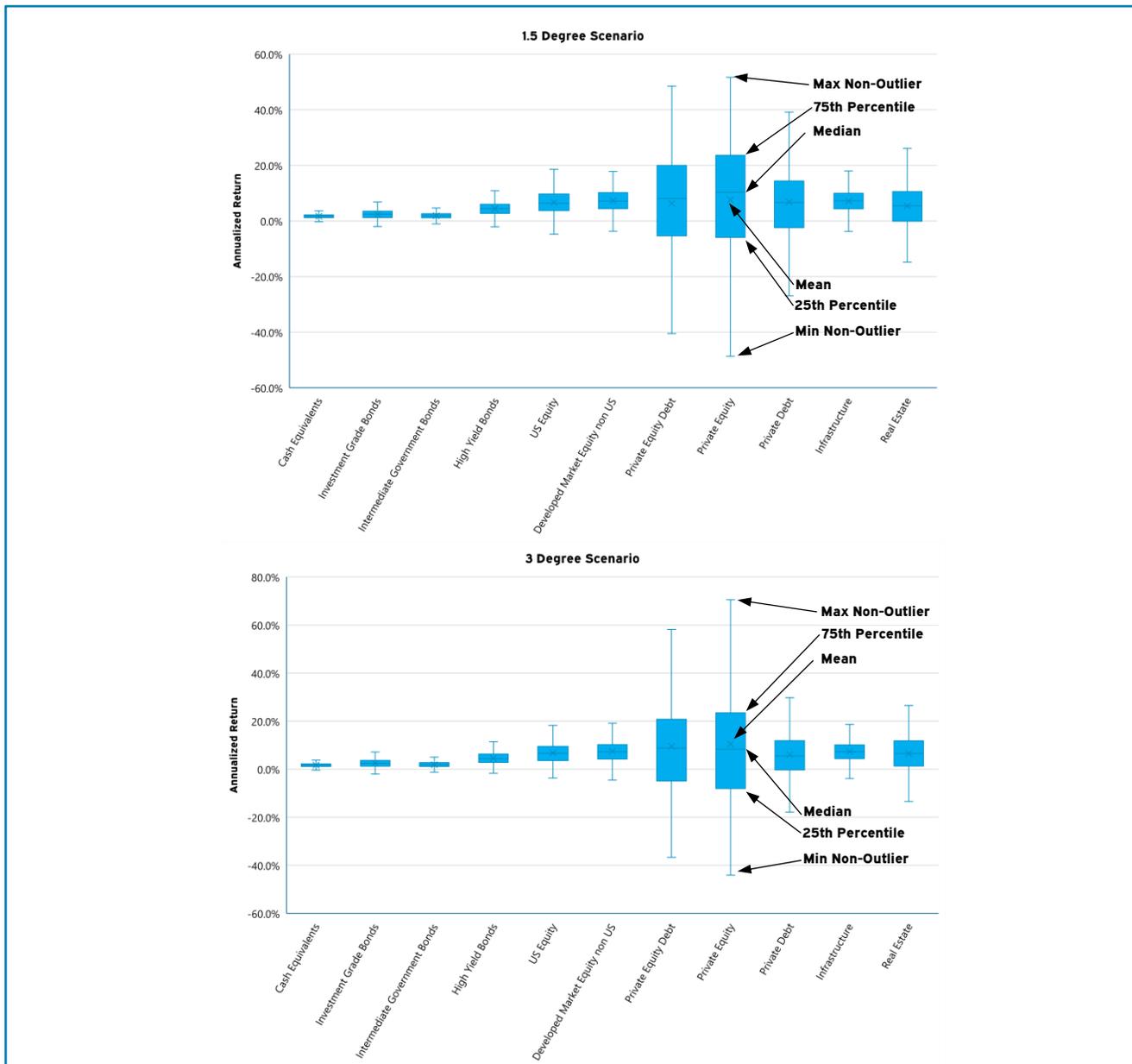


- Across simulations, the SBI’s target portfolio has an average expected return approximately 0.7% higher in a 3.0-degree scenario than 1.5° scenario.
- The range of likely outcomes (i.e., the middle 50% of simulations) substantially overlap, though the 3.0-degree scenario has greater variation in outcomes.
- Given current capital market conditions and the current target asset allocation, the portfolio is more likely to moderately outperform in a 3.0° scenario than in a 1.5°. That outcome is uncertain and subject to change as markets and climate conditions change.

**For the 20-year time frame beginning December 31, 2021, the SBI climate scenarios indicate that the 3.0° scenarios produce a higher variation in results, with a somewhat higher mean return than the 1.5° scenarios.**



Figure 25: SBI Current Target Portfolio: 20-year Climate Scenario Analysis Distribution of Asset Class Returns (December 31, 2021)



→ Although alternative asset class returns are currently expected to be higher on average in a 3.0° scenario than a 1.5° scenario, the highest reasonably expected return (the 25<sup>th</sup> percentile return) is higher in a 1.5° scenario.

For the 20-year time frame beginning December 31, 2021, in both the 1.5° and 3.0° scenarios, fixed income returns display less variability in outcomes than equities and real assets. Private equity, private debt, infrastructure, and real estate have substantial variability in outcomes relative to other asset classes.

