

CalPERS' Investment Strategy on Climate Change

First Report in Response to the Taskforce on Climate-Related Financial Disclosure

June 2020



Table of Contents

Introduction	1
TCFD Framework	3
Executive Summary	5
Governance	7
Strategy	10
Risk Management	15
Metrics and Targets	29
Conclusion	39
Appendix 1: CDP Analysis of Climate Action 100 Companies' Potential Contribution to Emissions Reductions	41
Appendix 2: Scenario Analysis Results	51
Glossary	58

Introduction

This first report by the California Public Employees' Retirement System (CalPERS) responds to the recommendations of the Taskforce on Climate-Related Financial Disclosure (TCFD). CalPERS has been an active supporter of the TCFD's work from the outset.¹

At the time this report is being published, the world is facing a global humanitarian tragedy and severe economic uncertainty as governments, business, finance and civil society respond to COVID 19. The pandemic has demonstrated with brutal clarity that tackling a systemic risk requires international cooperation between the public and private sector, driven by innovation at pace and scale. The lessons are evident: we need vision, partnership, and a relentless pursuit of scientific evidence to drive decision-making.

CalPERS' motivation to address climate change is to ensure that we can provide benefits in retirement, disability and illness for our nearly 2 million members, people who come from all walks of life. CalPERS makes annual benefit payments of approximately \$25 billion. For every dollar paid out, 58 cents come from investment returns. With a pre-crisis funding ratio of just over 70% and a target rate of return of 7%, we must seize the opportunities and control for the risks climate change presents to our portfolio.

Scientific evidence demonstrates that reducing greenhouse gas (GHG) emissions is critical to slowing global warming and driving sustainable economic growth. Physical impacts pose short and long-term risks to our members' assets. These risks include rising sea levels, floods, severe storms, drought, and wildfires. Dramatic changes to the global energy economy, particularly as the world recovers from COVID-19, also pose transition risk as companies are challenged to adopt new strategies, without leaving their investors holding stranded assets, or in extreme cases, bankruptcy. In addition, companies are increasingly vulnerable to litigation.

Climate change is a global challenge and one we cannot afford to ignore as long term investors, with inviolable fiduciary duty to our members. The consequences of inaction will be measured not just in the impact on workers and communities, but also on the companies we rely upon to generate the investments that pay benefits. The United States government's own fourth National Climate Assessment notes the impending financial impact:

"The impacts of climate change beyond our borders are expected to increasingly affect our trade and economy, including import and export prices and US businesses with overseas operations and supply chains."²

¹ Taskforce on Climate-Related Financial Disclosure, statement of CalPERS support www.tcf.org

² <https://nca2018.globalchange.gov/chapter1>

However, climate change also brings tremendous new opportunity for investors. A forecast from the Global Commission on the Economy and Climate concludes that,

“Low-carbon growth could deliver economic benefits of US\$ 26 trillion to 2030 - and this is a conservative estimate.”³

CalPERS is addressing both the risks and opportunities of climate change through our four channel strategy: **engagement**, to ensure the companies we invest in bring down their GHG emissions; **advocacy**, to support the policy and regulation that will foster the transition to a low-carbon economy; and **integration**, to bring consideration of climate change risk and opportunity into our investment decision-making. Our strategy is based on **partnership** with others, such as our fellow investors through Climate Action 100+, international bodies such as the United Nations’ Net Zero Asset Owner Alliance and innovative research such as physical risk mapping based on the scientific data from the U.S. meteorological center at Woods Hole.

Acknowledging this is our first TCFD report, we welcome the opportunity for dialogue it will provide. Our findings are based on the most current data and methodologies. We will continue to advocate for mandatory climate risk reporting and support best practice frameworks as an interim measure. Ultimately, as corporate reporting improves, so will the ability of investors to assess both the risks and opportunities of climate change and act accordingly. The transition requires the full force of financial market, in partnership with the public sector, business and civil society to address the urgent challenge of climate change.

³ “Unlocking the Inclusive Growth Story of the 21st Century: Accelerating Climate Action”, The Global Commission on the Economy and Climate

TCFD Framework

Recognizing the potential impact of climate change upon financial markets, the G20 Finance Ministers and Central Bank Governors asked the [Financial Stability Board](#) (FSB) to review how the financial sector can take account of climate-related issues. As part of its review, the FSB established the [TCFD](#), an industry-led taskforce. Michael Bloomberg was appointed as chair of the TCFD in December 2015.

The mandate was to develop recommendations for companies to inform their investors, lenders and insurance underwriters about climate-related financial risks and opportunities.⁴ The recommendations were issued in 2017 to provide voluntary, consistent, climate-related financial disclosures that would be useful to investors and others in understanding material risks.

The TCFD recommendations are intended to be: adoptable by all organizations; included in financial filings; designed to solicit decision-useful, forward looking information on financial impacts; and to provide a strong focus on risks and opportunities related to transition towards a lower-carbon economy.

Although the TCFD recommendations were designed for corporate reporting, asset owners were also encouraged to report using the same four-part disclosure framework, which we follow in this first report by CalPERS:

- **Governance:** Detailing the CalPERS' Board and Management governance around climate-related financial risks and opportunities.
- **Strategy:** Explaining how the CalPERS' investment strategy accounts for current and potential climate-related risks and opportunities.
- **Risk Management:** Setting out how CalPERS' investment strategy identifies, assesses, and manages climate-related risks.
- **Metrics and Targets:** Disclosing the metrics and targets used to assess and manage relevant climate-related risks and opportunities where such information is material.

To illustrate the relevance of climate-related financial reporting, the TCFD taskforce mapped out the major categories of potential impact on corporate income statements and balance sheets. These include the potential impact on revenues for companies that may be affected by changing demand for their products and services and, also, the related expenditures.

On the balance sheet for companies, the TCFD recommendations consider changes to both assets and liabilities as changes to both supply and demand are driven by policies, technology, and market dynamics related to climate change. The TCFD advises that companies focus on existing and committed future activities and decisions requiring new investment, restructuring, write-downs or impairment.⁵

⁴ [Financial Stability Board](#)

⁵ Recommendations of the Task Force on Climate-related Financial Disclosures, June 2017, page 9 figure 2,

The TCFD also includes reference to capital financing, noting that climate-related risks and opportunities may change the profile of an organization's debt and equity structure, either by increasing debt levels to compensate for reduced operating cash flows or for new capital expenditure or research and development.

Moreover, the TCFD framework identifies the business sectors where they see the greatest risk, and in this report, we set out our detailed assessment of risk for each of these in our portfolio based on assessments across our public and private market asset classes.

We have also commissioned new data analysis and modelling to provide a first estimate of the global warming potential in our portfolio, and a scenario to assess the impact of our engagement strategy through Climate Action 100+.

Executive Summary

- **CalPERS has long recognized the scale and multi-faceted nature of climate change, which pose opportunities and risks to the portfolio.**⁶ CalPERS' Board adopted and oversees a Total Fund Policy that includes Investment Beliefs⁷ which highlight climate change in long term value creation and risk mitigation.
- **CalPERS' portfolio is globally diversified and thereby broadly tracks the global warming potential of the wider economy.** CalPERS commissioned data analysis and modelling from a range of specialist sources to provide different lines of sight into the portfolio risk and opportunity related to climate change. The aggregate impact of companies in CalPERS' public asset class portfolios - Global Equity and Global Fixed Income account for 75% of Assets Under Management (AUM) - currently track to a warming potential by 2050 of 3.23 degrees Celsius.
- **CalPERS completed the first carbon footprint measurement of our Real Assets portfolio in 2019, which includes real estate, infrastructure and forestland.** The majority of the GHG emissions for the portfolio are concentrated in our Infrastructure holdings. Delivering this footprint meets one of the objectives in the climate change workstream in our strategic plan for sustainable investment. Carbon foot printing has now been completed for Global Equity, Global Fixed Income and Real Assets, which together account for 90% of the Total Fund.
- **CalPERS' work on engagement, advocacy and integration of climate change risk and opportunity is rooted in partnerships.** CalPERS is the convener and co-founder of the world's largest investor engagement initiative, Climate Action 100+ with over \$40 trillion AUM. CalPERS' advocacy work is channeled through our role at regulatory bodies where we sit on the advisory boards and special panels addressing corporate risk reporting.
- **CalPERS' strategy on climate change is having impact with the potential to significantly reduce greenhouse gas emissions through Climate Action 100+.** CDP was commissioned to estimate a notional potential reduction of 55 gigatons (Gt) of greenhouse gas by Climate Action 100 companies, based on percentage reductions in scopes 1 and 2. This is the equivalent of the annual emissions from nearly 12 billion passenger cars. This measure does not include the related scope 3 emissions which are greater.
- **CalPERS' advocacy on policy measures can help drive the low-carbon transition.** To meet the goal of limiting global warming, we are working with business, government, and regulators to broaden and deepen carbon pricing across energy markets as well as the elimination of public subsidies for fossil fuels. We also support mandatory climate risk reporting to ensure the financial markets have information which is timely, relevant and reliable in order to allow pricing of risk and opportunity.
- **CalPERS' strategic plan on sustainable investment integrates material factors into the investment decision processes.** This is to ensure a consistent and evidence-based integration of climate change into investment decision making across the total fund, reflecting the specific strategies of each asset class.

⁶ CalPERS SB964 report: page 2

⁷ CalPERS' Investment Beliefs adopted by the CalPERS' Board 2013

CalPERS is committed to the Net Zero Asset Owner Alliance which sets a 2050 goal for portfolio emissions in line with 1.5 degrees Celsius global warming.

Governance

In this section we set out how CalPERS' Board oversees our strategy on climate change, and the role of management in executing the strategy.

The Role of the Board

The California Constitution ([Article XVI, Section 17](#)) details the authority and fiduciary responsibility of the CalPERS Board of Administration. This includes discharging their duties for the exclusive purpose of providing benefits to members and their beneficiaries, minimizing employer contributions and defraying reasonable expenses.

CalPERS' Board of Administration comprises 13 members who are elected, appointed or hold office ex officio for four-year terms. The Board of Administration delegates to a series of committees, which provide oversight of investment, pensions and health benefits, finance and audit, performance and compensation, and risk and governance. The Board elects its president each year, who in turn appoints board members to committees which nominate their own chair and vice chair. Each committee operates under a formal delegation and policy which sets out their authority. These are publicly available [online](#). The Board's Investment Committee meets at least quarterly and has specific responsibility in its delegation for oversight of CalPERS' environmental, social and governance program.

Board and committee meetings are held in open session to allow beneficiaries and stakeholders to attend and provide public comment. Closed session discussion is limited to personnel matters and market sensitive financial information.

CalPERS' purpose is set out in its [Mission & Vision](#) which are guided by [CalPERS' Investment Beliefs](#), which specifically address climate change in relation to both risk and return when first adopted by the Board in 2013. The Investment Beliefs are set out below, highlighting the detail which is relevant to climate change.

- 1. Liabilities must influence the asset structure:** Ensuring the ability to pay promised benefits by maintaining an adequate funding status is the primary measure of success for CalPERS.
- 2. A long-time investment horizon is a responsibility and an advantage:** Long time horizon requires that CalPERS (inter alia) consider the impact of its actions on future generations of members and taxpayers; encourage investee companies and external managers to consider the long-term impact of their actions
- 3. Investment decisions may reflect wider stakeholder views, provided they are consistent with CalPERS' fiduciary duty to members and beneficiaries:** As a public agency, CalPERS has many stakeholders who express opinions on investment strategy or ask CalPERS to engage on an issue. CalPERS' preferred means of responding to issues raised by stakeholders is engagement. CalPERS' primary stakeholders are members/beneficiaries, employers and California taxpayers, as these stakeholders bear the economic consequences of CalPERS' investment decisions.
- 4. Long-term value creation requires effective management of three forms of capital: financial, physical and human:** CalPERS may engage investee companies and external managers on their governance and

sustainability issues, including: (inter alia) environmental practices, including, but not limited to, climate change and natural resource availability.

5. **CalPERS must articulate its investment goals and performance measures and ensure clear accountability for their execution**
6. **Strategic asset allocation is the dominant determinant of portfolio risk and return**
7. **CalPERS will take risk only where we have a strong belief that we will be rewarded for it:** An expectation of a return premium is required to take risk; CalPERS aims to maximize return for the risk taken.
8. **Costs matter and need to be effectively managed**
9. **Risk to CalPERS is multi-faceted and not fully captured through measures such as volatility or tracking error:** (inter alia) as a long-term investor, CalPERS must consider risk factors for example, climate change and natural resource availability that emerge slowly over long time periods, but could have a material impact on company or portfolio returns.
10. **Strong processes and teamwork and deep resources are needed to achieve CalPERS goals and objectives.**

The CalPERS' Board and Committee policies are reviewed and approved annually. This includes [Governance & Sustainability Principles](#) which since 2008 have guided CalPERS' engagement with companies including proxy voting, advocacy with policy makers and recognition of best practice initiatives across our partnerships. The Principles specifically address climate change in references to environmental management, carbon pricing, deforestation, aligning political lobbying and compensation, ensuring board climate competence and integrated corporate reporting.

The Role of Management

The CalPERS Board of Administration delegates management responsibility to the Chief Executive Officer (CEO) to whom the Chief Investment Officer (CIO) reports. CalPERS' strategy on climate change is led by the CEO in relation to advocacy and strategic partnerships such as Climate Action 100+ and the Net Zero Asset Owner Alliance. Responsibility for the integration piece of CalPERS' strategy is overseen by the CIO and includes CalPERS sustainable investment program, which is led by the Managing Investment Director who works with and supports asset class leads on implementing the strategy for both public and private markets.

To ensure coordination across the Total Fund and CalPERS as an Enterprise, a Governance and Sustainability committee meets monthly. Membership comprises representatives from each of the asset classes and programs in the investment office, and includes representatives from the office of the CEO, legal office and stakeholder relations team. A core responsibility is driving implementation of the five-year [Total Fund Governance and Sustainable Investment Strategic Plan](#) which was adopted by the Board in 2016. This includes climate change risk as one of six priorities. The strategy was developed following an extensive review of academic literature, led by UC Davis and Columbia University. Moreover, CalPERS'

Sustainable Investment Research Initiative considered over 1,800 peer reviewed papers in two phases to identify which issues were relevant for CalPERS' to consider addressing.

The strategic plan priorities include establishing consistent manager expectations across the total fund for addressing environmental, social, and governance issues which are relevant for each asset class. For those asset classes which are primarily externally managed (Real Assets and Private Equity) these expectations are provided as a basis for dialogue. For those asset classes which are primarily internally managed (Global Equity and Global Fixed Income) the expectations provide guidance in relation to the particular investment strategy, be it engagement of companies held through an index, or fundamental analysis for actively traded securities.

Strategy

The goal of CalPERS' strategy on climate change is to ensure our portfolio is resilient to risk and positioned for the investment opportunities that the transition to a low-carbon economy bring, in line with our target rate of return.

CalPERS' strategy sets out four areas of focus:

Engagement

Engagement uses CalPERS' position as a provider of financial capital to companies and managers, to foster alignment with our climate change strategic priorities. We have engaged extensively with the largest emitters of GHGs which we identify as "systemically important carbon emitters". These engagements are intended to drive business action to cut emissions which are causing climate change. Our engagement focus also includes the need to protect and restore the natural carbon sinks which help to absorb those emissions, for example, through our work on deforestation.

Examples of our engagement strategy include CalPERS' leadership role in the founding of Climate Action 100+, which is now the world's largest shareowner engagement project with signatories with assets under management totaling \$40 trillion. We also use our proxy voting influence to support climate risk reporting, and alignment of corporate lobbying and executive compensation to ensure a just transition among the world's systemically important carbon emitters.

Advocacy

As part of our risk management related to climate change, we advocate for policies that can drive the transition to a thriving low-carbon global economy in which we can invest. CalPERS has consistently supported both state, federal and international policy in support of greater disclosure from companies on climate-related financial risks, reduced fossil fuel subsidies, and regulation that prices carbon emissions.

