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New York City Retirement Systems (Systems)

Board of Education Retirement System of the City of New York (BERS)
New York City Employees' Retirement System (NYCERS)
Teachers' Retirement System of the City of New York (TRS)

DRAFT: October 30, 2020

Investment and Fiduciary Analysis of Prudent Strategies for Divestment of Securities Issued by Fossil Fuel Reserve Owners

Phase 2: Analysis of Fossil Fuel Reserve Owners

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I. Executive Summary

Global markets have begun to undergo enormous change as the transition to renewable energy accelerates and physical climate risks escalate. More and more governments, corporations, and investors are actively increasing their support for an energy transition and seeking ways to mitigate physical climate risks. The climate policies of governments and of corporations are shifting to sharply curtail the use of fossil fuels and low carbon alternatives are becoming competitive. The risks facing fossil fuel reserve owners are increasingly evident in the long-term decline of the traditional energy sector's market share and in the relatively poor financial health of over half the universe of fossil fuel owners. Escalating climate risks, including the risks of investment in fossil fuel reserve owners, are materially affecting investor returns and risk.

The analysis in this report aims to gauge the risk investments in fossil fuel reserve owners pose to the long-term outlook for the Systems portfolios. We first present Meketa's estimate of the Systems' exposure to fossil fuel reserve owners. We then review portfolio and company level climate and financial risks regarding fossil fuel reserve owners in the Systems portfolios. The company analysis draws on a variety of data sources and metrics to assess each company's potential to successfully transition to a low carbon economy.

Data availability is an essential element of investment analysis. In general, we found sufficient, but far from complete, quality climate data, with more data available for larger companies than for smaller companies. We expect that over time: the quality of climate data on companies will continue to improve; the coverage of companies will continue to expand; and climate metrics will be refined and newly developed that potentially enhance our ability to analyze the climate risks investors face.

As of June 30, 2020, the Systems were invested in [redacted] publicly listed fossil fuel owners, representing $[redacted], or [redacted]% of the Systems total market value, or [redacted]% of the Systems Public Equity and Fixed Income asset classes. Equity investments in fossil fuel owners accounted for $[redacted], and $[redacted] was invested in Fixed Income securities. We find that all [redacted] fossil fuel reserve owners contribute to the Systems exposure to emissions intensity by 10% - 20%.

We utilized both 1.5° C. and 3° C. future climate scenarios to assess the potential performance and risk impact on the Systems actual portfolios, including all fossil fuel reserve owners. Whether limiting global temperature rise to 1.5° C. or 3° C., expected return is lower than expected returns absent climate change assumptions. The decline in expected return is greater in the 3° C. temperature rise scenario, roughly double the decline associated with restricting temperature rise to 1.5° C.

This analysis concludes with a company risk analysis that provides a more granular assessment of the [redacted] companies being considered for potential prudent divestment. For this analysis, we looked at 11 metrics, representing four risk categories: (1) Fossil Fuel Reserve Exposure, including Potential Stranded CapEx and Power and Utility Coal and Gas Relative Paris Alignment; (2) Transition Management Risk, including Transition Management Initiative ("TPI") Management Quality Scores, Green Revenue Shares, Emissions Intensity and Percentage Change in Emissions Intensity; (3) Financial Health, including Altman Z-Score and Economic Value Added/Sales ("EVA/Sales"); and (4) Physical Climate Risk Scores.

Broadly, the company analysis indicates that companies have varying degrees of exposure to potential stranded assets and to transition risk. Some companies exhibited the potential stranded asset, transition management qualities, and financial health likely to underpin a successful transition to a low carbon economy. However, the majority of the companies exhibited high potential risk for economic disruption from a low carbon transition. In all, the analysis suggests that there are prudent divestment options that may help insulate the Systems from the increasing risks facing reserve owners while protecting return. The next and final report will analyze how tailored divestment options could affect portfolio performance.