## VII. Policy Options Discussion

The growing attention being devoted to climate change physical and transition risks includes consideration of multiple different investment tools and implementation efforts. Each investment tool can be used in multiple ways.

Figure 26: Public Pension Plans and Climate Investment Risk and Opportunity Tools



→ **Climate Change Investment Issues are Complex**

- Decarbonizing an investment portfolio and helping move the market beta toward Net Zero are not equal.

→ **No Best Practices**

- There is a wide range of approaches by plans to address climate risks and opportunities.
- Plans of all sizes, and widely varying experience in addressing climate, continue to evolve their approaches and use of different investment tools.

→ **Growing Trend to Adopt Net Zero by 2050 or Before**

- Net Zero strategies focus on transition in the real economy and vary widely.

The range of investment tools can each be implemented in different ways, and can have differing impacts on the real economy, and costs and complexity of implementation.

**Figure 27: Climate Investment Tools – Impact on Real Economy, Costs and Complexity**

Approaches to addressing Climate Risks and Opportunities	Impact on Real Economy	Cost	Complexity
Support Investor Organizations	Can improve collaborative results	Low	Low
Portfolio Measurement and Monitoring	Can improve portfolio impact	Medium	Low to Medium
Stewardship- Proxy Voting and Engagement	Medium	Low to High	Low to Medium
Investing in Climate Solutions	Medium to High	Low	Low
Exclusion	None	Low to Medium	Low to Medium
Net Zero Goal	Medium to High	Medium to High	High

= None to Low   
  = Low to Medium   
  = Medium   
  = Medium to High   
  = High

- **Investor Organizations** – The SBI is a signatory to investor organizations focused on climate, including CII, PRI, Ceres, Climate Action 100+, TCFD and CDP. Such organizations provide mechanisms for the SBI to enhance its proxy voting and engagement, and climate strategy efforts through education and work with other institutional investors.
- **Portfolio monitoring of climate metrics** can vary in complexity from low, measuring a few metrics, to high, monitoring more metrics and using scenario analysis. The SBI has begun to implement more complex climate assessments.
- **Stewardship** - The SBI votes all its proxies in-house, supported by an operational structure of separately managed accounts in public markets equities. The SBI has sponsored a climate related shareholder proposal in conjunction with CA100+.
- **Investing** - The SBI has invested in some private market funds devoted to climate solutions. Increasing the SBI’s exposure to investments more geared toward mitigating climate risks may have a medium to high effect on the real economy, while incurring low additional costs.
- **Exclusion** – The SBI excludes thermal coal companies, and its separate account structure can support targeted, case by case exclusions in public markets. The most expensive approach excludes fossil fuel companies from existing private market funds.

**There is a wide range of options for the SBI to consider while evolving their climate change approach. Adopting a portfolio-wide Net Zero Goal strategy would likely be both the most complex approach and offer the greatest potential impact on the real economy.**

Addressing climate risks and opportunities is still an art, not a science, and one for which asset owners are continually evolving their approach. Investment climate risks and opportunities represent rapidly moving targets, as policies, technologies, and consumer preferences change with heightened physical climate risks, and with the ability to address these issues change with improved data and analysis. Investment policies may seek to enhance a dynamic global process. For discussion, we offer three broad policy options: Climate Aware (Current), Energy Supply Exclusion (Broad Exclusion of Fossil Fuel Suppliers, and a Portfolio-wide Strategic Net Zero Goal.

**Figure 28: Climate Policy Approaches**

Approach	Implementation	Pros	Cons
<b>Climate Aware (Current)</b>	Maintain Existing approach to investment climate risk and opportunities	No additional time and resources required	Low to medium expected long-term contribution to lowering real economy climate risks and increasing risk-adjusted return of investment portfolio
<b>Energy Supply Exclusion (Broad FF Exclusion)</b>	Expand coal exclusion to all fossil fuel suppliers, and maintain rest of existing approach to climate risks and opportunities	Minimal to medium implementation costs and resources, depending on approach to private markets	Low expected long-term contribution to lowering real economy climate risks and expected low contribution to improving risk-adjusted return of investment portfolio
<b>Portfolio-wide Strategic Net Zero Goal</b>	Take greater advantage of opportunities and attention to material risks by increasing investment in climate solutions and engagement; and evolving to targeted exclusions using forward-looking metrics if, and when, they enhance engagement and investment strategies.	Expected greatest long-term contribution to lowering real economy climate risks and to potentially improving risk-adjusted return of the investment portfolio.	Most time and resource intensive. Implementation will evolve as conditions change.

→ These three broad approaches each carry their own pros and cons and are not necessarily mutually exclusive. For example, among four large U.S. public pension funds with Net Zero commitments, CalPERS and CalSTRS avoid exclusions; the NYSCRF embraced a Net Zero Goal focused on engagement and climate solution investing, with case-by case exclusions; and three NY City plans enacted broad fossil fuel exclusion then subsequently made a Net Zero Pledge.