CalPERS believes that the voluntary recommendations of the TCFD should be integrated into mandatory corporate reporting, as overseen by the SEC's Financial Accounting Standards Board for the United States and in other markets through the International Accounting Standards Board.⁸ We support proposals to include mandatory climate risk reporting as part of the agenda for the 2021 intergovernmental meeting, known as COP 26.⁹ In preparation, we welcome the mapping presented by IFRS Board to illustrate a path for integrating TCFD recommendations into international corporate reporting under existing conventions for International Reporting Financial Standards which guide accounting disclosure in markets outside the US.

⁸ CalPERS is a member of the SEC's Investor Advisory Committee and also the Financial Accounting Standards Advisory Committee, in addition to representing the Council of Institutional Investors on the International Financial Reporting Standards Advisory Council.

⁹ Convention of the Parties which include the governments which support the United Nations Framework Convention on Climate Change, which resulted in the landmark Paris Agreement in 2015 supported by close to 200 governments setting an ambition to limit global warming to well below 2 degree Celsius.

We consider that pricing carbon emissions facilitates the transition to a low-carbon economy through market mechanisms, which is an investor-aligned approach. We support pricing carbon emissions at a meaningful level to effectively drive the transition to a low-carbon economy. In September 2019, the CalPERS' Board adopted the following language in our Government and Sustainability Principles, which guide our advocacy efforts regarding carbon pricing policy:

“Policymakers should establish stable and clear carbon pricing policy that appropriately prices the externalized cost to the economy and society from greenhouse gas emissions. Specifically, carbon pricing should be set at a level, and with the regulatory certainty, that incentivizes the business practices, consumer behavior, and related investment decisions needed to drive the transition to a thriving, low-carbon global economy. Effective carbon pricing policies should decrease emissions and therefore the physical risk to investors' portfolios from climate change.

Additionally, policies should be designed to avoid exacerbating economic inequality and its associated geopolitical risks, and policies should be designed to provide incentives for carbon sequestration, including through natural methods, such as ecosystem protection and restoration.”

Furthermore, CalPERS supports initiatives which the [2018 Global Investor Statement to Governments on Climate Change](#). This as part of the work of The Investor Agenda initiative which we support calls on world governments through groups such as the G7 and G20 for implementation of the Paris Agreement and for strengthening country commitments through their Nationally Determined Contributions (NDCs) with the goal of limiting the global temperature rise to 1.5 degrees Celsius above preindustrial levels.

A further example of CalPERS' advocacy strategy is seen in our participation in the Commodities and Futures Trading Commission sub-committee on Climate-related Market Risk ¹⁰ which is an important step as it represents the first time a US financial regulator has considered the topic of climate risk in-depth. The subcommittee approved 35 members through a nomination process and tasked them with providing a report to the CFTC's Market Risk Advisory. The report due mid-2020, will address topics such as the challenges in evaluating climate-related risks to the U.S. financial markets, climate-related stress tests and policy measures regulators could pursue to enable better risk management and disclosures.

Also, it is important to note that CalPERS is aligned with the goals of many of California Climate Policies such as the Renewable Portfolio Standards Program, the Clean Energy and Pollution Reduction Act, and the Global Warming Solutions Act.

For example, in 2015, CalPERS identified approximately two dozen companies in our public asset investment universe as potentially meeting the definition of a “thermal coal company” as specified in the Public Divestiture of Thermal Coal Companies Act (Act). Following the October 19, 2015, Investment Committee meeting, we prohibited new or additional investments in the identified companies and began

¹⁰ Climate-Related Market Risk Subcommittee

https://www.cftc.gov/About/CFTCCommittees/MarketRiskAdvisoryCommittee/mrac_subcommitteemembers.html

engagement activities. In May 2017, the Board’s Investment Committee evaluated the outcome of engagement activities undertaken per the requirements of the Act, as well as the investment performance and risk considerations of the identified companies, and implications for the portfolio. The Committee considered the following, consistent with their fiduciary duty:

- Three companies had indicated plans to adapt their business models in consideration of clean energy generation (such as through a reduction of thermal coal mining revenues), and were exempt from the divestment requirement of the Act
- Fourteen companies failed to indicate applicable business plan adaptations, or failed to respond to our engagement efforts and were subject to divestment per the requirements of the Act
- Although we had no holdings to divest, an additional eight companies were identified as subject to the Act

All applicable holdings were divested in advance of the July 1, 2017 deadline specified by the Act¹¹.

Integration

Integration ensures consideration of relevant sustainability factors in the investment decision-making process across CalPERS’ total fund and includes assessing both physical and transition risks in the shift to a low-carbon economy. We have set a goal of having 100 percent of our investment policy and procedures integrating sustainability factors which are relevant to risk and return, including climate change across the total fund portfolio, by 2021 as part of our strategic plan on sustainable investment referenced above.

CalPERS makes use of a range of asset class specific reporting frameworks such as the Global Real Estate Sustainability Benchmark for both real estate and infrastructure. We have also collaborated with Wellington Asset Management to produce a corporate disclosure framework focused on the physical risks of climate change ([P-ROCC Framework](#)). This work was based upon meteorological data provided by the Woods Hole Institute. The P-ROCC Framework will help us evaluate how our portfolio companies are preparing to adapt to or mitigate risks from such climate variables as extreme heat, drought, wildfires, hurricanes, flooding and water access, and understand the time frames during which they identify material risks. The P-ROCC Framework describes five categories of potential risk to a company from physical climate change: demand, expenditures, logistics, talent and acquisition, or DELTA for short.¹²

Partnership

Partnership allows CalPERS to share insight and pool resources with fellow investors with shared objectives. One example CalPERS’ convened and co-founded Climate Action 100+ in order to scale up engagement with the world’s largest greenhouse gas emitters. This work is discussed in the risk management, metrics and targets sections below, with more detail in the appendix.

¹¹ [Public Divestiture of Thermal Coal Companies Act Report to Legislature](#)

¹² [Wellington Management and CalPERS. “Physical Risks of Climate Change \(P-ROCC\) A new framework for corporate disclosures.”](#)

We work closely through membership of organizations such as the Principles for Responsible Investment (PRI), industry leaders such as Ceres, the United Nations Global Investors for Sustainable Development, and the Vatican Dialogue on the Energy Transition and Care for Our Common Home.

Likewise, we use our positions on the advisory boards of regulators to argue for mandatory climate risk reporting. These include the Investor Advisory Committee to the SEC, the Investor Advisory Group to the Public Company Accounting Oversight Board (PCAOB) and Financial Accounting Standards Advisory Committee (FASAC) and Commodities and Futures Trading Commission (CFTC) special committee on climate change, plus the International Financial Reporting Standards (IFRS) Advisory Council where we represent the Council of Institutional Investors (CII).

We also participate in the SASB's Investor Advisory Group to encourage best practices in standardization of data and corporate reporting metrics on topics such as climate change.

Asset Class Considerations

CalPERS primarily invests across four asset classes - Real Assets, Global Fixed Income, Global Equity and Private Equity - through a combination of internal and external management. Nearly three-quarters of the total fund is invested in public markets.

Our risk management approach for these different asset classes depends on whether the investment strategy is driven by fundamental analysis and/or staff discretion on selection of individual assets, securities, or index orientation.

Fundamental Analysis

Fixed Income is driven by internal fundamental analysis of securities, while Real Assets and Private Equity rely upon the fundamental analysis conducted by external managers. Depending on the asset class, we retain some discretion in security or asset selection, utilizing data and tools to understand our exposures to the low-carbon transition and/or physical risks expected during the time horizon of the investment and assess whether the risks are priced in. This helps our staff and external managers make more informed investment decisions.

Index Orientation

In Global Equity our investment approach is focused on index orientation, and the levers for managing risk are benchmark selection and engagement. For this style of investing, the benchmark is the key factor in determining our portfolio holdings and weights, and thus our exposures to climate risks. Research on how the transition to a low-carbon economy and physical climate risks could be incorporated into our benchmarks is in progress. We may consider including the findings as part of our asset allocation process at a future date. In approaching this benchmark research, we acknowledge the following:

1. The complexity of understanding and analyzing transition and physical risks and opportunities
2. The evolving nature of the data and tools available in the financial industry

3. Understanding that companies and governments are not static and can evolve and adapt
4. That climate risks will materialize over various time horizons

Risk Management

This section of the report sets out how CalPERS' analysis considers exposure to both short- and long-term risks of climate change. They include the following categories as set out in the TCFD's recommendations:

Transition risks

Transition risks are shifts in the market, policies and technologies that can affect the financial success of existing business models and industries. Our portfolio companies' performance depends to various degree on how successfully they can navigate the transition brought by climate change. These include indirect risks, such as disruptions that threaten global policy momentum to address climate change. Transition risks include litigation such as third-party and class action claims against public companies as well as direct action(s) by shareowners against companies relating to damages directly or indirectly stemming from climate change. These claims, while difficult to quantify, have the potential to significantly impact share price, company goodwill, and valuation.

Physical Risks

Physical risks such as wildfires, extreme weather, sea-level rise, and drought can affect fixed assets, like real estate or infrastructure, and disrupt portfolio companies' supply chains and operations. Climate change's acute and chronic physical impacts can affect people's health, food security, migration, water supply, and other ecosystem services in ways that could bring heightened volatility to financial markets and harm economic growth.

Opportunities

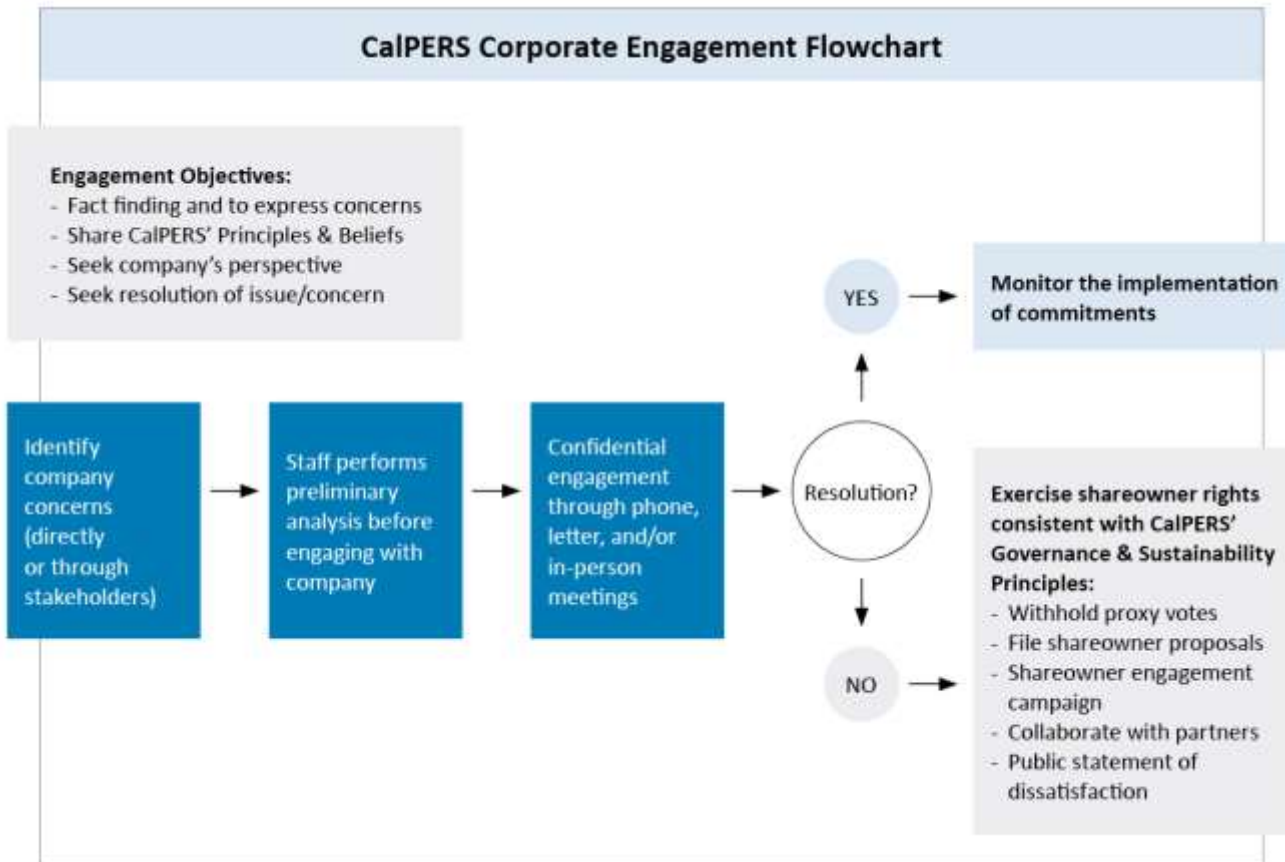
CalPERS' strategy seeks to identify investments poised to benefit from the transition to a low-carbon economy or operating in areas where physical risks are lower and/or can be mitigated. It is important to note these investments must be rooted in the fund's fiduciary responsibility to meet maximize CalPERS' target rate of return.

Within our large and diverse portfolio, investment strategies involve different time horizons, asset types and geographies. Given this, our risk management process includes analysis of risks at the portfolio level, asset-class level, industry level, and for different scenarios and time horizons.

Engagement as Risk Management

A major risk management tool that we utilize is company engagement. CalPERS exercises its ownership rights to hold boards accountable for their oversight of management strategy. The underlying objective is to ensure these companies are managed to create long-term, sustainable value for shareowners, consistent with CalPERS' fiduciary duty. The process is set out in the chart on the next page.

CalPERS' Corporate Engagement Flowchart



Proxy Voting

CalPERS casts proxy votes at over 10,000 companies' annual general meetings, exercising our shareowner rights to reflect the results of corporate engagement in line with our **Governance & Sustainability Principles**. We post our votes in advance on our website, with additional information for high profile votes and company-specific shareowner campaigns. During the 2019 proxy season, we voted on 81 shareowner proposals related to environmental topics. We reviewed each of the proposals in consideration of our Principles and assessed whether the proposal could add value to the investment if implemented.

In 2019, in aggregate, we supported 44 of the 81 proposals (54%) and 33 of the 36 proposals (92%) that asked companies to report on risks linked to sustainability, the environment, or climate change. CalPERS has consistently supported such proposals over the years, including filing proposals and running proxy solicitations to inform fellow investors on the issue being addressed.

CalPERS' Path to Climate Action 100+

Recognizing the scale and complexity of the climate change transition, CalPERS convened a new engagement initiative to consider how long-term investors could respond to the risk and opportunities this presents. Critical to the work was an extensive analysis of data and modelling which identified that a

small fraction of portfolio companies was responsible for the overwhelming majority of greenhouse gas emissions.

The origins of Climate Action 100+¹³ lie in CalPERS' commitment to mapping its carbon footprint. In 2014 CalPERS committed to the PRI Montréal Pledge, as the first U.S. signatory to measure and publicly disclose the carbon footprint of our global equity investment portfolio. After analyzing more than 10,000+ companies within the portfolio, approximately 80 companies were found to be responsible for 50% of the portfolio's scope 1 and 2 GHG emissions. The emission trajectory of these systemically important carbon emitters is critical to whether the global economy will meet the goals of the Paris Agreement to keep global warming to 1.5 degrees Celsius.

CalPERS recognized other global investors were likely to have similar holdings in their portfolios and convened a series of meetings hosted by the French mission to the United Nations. The result was a new partnership between regional and global investor networks (North America, Europe, Australasia, and Asia) to found and launch Climate Action 100+. Companies in Climate Action 100+ include companies from a wide range of sectors: oil and gas, utilities, transportation, metals and mining, construction materials, industrials, chemicals, and food, beverages, and forestry. These companies were identified through CDP's estimates of emissions by scopes 1, 2, and introduced an important selection assessment through appraisal of scope 3 emissions. In addition to the Climate Action 100 an additional group of companies was added reflecting their importance at regional level or importance to the global transition. These companies were dubbed the plus list, hence the moniker "Climate Action 100+" when launched at the One Planet Summit in December 2018. The initiative has since been recognized by the United Nations as one of the private sector initiatives which will drive progress towards meeting the ambition of holding global warming to 1.5 degrees Celsius.