II. Global Trends and Implications for Fossil Fuel Owners

The accelerating transition to renewable energy and escalation of physical climate risks is spurring significant change in global markets. An increasing number of organizations are strengthening their support for an energy transition and looking for ways to mitigate physical climate risks, as evidenced by renewable energy investment, corporations trying to reduce their carbon footprints, and state-run entities releasing climate pledges, policies, and legislation.

Climate Change Global Outlook

Climate change can be broadly defined as the variation in average weather conditions or patterns stretched out over an extended period of time–ranging from a few decades to millions of years. In today's context, our primary concern is the increasing temperature of our atmosphere brought on by gases that trap heat, known as greenhouse gases ("GHG"). The current consensus within the scientific community is that human activity drives a significant portion of GHG emissions and is the primary cause of climate change.

Based on 2018 data, the US Environmental Protection Agency estimates that carbon dioxide ("CO_2") accounts for 81.0% of all GHG emissions and primarily makes its way into the atmosphere by burning fossil fuels or certain chemical reactions.[1] One result of these emissions is global warming. Since 1880, the ten warmest years measured have all occurred after 2005. As of the end of 2019, the past six years have been the warmest on record.[2]

Global warming is not an isolated risk factor that affects a subset of people or companies. It has and will continue to change how economies and industries operate. Rising temperatures already impact many lives. The time seems to be rapidly approaching when the damage becomes so severe that future generations may not have the opportunity to course correct.

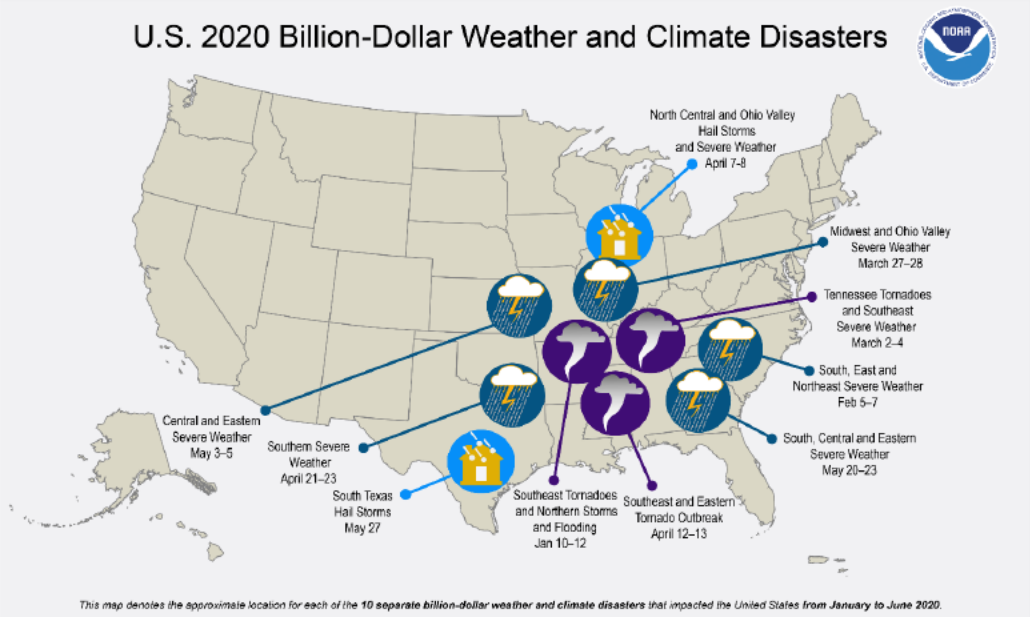
Beyond the increase in global temperatures, climate change has also been linked to extreme weather trends through attribution studies. Carbon Brief analyzed several hundred of these studies and found that in a majority of cases, human-related climate change either increased the likelihood of or exacerbated the effects of extreme weather events.[3]

Climate trends such as more extreme heatwaves, droughts, hurricanes, flooding, and other events associated with high temperatures are expected to increase in severity as global temperatures rise. The brushfires in Australia at the beginning of the year may become commonplace should steps not be taken to reduce our carbon footprint. From June 2019 through May 2020, wildfires burned approximately 72,000 square miles across Australia (roughly the size of New York, Vermont, and New Hampshire, combined), killed at least 34 people, and caused approximately $110.0 billion in total damage and economic loss.[4]