**A portfolio-wide strategic Net Zero goal may best address the dynamic changes underway in the global economy; likely require the greatest increase in resources; and can be implemented to enhance elements of the SBI's current approach and use exclusions where they support the SBI's stewardship and investment strategy.**



To provide some indication of the potential financial return and risk of each investment policy approach, we modeled the three policy options across two different climate scenarios (temperatures constrained to 1.5 degrees of temperature rise and a scenario with warming up to 3.0 degrees) and across a 'base case' scenario that does not factor climate impacts into the forecasts. Each policy option begins with the SBI's current target asset allocation<sup>1</sup>. The policy scenarios are proxied by a:

- 1) **Climate-Aware Policy (current approach):** SBI portfolio invested at current asset class targets,
- 2) **Energy Supply Focused policy:** SBI portfolio exposure to fossil fuel suppliers removed, and
- 3) **Net Zero goal portfolio-wide strategy:** a scenario geared toward solutions across all asset classes that are more likely to succeed in a transition to a 1.5° global economy.

Figure 29: Climate Policy Approaches – Climate Scenario Analyses

SBI 20-Year Climate Scenario Analysis: Target Portfolios (As of December 31, 2021)			
	Base (%)	1.5 Degree (%)	3 Degree (%)
<b>Long-Term Expected Return (annualized)</b>			
Climate Aware (Current)	6.9	6.0	6.7
Energy Supply Focus (ex-FF suppliers)	6.9	5.9	6.7
Portfolio-Wide Strategic Net Zero Goal	6.9	8.0	9.1
<b>Standard Deviation</b>			
Climate Aware (Current)	14.7	15.5	15.1
Energy Supply Focus (ex-FF Suppliers)	14.7	15.4	15.3
Portfolio-wide Strategic Net Zero Goal	14.7	15.5	15.1
<b>Sharpe Ratio</b>			
Climate Aware (Current)	0.35	0.28	0.33
Energy Supply Focus (ex-FF Suppliers)	0.35	0.27	0.32
Portfolio-wide Strategic Net Zero Goal	0.35	0.41	0.49

Compared to the SBI's long-term investment target return of 7.5%, the current 20-year forward base case, with no climate factors, would be expected to underperform 7.5%. The current target allocation, and the ex-fossil fuel suppliers' portfolio underperformance, compared to the SBI's target return, is expected to be even worse with climate factored in under 3.0 and 1.5 degree scenarios.

The portfolio-wide strategic Net Zero Goal portfolio would be expected to have the greatest likelihood of achieving or exceeding the SBI's 7.5% long-term target return. We emphasize that all long-term forecasts have a high degree of uncertainty, even before consideration of the high level of dynamic change and uncertainty due to climate change that we face this century.

<sup>1</sup> See Appendix I for discussion of modeling method and assumptions.

- Climate change, whether mitigated or not, is likely to increase portfolio volatility and decrease expected returns relative to traditional forecasts.
- Currently, a 1.5° scenario is forecast to have a more negative impact on the SBI portfolio risk and return than a 3° scenario.
  - This dynamic is due in part to the financial focus of the model, which accounts for changing capital market conditions and risks reflected in market pricing. Presently, this approach will tend to better reflect transition risks than physical risks. We expect the 1.5° scenarios to have a greater degree of transition risk while the 3° scenarios to have greater exposure to physical risks.
  - This dynamic is also due in part to a relatively strong degree of exposure to alternative asset classes, which are forecast to be more highly sensitive to climate change impacts. This exposure is amplified by the start date of the period of analysis, which begins with asset classes such as private equity being at relatively high historic values and would be expected to revert to a long-term mean overtime.
  - The difference between the scenarios could decline or potentially reverse as capital market conditions change (e.g., fossil fuel supplier valuations change), the policy landscape forces markets to better reflect climate risks (e.g., carbon taxes, improved company climate reporting), or the portfolio changes (i.e., while alternative assets are most sensitive to climate impacts, they also provide the greatest upside for correctly navigating climate change risk and opportunities).
- Excluding fossil fuel suppliers has a minor impact on portfolio risk and return.
  - The allocation to fossil fuel providers is relatively small compared to the entire portfolio (less than 5%), and the risks of climate change are diffused throughout the economy (i.e., they are not isolated to fossil fuel providers).
- A Portfolio-wide Net Zero Goal approach can outperform levels of return consistent with current forecasts, albeit with an increased level of risk, to achieve improved Sharpe Ratios.
  - There are sufficient potential “upside” scenarios across asset classes (particularly in alternative assets) that climate risks could be feasibly managed.

**Excluding all fossil fuel suppliers has a minor impact on portfolio risk and return (it represents less than 5% of the entire portfolio) and has limited impact on reducing real economy climate risks that are diffused throughout the economy.**

**A portfolio-wide strategy geared toward a Net Zero goal has the best likelihood of maintaining or exceeding current forecasts, as this includes sufficient potential ‘upside’ scenarios across asset classes that can feasibly manage climate risks.**

## VIII. Conclusions

A growing number of public pension plans have adopted Net Zero or Paris-aligned investment strategies. The relatively recent growth in Net Zero pledges is indicative of the rapid increase in attention to climate investment issues. With this attention, plans of all sizes, and widely varying experience in addressing climate risks and opportunities, continue to evolve their approach.