CalPERS plays a leading role in Climate Action 100+ as the inaugural chair and a member of the Steering Committee, which sets the strategy for the initiative. CalPERS' CIO also chairs the Climate Action 100+ Asia Advisory Group which draws together expertise for that region. Our Corporate Governance team assumed the lead role for 22 of the companies identified for engagement which is the largest number engaged by a single asset owner in the initiative. The responsibilities of the lead investor include meeting in person with the company's leadership, including senior management and board members to communicate and engage on the Climate Action 100+ goals of governance, targets and transparency, as listed below.

- **Governance:** Implement a strong governance framework for each company that clearly articulates the board's accountability for oversight of climate change risk and opportunities. This includes ensuring that corporate lobbying and executive compensation are aligned with the Paris Agreement to facilitate a low-carbon transition.
- **Targets:** Act to reduce greenhouse gas emissions across the company's value chain, consistent with the goal of limiting global average temperature increase to 1.5 degrees Celsius above pre-industrial levels.

¹³ <http://www.climateaction100.org/>

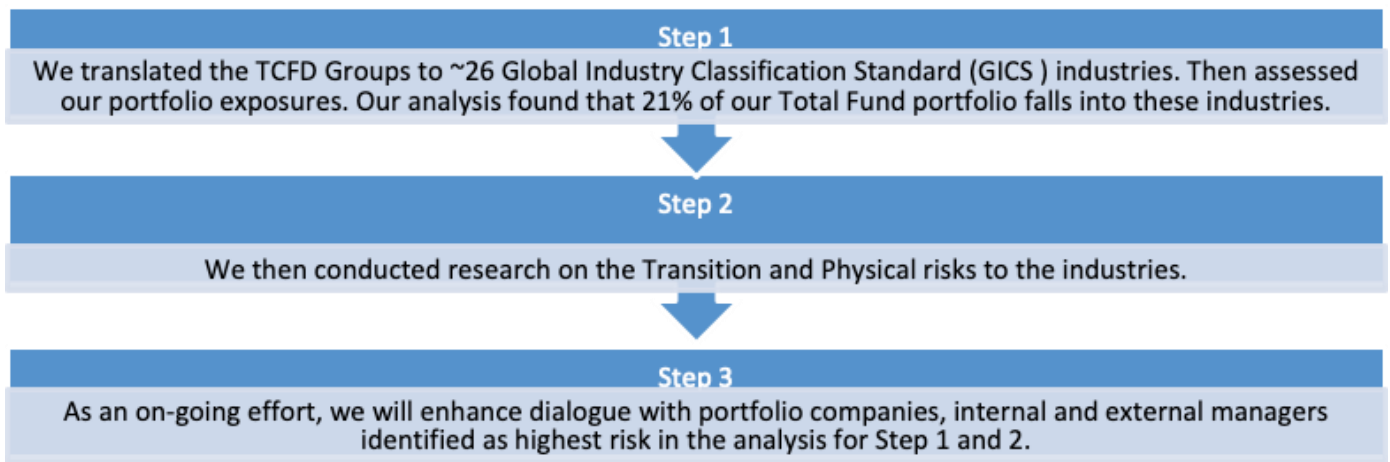
This includes scope 1, 2 and 3 emissions to ensure complete tracking of climate impact through emissions. This target requires that companies achieve a net-zero goal on emissions no later than 2050.

- **Transparency:** Provide enhanced corporate disclosure in line with the TCFD recommendations and, when applicable, sector-specific Global Investor Coalition on Climate Change expectations to enable investors to assess the robustness of a company’s strategy against a range of climate change scenarios.¹⁴

Results from the first stage of corporate engagements are detailed in the [Climate Action 100+ 2019 Progress Report](#). In the next section we share some of these results.

Risk Analysis by TCFD Sector

To focus our risk analysis, we identified our investments in the groups of industries noted by the TCFD as being most exposed to climate risks and opportunities – energy, transportation, materials and buildings, and agriculture, food and forestry. For these industries, we performed the following steps:



The assessment in relation to the TCFD sectors was conducted through extensive research and analysis by a cross-asset class team. CalPERS identified the percentages of aggregate public market investments in the sectors defined by the TCFD as most exposed to climate risks and opportunities. We understood the TCFD sectors as mapping to the following underlying Global Industry Classification Standard (GICS) sectors:

GICS Sector	TCFD Sector Group
Materials	Agriculture, Food, Forest Products Materials and Buildings
Consumer Staples	Agriculture, Food, Forest Products
Utilities	Energy

¹⁴ The Principles for Responsible Investment (PRI, Ceres, the Institutional Investors Group on Climate Change (Europe), the Asia Investor Group on Climate Change and the Australian Investor Group on Climate Change

Industrials	Agriculture, Food, Forest Products Materials and Buildings, Transportation
Energy	Energy
Consumer Discretionary	Materials and Buildings, Transportation
Real Estate	Materials and Buildings

The following is a summary of public market exposures and anticipated climate related financial risks in these sectors. Unless otherwise noted, all public market holdings information for this analysis was for the most recent fiscal year at the time of writing (June 30, 2019).

TCFD Sector	Combined Weight in Portfolios ¹⁵
Energy ¹⁶ (Includes Energy and Utilities Holdings)	8%
Materials and Buildings	6%
Agriculture, Food, and Forestry	4%
Transportation	3%
Total	21%

The sections below set out our current understanding of the risks and opportunities for each TCFD sector and provide examples of how Climate Action 100+ engagement has led to results that drive action towards reducing emissions.

Energy

The energy sector is in a critical stage of transformation. Big shifts are emerging that offer alternatives to the traditional model of centralized power grids and transportation that run almost exclusively on fossil fuels. Such shifts are driven by technological advances enabling more consumer choice and decentralization along with a growing demand for electrification and desire for decarbonization. These shifts could have a profound effect on the energy sector and our investments in energy across the fund.

The following table lists some of the elements we take into consideration.

Transition	Market	<ul style="list-style-type: none"> Renewable energy and natural gas are increasingly cost-competitive.¹⁷
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¹⁵ Considers CalPERS' Global Equity and Investment-grade Corporate Fixed Income portfolios

¹⁶ The Global Industry Classification Scheme includes the following industries in each Sector below:

Energy: Energy Equipment and Services, Oil, Gas and Consumable Fuels

¹⁷ Renewable energy is now the cheapest form of power in 2/3 of the world.

		<ul style="list-style-type: none"> • Consumer demand shifting towards lower carbon assets and decentralization, where lower-cost options are available. • Fossil fuel reserves and development of new reserves face risk of becoming stranded assets due to policy and consumer demand shifts toward a low-carbon economy.
Transition	Policy	<ul style="list-style-type: none"> • Carbon pricing - over the past decade the number of global jurisdictions with carbon pricing initiatives has doubled. • Energy subsidies provided to fossil fuels currently distort market pricing and may be eliminated. • State and country commitments and targets are emerging and can affect assets in these markets: for example, <ul style="list-style-type: none"> ○ New York’s Senate Bill 6599 sets a 30-year goal to pivot 100% of generation to renewables¹⁸ ○ California’s Senate Bill 100 requires 100% of total retail electricity sales to come from eligible renewable energy and zero-carbon resources by December 31, 2045¹⁹ • Plastic regulation brings risk to oil and gas companies looking to plastic demand for revenue growth as they decarbonize. • Global growth in anti-plastics regulation and consumer/corporate sentiment due to plastics persistence and harm in the environment.
Transition	Technology	<ul style="list-style-type: none"> • Massive projected increases in energy from wind and solar in the future, up to 50% by 2050. • Growth of renewables and battery storage solutions may decrease role of gas peaker generation. • Technology shifts can have knock-on effects for commodities and parts suppliers.
Physical	Extreme Temperatures	<ul style="list-style-type: none"> • Equipment may not be built to tolerate and/or function at new temperature extremes.
Physical	Hurricanes	<ul style="list-style-type: none"> • Oil and gas drilling rigs and refining capacity are susceptible to risks from hurricanes, which may interrupt oil exploration and production. Infrastructure may be exposed to damage, depending on location.
Physical	Water Scarcity	<ul style="list-style-type: none"> • Utility holdings and power asset holdings may have increased vulnerability to drought due to water use for hydropower and water-cooled thermal generation.

¹⁸ [New York Climate Leadership and Community Protection Act](#)

¹⁹ [California Renewables Portfolio Standard Program](#)

Climate Action 100+ Engagement Results: Energy Sector Examples

BP

Sector: Energy Minerals (oil and gas), United Kingdom

In February 2020, BP announced its ambition to achieve net-zero emissions by 2050 or sooner. To achieve this goal, the company will need to eliminate around 415 million tons of emissions - 55 million from operations and 360 million tons from the carbon content of upstream oil and gas production.

The company is aiming to cut the carbon intensity of the products they sell by 50% by 2050 or sooner. BP agreed to include its top 14,000 executives in a compensation plan aligned with its emissions reduction goals.

BP also announced that it withdrew its membership in three U.S.-based trade associations, including the country's main refining lobby, because of disagreements over their climate-related policies and activities.

BP plans to pursue opportunities to work with organizations which share the company's approach to the low-carbon transition.

Duke Energy

Sector: Utilities (electric utilities), USA

One of the largest electric utilities in the US, Duke Energy has committed to net-zero emissions by 2050.

In September 2019 the company joined a growing number of electric utilities that have made the same commitment following shareowner engagement. On the Climate Action 100+ roster these include Xcel Energy, Southern Company, Enel, RWE, and DTE.

In the company's press release, Duke's CEO, Lynn Good, stated, "A diverse mix of renewables, nuclear, natural gas, hydro and energy efficiency are all part of this vision, and we'll take advantage of economical solutions to continue that progress. In the longer-term, innovation and new technologies will be critical to a net-zero carbon future."

Materials and Buildings

Cement, steel and building management are the principal sources of emissions for the industries in this category.²⁰ Here, we focus on steel and cement. Our approach to energy management in buildings is covered in our discussion of the Energy Optimization Program for our Real Estate portfolio in the Metrics and Targets section.

²⁰ [The Economist. "The Circular Economy"](#)

Below are some of the elements we take into consideration:

Transition	Market	<ul style="list-style-type: none"> Producing a ton of cement generates nearly a ton of CO₂, and 1.9 tons of CO₂ are emitted for every ton of steel produced.²¹ Those firms that can produce cement and steel with relatively lower emissions may fare better in an environment where carbon emissions are priced.
Transition	Technology	<ul style="list-style-type: none"> Technology exists to lower emissions from these industries, but no commercially scalable technology is available yet that will reduce emissions from cement or steel in line with a well-below 1.5 degrees Celsius scenario. Decarbonization may require advances that rely on emerging technologies to further reduce the role that high-intensity thermal processes currently play in driving refinement of iron ore.
Physical	Extreme Heat, Hurricanes & Storm Surge	<ul style="list-style-type: none"> Each of these variables may affect the ability of people to work outdoors. Each of these physical risks may impair the functionality, operating costs, capital expenditures and value of fixed assets such as buildings.
Physical	Water Scarcity	<ul style="list-style-type: none"> Mining operations which produce key materials within this sector depend upon water in extraction processes. As drought and water scarcity grow, companies' license to operate may be at risk. Drought may affect the operations and operating costs of real estate buildings.

Climate Action 100+ Engagement Results: Materials and Buildings Sector Examples

HeidelbergCement

Sector: Non-Energy Minerals (cement), Germany

HeidelbergCement has set short-term targets for 2030 with a goal to realize a carbon neutral ambition for concrete by “2050 at the latest”. Cement-making is a “hard to abate” sector that accounts for about 7% of global emissions. In May 2019, the world’s fourth largest cement-making company, HeidelbergCement, announced that it had become the first cement company to receive approval for a science-based target. A “science-based target” is an emissions reduction target aligned with the goals of the Paris Agreement.

²¹ Wood Mackenzie. “Energy Transition Outlook H1 2018: The Sustainability Challenge”.

To achieve its goals, HeidelbergCement will improve its energy efficiency and increase its use of alternative fuels and raw materials. It will also need to continue developing new technologies for carbon dioxide sequestration and use in the cement-making process.

Repsol

Sector: Energy Minerals (oil and gas), Spain

Spain's largest oil company, Repsol, announced a commitment to net-zero emissions by 2050 in December 2019. This was a world first for an oil and gas company.

Repsol's commitment was particularly noteworthy because it also covered the emissions released from the oil and gas it sells (which are captured in scope 3 emissions). These emissions are generally much larger compared to the emissions generated from the company's own operations.

In its press release, Repsol said it would pursue a number of measures to reach its goals. These include scaling up its renewable energy portfolio, increasing its production of biofuels and chemical products with low-carbon footprints, and ensuring that all its future oil and gas projects are compatible with the emissions levels implied by the Paris Agreement. In addition, the company said it would use carbon capture technologies, reforestation, and natural climate solutions if it was unable to reach its goals via other means.

Rio Tinto

Sector: Non-Energy Minerals (mining), UK

In February 2020, Rio Tinto announced plans to invest around \$1 billion over the next five years to support the delivery of its new climate change targets and a company objective for net-zero emissions from operations by 2050.

The company established new targets for 2030: (1) further 30% reduction in Rio Tinto's emissions intensity from 2018 levels, and (2) further 15% reduction in Rio Tinto's absolute emissions from 2018 levels. Under these targets, Rio Tinto's overall growth between now and 2030 will be carbon neutral.

The company stated that "Climate change is a global challenge and will require action across nations, across industries and by society at large. New technologies, partnerships and effective government policies will be key in achieving this goal but today there is no clear pathway for the world to get to net-zero emissions by 2050."

ThyssenKrupp

Sector: Non-Energy Minerals (steelmaking), Germany

Germany's largest steelmaker, ThyssenKrupp, announced plans in July 2019 to be climate neutral by 2050. The company's commitment is particularly significant because steelmaking is a "hard to abate" sector. There are currently few readily available and cost-effective ways to reduce emissions from the

steelmaking process. And yet, steelmaking accounts for about 7% of global emissions, or roughly the same amount as the entire country of India in 2018.

ThyssenKrupp plans to pursue several measures to achieve carbon neutral steel. These include capturing emissions from steel mills and converting them into useful chemicals, as well as replacing the coal used in the steel production process with hydrogen.

Agriculture, Food and Forestry

The companies involved in the Agriculture, Food, and Forestry sectors meet critical needs including the production, distribution, and security of food. These industries interact with, and in some cases imperil or support, natural ecosystems which serve as critical carbon sinks capturing significant amounts of CO₂ emissions. The overall rise in temperature alongside more frequent and severe weather events create acute and chronic physical risks expected to have substantial impact on this sector.

Below are some of the elements we are monitoring:

Transition	Market	<ul style="list-style-type: none"> • Increased consumer demand for alternative meat proteins.²² • Increased consumer demand for deforestation free products. • According to the CDP, many of FMCG companies are facing product demand shifts – Consumers are asking companies to rethink their product design with preferences for incorporating lower waste and greater recycling, in part due to climate awareness.²³
Transition	Policy	<ul style="list-style-type: none"> • Policy on land use change that protects or encourages natural carbon sinks, may reduce physical risks from climate change and create new business opportunities. • Policy that restricts land-use change in sensitive regions may impact specific commodities or companies.
Transition	Technology	<ul style="list-style-type: none"> • Developments in lab-grown and plant-based proteins that have significantly lower carbon footprints than livestock/dairy. These new foods require significantly less land use conversion away from natural carbon sinks and into land used for such activities as cattle grazing. • Developments in precision farming may disrupt incumbent farming practices by offering lower CO₂ and lower water use methods of farming. • Developments in food waste prevention technologies and practices may improve agricultural companies’ performance while reducing GHG emissions.