[1] Source https://www.epa.gov/ghgemissions/overview-greenhouse-gases
[2] Source https://climate.nasa.gov/scientific-consensus/
[3] Source https://www.carbonbrief.org/mapped-how-climate-change-affects-extreme-weather-around-the-world
[4] Source https://www.accuweather.com/en/business/australia-wildfire-economic-damages-and-losses-to-reach-110-billion/657235

In the US, there has been a marked uptick: ten such events occurred this year through July 8th versus an annual average of 6.6 from 1980–2019.[1]

Figure II.1 – US 2020 Billion-Dollar Weather and Climate Disasters[2]



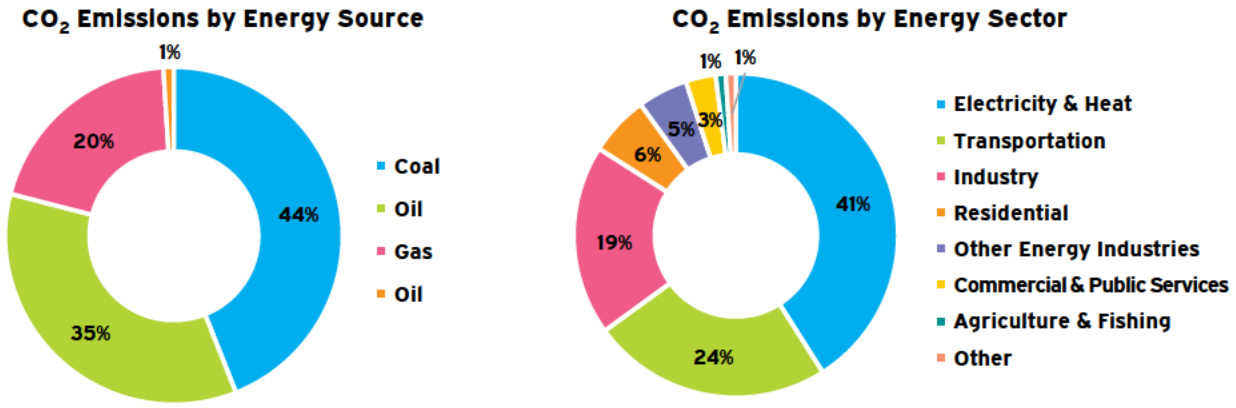
As of September 15, 2020, the wildfires in California, Oregon, and Washington had burned more than 7,800 sq. miles and killed at least 27 people. An initial estimate of the direct damages related to the wildfires in the Western US are in excess of $20.0 billion (excludes many costs including healthcare-related expenses, loss in property value, disruptions to business, and loss in tax revenue).[3,4]

The 100-year "global warming potential" of CO_2 and methane account for 74.4% and 17.3% of annual GHG emissions, respectively. The primary global emitter of methane is the agriculture sector at ~40.0%, coming mostly from livestock, followed by fugitive emissions (i.e. gas leaks) with ~30.0%. Although methane has much stronger warming potential than CO_2, it remains in the atmosphere for less time– about 12 years. Addressing methane emissions may be an efficient way to help mitigate the nearer-term, negative effects of global warming.[5,6]

The primary causes of CO_2 emissions by fuel source are coal and oil which account for 44.0% and 35.0% of global CO_2 emissions, respectively. They have the highest carbon intensity per unit of heat or electricity generated.[7] By industry, ~84.0% of CO_2 emissions are attributable to three sectors: electricity and heat (41.0%), transportation (24.0%), and industry (19.0%).