As the SBI considers how best to evolve its approach to investment climate risks and opportunities, Meketa offers three distinct, broad approaches. There is no consensus in the investment community on best practice. The three broad approaches are not mutually exclusive, and there are many variations within each of these three broad approaches. Seeking to reduce the carbon emissions of the SBI's portfolio is not equivalent to seeking to reduce the real economy systemic climate risks throughout the portfolio. For example, neither broad exclusion of fossil fuel producers, nor hedging the portfolio to become 'carbon neutral', directly address reducing the climate risks in real economy. The three approaches, summarized below, each carry pros and cons, and each can be implemented in a variety of ways.

- 1) **Climate Aware Approach (Current).** Continue the SBI's proxy voting on climate issues; exposure to climate transition opportunities in private markets; exclusion of thermal coal producers; manager engagement around climate issues through periodic climate surveys, engagement with regulators, and participation in institutional investor organizations focused on climate.
- 2) **Energy Supply Focused Approach: (exclude all Fossil Fuels).** Exclude all companies with fossil fuel revenues and continue other climate aware available elements of current approach (i.e., proxy-voting and engagement limited to non-fossil fuels companies).
- 3) **Portfolio-Wide Strategic Net Zero Goal Approach.** Develop an overarching portfolio-wide strategy that seeks to help reduce climate risks in the real economy facing the plan, by coordinating and strengthening the use of tools available to address climate issues, including increased attention to proxy voting, engagement with managers, portfolio companies and governments, increased investments in climate solutions appropriate to each asset class, using exclusions selectively if and when they enhance an engagement and investment strategy (which may include situations where a company misrepresents climate risks and significantly lags peers in enacting a meaningful transition plan), and appropriate participation in institutional investor organizations addressing climate.

### A recommendation for the SBI's consideration –

**Adopt a two-step process to first establish a Net Zero Goal, followed by a second step to develop a thoughtful implementation plan using elements of all three approaches, with an emphasis on Climate Aware and Net Zero approaches, using exclusions selectively if, and when, such actions may enhance a portfolio-wide engagement and investment strategy.**



In our opinion, while a Net Zero approach will likely require the greatest effort, it may also yield the strongest results for the long-term benefit of the plan. We believe the SBI's current operations have a flexible structure that can accommodate change and are well-structured to support a portfolio-wide approach. The recommendation would be in concert with taking the first step in an ongoing four-stage Net Zero process to pledge, plan, proceed and publish.

As science and markets continue to provide more and better information from which policymakers can rely upon there will be a need to reflect those developments in whatever investment policy the SBI adopts. We anticipate both new metrics and analytic tools, and use of metrics at the regional and industry level to assess the most impactful implementation of investment tools to address climate risks and opportunities, and the integration of physical climate risk and physical climate risk management into portfolio analysis. This continual evolution is consistent with existing SBI practices of regular and timely review of all aspects of the investment portfolio and is, in our opinion, a best practice.



## Appendix I

### Climate Scenario Analyses of the SBI Portfolio

Historically, climate change modeling within asset owner portfolios focused on “bottom-up” methods. These approaches generally take detailed information about individual companies and industries and aggregate them across an entire portfolio. These approaches are very granular, providing insights about current practices and exposures and potential impacts from highly specific policy, technical, and behavioral interventions. However, precise analysis over short time periods does not necessarily yield results that translate to long term, strategic decision making. Fiduciaries typically consider investment decisions across longer, multi-decade timespans. Bottom-up analysis provides a snapshot of a portfolio at a given time but can encounter difficulty forecasting into the future. Companies change, business practices change, consumers’ tastes change. Though analysts can make assumptions about trends going forward, any long-term analysis will be dependent on the accuracy of those assumptions.

To avoid becoming overly dependent on current conditions and future assumptions, Meketa uses a top-down, multifactor framework to assess long-term trends and scenarios. We specify broad, economically linked quantitative factors and project their future behaviors based on underlying historical relationships. Not specifically a climate model, our macroeconomic model can contextualize past environmental changes (e.g., mean global temperature rise over the pre-industrial baseline) alongside economic and financial factors and project various climate scenarios going forward over a long timeframe. Our approach is somewhat more dependent on the continuation of historical trends than bottom-up models and lacks their granularity, but it offers a broader range of potential situations for consideration. As time horizons lengthen, it becomes increasingly difficult for any climate change model to estimate the impact of climate on companies, reflecting increasing uncertainty with longer-timespans.

Given its focus on broad economic/financial measures and lack determinative mechanisms, the model’s strength is financial impacts that are easily quantifiable and behave relatively consistently over time. In a climate context, we expect the model will tend to better represent transition risks better than physical risks. Additionally, the model is less suited to evaluating distinct, well-defined policy scenarios where the potential outcomes are known with some certainty than a determinative model. Meketa’s model is better suited to assessing potential impacts of broad portfolio change whose occurrence is uncertain.