²² [Appetite for Disruption, FAIRR](#)

²³ [\[2\] CDP. “Fast Moving Consumer Goods”](#)

Physical	Biodiversity	<ul style="list-style-type: none"> • Changing climate may contribute to a decline in pollinator species (insects, birds and bats) which negatively affects the world's food crops dependent on their pollination services. • Changing climate may increase risks of, and thus costs of managing, pests and pathogens. • Warming ocean imperils vulnerable marine ecosystems and the fishing industry and supply chains that rely on them.
Physical	Extreme Heat	<ul style="list-style-type: none"> • Decreased yield of dairy animals due to heat exhaustion. • Decreased yield of crops that cannot tolerate extremes. • Decreased productivity when workers are unable to work outside.
Physical	Flooding	<ul style="list-style-type: none"> • Delays in planting that could affect production for entire seasons. • Damage to planted fields, contamination of fields and/or water can create additional costs, restrict market access, and have unforeseen impacts on local communities which may further reduce productivity.
Physical	Water Scarcity	<ul style="list-style-type: none"> • Increased drought, and changing precipitation patterns, may decrease yield of certain crops, increasing pressure on irrigation systems which are already among the more intensive users of water.

Climate Action 100+ Engagement Results: Agriculture, Food and Forestry Sector Examples

Nestlé

Sector: Consumer Products (food and beverage), Switzerland

Swiss food and beverage giant Nestlé announced in September 2019, a commitment to net-zero emissions by 2050.

To reach its ambitious new goal, Nestlé said it would produce more environmentally friendly products, scale up agricultural initiatives that absorb carbon, and use 100% renewable electricity in its operations.

The company said it would take two years to develop a plan to reach net-zero emissions, and that this plan would include short-term targets on the way to the 2050 goal.

PepsiCo

Sector: Consumer Products (food and beverage), USA

In January 2020, the company announced its expectation to achieve 100% renewable electricity for its U.S. direct operations during the year. The U.S. is PepsiCo’s largest market and accounts for nearly half of its total global electricity consumption.

The company previously established a target that was approved by the Science Based Targets initiative to reduce scope 1, 2, and 3 GHG emissions by 20% by 2030, using a base year of 2015. PepsiCo has also set goals out to year 2025 to help build a more sustainable food system – specific goals are related to: agriculture, water, packaging, products, climate and people.

Transportation

The transportation sector is beginning a global transformation driven by electrification, decarbonization, shared mobility and autonomous driving. Much of the change in the coming decades will be in tandem with the low-carbon transition. Battery prices continue to fall and are opening opportunities for electric drivetrains in new segments. Municipal, national, and international policy is driving the automotive market toward low-carbon options and improved fuel efficiency. Meanwhile, new mobility business models such as ride-hailing are scaling quickly and expanding to new markets around the world.

Below are some of the elements we take into consideration:

Transition	Market	<ul style="list-style-type: none"> Trends towards electric, shared, autonomous transport are occurring at a different scale and pace across segments, including commercial automobiles, trucks and buses. The combined impact on emissions may be positive or negative.
Transition	Policy	<ul style="list-style-type: none"> Policies supporting electrification are growing at the national and local levels. At least 14 countries already have policy goals to phase out the sales of internal combustion engine vehicles. The emergence of policies that meaningfully price carbon will drive the market toward lower carbon transport, negatively affecting more carbon intense technologies
Transition	Technology	<ul style="list-style-type: none"> Short term: Types, duties, and use cases of electric vehicles are expected to increase, with estimates of heavy-duty electric vehicles reaching total cost of ownership parity with diesel vehicles by the mid-2020s. On-going: Cost of battery production expected to further decline 10% annually through the 2040s.
Physical	Extreme Heat, Hurricanes and Storm Surge	<ul style="list-style-type: none"> Railways and air transportation equipment and infrastructure have vulnerability to temperature extremes, with potential impacts to critical processes and services.

Climate Action 100+ Engagement Results: Transportation Sector Examples

Maersk

Sector: Transportation, Netherlands

A.P. Moller Maersk is the world's largest container shipping company. In December 2018, because of engagement and dialogue with Climate Action 100+ investors, Maersk committed to achieving net-zero emissions by 2050.

This commitment is particularly notable because the shipping sector does not have many readily available options to decarbonize and its assets can last for 20-25 years.

Honda

Sector: Transportation, Japan

Honda recognizes climate change as a serious environmental concern for all of society. For years, the company has been committed to mitigating climate change throughout our corporate activities. The company was one of the first to declare its own Environmental Statement in 1992 and in 2011, went one-step further when it issued its Environmental and Safety Vision.

Shinji Aoyama, President & CEO of American Honda Motor Co., Inc. and Honda North America Inc. wrote in the Honda's 2019 North American Environmental Report, "In 2017, the company articulated its 2030 Vision, which focused on Honda's longstanding concept that the purpose of technology is to help people. Based on this direction, we have set a challenging global goal of having emissions from Honda's total business activities in 2050 to be half the amount emitted in 2000."

Honda has outlined three initiatives to realize this target:

1. **Efficiency improvements** of internal combustion engines
2. Introducing **environmentally innovative technology and diversifying energy sources**
3. The use of **renewable energy and total energy management**

As an interim target, Honda set a 2020 Product CO₂ emissions reduction target to lower emissions intensity from the use of motorcycles, automobiles, and power products by 30% by 2020, compared to 2000 levels.

- Automobiles account for approximately three quarters of Hondas sales revenue. Honda has set a target to electrify two-thirds of its global automobile sales by 2030. Honda is focusing on the development of plug-in hybrid electric vehicles (PHEV), electric vehicles (EV), and fuel cell vehicles (FCV), and entering into partnerships with other companies for preparation of a hydrogen infrastructure such as hydrogen stations.
- For motorcycles, Honda is selling and conducting demonstration experiments for the PCX Electric/Hybrid.
- For power products, Honda has expanded product selection in line with customer needs by accelerating product electrification which includes storage batteries, portable power sources, and robotic lawn mowers.

Note on Other Sectors

We also continue to engage companies where climate risk issues arise, beyond the Climate Action 100+ initiative and the TCFD sector priorities. An illustrative example to show the level of detail involved lies with a rail company and our engagement on potential exposure to extreme heat. Through the engagement we learned the company had identified increased buckling of rail ties as a risk from extreme heat and introduced measures to mitigate the risk.

The banks and financial services sector's role in financing assets at risk from transition to the low-carbon economy, as well as financing climate solutions is an issue of growing importance. CalPERS does see this as a relevant part of our portfolio for us to monitor for climate risks. An example of our work in this area is our contribution to the review of the Equator Principles' risk framework requirements for physical and transition risk analysis by global financial institutions.²⁴ We expect this area of focus to expand as new data and analysis are developed.

²⁴ [Investor Submission to Equator Principles Association on Its EP4 Draft and Rights of Indigenous Peoples – Boston Common Asset Management](#)

Metrics and Targets

This section of the TCFD guidance helps us ask: How do carbon emissions in the real economy create financial risks in our portfolio? To begin answering that question, we turned to the tools and data currently available, and used several metrics as each serves a different purpose. In this section, we will share the results in order to contribute to the continuous improvement of climate metrics for financial institutions.

Understanding the history of currently available tools is important to putting the metrics in context. CDP (known formerly as Carbon Disclosure Project) began the practice of collecting carbon data through voluntary disclosure by companies in 2002. CalPERS is a long-standing supporter of the CDP's annual surveys. Since then, some jurisdictions have mandated carbon reporting and the practice more generally has grown. More than 6,300 companies disclose environmental data through CDP, along with over 570 cities and 100 states and regions. CDP aligned its survey with the TCFD's recommendations, while introducing a sectoral focus and a forward-looking approach.

CalPERS conducted our first carbon footprint of our Global Equity portfolio in 2015, but we only had data for 70% of firms by portfolio value and less than 50% by number of holdings. Since then, we have learned by conducting footprints of other asset classes and the data has improved both in terms of coverage and estimation methods by data providers. We have also seen the development of climate related scenarios, such as carbon budget analysis and portfolio warming potential alongside frameworks to help understand the physical and transition risks.

Functional View of the Metrics

In line with the Greenhouse Gas Protocol (GHGP), CalPERS considers emissions in three types:

Scope 1: Direct emissions that are a result of a firm's facilities, plant, or equipment (including vehicles) use during the production of goods or services

Scope 2: Indirect emissions derived from the generation or purchase of energy that a company consumes as an ancillary activity to the production process

Scope 3: All other indirect emissions, including across the company's value chain for its goods and services, or suppliers and customers.

Below, we explain the metrics we use and the role these metrics play.

Carbon metrics	Asset class carbon metrics	Climate scenarios	Risks / Opportunities
<i>Point in time</i>	<i>Ongoing decision process</i>	<i>Trajectory</i>	<i>Point in time</i>
<ul style="list-style-type: none"> - Carbon footprint - Carbon intensity - Weighted average carbon intensity (WACI) - CO₂e / enterprise value 	<ul style="list-style-type: none"> - Opportunity cost - Pricing of carbon risk premium - Investable universe 	<ul style="list-style-type: none"> - Portfolio 2°C alignment - 1.5°C portfolio warming potential 	<ul style="list-style-type: none"> - Climate value-at-risk - Carbon earnings-at-risk - Solvency-at-risk

Climate Change Metrics - Framework

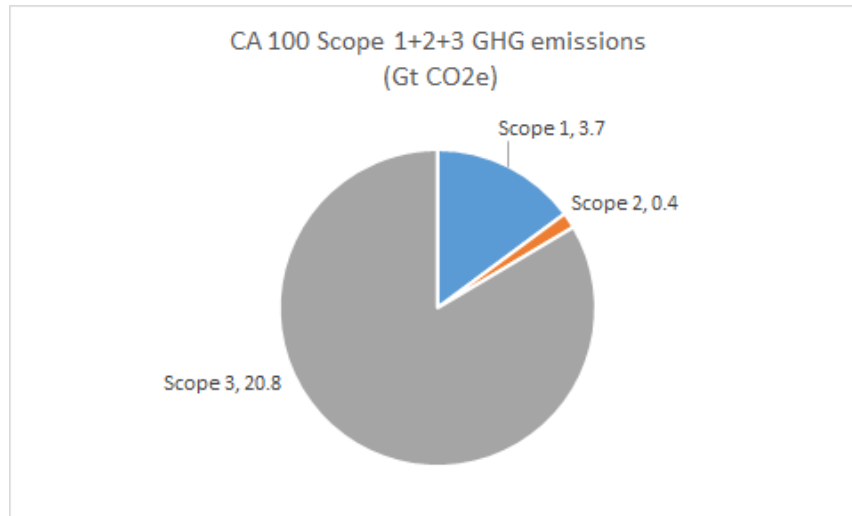
Emissions can then be converted into a range of climate metrics. We consider our portfolio’s carbon impact from the vantage point of:

- **Carbon metrics:** To understand the source of current GHG emissions in the portfolio, identify which industries may be most impacted by future developments, for example, a price on carbon.
- **Asset class carbon metrics:** Metrics chosen as more relevant to decision-making within each asset class (e.g. Weighted Average Carbon Intensity for fixed income vs. Metric tons CO₂e per \$NAV for Real Assets)
- **Climate scenarios:** To understand the potential trajectory of emissions across our portfolio.
- **Risks/opportunities:** To begin relating climate metrics to financial risk.

Quantifying Success for Engagement of Climate Action 100+ Companies

Moving beyond looking at our portfolio level carbon budget, CalPERS worked with CDP to answer the question: “What would be the reduction in total global GHG emissions if the Climate Action 100 engagements are successful?” For this analysis we focused on the 100 companies which CDP assessed for the original selection. CDP’s annual surveys have recently grown to include questions about scenario analysis in its climate change and water frameworks. They specifically ask how companies evaluate their climate risks and integrate these into business strategies. Some companies rely upon publicly available scenarios, of which CDP highlights several, while some use their own proprietary scenarios or a combination. The results here draw on CDP’s climate data.

For the core Climate Action 100 companies, CDP measured current CO₂e emissions and modeled an ambitious best case for achieving net-zero emissions in 2050 by applying the Science Based Target Initiatives’ 1.5 degrees Celsius pathway. This pathway entails a 4.2% reduction in absolute emissions annually between 2020-2030 and 2.7% annual reduction from 2030-2050. Given the challenge of double-counting inherent with applying scope 3 emissions at a portfolio level, the 1.5 degrees Celsius scenario was initially modeled for scope 1 and 2 emissions. A further analysis was carried out for each company in the 100 cohort to provide a scenario individually for illustrative purposes.



Climate Action 100 GHG inventory breakdown for 2020

CDP Results

The CDP analysis on Climate Action 100 company emissions show total scope 1, 2 and 3 for the companies is approximately 25 Gt CO₂e emissions per year. **CDP found that the Climate Action 100 companies would collectively avoid 55Gt of CO₂e scope 1 and 2 emissions if they all reach net-zero emissions by 2050. This is equivalent to 13% of the world's remaining carbon budget through 2050 (420 Gt CO₂e) to have a 66% chance of limiting warming to 1.5 degrees Celsius.** Scope 1 and 2 emissions of the 100 companies is estimated currently to be 4.1 Gt of CO₂e. Scope 3 emissions alone are estimated to be 20.8 Gt of CO₂e.

CDP cautions that the analysis of scope 3 emissions is for illustrative purposes only. Due to the low level of reporting and potential for double accounting for emissions, scope 3 emissions of companies they caution should not be aggregated and compared to global carbon budgets. They recommend using scope 3 on a company-by-company basis to identify how a company can influence its value chain to reduce emissions. A more comprehensive explanation provided by CDP is included in the Appendix.

CalPERS Specific Results

Looking specifically at our ownership in the Climate Action 100 companies (as of June 30, 2019), CDP found that CalPERS' holdings account for 0.19% of scope 1 and 2 emissions (~7.7 million metric tons CO₂e). They also found the top 25 companies in our portfolio by emissions are responsible for 85% of CalPERS' total owned emissions (note: not all Climate Action 100 companies are in CalPERS' portfolio).

CDP found that if the Climate Action 100 companies were to reach net-zero emissions by 2050, and if CalPERS' ownership in these companies remained constant, the total avoided GHG emissions would be approximately 100 million metric tons of CO₂e by 2050.

Risk Metrics

Climate Value at Risk

A further line of sight into considering the potential impact of risk on CalPERS' portfolio comes from the concept of Climate Value at Risk (CVaR). MSCI/Carbon Delta's²⁵ CVaR tool seeks to analyze the risks and opportunities for investments related to climate change on a quantitative, forward-looking basis. The tool also estimates the current temperature trajectory of the portfolio.

The CVaR analysis looks at data over a 15-year time horizon with the following framework:

1. **Transition Risk and Opportunity**, made up of: Policy, which captures the commitments made by countries and companies to reduce GHG emissions; and technology, which aims to be a forward-looking opportunity measure that captures potential revenues from business activities that produce fewer GHG emissions.
2. **Physical Risk and Opportunities**: Estimates the expected cost to a company based on its geographic exposure, the type of hazards it might experience, and its vulnerability to damage and business disruption.

CalPERS used the CVaR tool to help us better understand our public asset classes relative to the models for:

- **Net-Zero Target**: A 1.5 degrees Celsius transition risk assessment with average physical risk at the enterprise level for companies in our Global Equity and Global Fixed Income portfolios as well as just our Global Equity portfolio. This helps us understand the risks and opportunities to our current public market portfolio if the world moves toward 1.5 degrees Celsius alignment.
- **The Real Economy**: We conducted a 1.5 degrees Celsius and 3 degrees Celsius transition risk with average physical risk assessment on MSCI's ACWI GDP-weighted index as our global economy baseline. CalPERS is very aware that true physical risk mitigation requires global emissions reduction. While we consider our global equity portfolio to be a good proxy for the real economy, our portfolio is more heavily weighted towards the U.S., so we felt it made sense to run an assessment with a more robust proxy.