[1] Source https://www.ncdc.noaa.gov/billions/overview
[2] Source https://www.ncdc.noaa.gov/billions/overview
[3] Source https://www.nytimes.com/2020/09/16/us/california-fires-cost.html
[4] Source for $20.0 billion direct damages https://topclassactions.com/lawsuit-settlements/disaster-help/wildfire/experts-estimate-direct-cost-of-wildfires-to-exceed-20-billion-in-2020/
[5] Source https://ourworldindata.org/greenhouse-gas-emissions#by-gas-how-much-does-each-contribute-to-total-greenhouse-gas-emissions
[6] Source https://ourworldindata.org/emissions-by-sector#methane-ch4-emissions-by-sector
[7] Source https://ecofininvest.com/resources/insights/commentary/climate-action-the-ripple-became-a-swell-and-real-progress-is-underway/

Figure II.2 – CO_2 Emissions by Energy Source and Sector[1]



The changes in climate already underway are systemic and affect all economic sectors. Reducing both the supply and demand for fossil fuels is essential to creating a low carbon economy. Fossil fuel reserve owners and the traditional energy sector increasingly face headwinds in the form of government and corporate climate policies, and global demand shifting to renewable sources of energy.

Energy Sector Outlook

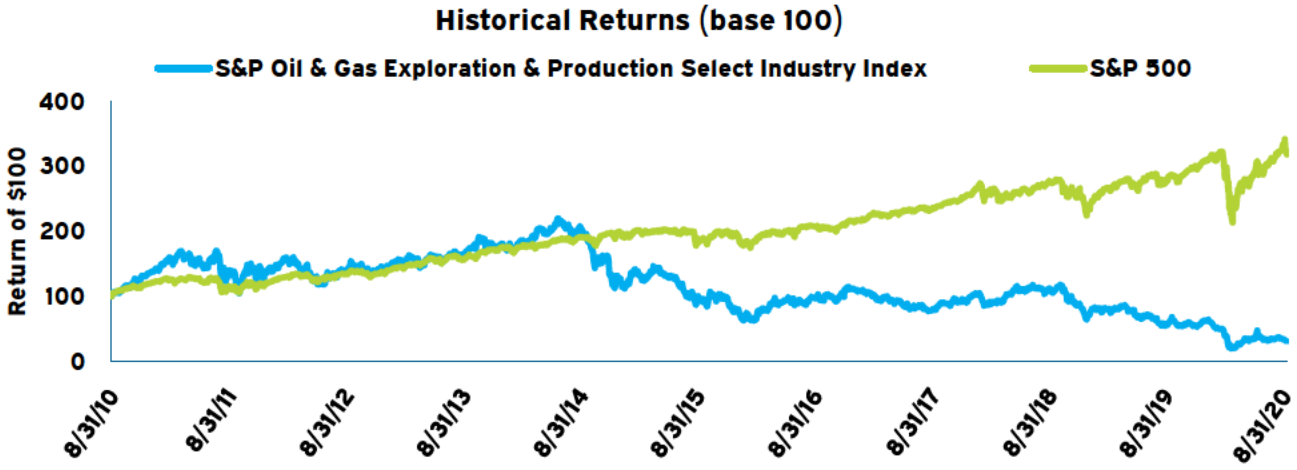
Companies in the energy sector face intense and growing scrutiny. Governments around the globe, from Europe, to China, to 23 individual states in the United States are adopting more aggressive policies to support economic transitions consistent with the Paris Accord, which targets net zero carbon emissions by 2050, with the aim of limiting global warming to 1.5° C. Investor concerns are escalating over the need for climate-related disclosures and updated corporate business models that can accommodate a low carbon future. Many energy sector companies have been slow to adopt greener business practices and products. In response, global investor confidence has slowly deteriorated as evidenced by the performance of fossil fuel related indices.

The performance of fossil fuel owners generally correlates closely with the prices of commodities such as oil and natural gas. Over past 10 years ending September 30, 2020, the price of crude oil fell from $81.60 per barrel to $38.70. During the same period, natural gas prices have fallen from about $4.00 to $2.50 (outside of a 2018 spike for natural gas), having reached a 25-year low in June 2020.