By default, Meketa’s model uses 34 factors to generate expected returns for 97 asset classes. To assess the impacts of climate change, we added a global land and ocean mean temperature factor. With the available history for each factor, we used a VAR (vector auto-regression) model to estimate the relationship among factors through time, with a greater weight on more recent trends than those in the past. For each simulation, we begin with the most recent data point for each factor and adjust them in a randomized fashion, based on a normal distribution with mean matching the most recent data point and distribution based on historically observed variability. The new value is then adjusted based on the VAR-estimated factor interaction effects to yield a forecast return for each factor in that month. This process then repeats to generate monthly factor returns over a 20-year time period in approximately 10,000 simulations. We generate asset class returns from these factors based on historical relationships which are recentered on Meketa’s traditional capital market expectations. Once generated, by analyzing a subset of simulations with select characteristics (e.g., all scenarios with temperatures consistent with +3.0°C of temperature rise above the pre-industrial average by 2100), we analyze a range of possible outcomes consistent with the desired characteristics.



# Minnesota State Board of Investments

## Phase III: SBI Climate Exposures and Policy Options

### Standard Factors Forecasted

Industrial Production	Energy	European Consumer Prices
Retail Sales	Metals	European Interest Rates
Construction Spending	U.S. Market	European Term Structure
Consumer Prices	Size	Japanese Industrial Production
Personal Expenditure	Value	Japanese Retail Sales
Inflation Risk Premium	Momentum	Japanese Consumer Prices
Interest Rates	Min Variance	Japanese Interest Rates
Term Structure	Dividend Yield	Japanese Term Structure
Systemic Risk	European Industrial Production	Baltic Dry Index
Trade-Weighted USD	European Retail Sales	Chinese Leading Indicators
Agriculture	European Construction Spending	EM Consumer Prices

For SBI, we assume the portfolio is invested at its asset class targets:

- 33.5% US Equity,
- 16.5% Non-US Equity,
- 10% Government Bonds,
- 5% Core/Core-Plus Bonds,
- 5% Return-Seeking Bonds,
- 5% Cash/Laddered Bonds, and
- 25% Private Markets (allocated among private equity, debt, infrastructure and real estate based on current investment allocations).

The following scenarios were examined:

- **Current Portfolio with Temperature Changes:** Examine simulations where global mean temperature rises consistent with changes of +1.5°C and +3.0°C above the pre-industrial baseline by the year 2100 versus a traditional set of baseline capital market expectations. These scenarios represent decreased and increased levels of carbon emission mitigation relative to current climate-naïve financial projections respectively.
- **Fossil Fuel Exclusions with Temperature Changes:** Examine simulations where the current portfolio exposure to companies with greater than 25% revenue exposure from fossil fuels (approximately 4% of the overall portfolio) is removed from the portfolio in environments where global mean temperature rises consistent with changes of +1.5°C and +3.0°C above the pre-industrial baseline by the year 2100 as well as in the baseline forecast and redistributed pro-rata to the rest of the portfolio.
- **Portfolio-wide Net Zero Goal with Temperature Changes:** Examines simulations where the portfolio is assumed to be invested with manager or in strategies which have better-than-median performance in simulations where global mean temperature rises consistent with changes of +1.5°C and +3.0°C above the pre-industrial baseline by the year 2100.

It is important to note that, given the non-deterministic nature of the model, we do not explicitly make additional assumptions in our scenarios. We do not predetermine the path of public policy, consumer behavior, government intervention, etc. Instead, we use our simulations to represent a broad variety of different environments that represent varying behaviors economic actors may implement over different time periods that are consistent with the specified changes to be examined. By contrast with other climate forecast models, we do not require a strong view on the implementation details (or lack thereof) of climate change mitigation efforts. Instead of assuming specific technological and policy changes with each scenario, we allow for any combination of policy and technology changes that are consistent with the scenario under investigation, in this case various temperature changes. Provided that a suitable number of simulations are generated, most relatively common configurations of circumstances are represented in the model output.

### Temperature Change Scenarios

Our initial analysis concerns the portfolio's current target asset allocation and portfolio construction's reaction to varying amounts of temperature change by the end of the current century. We selected simulations with:

- 1) temperatures that stayed beneath 1.5°C over the pre-industrial baseline through the end of the 20-year period, and
- 2) temperatures within 0.25°C of temperatures consistent with a 3.0°C temperature rise by 2100.

These projections are compared to a baseline scenario for traditional capital markets forecast based primarily on financial measures with no special consideration for climate change impacts.



Climate Scenario Analysis: Average Target Portfolios (As of December 31, 2021)			
	Base (%)	1.5 Degree (%)	3 Degree (%)
<b>Long-Term Expected Return (annualized)</b>			
SBI (Current)	6.9	6.0	6.7
<b>Standard Deviation</b>			
SBI (Current)	14.7	15.5	15.1
<b>Sharpe Ratio</b>			
SBI (Current)	0.35	0.28	0.33

In terms of average expected long-term risk and return, the various degrees of climate change had similar directional impacts across portfolios. Whether limiting global temperature rise to only 1.5°C or 3°C, expected return is lower than expected return absent climate change assumptions. Both alternative temperature scenarios will entail social and economic changes consistent with either mitigating causes of climate change or grappling with the consequences of not doing so. The decline in expected return is greater in the 1.5°C temperature rise scenario than the 3.0°C (approximately 0.9% versus 0.2%).