Interpreting Results

The results from the CVaR analysis are summarized in the table below. **These results should be interpreted as directional signals rather than absolute numbers and point clearly to significant exposure to climate risk. It also reveals that transition and physical risks may present a significant drag on returns, therefore we must develop a deeper understanding of how different risks impact CalPERS' public market portfolios.**

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CVaR Net Zero by 2050 Analysis

	CalPERS' Portfolio (Public Markets)	CalPERS' Portfolio (Global Equity)
Transition Risk	-3.1%	-3.0%
Physical Risk	-3.8%	-4.4%
Climate VaR	-6.9%	-7.4%

Key Findings

Using the results of the CVaR analysis as directional cues, we have three key takeaways that we hope will inform future analyses:

- 1. Reductions made today will minimize future physical impacts because much of the physical risk we will experience in the next 15 years is a consequence of actions taken in the past.** Even if we move to 1.5 degrees Celsius today, we will experience physical risks (these will potentially be less material in the future). If we do less today, we will need to do more later. Increasing transition risk today is a way to mitigate increased future physical risk.
- 3. There are complex interplays of risk and opportunity.** Industries that are higher risk in terms of policy, such as electricity distribution and transmission, also have significant technology opportunities.
- 4. The results show that Physical risks may be even more material to the portfolio than Transition risks.** We caveat this finding that the interplay between Transition and Physical risks is not built into the CVaR tool yet, and these results may shift as tools evolve.

Portfolio Warming Potential

We also ran a data and analysis exercise to consider the lens of warming potential in the portfolio, relative to the goal of keeping global warming to the 1.5 degrees Celsius goal. MSCI's CarbonDelta²⁶ has created a proprietary warming potential assessment in which each company is associated with a degree of warming temperature. This is applied at the portfolio level by estimating that the warming potential of the portfolio is a weighted average of the warming potential of its constituents.

The results show CalPERS' public asset classes (Global Equity and Global Fixed Income) portfolios have a warming potential of 3.23 degrees Celsius, which tracks to the global warming potential of the wider economy. As CalPERS is a universal owner, this result is not surprising as it tracks the warming expected taking the current state of global climate commitments through policy into account.

Current commitments made by countries through the Nationally Determined Contributions (NDC) proposals and by companies setting targets help CalPERS understand the warming potential of our public asset classes. This reinforces the importance of activities such as company engagements through initiatives

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like Climate Action 100+ and public policy advocacy. It also allows us to assess how much work is needed to help us realize net-zero emissions by 2050.

CVaR Comparison of CalPERS’ portfolio to the Global Economy²⁷

	Global Economy Proxy	CalPERS’ Portfolio (Public Markets)	CalPERS’ Portfolio (Global Equity)
Current Temperature Trajectory of the Portfolio	3.1 degrees Celsius	3.2 degrees Celsius	3.2 degrees Celsius

Contributors to Portfolio Warming

Diving deeper into the results from the CVaR analysis, CalPERS looked at the country and sector contributors to portfolio warming to understand which regions contribute the most to the calculated warming potential.

While a significant gap exists between regions all remain on trajectories consistent with a warming above 3.5 degrees Celsius.

There is also a wider differentiation in the “distance to warming objectives” across sectors. The energy, utilities, and materials sectors have warming potential above 5 degrees Celsius whereas sectors considered less carbon intensive like financials have warming potentials at or below 2 degrees Celsius. These findings are summarized in Appendix 2 – Scenario Analysis Results.

Technology Opportunities

The production and adoption of technologies that provide for a transition to a low-carbon economy demonstrate the potential to decrease emissions and avoid the worst effects of climate change.

MSCI ESG Research provides a low-carbon technology opportunity scenario analysis that is based on company-specific patent data. Using this analysis, we found significant differentiation across countries and sectors. We also found the current high carbon emitters have the largest opportunities, which supports our second key takeaway.

Emissions Concentrations

Looking beyond sectors and at industry and business activity groupings helps explain if and where emissions are concentrated. **As illustrated in the Appendix, six industries account for 92% of CalPERS’ scope 1 and 2 emissions and seven industries account for 92% of Scope 3 emissions. These results underscore that multiple industries drive exposure to climate risk and the findings support a focused approach on industries whose business activities produce the highest emissions.**

²⁷ Certain information ©2020 MSCI ESG Research LLC. Reproduced by permission

Data Limitations

This section is our caveat to all the analysis presented in this report. It summarizes the lengthy process of analyzing the data we commissioned from a variety of providers who have contributed detailed analytics to this report, as well as our observations on the care needed when the data are interpreted. There is an encouraging improvement in corporate reporting, particularly due to the impact of the TCFD recommendations, which have been supported by investors through initiatives such as Climate Action 100+.

To take risk analysis to a deeper level, investors need comparable, reliable, and timely reporting on climate risk. For that reason, we consider the private sector voluntary initiatives to improve reporting need to be buttressed by mandatory reporting requirements by standard setters both in the US and internationally. This is a focus of our advocacy work. Meanwhile, we will continue to engage companies to support reporting into platforms such as CDP and in line with the TCFD recommendations.

Real Assets Carbon Footprint

In 2019, CalPERS completed the first carbon footprint measurement of our Real Assets portfolio which includes real estate, infrastructure and forestland. Delivering this footprint meets one of the objectives in the climate change workstream in our strategic plan for sustainable investment.

In total, we received GHG emissions data from our external managers and asset operators representing 93% of the Real Asset portfolio's Net Asset Value as of December 31, 2018. The analysis was conducted internally utilizing data submitted through the Global Real Estate Sustainability Benchmark (GRESB) platform, as described further below. Given this was our first attempt at collecting this information across the Real Assets portfolio, receiving data for such a high percentage of our portfolio's NAV underscored the importance of the work initiated over the past several years in requesting our managers to track this data and submit it through the GRESB platform. We appreciate the work our managers have done in putting in place the capabilities to track this data.

We asked managers to report on scope 1 emissions - or those from their direct operations, and scope 2 emissions - from purchased electricity. Scope 3 refers to those emissions that arise from sources which are not directly controlled by our holdings and were not included here. Results of the Real Assets carbon footprint are as follows:

Real Assets Carbon Footprint	Scope 1 and 2 Emissions (tCO₂e)
Total Emissions	7,587,298
Total Offsets	2,119,777
Net Emissions	5,467,521

Offsets for this calculation are avoided or stored emissions, measured in tons of carbon-dioxide equivalent (tCO₂e), that emitters can purchase to reduce their total carbon footprint. The combined effect of these two offsetting activities reduced the carbon footprint by 2.1 million tCO₂e for a net portfolio carbon footprint of 5.5 million tCO₂e.

The majority of the GHG emissions for the Real Assets portfolio are concentrated in our Infrastructure holdings. Of the Real Assets portfolio, Infrastructure accounts for 12% of the NAV and 90% of the reported net GHG emissions. This is primarily driven by power and energy assets, which make up 48% of the Infrastructure portfolio's NAV. Other related metrics worth noting regarding our power and energy assets include that:

- 50% comprised renewables and carbon-agnostic transmission assets; and,
- 39% comprised renewable energy power plants

It is important to note that our portfolio holdings are not static and in many cases our managers and our asset operators are taking steps to manage the carbon emissions of our assets. Examples include:

- In 2017, one of our portfolio holdings, Gatwick Airport, became the first carbon neutral airport in London. The airport uses 100% renewable energy and purchases Gold Standard carbon credits to offset ground fuel emissions.
- Two waste coal power plants that make up a significant amount (13%) of the net carbon footprint for Real Assets are expected to be retired by the end of 2020, as anticipated and underwritten when the assets were purchased.

As noted above, this first Real Assets carbon footprint does not include scope 3 emissions, such as those generated for example, by the activities of the tenants in our real estate holdings and the airlines that use airport holdings in the portfolio. A further consideration is that, in some cases, we own both equity and debt in companies that are tenants in our buildings.

CalPERS has established a Real Estate Energy Optimization Program which is focused on energy use in our buildings holistically, including our tenants' energy use. This initiative seeks to facilitate transitioning of CalPERS' portfolio towards carbon neutrality where accretive to performance.

CalPERS Energy Optimization Program focuses on finding economically attractive opportunities that also reduce the carbon intensity of our real estate assets. This helps us mitigate the systemic risk of climate change to the real estate portfolio, and to meet our investment target rates of return. In the first three years of piloting our approach to energy optimization, our Real Estate managers identified 113 opportunities to make energy efficient capex investments into our portfolio, which will save approximately 23 million kWh of energy a year and are expected to deliver approximately \$39 million of Net Present Value (NPV). Based on the early success of the initiative, we launched a framework in July 2019 to formalize it as an internal program and more systematically roll this process out across our real estate portfolio.

In addition, we ask our Real Estate and Infrastructure external managers to report into the GRESB sustainability performance benchmarking platform. This reporting allows our team to monitor, analyze and understand our managers' practices and asset exposures around such climate relevant topics as energy and water.

Real Estate and Infrastructure managers participated in the GRESB annual survey for the third time in 2019. Managers representing 85% of the combined Real Estate and Infrastructure NAV completed GRESB submissions, up from 80% in 2018 and 75% in 2017.

Real Estate Sustainability Certifications

Sixty-seven of the Real Estate portfolio's buildings, representing approximately \$10.8 Billion of our real estate NAV, have sustainability certifications. Examples include Leadership in Energy & Environmental Design (LEED), Building Owners and Managers Association (BOMA), and Energy Star.

Given the increasing interest by corporate tenants in reducing the carbon footprint of their operations both to meet the expectations of investors such as CalPERS and of their own employees desiring to work in sustainable buildings, we see our real estate managers' efforts on sustainability as important to value preservation and value creation in our real estate holdings.

Real Assets are externally managed through separate accounts which utilize CalPERS proprietary ESG Consideration matrix when underwriting infrastructure and real estate. This means that when any new infrastructure or real estate asset joins the CalPERS portfolio through one of our separate accounts, it has been analyzed for physical and transition risks relevant to that asset. Separate accounts are the predominant investment vehicles utilized by real assets in acquiring new assets. CalPERS' strong governance in these accounts has enabled us to effectively integrate ESG considerations into decision-making.

Private Equity

CalPERS' Private Equity portfolio is largely managed through commingled funds. As such, our approach to understanding our Private Equity portfolio's climate change risks involved internal analysis based on the information we have about our portfolio company holdings and the sectors in which they are located.

To understand our Private Equity portfolio's climate risks better, we focused our analysis on the portfolio's exposures to the key TCFD industries (energy, transportation, materials and buildings, agriculture, food and forestry as described in the Risk Management section). Within those industries, we attempted to classify our exposures to both the risks and opportunities in the transition to the low-carbon economy by determining how much of the portfolio was in investments that are potential climate solutions or are fossil-fuel related. A potential climate solution was classified as any business that provides a solution to reducing emissions from climate change. A fossil fuel related company was defined as any business in an industry (including oil, gas, and coal assets of any kind) with significant emissions and could be at risk of being disrupted in the transition to the low-carbon economy.

We found that ~1% of the portfolio is in climate change solutions and ~10% is in fossil fuel related businesses. As we think about the time horizons of financial risks from climate change, we also think about the time horizons of our investments. With that in mind, it is important to note that the majority of the private equity assets included in this analysis will not be held beyond 2030 because of the terms of the funds in which they are held.

Additionally, as an initial step in preparing to do a carbon footprint for our Private Equity portfolio, we have surveyed our external managers and some asset owner peers on their approach to gathering carbon emissions data for private companies.

Combining CalPERS investments through our Private Asset Classes (both Real Assets and Private Equity), we calculated \$12.1 billion or ~18% of our Private Assets are invested in Climate Solutions, Renewable Energy and Sustainably Certified Buildings as of December 31, 2018. The vast majority of this value is invested in sustainably certified buildings.

Conclusion

Climate change poses an urgent and complex challenge for investors. In conducting climate change analysis across our portfolio, CalPERS observed the breadth and depth of risks across the total fund, and opportunities in the transition to a low-carbon economy. Climate change is a systemic risk which must be managed and mitigated through global cooperation between the public and private sectors in partnership with civil society. With our long-term investment horizon and multiple generations relying on us for pension security, CalPERS believes that the shift to a sustainable low-carbon global economy is vitally important to our ability invest our members' assets and earn our target rate of return upon which they rely for the payment of benefits.

CalPERS' portfolio tracks the potential of the global economy to produce global warming at 3.23 degrees Celsius which would produce unparalleled impact. We believe our strategy of advocacy, engagement, integration and partnerships is showing promise, and we must stay the course, maintain our focus and redouble our efforts with our partners to keep global warming to 1.5 degrees Celsius.

For an intergenerational universal owner, there is nowhere to hide. With CalPERS' funding status and target rate of return, CalPERS acknowledges that our strategy towards a low-carbon future may differ from our peers who have different investment objectives and constraints.

The climate change transition brings opportunity. New breakthrough technologies may expedite the transition to a low-carbon economy, for example to sequester carbon emissions at a scale commensurate with the challenge. Or policymakers may yet establish a clear and stable carbon-pricing regime that gets the global economy on track for a thriving low-carbon future.

Climate risk poses systemic risk with global impact for society. It is still possible that collectively our global ambition falters and we do not rein in emissions through the combined and dynamic impact of government policy, technology breakthroughs, and major shifts in consumer demand. If so, then we enter a dangerous time of climate extremes, volatility, ecosystem collapse, vast migration, and resource scarcity.

CalPERS will continue to lead on climate change. We are proud to have cofounded Climate Action 100+, to have committed to the United Nations convened Net-Zero Asset Owner Alliance which commits us to the same goal we are setting for the largest emitters in our portfolio. We will continue to innovate through research and investment practice. We will continue to build climate resilience into our portfolio and seek investment opportunities in the low-carbon economy. In all this work, our partnership with fellow investors, policymakers, the business sector and civil society will be continue to be of vital importance. Tackling the climate crisis is urgent work, and it will take all sides pulling together if we are to meet the goals of limiting global warming to 1.5 degrees Celsius.