Long-term underperformance in energy-related stocks is evident in the performance of sector-specific indices. Specifically, the S&P Oil and Gas (O&G) Exploration & Production Select Industry Index and S&P 500 Energy Index both began significantly lagging the S&P 500 around 2014.[2,3] (See Figures II.3-II.4.)

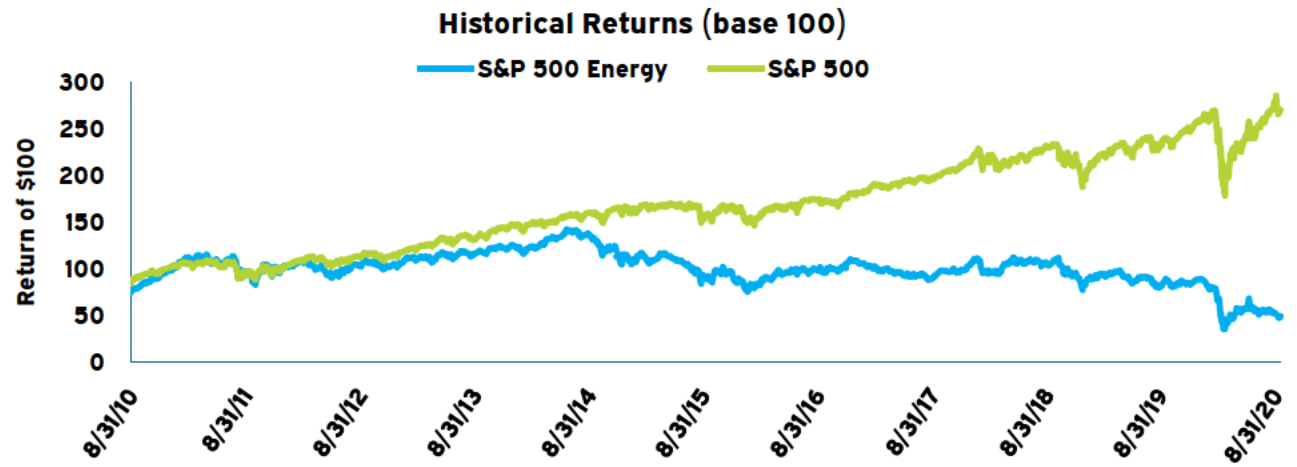
[1] Source IEA, 2017.
[2] Source https://www.spglobal.com/spdji/en/indices/equity/sp-oil-gas-exploration-production-select-industry-index/#overview
[3] Source https://fossilfreeindexes.com/energy-transition-strategies/

Figure II.3 – S&P O&G Exploration & Production Index Performance vs. S&P 500[1]



As of September 30, 2020, the S&P 500 Energy Sector was the only sector with negative annualized returns over the previous 10-year period, generating (5.9%) returns compared to S&P 500 returns of 11.4%. A primary cause for energy sector-related index returns trailing the S&P 500 is that the latter benefitted from the inclusion of information technology companies. Over the last ten years, the IT industry had an annualized return of 18.6%. Just by excluding the IT industry, the S&P 500 sacrifices 1.8% of its annual returns.[2,3]