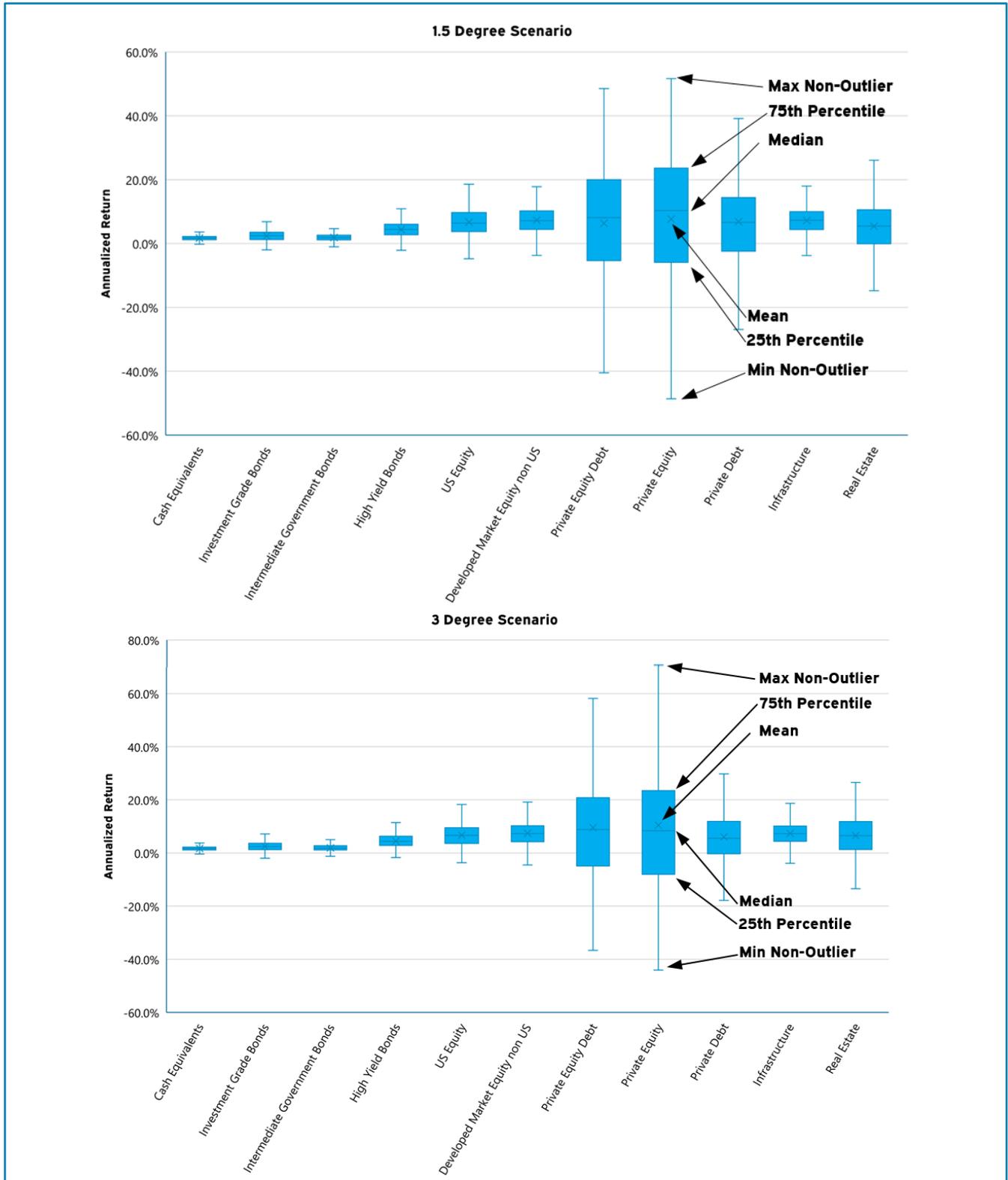
Regarding risk, in both temperature-rise scenarios, portfolio risk, as measured by standard deviation increases, rising more in the 1.5°C scenario than the 3°C scenario. The degree to which risk increases in each scenario varies is roughly similar to the difference displayed among returns, with the change risk of the 1.5°C scenario higher than that of the 3°C scenario.

The simultaneous increase in risk and decrease in expected return versus an idealized baseline is not necessarily surprising. Both temperature scenarios reflect transition and physical risks that are not accounted for in the baseline forecast and will contribute to poorer risk-adjusted performance on a relative basis. The results indicate that the risks to performance are potentially higher in a situation where temperatures are kept lower, presumably through greater societal efforts to curtail carbon emissions and incentivize climate-friendly economic initiatives though they are still present in a less aggressive climate change mitigation environment.