Appendix 1: CDP Analysis of Climate Action 100 Companies' Potential Contribution to Emissions Reductions

Percent Emissions Saved from Current Year by Following a Net-zero Pathway

Companies							
#	% Emissions saved	2025	2030	2035	2040	2045	2050
1	Coal India	1.22%	2.44%	3.28%	4.12%	4.96%	5.80%
2	PJSC Gazprom	1.02%	2.03%	2.73%	3.44%	4.14%	4.84%
3	Exxon Mobil Corporation	0.74%	1.48%	1.99%	2.50%	3.01%	3.52%
4	BHP Billiton	0.73%	1.46%	1.97%	2.47%	2.98%	3.49%
5	Royal Dutch Shell	0.68%	1.35%	1.82%	2.28%	2.75%	3.22%
6	China Shenhua Energy	0.65%	1.29%	1.74%	2.19%	2.63%	3.08%
7	Vale	0.59%	1.18%	1.59%	2.00%	2.41%	2.82%
8	Rio Tinto	0.57%	1.14%	1.53%	1.92%	2.32%	2.71%
9	BP	0.55%	1.11%	1.49%	1.88%	2.26%	2.64%
10	China Petroleum & Chemical Corporation	0.52%	1.05%	1.41%	1.77%	2.14%	2.50%
11	Total	0.49%	0.97%	1.31%	1.65%	1.98%	2.32%
12	Valero Energy Corporation	0.48%	0.96%	1.28%	1.61%	1.94%	2.27%
13	Glencore plc	0.48%	0.95%	1.28%	1.61%	1.94%	2.26%
14	Chevron Corporation	0.45%	0.90%	1.21%	1.52%	1.83%	2.14%
15	PETROCHINA Company Limited	0.45%	0.90%	1.21%	1.52%	1.83%	2.14%
16	Volkswagen AG	0.44%	0.88%	1.19%	1.49%	1.80%	2.10%
17	Petróleo Brasileiro SA – Petrobras	0.44%	0.88%	1.18%	1.49%	1.79%	2.09%
18	Toyota Motor Corporation	0.42%	0.83%	1.12%	1.40%	1.69%	1.98%
19	Phillips 66	0.38%	0.75%	1.01%	1.27%	1.53%	1.80%
20	Marathon Petroleum	0.37%	0.74%	0.99%	1.25%	1.50%	1.76%
21	Lukoil OAO	0.37%	0.73%	0.98%	1.24%	1.49%	1.74%
22	Hon Hai Precision Industry	0.36%	0.71%	0.96%	1.20%	1.45%	1.69%
23	Equinor	0.34%	0.69%	0.92%	1.16%	1.40%	1.63%
24	Daikin Industries, Ltd.	0.34%	0.67%	0.91%	1.14%	1.37%	1.60%
25	Honda Motor Company	0.31%	0.63%	0.84%	1.06%	1.28%	1.49%
26	Ingersoll-Rand Co. Ltd.	0.30%	0.60%	0.81%	1.01%	1.22%	1.42%
27	Rosneft Oil Company	0.29%	0.59%	0.79%	0.99%	1.20%	1.40%
28	General Motors Company	0.27%	0.54%	0.73%	0.92%	1.10%	1.29%
29	JXTG Holdings, Inc	0.27%	0.53%	0.72%	0.90%	1.08%	1.27%
30	Boeing Company	0.26%	0.52%	0.69%	0.87%	1.05%	1.23%
31	Reliance Industries	0.25%	0.51%	0.68%	0.86%	1.04%	1.21%
32	Eni SpA	0.25%	0.51%	0.68%	0.86%	1.03%	1.21%
33	Airbus Group	0.23%	0.45%	0.61%	0.76%	0.92%	1.08%

Companies							
#	% Emissions saved	2025	2030	2035	2040	2045	2050
34	Nissan Motor Co., Ltd.	0.21%	0.42%	0.56%	0.70%	0.85%	0.99%
35	Siemens AG	0.21%	0.41%	0.55%	0.70%	0.84%	0.98%
36	General Electric Company	0.20%	0.39%	0.53%	0.66%	0.80%	0.93%
37	Repsol	0.19%	0.39%	0.52%	0.65%	0.79%	0.92%
38	ConocoPhillips	0.19%	0.38%	0.51%	0.64%	0.77%	0.90%
39	Saic Motor Corporation	0.19%	0.38%	0.50%	0.63%	0.76%	0.89%
40	Anglo American	0.18%	0.37%	0.49%	0.62%	0.74%	0.87%
41	Ford Motor Company	0.18%	0.36%	0.48%	0.60%	0.73%	0.85%
42	Oil & Natural Gas	0.17%	0.34%	0.46%	0.58%	0.69%	0.81%
43	CNOOC	0.17%	0.33%	0.45%	0.56%	0.68%	0.79%
44	PTT	0.16%	0.33%	0.44%	0.56%	0.67%	0.78%
45	Canadian Natural Resources Limited	0.16%	0.32%	0.43%	0.55%	0.66%	0.77%
46	PACCAR Inc	0.16%	0.32%	0.43%	0.54%	0.65%	0.76%
47	SK Innovation Co Ltd	0.16%	0.32%	0.43%	0.54%	0.65%	0.76%
48	ENGIE	0.14%	0.28%	0.38%	0.48%	0.58%	0.67%
49	Hitachi, Ltd.	0.14%	0.28%	0.37%	0.47%	0.56%	0.66%
50	Centrica	0.14%	0.27%	0.37%	0.46%	0.56%	0.65%
51	BASF SE	0.13%	0.26%	0.34%	0.43%	0.52%	0.61%
52	Caterpillar Inc.	0.12%	0.24%	0.33%	0.41%	0.50%	0.58%
53	Fiat Chrysler Automobiles NV	0.12%	0.24%	0.32%	0.40%	0.48%	0.56%
54	OMV AG	0.12%	0.23%	0.32%	0.40%	0.48%	0.56%
55	Ecopetrol Sa	0.10%	0.19%	0.26%	0.33%	0.40%	0.46%
56	Dow Inc.	0.09%	0.18%	0.25%	0.31%	0.38%	0.44%
57	Volvo Trucks	0.09%	0.17%	0.23%	0.29%	0.35%	0.41%
58	Nippon Steel Corporation	0.08%	0.17%	0.23%	0.29%	0.34%	0.40%
59	ArcelorMittal	0.08%	0.16%	0.22%	0.28%	0.33%	0.39%
60	Teck Resources Limited	0.08%	0.16%	0.22%	0.27%	0.33%	0.38%
61	Enel SpA	0.08%	0.16%	0.22%	0.27%	0.33%	0.38%
62	Nestlé	0.08%	0.16%	0.22%	0.27%	0.33%	0.38%
63	LyondellBasell Industries	0.08%	0.16%	0.22%	0.27%	0.33%	0.38%
64	Panasonic Corporation	0.08%	0.16%	0.21%	0.26%	0.32%	0.37%

Companies							
#	% Emissions saved	2025	2030	2035	2040	2045	2050
65	Suzuki Motor Corporation	0.08%	0.16%	0.21%	0.26%	0.32%	0.37%
66	EDF	0.07%	0.15%	0.20%	0.25%	0.30%	0.36%
67	Formosa Petrochemical	0.07%	0.14%	0.19%	0.24%	0.29%	0.34%
68	thyssenkrupp AG	0.07%	0.14%	0.19%	0.24%	0.29%	0.34%
69	Berkshire Hathaway	0.07%	0.13%	0.18%	0.22%	0.27%	0.32%
70	Korea Electric Power Corp	0.06%	0.11%	0.15%	0.19%	0.23%	0.27%
71	Vedanta Ltd	0.06%	0.11%	0.15%	0.19%	0.23%	0.27%
72	Rolls-Royce	0.06%	0.11%	0.15%	0.19%	0.23%	0.26%
73	Imperial Oil	0.05%	0.11%	0.15%	0.18%	0.22%	0.26%
74	Raytheon Technologies	0.05%	0.10%	0.14%	0.17%	0.21%	0.24%
75	Nornickel	0.05%	0.10%	0.14%	0.17%	0.21%	0.24%
76	PepsiCo, Inc.	0.04%	0.09%	0.12%	0.15%	0.17%	0.20%
77	Sasol Limited	0.04%	0.07%	0.10%	0.13%	0.15%	0.18%
78	Cummins Inc.	0.04%	0.07%	0.10%	0.13%	0.15%	0.18%
79	Koninklijke Philips NV	0.04%	0.07%	0.10%	0.12%	0.14%	0.17%
80	Naturgy	0.04%	0.07%	0.09%	0.12%	0.14%	0.17%
81	Duke Energy Corporation	0.03%	0.07%	0.09%	0.12%	0.14%	0.17%
82	Lockheed Martin Corporation	0.03%	0.06%	0.09%	0.11%	0.13%	0.15%
83	Southern Copper Corporation	0.03%	0.06%	0.09%	0.11%	0.13%	0.15%
84	E.ON SE	0.03%	0.06%	0.08%	0.10%	0.13%	0.15%
85	Procter & Gamble Company	0.03%	0.05%	0.07%	0.09%	0.11%	0.13%
86	Exelon Corporation	0.02%	0.05%	0.07%	0.08%	0.10%	0.12%
87	The Southern Company	0.02%	0.05%	0.06%	0.08%	0.10%	0.11%
88	LafargeHolcim Ltd	0.02%	0.05%	0.06%	0.08%	0.09%	0.11%
89	A.P. Moller – Maersk	0.02%	0.04%	0.06%	0.07%	0.09%	0.10%
90	American Electric Power Company, Inc.	0.02%	0.04%	0.06%	0.07%	0.08%	0.10%
91	POSCO	0.02%	0.04%	0.05%	0.07%	0.08%	0.10%
92	Bayer AG	0.02%	0.03%	0.04%	0.05%	0.06%	0.07%
93	International Paper Company	0.02%	0.03%	0.04%	0.05%	0.06%	0.07%
94	Anhui Conch Cement	0.02%	0.03%	0.04%	0.05%	0.06%	0.07%
95	Toray Industries, Inc.	0.01%	0.03%	0.04%	0.05%	0.06%	0.07%
96	Suncor Energy Inc.	0.01%	0.02%	0.03%	0.04%	0.05%	0.05%
97	Wesfarmers	0.01%	0.02%	0.03%	0.03%	0.04%	0.05%
98	Martin Marietta Materials, Inc.	0.00%	0.01%	0.01%	0.01%	0.02%	0.02%
99	NTPC Ltd	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
100	Tesoro Corporation (Andeavor+Marathon)	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

CalPERS – Climate Action 100 Net-Zero | Scenario Analysis

Eoin White & Nico Fettes, on behalf of CDP Europe, April 22, 2020

Introduction

This appendix presents an overview of the CalPERS – Climate Action 100 net-zero analysis produced by CDP Europe on behalf of CalPERS. This is accompanied with a spreadsheet that contains all underlying data and visualizations.

The Special Report on 1.5 degrees Celsius (SR15) released by the Intergovernmental Panel on Climate Change (IPCC) in 2018 confirmed that, in order to limit global warming to 1.5 degrees Celsius, we need to reach net-zero CO2 emissions at the global level by mid-century. Since then, the concept of net-zero emissions has been gaining prominence in the climate policy and climate action arena with a number of countries and non-state actors increasingly setting long-term goals to reach net-zero emissions.

Pathways that limit warming to 1.5 degrees Celsius with no or limited overshoot use carbon dioxide removal (CDR) to some extent to neutralize emissions from sources for which no mitigation measures have been identified and, in most cases, also to achieve net negative emissions to return global warming to 1.5 degrees Celsius following a peak. The longer the delay in reducing CO2 emissions towards zero, the larger the likelihood of exceeding 1.5 degrees Celsius, and the heavier the implied reliance on net negative emissions after mid-century to return warming to 1.5 degrees Celsius.

1.1 Net-zero emissions – the Science-based Targets Initiative (SBTi) working definition

Net-zero emissions are achieved when anthropogenic emissions of greenhouse gases to the atmosphere are balanced by anthropogenic removals over a specified period. Where multiple greenhouse gases are involved, the quantification of net-zero emissions depends on the climate metric chosen to compare emissions of different gases (such as global warming potential, global temperature change potential, and others, as well as the chosen time horizon).

For further analysis of net-zero pathways and the role of decarbonization vs. carbon removals, please see the SBTi's [net-zero guidance paper](#). The SBTi's [1.5 degrees Celsius pledge](#) enables companies to set net-zero commitments by setting a public goal to reach net-zero emissions by no later than 2050 in line with 1.5 degrees Celsius scenarios and interim quantitative targets, consistent with this ambition, and in line with the criteria and recommendations of the Science Based Targets initiative.

1.1 Net-zero pathways

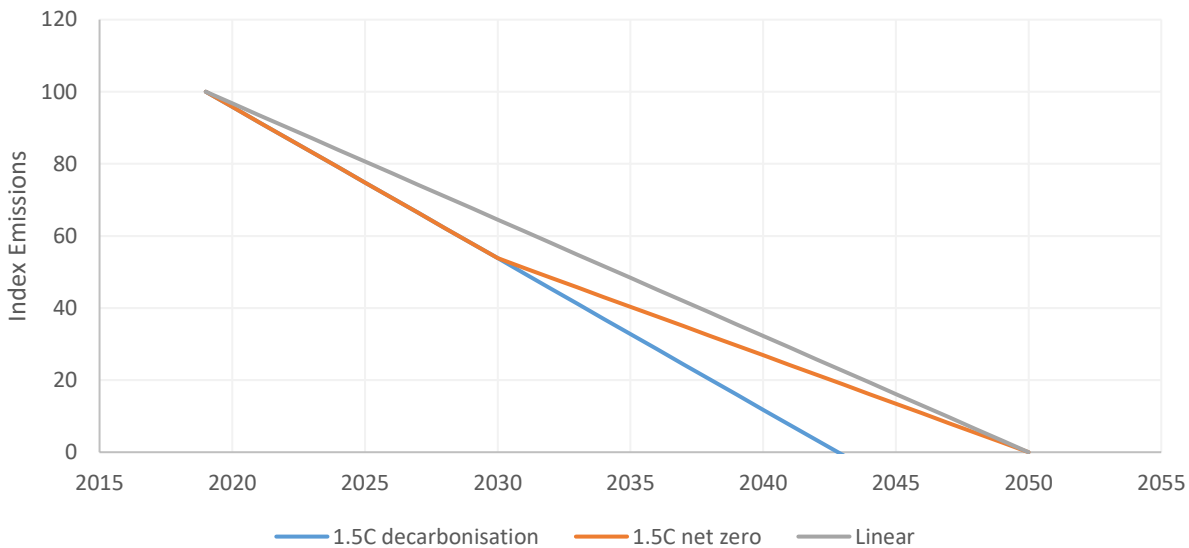
In order to define net-zero pathways for the corporate sector, three decarbonization pathways are modelled, these do not include removals, or overshoot, but should serve as an ambitious best case for achieving zero net emissions in 2050. **Error! Reference source not found.** presents 3 possible pathways to net-zero.

Pathway 1: 1.5 degrees Celsius decarbonization. This pathway assumes companies decarbonize along 1.5 degrees Celsius pathways using the SBTi’s 1.5 degrees Celsius ambition thresholds. This assumes that companies achieve 4.2% linear annual reductions from 2020 through 2050.

Pathway 2: 1.5 degrees Celsius + net-zero 2050. The second pathway applies the SBTi’s 1.5 degrees Celsius pathway of 4.2% linear annual reductions in absolute emissions over the 2020-2030 time period, and 2.7% linear annual reductions from 2030 through to 2050, meaning net-zero emissions are reached at 2050

Pathway 3: Linear net-zero 2050. This pathway follows a simple linear approach to emission reductions, meaning companies would reduce emissions by 3.2% per year in absolute terms over the 2020-2050 time period, to achieve net-zero emissions by 2050.

Three possible paths to zero emissions focusing on decarbonisation in the corporate sector



Net-zero pathways for the corporate sector

Pathway 2 serves as the representative pathway for this study and should be used by CalPERS to define the most credible net-zero pathway. This aligns with the SBTi’s net-zero pledge to ensure that companies set net-zero 2050 goals, but also have ambitious short-term emission reductions along a 1.5 degrees Celsius pathway.

Climate Action 100 GHG Inventory

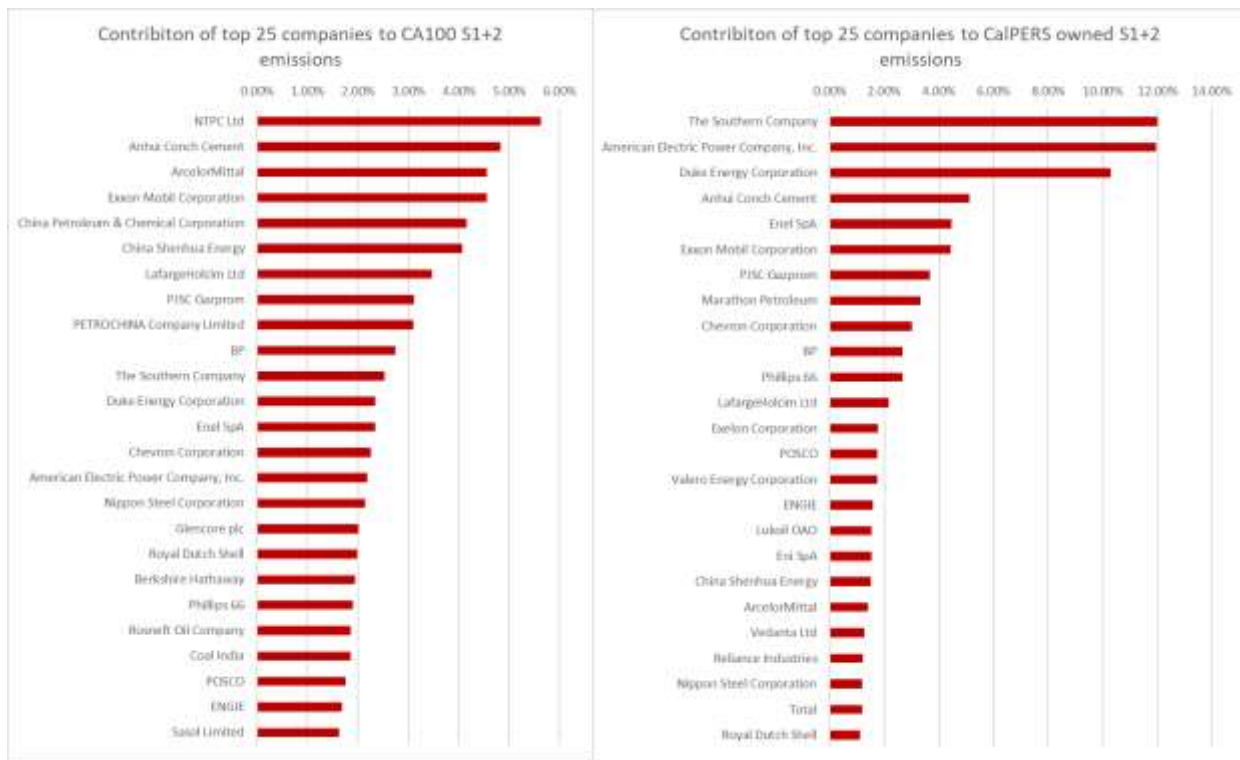
Climate Action 100+ is an investor initiative to ensure the world’s largest corporate greenhouse gas emitters take necessary action on climate change. The companies include 100 “systemically important emitters,” accounting for two-thirds of annual global industrial emissions, alongside more than 60 others with significant opportunity to drive the low-carbon.