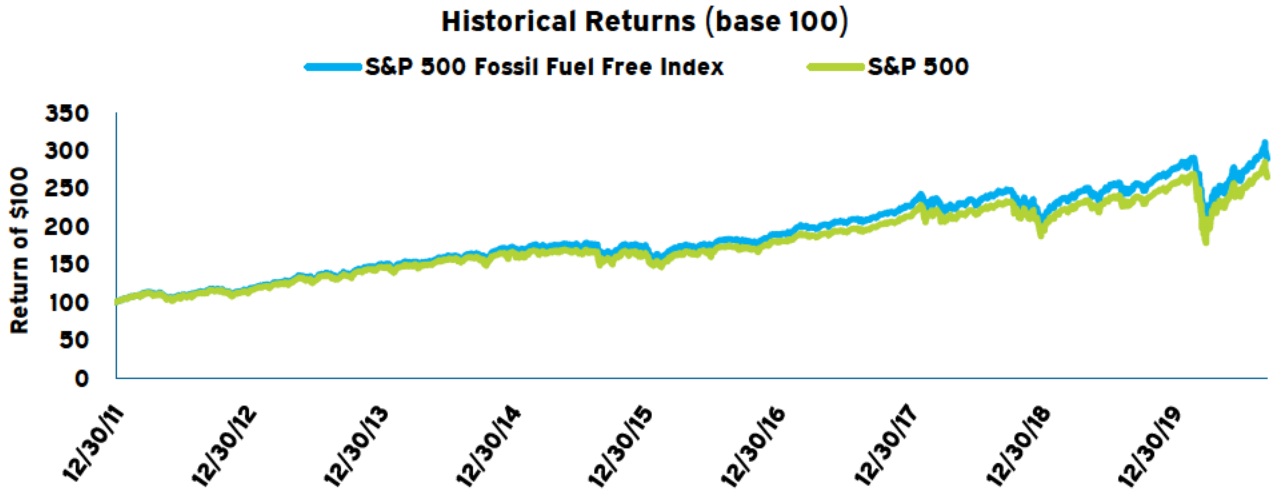
Figure II.4 – S&P 500 Energy Index Performance vs. S&P 500[4]



[1] Source https://www.spglobal.com/spdji/en/indices/equity/sp-oil-gas-exploration-production-select-industry-index/#overview
[2] Source https://www.spglobal.com/spdji/en/indices/equity/sp-500-information-technology-sector/#overview
[3] Source https://www.spglobal.com/spdji/en/indices/equity/sp-500-ex-information-technology/#overview
[4] Source https://www.spglobal.com/spdji/en/indices/equity/sp-oil-gas-exploration-production-select-industry-index/#overview

The underperformance of energy sector indices are also reflected in index strategies that exclude fossil fuel companies. For example, the S&P 500 Fossil Fuel Free ("FFF") Index performed more in-line with the S&P 500.[1] (See Figure II.5.) The S&P FFF index is "designed to measure the performance of companies in the S&P 500 that do not own fossil fuel reserves. Fossil fuel reserves are defined as economically and technically recoverable sources of crude oil, natural gas and thermal coal." The FFF index performed in line with, and even slightly better than, the S&P 500 because it holds 488 of the 500 companies, with the 12 exclusions being from the Energy sector.

Figure II.5 – S&P 500 FFF Index Performance vs. S&P 500[2]



Energy sector index returns are mirrored in the broad reduction of the energy sector market capitalization share in major indices. The energy sector made up 10.9% of the S&P 500 ten years ago, 6.8% five years ago, and now accounts for just 2.5% of the index.[3] The declining market share of fossil fuel companies in indexes incorporates both the decline in market capitalization of fossil fuel companies in the index and a reduction in the number of fossil fuel companies included in the index.

The reduction in the number of fossil fuel companies in broad indexes can reflect mergers, companies going out of business or going private, and the removal of some energy sector companies. For example, the S&P Dow Jones Industrial Average announced on August 25th, 2020 that it would be removing its longest tenured constituent, Exxon Mobil, due to its poor performance and negative investor sentiment. Exxon was the most valuable publicly-traded company in the world as recently as 2013. As traditional energy companies decline in market value, renewable energy companies are gaining market share. On October 2, 2020, the solar and wind company, NextEra Energy, the largest renewable energy company in the U.S, briefly surpassed Exxon in market capitalization. That made NextEra the most valuable company among all US energy and utility stocks. Since 2011, the US alone has retired 60.0% of all US-based, coal-fired power plants.[4]

[1] Source https://www.spglobal.com/spdji/en/indices/equity/sp-500-fossil-fuel-free-index/#overview
[2] Source https://www.spglobal.com/spdji/en/indices/equity/sp-oil-gas-exploration-production-select-industry-index/#overview
[3] Source https://www.cnbc.com/2020/08/25/exxon-mobil-replaced-by-a-software-stock-after-92-years-in-the-dow-is-a-sign-of-the-times.html
[4] Source https://www.sierraclub.org/press-releases/2020/09/bloomberg-philanthropies-and-sierra-clubs-beyond-coal-campaign-reaches

Similar trends are evident in Global Indexes. The MSCI All Country World Index, Investable Market Index ("MSCI ACWI IMI") captures large, mid, and small cap representation across 23 Developed Markets and 26 Emerging Markets countries. With 8,768 constituents, the index is comprehensive, covering approximately 99% of the global equity investment opportunity set.