Regarding the lower relative return of the 1.5°C scenario versus the 3°C scenario, the result likely stems in part from SBI’s somewhat relatively high allocation to alternative vehicles. Alternative asset classes have historically displayed a positive relationship with temperature and more sensitivity to changes in the climate forecast, increasing the asset class’s variability while decreasing average returns. It is important to also note that the scenarios are subject to current capital market conditions. As these market condition change, particularly with regard to valuation levels and realized performance, expected returns for different scenarios can shift and potentially reverse position. Additionally, these results only reflect financial performance; they do not directly include non-financial impacts on living conditions or general wellbeing. To the extent non-financial impacts become reflected financially (i.e., market externalities become internalized and integrated in markets), their influence may vary between scenarios.



In addition to examining mean risk and return, examining the distribution of outcomes supports the same general conclusions.





The return distributions share several characteristics in common: equity asset class returns are generally wider than those of fixed income asset classes while private market asset classes have wider distributions than comparable public asset classes, returns for the +3.0°C scenario are in general higher than those of the +1.5°C scenario. However, the shape of the distribution varies. Distributions are in almost all cases positively skewed in the +3.0°C scenario with relatively symmetrically sized 2<sup>nd</sup> and 3<sup>rd</sup> quartile outcomes. By contrast, the skew of returns for the +1.5°C scenario is more mixed. Public equity, government debt, and floating rate private debt exhibit positive skew while nominal corporate credit, private equity, infrastructure, and real estate asset classes have negative skew. In addition, the middle 50% of outcome is less symmetrical, with much more scope for downside outcomes particularly among private debt and private equity investments.

The practical conclusion to draw from an examination of the scenarios' return distribution is similar to that of the average results – a world with more climate change mitigation measures presents more challenges with generating high returns and broadens the scope for downside financial outcomes. By contrast, a “milder” mitigation scenario leaves greater possibilities for positive outcomes across virtually all asset classes. However, for a number of asset classes, including those with significant leftward skews like private equity, potential outcomes are sufficiently variable client returns may be able to significantly outperform the average forecast result for the given asset class.

**Fossil Fuel Exclusion**

When considering ways to mitigate the risks of climate change, whether due to transition or physical risk, a much-discussed approach is excluding fossil fuel exposure. Theoretically, excluding fossil fuel exposure could help hedge out certain transition risks (e.g., stranded asset risk).

Climate Scenario Analysis: Average Target Portfolios (As of December 31, 2021)			
	Base (%)	1.5 Degree (%)	3 Degree (%)
<b>Long-Term Expected Return (annualized)</b>			
SBI (Current)	6.9	6.0	6.7
SBI (ex-FF)	6.9	5.9	6.7
<b>Standard Deviation</b>			
SBI (Current)	14.7	15.5	15.1
SBI (ex-FF)	14.7	15.4	15.3
<b>Sharpe Ratio</b>			
SBI (Current)	0.35	0.28	0.33
SBI (ex-FF)	0.35	0.27	0.32



However, the impact of excluding companies with greater than 25% revenue exposure from fossil fuels (approximately 4% of the overall portfolio) has a minor impact on the forecasts for both temperature scenarios. Assuming the same distribution of returns in each individual asset class, in a +1.5°C scenario which reflects a high level of climate change mitigation efforts, exclusion reduces portfolio risk by less than 0.1% while simultaneously reducing expected return by less than 0.1%. In a +3.0°C scenario, where continued fossil fuel use could be expected for a greater proportion of the period and/or have a greater intensity of use relative to the +1.5°C scenario, expected return is also expected less than 0.1% while portfolio risk actually increases by approximately 0.1%.

The small magnitude of the impact of fossil fuel exclusion is likely due in part to the relatively modest amount of assets being excluded, which are subsequently reinvested in the same broad asset classes that still have indirect economic exposure to fossil fuels. Additionally, the direction of impact is likely negative due to the status of energy markets at the end of 2021. While not as low relative to historical averages as at the end of 2020 due to public health measures enacted in response to the global COVID-19 epidemic, energy prices were still low enough that a model which incorporates a degree of mean reversion in prices. The impact of this mean reversion will be lower in scenarios with greater climate change mitigation but still present. The greater potential impact of energy price reversion in the +3.0°C scenario likely accounts for the decrease in expected return as well as greater standard deviation.

### **Portfolio-Wide Net Zero Goal**

An alternative approach to fossil fuel exclusion to mitigate climate-related portfolio risks is to adopt a Portfolio-wide Net Zero Goal investment framework, selecting portfolio approaches or investment strategies that take into account the impacts of climate change and attempt to avoid negative impacts from transition and physical risk while simultaneously capitalizing on new opportunities. Estimating the potential gains from such an approach are necessarily uncertain; Net Zero Goal investing represents a deviation from the broadly diversified portfolios often assumed in asset allocation. To aid our analysis, we adapt an approach to estimate the potential impact of successfully selecting strong active investment managers for portfolios, assuming that the Net Zero Goal portfolios could potentially outperform our forecast median returns at the asset class level in line with the degree of intra-quartile spread exhibited in the forecasts.