This assessment focuses on the original Climate Action 100 list. The current scope 1 and 2 emissions of these 100 companies stands at 4.1 billion tons (Gt) of CO₂e, with a further 20.8 Gt when accounting for the scope 3 value chain emissions of these companies.

A contribution analysis reveals that just 25 of the Climate Action 100 companies are responsible for 70% of the group’s operational emissions. The total value chain emissions of the Climate Action 100 companies amount to approximately 25 Gt, representing approximately 75% of global energy annual energy related CO₂e emissions.

The CalPERS owned emissions of the Climate Action 100 companies is calculated by using an equity ownership based on invested value divided by the company’s market capitalization. Through their investments in these companies, CalPERS accounts for 0.19% of total scope 1+2 emissions, equating to 7.7 million tons CO₂e. When taking into account the full value chain, this equates to 31.7 million tons of CO₂e on an annual basis. From CalPERS’ perspective, the top 25 companies are responsible for 85% of the total owned emissions of our portfolio.

The figure below displays the contribution analysis and the key companies of concern for both the absolute Climate Action 100 companies and the corresponding owned emissions.



GHG Contribution Analysis of Climate Action 100 companies

Annual and Cumulative Emission Reductions

Using the three net-zero pathways that were introduced in Section 1, the projected reductions are calculated. Due to the issue of double counting of emissions in scope 3, estimates of emission reductions

are only generated for scope 1 and 2 emissions. Figure 1 highlights that scope 1 and 2 GHG emissions must reduce by approximately 42% by 2030, and then to zero in 2050 in for these pathways to meet. This equates to approximately 120 million tons of CO₂e that must be collectively reduced on an annual basis to meet the net-zero pathways.

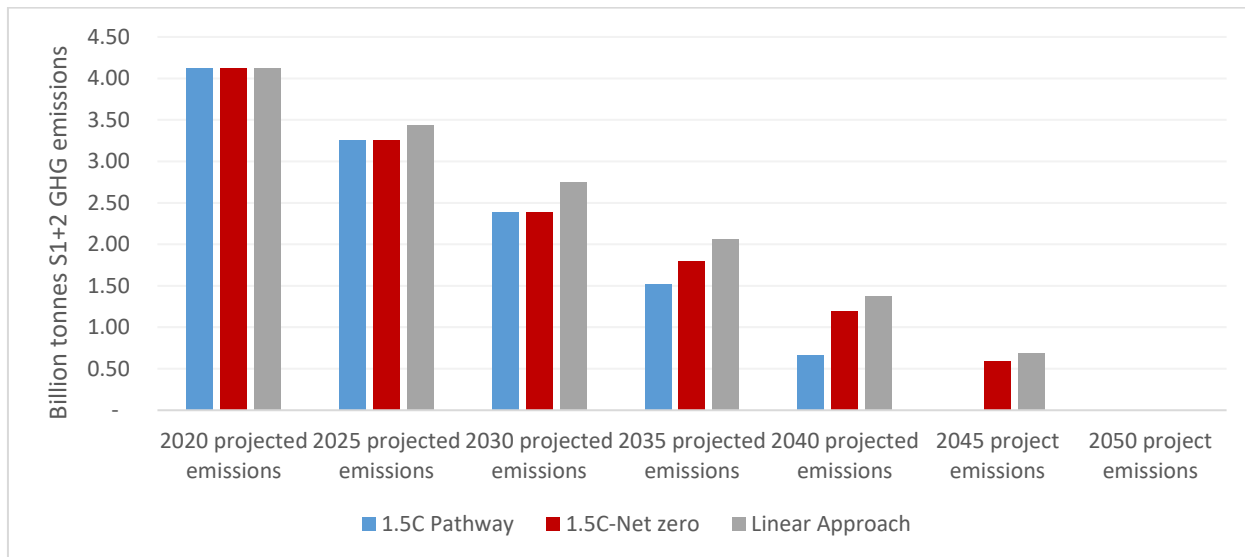
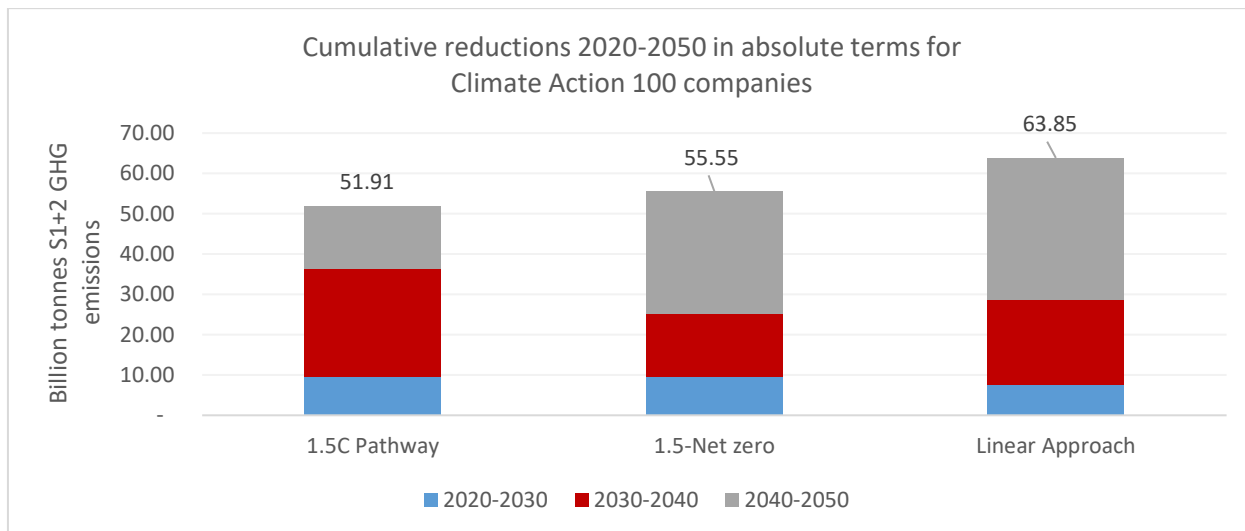


Figure 1. Projected emissions from 2020-2050 in absolute terms for Climate Action 100 companies

In cumulative terms, taking the representative 1.5 degrees Celsius net-zero scenario, this means that these 100 companies would collectively avoid 55 Gt of scope 1 and 2 GHG emissions, if all Climate Action 100 companies were to decarbonize along 1.5 degree Celsius pathways and reach net-zero emissions by 2050.



When observing simply the owned emission reductions, the annual reductions required by the CalPERS owned inventory would equate to approximately 225,000 tons of scope 1 and 2 GHG emissions. In cumulative terms, this means total avoided GHG emissions of approximately 100 million tons of CO₂e by

2050, if all Climate Action 100 companies were to decarbonize along 1.5 degrees Celsius pathways and reach net-zero emissions by 2050.

Contribution to Global GHG Emissions

The International Energy Agency [estimates](#) that, as of 2018, global annual energy related CO2 emissions are 33 Gt. This means that the current annual emissions of the Climate Action 100 companies represent 12% when considering scope 1 and 2, and 75% when including scope 3 emissions (although this will include double counted emissions). When considering the owned emissions of the CalPERS investments in the Climate Action 100 companies, the investments are responsible for 0.023% of global annual emissions when considering scope 1 and 2 emissions.

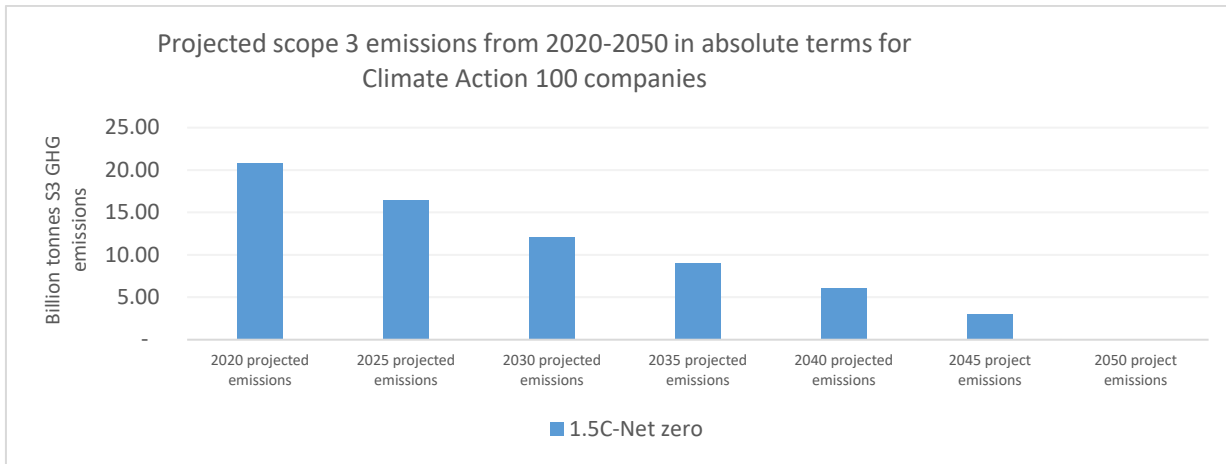
In cumulative emission terms, by the Climate Action 100 companies decarbonizing along 1.5 degrees Celsius pathways, 29% of global annual emissions would be avoided by 2030, with this rising to 168% of global annual emissions by 2050. This means that if these companies were to implement and meet net-zero goals, approximately 1.5 years of current global annual emissions would be avoided over the 2020 to 2050 time period.

Scope 3 Analysis

The original Climate Action 100 list of companies had the highest combined direct and indirect scope 1, 2 and 3 emissions (emissions associated with the use of their products) using CDP modelled and reported data. This represented up to two-thirds of annual global industrial greenhouse gas emissions.

The total emission figures in this first Climate Action 100 analysis contained double counted emissions. This is because the scope 3 emissions of primary producers (fuels, materials) also represent the scope 1 and 2 and scope 3 of other industrial companies. For example, oil and gas companies such as Shell and Exxon Mobil report significant quantities of scope 3 emissions originating from the use phase of their products (i.e. the combustion of oil and gas to generate energy). Other companies on the list like auto manufacturers such as Volkswagen AG and Toyota Motor Corporation will also report the emissions from the same sources as part of their scope 3, as the products they produce directly consume the fuels produced by oil and gas industry. Therefore scope 3 is inherently double counted across sectors.

The analysis reveals that the current GHG inventory of the Climate Action 100 companies is 20.8 billion tons GHG emissions, compared to just over 4 billion tons of direct scope 1 and 2 emissions. When following the 1.5 degrees Celsius net-zero pathway, collective scope 3 emission of these companies would have to be reduced by 0.87 billion tons each year between 2020 and 2050. This results in a cumulative saving of 280 billion tons GHG emissions by 2050. The projected annual emissions of these companies are displayed in the below chart.



This analysis is for illustrative purposes only. Due to the double accounting issue mentioned above, scope 3 emissions of companies should not be aggregated and compared to global carbon budgets. While these numbers can be indicative of the overall significance of a group of companies, it is not appropriate nor scientifically credible to link or compare these combined figures to global emissions pathways.

To better utilize the scope 3 analysis, a company by company assessment is recommended. This is conducted to identify which companies can influence the most reductions, in absolute terms, across their value chains.

CDP Conclusions

This assessment enables CalPERS to determine the current emissions of Climate Action 100 companies, and the potential emission savings that could be achieved if this group of companies were to follow 1.5 degrees Celsius pathways to reach net-zero emissions by 2050. These companies currently represent 4.1 Gt, or 12% of global annual emissions (for scope 1 and 2). **By decarbonizing along 1.5 degrees Celsius pathways these companies would collectively avoid 120 million tons of GHG emissions per year over the 2020-2050 period.** The emissions are owned by CalPERS through its investments in these companies represents 0.19% of the current scope 1 and 2 emissions. The reductions that would be accountable to CalPERS investments equate to 225,000 tons of GHG emissions per year over the 2020-2050 time period.

The scope 3 analysis is performed to better understand the influence of these companies on reducing scope 3 emissions in absolute terms, and not on a comparison to global carbon budgets. Due to the limitations imposed by the double counted emissions, aggregating scope 3 values should be used for illustrative purposes only.

Assumptions and Limitations

The following section presents the key assumptions in the CDP’s analysis as well as a number of limitations when it comes to utilizing the results.

- The three emission reduction pathways are based only on decarbonization, and do not consider the potential for removals or other forms of offsets. Therefore, all data presented above in terms of absolute reductions in emissions would be from a direct reduction in emissions by these companies. This is an ideal scenario where companies would directly reduce their emissions to zero by 2050. Companies, however, may choose to use carbon sequestration or other forms emission removals to reduce emissions, and then compensate with removals to reach net-zero. In these cases, companies will still have positive GHG emissions in 2050, but will compensate these with an equivalent amount of negative emissions (removals) e.g. carbon sequestration via reforestation.
- Of the three pathways presented, the 1.5 degrees Celsius net-zero pathway aligns with the best practice approach of the SBTi. The SBTi classifies companies as 1.5 degrees Celsius aligned if they reduce scope 1 and 2 emissions by at least 4.2% per year by 2035. After that it is expected that companies reduce emissions to reach net-zero by 2050
- Current carbon budgets are set at a global level and directly link the amount of CO₂e emitted to temperature rises. Therefore, carbon budgets are the aggregation of all anthropogenic GHGs emitted. These budgets can then be broken down into sector and company level budgets. At a company level, only scope 1 emissions from a company can be accurately assumed to not be double counted. Scope 2 emissions are the scope 1 emissions of power generation companies. Hence, when aggregating emissions, scope 1 and 2 emissions can be used to understand a company's contribution to a global carbon budget, whereas scope 3 cannot, as many companies will report the same emission sources as part of scope 3.
- Aggregated scope 3 reductions should only be used for illustrative purposes. The total Climate Action 100 emissions can be compared against each other i.e. how will one company's reduction compare to the rest of Climate Action 100, but should not be compared to global carbon budgets. The scope 3 assessment presented above should only be used to understand which companies within the Climate Action 100 sample can have the greatest impact on reducing this sample's emissions.

Appendix 2: Scenario Analysis Results

Evaluating Emissions Data

The source of data is important to its assessment. CDP is the primary source for self-reported corporate carbon emissions data. CDP also estimates data for non-disclosing companies.²⁸ **Using CDP data, CalPERS conducted a deep analysis of the scope 1, 2 and 3 emissions for our Global Equity portfolio.**

Three high level insights from this analysis:

1. **To run a portfolio footprint, more than 50% of the data used in portfolio-level carbon footprinting must be estimated because most companies still do not report emissions data.** Scope 1 and 2 emissions are reported more consistently than scope 3 emissions.