Over the last decade, the energy sector market share of the MSCI ACWI IMI dropped from nearly 10.0% in 2010 to 6.9% in 2015, and continued falling to under 3.0% by September 30, 2020. (See Figure II.6.) The Oil and Gas subsector, which comprises the vast majority of the Energy Sector witnessed a similar reduction from 8.7% to 2.6% over the same 10 years. The Coal sub-industry collapsed ~76.0% from 0.34% in 2010 to 0.8% in 2015, and then continued to shrink to 0.5% market share by 2020.

Figure II.6 - MSCI ACWI IMI Energy Sector Market Share[1]

MSCI ACWI IMI Energy Sector Market Share			
% of ACWI IMI	Sector Energy (%)	Industry Oil Gas & Cons Fuel (%)	Sub Industry Coal & Cons Fuels (%)
June 30, 2010	9.92	8.69	0.34
June 30, 2015	6.91	6.04	0.08
June 30, 2020	3.43	3.25	0.05
September 30, 2020	2.77	2.62	0.05

The risk profile of indices that exclude fossil fuel reserve owners have been very similar to their parent benchmarks, often with slightly lower risk. For example, since 2010, the MSCI ACWI ex-Fossil Fuels index was less volatile than the MSCI ACWI index with a Beta of 0.98 and lower annualized standard deviation over the 3- and 5-year periods. The MSCI ACWI ex-Fossil Fuels index includes any constituent of the MSCI ACWI index except those "identified as having fossil fuel reserves (proved & probable coal reserves, oil & natural gas reserves) that are used for energy purposes." The ex-Fossil Fuels index earned higher absolute and risk-adjusted returns, as measured by the Sharpe Ratio, than the MSCI ACWI over all time periods measured.[2] Because the ex-Fossil Fuels index replicates the performance of the broad market, without fossil fuel reserve exposure, the outperformance is not dramatic but seems to capture the energy sector's struggles.

Renewable Energy Outlook

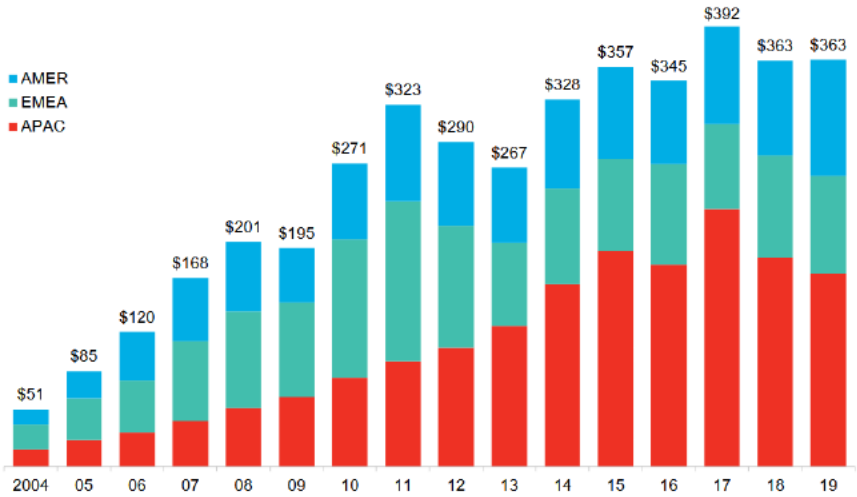
While investment in fossil fuel companies shrank over the past decade, investors increased investments in renewable energy projects. (See Figure II.7.) Renewable energy cost reductions, technological innovations, and government subsidies all helped support attractive value propositions.[3] As the energy transition progresses, the nature and extent of government subsidies is likely to change. It remains to be seen whether governments will introduce new, increase, and/or roll back certain incentive programs that in some cases began when renewable energy was a nascent industry. Further, it is too soon to tell whether economy-wide efforts, such as carbon-pricing, will be broadly adopted globally and further accelerate the transition to a low carbon economy.