Climate Scenario Analysis: Target Portfolios (As of December 31, 2021)			
	Base (%)	1.5 Degree (%)	3 Degree (%)
<b>Long-Term Expected Return (annualized)</b>			
SBI (Current)	6.9	6.0	6.7
SBI (Portfolio-Wide Net Zero Goal)	6.9	8.0	9.1
<b>Standard Deviation</b>			
SBI (Current)	14.7	15.5	15.1
SBI (Portfolio-Wide Net Zero Goal)	14.7	15.5	15.1
<b>Sharpe Ratio</b>			
SBI (Current)	0.35	0.28	0.33
SBI (Portfolio-Wide Net Zero Goal)	0.35	0.41	0.49

In both climate change scenarios, a Portfolio-Wide Net Zero investment framework has the potential to meaningfully impact expected returns, increasing forecast returns beyond those of the Base case (6.9%) long-term return as well as improving on the scenarios returns by over 2% in both cases. While this level of return is subject to uncertainty and cannot be taken as given, it indicates exploring such an approach is a worthwhile exercise.



### Conclusions

**Climate Change Will Likely Increase Investing Challenges:** Compared to a traditional baseline, we can expect lower returns and higher volatility in the future. The magnitude of the change may vary with different degrees of climate change mitigation, and the mix of costs will shift (i.e., transition versus physical impacts) but the general trend is clear.

**Fossil Fuel Exclusion May Have a Limited Impact:** Though there may be other rationales for divesting from fossil fuel companies and the direction of impact of divestment may vary with the economic environment, the scale of impact on portfolio risk and return from divestment is expected to be relatively modest.

**A Portfolio-wide Net Zero Goal:** For investors seeking to keep a stable level of nominal return or maintain a set level of risk, the potential impact of a Portfolio-wide Net Zero Goal investment approach appears to be sufficient to help meet existing objectives. However, implementation may be challenging, particularly in a +1.5°C climate mitigation scenario where substantial downside risk exists in several asset classes.

## Appendix II

### Summary Descriptions of Institutional Investor Organizations with a Climate Focus

Year Founded	Organization Name	Abbreviation	About
1985	Council of Institutional Investors	CII	CII is a nonprofit association of US public, corporate and union employee benefit funds, other employee benefit plans, state and local entities charged with investing public assets and foundations and endowments with combined assets under management of approximately \$4 trillion.
1989	Ceres	Ceres	Ceres is a nonprofit organization transforming the economy to build a just and sustainable future for people and the planet. Through powerful networks and global collaborations of investors, companies and nonprofits, Ceres drives action and inspires equitable market-based and policy solutions throughout the economy.
2000	Carbon Disclosure Project	CDP	CDP is a not-for-profit charity that runs the global disclosure system for investors, companies, cities, states, and regions to manage their environmental impacts. The world’s economy looks to CDP as the gold standard of environmental reporting with the richest and most comprehensive dataset on corporate and city action.
2005	Principles for Responsible Investing	PRI	The PRI is the world’s leading proponent of responsible investment. It works to understand the investment implications of environment, social and governance (“ESG”) factors and to support its international network of investor signatories in incorporating these factors into their investment and ownership decisions
2009	Global Real Estate Sustainability Benchmark	GRESB	GRESB is the global ESG benchmark for financial markets, composed of an independent foundation and a benefit corporation. Working together as one, the GRESB Foundation focuses on the development, approval, and management of the GRESB Standards while GRESB BV performs ESG assessments and provides related services to GRESB Members.
2011	Sustainability Accounting Standards Board	SASB	SASB Standards guide the disclosure of financially material sustainability information by companies to their investors. Available for 77 industries, the Standards identify the subset of ESG issues most relevant to financial performance in each industry.



Year Founded	Organization Name	Abbreviation	About
2015	The Task Force on Climate-related Financial Disclosures	TCFD	Created by the Financial Stability Board, the TCFD has set out its series of recommendations to establish a framework for businesses to manage climate risks; both transition and physical, and benefit from the related opportunities
2017	Climate Action 100+	CA100+	Climate Action 100+ is an investor-led initiative to ensure the world’s largest corporate greenhouse gas emitters take necessary action on climate change.
2017	Transition Pathway Initiative	TPI	The Transition Pathway Initiative (“TPI”) is a global, asset-owner led initiative which assesses companies’ preparedness for the transition to a low carbon economy.
2017	The Institutional Investors Group on Climate Change	IIGCC	IIGCC is the European membership body for investor collaboration on climate change.
2019	Net Zero Asset Owner Alliance	NZAOA	Institutional investors transitioning their portfolio to Net Zero GHG emissions by 2050.
2019	Paris Aligned Investment Initiative	PAII	The Paris Aligned Investment Initiative is a collaborative investor-led global forum enabling investors to align their portfolios and activities to the goals of the Paris Agreement. The Paris Aligned Investment Initiative (“PAII”) was established in May 2019 by the Institutional Investors Group on Climate Change (“IIGCC”). As of March 2021, the initiative has grown into a global collaboration supported by four regional investor networks – AIGCC (Asia), Ceres (North America), IIGCC (Europe) and IGCC (Australasia).
2021	ESG Data Convergence Project	ESG DCP	The Project's objective is to streamline the private investment industry’s historically fragmented approach to collecting and reporting ESG data in order to create a critical mass of meaningful, performance-based, comparable ESG data from private companies. This allows GPs and portfolio companies to benchmark their current position and generate progress toward ESG improvements while enabling greater transparency and more comparable portfolio information for LPs.



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