Source of Emissions Data reported to CDP

	Scope 1	Scope 2	Scope 3
Self-Reported	44%	46%	33%

2. **For most industries, scope 3 emissions are the most significant in terms of the total amount, relative to scope 1 and 2.** Comparing self-reported emissions and estimated emissions, we also note that CDP's model currently estimates a higher percentage of total emissions counted as scope 3.

Relative importance of emissions by Scope

	Scope 1	Scope 2	Scope 3
Self-Reported	24%	5%	71%
Estimated	19%	4%	77%

3. **There are still significant gaps in the breadth and depth of companies that report all three scopes of emissions.**

By portfolio value: 91% of the portfolio is covered. The coverage is greater because the companies that do report (or are estimated) have larger market capitalizations. By number of companies: Emissions for most companies are estimated because most companies do not report. Compared to our portfolio of 10,000+ companies, CDP has reported + estimated emissions for 4,460.

²⁸ We have found that most research firms marketing carbon data begin with CDP data, and then modify it and run their own model for estimating data for firms that do not disclose.

CalPERS Global Equity Portfolio Coverage by CDP

Companies	Self-Reported	All
Scope 1	2,160	4,460
Scope 2	1,964	
Scope 3	718	

% Value	Self-Reported	All
Scope 1	67%	91%
Scope 2	64%	
Scope 3	30%	

Number of Companies in Portfolio: 10,077

Point in Time Metrics

This section focuses on point in time carbon metrics, specifically carbon footprint, carbon intensity, and weighted average carbon intensity (WACI). These metrics provide a backwards looking snapshot of emissions. They help us understand the source of current GHG emissions in the portfolio and insights into the industries and firms most exposed to policy measures such as a price on carbon. When compared to past emissions, we can also analyze trends in GHG emissions that inform the probability of experiencing different levels of physical risk.

Carbon Footprint

At the simplest level, the carbon footprint of CalPERS’ portfolio enables us to identify our ownership of carbon emissions. We see this as the first step to understanding how climate change impacts the portfolio’s risk-adjusted returns and informing forward-looking strategies and decision making.

Using an attribution approach, CalPERS reports total metric tons owned of carbon dioxide and equivalent emissions of its global equity and real asset portfolios. Identifying scopes 1 and 2 for individual companies is relatively clear-cut, when the data are available. However, we had to consider double-counting at the portfolio level as scope 3 emissions for one company may also be the scope 1 or 2 emissions of other companies.

If worldwide disclosure was mandated as CalPERS asserts, identifying and separating the scopes would provide a clearer picture of the carbon footprint. Today, data reporting and collation are improving, but estimations and modelling are still necessary to identify the share of each scope of emissions across firms.

CalPERS’ Global Equity Portfolio

CalPERS worked with MSCI and Institutional Shareholder Services Inc. (ISS) to assess the scope 1, 2 and 3 emissions of our global equity portfolio. Scope 1 and scope 2 emissions are broadly similar from both sources, likely as they are based on underlying CDP data. Each applies their own model to estimate missing data. The primary difference between these two lines of sight into the emissions associated with our global equity portfolio is the estimation of scope 3. CalPERS acknowledges the difficulties in the effort to calculate what is inherently challenging.

CalPERS' Global Equity Carbon Footprint

Global Equity Portfolio	MSCI²⁹	ISS
Scope 1	21,132,839	19,090,785
Scope 2	4,026,698	4,230,025
Scope 3	108,934,403	62,975,679
Net GHG Emissions	134,093,940	86,296,488

Emissions are in metric tons of CO2e

Portfolio as of 6/30/2019

The global equity portfolio carbon footprint originally conducted in 2015 has provided the basis for focused engagement through Climate Action 100+. When repeated at intervals, a carbon footprint could also allow for an assessment of emissions over time. Climate Action 100+ is engaged in this work through development of a benchmark for progress. However, this is not straightforward as adjustments are needed over time to address the portfolio benchmark shifts; the changing market capitalization of firms and ownership transactions; and the impact of international assets due to exchange rate moves versus the U.S. dollar, to name just a few.

Top Industry Contributors to Global Equity Carbon Footprint

Industry Activity Group	% of Total e1+e2
Power generation	33.70%
Thermal power generation	31.10%
Renewable power generation	2.10%
Materials	19.90%
Metal smelting, refining & forming	10.30%
Cement & concrete	8.40%
Fossil Fuels	19.70%
Oil & gas processing	8.60%
Coal mining	3.50%
Oil & gas extraction & production	3.50%
Oil & gas retailing	3.40%
Manufacturing	7.70%
Chemicals	4.20%
Electrical & electronic equipment	1.20%

# of Industries	% of total
1	34%
2	54%
3	73%
4	81%
5	87%
6	92%

²⁹ Certain information ©2020 MSCI ESG Research LLC. Reproduced by permission

Industry Activity Group	% of Total e1+e2
Transportation Services	5.70%
Air transport	3.50%
Marine transport	1.30%
Infrastructure	5.10%
Energy utility networks	3.20%
Construction	0.80%
Non-energy utilities	0.60%
Services	4.50%
Financial services	1.80%
Food, beverage & agriculture	1.20%
Retail	1.10%
Mineral extraction	0.90%
Hospitality	0.30%
Biotech, health care & pharma	0.30%

Asset-Class Specific Metrics

Public Markets

The carbon footprint is a useful metric to understand the total amount of emissions CalPERS owns. Carbon intensity allows comparison of how efficient firms within a sector or portfolio are most useful when reporting a comparable figure over time.

- Carbon Intensity is calculated as the total metric tons of CO₂e emissions owned as a share of a company's sales revenue, in millions of dollars.
- WACI assesses the overall carbon intensity by attributing this across portfolio weights.

The WACI still remains sensitive to changes in the portfolio size and to companies with a relatively higher market capitalization. The Carbon Intensity and WACI of CalPERS' Global Equity and Global Fixed Income portfolios as calculated by MSCI and ISS are presented in the figure below.

Carbon Intensity of CalPERS' Public Asset Classes

Global Equity Portfolio	MSCI³⁰	ISS
Carbon Intensity	225	223
Weighted Average Carbon Intensity	230	268

Portfolio as of 6/30/2019

Global Fixed Income Portfolio	MSCI³¹	ISS
Carbon Intensity	177	286
Weighted Average Carbon Intensity	378	325

Portfolio as of 6/30/2019

CalPERS' Real Assets Portfolio

In 2019, the CalPERS conducted a carbon footprint of the real assets portfolio.

This inaugural reporting on GHG emissions data covers more than \$39 billion or 93% of this portfolio's net asset value NAV as of December 31, 2018. This required a significant amount of work by the fund's real assets Team to standardize reporting for all our assets through our Sustainable Investment Practice Guidelines, real assets' strategic plan and our partnership with the GRESB for real estate and infrastructure.

Results are summarized in the table below. As this was the first year that we conducted this footprint, we focused on scope 1 and 2 emissions. Emissions in this asset class arise largely arise from constructing the real estate or infrastructure and on-going energy consumption to keep them running. As we invest in built assets, as opposed to greenfield development, we have the most visibility into scope 1 and 2 emissions.

CalPERS' Real Assets Carbon Footprint

Real Assets Portfolio	RA Managers
Scope 1	6,969,060
Scope 2	618,238
GHG Offsets	(2,119,777)
Net GHG Emissions	5,467,521

Emissions are in metric tons of CO₂e

Portfolio as of 6/30/2019

³⁰ Certain information ©2020 MSCI ESG Research LLC. Reproduced by permission.

³¹ Certain information ©2020 MSCI ESG Research LLC. Reproduced by permission.

Infrastructure accounts for the majority of the real assets portfolio emissions, associated with 12% of the portfolio by NAV. Infrastructure emissions are primarily driven by power and energy assets, which make up 48% of the Infrastructure portfolio's \$4.8 billion NAV. Renewable energy and carbon-neutral transmission assets comprise 50% of the power and energy Infrastructure NAV.

While measuring the carbon footprint for this portfolio is an important milestone for CalPERS, we acknowledge its limitations. The Real Assets carbon footprint was conducted at the partnership level without asset-specific information. We recognize the need to build capacity to conduct this type of analysis and will work with our partners to strengthen this process.

Scenario Analysis

CalPERS has made a net-zero by 2050 commitment. To measure our position relative to this goal will require a tool that contemplates the 1.5 degrees Celsius limit to global warming. The tools currently available to rely on frameworks adapted for temperature rise scenarios which are significantly higher - 2 degrees Celsius, 4 degrees Celsius or 6 degrees Celsius - and only evaluate public assets. The current frameworks and their outputs are described below. As this is a new field of inquiry, we examined different models and data sources, focusing on our Global Equity portfolio. Scenario analysis is a complex process, so we will first explain certain building blocks and then share our results.

Global Carbon Budget

The global carbon budget is an estimate of the total amount of emissions the world can emit while still having a likely chance of limiting global temperature rise to 1.5 degrees Celsius above pre-industrial levels. The Intergovernmental Panel on Climate Change Special Report: Global Warming of 1.5 degree Celsius, published in 2018 suggests "a remaining budget of about 420 Gt CO₂ for a two-thirds chance of limiting warming to 1.5 degrees Celsius, and of about 580 Gt CO₂ for an even chance."

Portfolio Carbon Budget

A portfolio carbon budget attempts to distill the global carbon budget into annual increments and to the companies in a listed equity portfolio. To do this, research firms leverage the internationally recognized data provided by the International Energy Agency to forecast emissions and one or both of two approaches to breakdown total emission by sector.

Results

CalPERS worked with Institutional Shareholder Services (ISS) and S&P Global (S&P) to assess how much of the global carbon budget for a 2 degrees Celsius temperature rise is consumed by the companies in our global equity portfolio.

Percent Carbon Budgets Utilized by CalPERS' Global Equity Portfolio

Global Equity Portfolio	ISS	S&P
2 degrees Celsius Budget used by 2020	70%	
2 degrees Celsius Budget used by 2023		107%
2 degrees Celsius Budget used by 2030	97%	

The data providers differ in their assessment of the portfolio's utilization of the carbon budget. We identified three reasons for this: timeline (ISS looks at the carbon budget over a longer term than S&P), company coverage (S&P applies a backwards and forward-looking analysis that relies on the consistency of data, which covers a smaller universe of companies than ISS), and use of frameworks (ISS relies exclusively on the SDA whereas S&P utilizes both the SDA and GEVA depending on the business activities of the company). Noting the variability in the results across providers and the nascent stage of this type of analysis, we look forward to improvements in such tools and working with peer investors to refine such analysis through the Net Zero Asset Owner Alliance.

Glossary

Limiting warming to 1.5 degrees Celsius: achieving net-zero CO₂-e emissions by 2050. This will require decreasing energy demand, decarbonizing electrical systems, electrification of end use energy, reducing agricultural emissions, and multiple forms of carbon storage

2 degrees Celsius scenario: the global community's accepted limitation of temperature growth to avoid significant and potentially catastrophic changes to the planet. Nearly 200 companies signed a pledge aiming to keep warming at or below 2 degrees Celsius

Carbon capture technologies: Carbon capture and storage is the process of capturing waste carbon dioxide usually from large point sources, such as a cement factory or biomass power plant, transporting it to a storage site, and depositing it where it will not enter the atmosphere, normally an underground geological formation

Carbon footprint: the amount of carbon dioxide and other carbon compounds emitted due to the consumption of fossil fuels by a particular person, group, etc.

Carbon intensity: the total reported or estimated metric tons of CO₂-e emissions divided by the company's sales revenue, in millions of dollars. This metrics allows for comparison between companies

Carbon risk premium: adjustment to the expected risk profile of an investment based on its vulnerability or resilience to political, technology and regulatory risks associated with the climate transition

CFTC: Commodity Futures Trading Commission

Climate Action 100+: the world's largest shareowner engagement project with signatories with assets under management totaling \$40 trillion

Climate Value at Risk (CVaR): modeling process developed by CarbonDelta (an MSCI company) that provides a quantitative, forward-looking analysis regarding risks and opportunities for investments related to climate change

Conference of Parties (COP) 25: The 25th UN Climate Change Conference, which took place from Dec. 2-13, 2019

Deforestation: the permanent removal of trees to make room for something besides forest. This can include clearing the land for agriculture or grazing, or using the timber for fuel, construction or manufacturing

GHG per Unit of Value Added (GEVA) approach: an intensity measure of GHG emissions per unit of value added by the company

Global carbon budget: the estimated amount of carbon dioxide the world can emit while still having a likely chance of limiting global temperature rise to 1.5 degrees Celsius above pre-industrial levels

Greenhouse Gas Emission Scopes Levels:

- Scope 1 emissions: are direct emissions from owned or controlled sources
- Scope 2 emissions: are indirect emissions from the generation of purchased energy
- Scope 3 emissions: are all indirect emissions (not included in scope 2) that occur in the value chain of the reporting company, including both upstream and downstream emissions

Green Swan: Climate change has been referred to as “Green Swan” for its potential to systemically impact the global economy as we know it and for the uncertainty surrounding its wake.

GRESB: Global Real Estate Sustainability Benchmark

Intergovernmental Panel on Climate Change (IPCC): The United Nations body for assessing the science related to climate change

Investable universe: also known as 'market portfolio' and includes all tradeable assets

Litigation risks: include but are not limited to third-party and class action claims against public companies as well as direct action(s) by shareowners against companies relating to damages directly or indirectly stemming from climate change

Montreal Pledge: launched in Montreal in 2014, it is a commitment by more than 120 investors to measure and publicly disclose the carbon footprint of their investment portfolios on an annual basis

Net asset value (NAV): the value of an entity's assets minus the value of its liabilities

Net-zero carbon emissions: the removal from the atmosphere of all man-made greenhouse gas emissions through reduction measures, thus reducing the Earth's net climate balance to zero

Paris Agreement: signed in December 2015, it is an agreement within the United Nations Framework Convention on Climate Change, dealing with greenhouse-gas-emissions mitigation, adaptation and finance

Physical risks: risks such as wildfires, extreme weather, sea-level rise, and drought that can affect fixed assets, like real estate, and disrupt portfolio companies' supply chains and operations

Reforestation: the process of restocking of existing forests and woodlands that have been depleted, usually through deforestation

Representative Concentration Pathways (RCPs): four independent pathways (RCP 2.6, RCP 4.5, RCP 6, and RCP 8.5) developed by four individual modeling groups that are meant to be inputs for climate models developed by the IPCC

SASB: Sustainability Accounting Standards Board

SB964: Bill signed in 2018 that requires the boards of CalPERS and CalSTRS to publicly report on the analysis of the material climate-related financial risks of their public market portfolios by January 1, 2020, and every three years thereafter

SEC: Securities and Exchange Commission

Sector: for the purposes of this report, sectors refers to the Global Industry Classification Standard (GICS), which are Materials, Consumer Staples, Utilities, Industrials, Energy, Consumer Discretionary, Real Estate, Health Care, Financials, Telecommunications and Technology

Sectoral Decarbonization Approach (SDA): a science-based model to help companies understand both how their current emissions are contributing to temperature rise and how much they need to decrease their emissions to align with a 2 degrees Celsius, 4 degrees Celsius, or 6 degrees Celsius temperature rise scenario

Task Force on Climate-Related Financial Disclosures (TCFD): seeks to develop recommendations for voluntary climate-related financial disclosures that are consistent, comparable, reliable, clear, and efficient, and provide decision-useful information to lenders, insurers, and investors

Transition risks: shifts in the market, policies, and technologies (due to movement toward a lower carbon economy) that can affect the financial success of existing business models and industries

Value chain: the full range of activities performed to create a product or service and deliver it to market

Weighted Average Carbon Intensity (WACI): This metric has two steps for calculation. First the total reported or estimated metric tons of CO₂e emissions for the company is divided by the company's sales revenue, in millions of dollars (carbon intensity). This output is then multiplied by the company's weight in the portfolio. This metric assesses the Fund's overall carbon intensity by attributing this intensity across portfolio weights

CalPERS' Investment Strategy on Climate Change

First Report in Response to the Taskforce on Climate-Related Financial Disclosure

June 2020