[1] Source MSCI.

[2] https://www.msci.com/documents/10199/b9fc9a1e-e1ac-4210-af4d-a0f58cbf4cb7

[3] https://data.bloomberglp.com/promo/sites/12/678001-BNEF_2020-04-22-ExecutiveFactbook.pdf?link=cta-text

Figure II.7 – New Financial Investment in Clean Energy by Region ($ billions)[1]



Like equity investments in renewable energy, green bond issuances followed a similar upward trend and reached $259.0 billion in 2019, making up the majority of the $465.0 billion in issuances of debt instruments labeled as sustainable.[2,3] Green bonds cover any debt format where the proceeds are used to finance climate change solutions, i.e., green assets.

The increase in green bond issuance, has yet to be directly associated with a reduction in carbon intensities. For example, the Bank of International Settlements released a report in September 2020 that found "no strong evidence that green bond issuance is associated with any reduction in carbon intensities over time at the firm level." The report clarifies that these results do not indicate that green bonds failed to meet their intended environmental goals, but rather, that the firms that issued these bonds did not exhibit a meaningful difference in their carbon intensity. The report suggests that firm-level ratings, similar to credit rating buckets or classifications, could better deliver on climate change goals rather than the current project-based system.[4]

Technological and financial innovations supported by government policies are expected to continue to lower the cost of de-carbonization. For example, Goldman Sachs finds that consistent application of low-cost, de-carbonization technology improvements at scale, breakthrough clean hydrogen technologies, financial innovations, and a lower cost of capital for low carbon activities can, in aggregate, reduce the annual costs of the path to net zero by roughly US$1.0 trillion. This cost reduction is a ~20.0% improvement over their 2019 Carbonomics cost curve estimate. Goldman Sachs also finds financial conditions tightening for hydrocarbon developments, leading to hurdle rates 20.0+% for long-cycle oil developments while low carbon projects, such as renewable power investment financing, have hurdle rates in the range of 3.0%–5.0%.[5]

[1] Source BloombergNEF.
[2] Source https://data.bloomberglp.com/promo/sites/12/678001-BNEF_2020-04-22-ExecutiveFactbook.pdf?link=cta-text
[3] Source https://www.climatebonds.net/files/reports/cbi_sotm_2019_vol1_04d.pdf
[4] Source https://www.bis.org/publ/qtrpdf/r_qt2009c.htm
[5] Source "Carbonomics Innovation, Deflation and Affordable De-carbonization", Goldman Sachs, October 13, 2020.

These developments are accelerating as large investors and banks, and market participants including large commodities traders are increasing their low carbon financial exposures. Recently, the world's four largest oil traders reportedly began efforts to invest billions of dollars in renewable energy projects in the next five years as they speed up preparations for a dramatic shift in the world's energy mix away from fossil fuels. For example, the CEO of Mercuria estimates that "over the next five years we should have about 50 percent of our investments into renewables."

Such developments are expected to further increase the financial pressure on fossil fuel reserve owners that do not evolve to be competitive in a low carbon economy.

Stranded Assets

As global markets continue transitioning to a low carbon economy, significant changes are beginning to be made to how energy is produced and consumed. Fossil fuel reserve owners are particularly vulnerable with assets on their books that may no longer be expected to have a positive future economic return during their useful lives, known as "stranded assets". Another similar definition from the International Energy Agency ("IEA") states that stranded assets are, "those investments which have already been made but which, at some time prior to the end of their economic life, are no longer able to earn an economic return."[1]

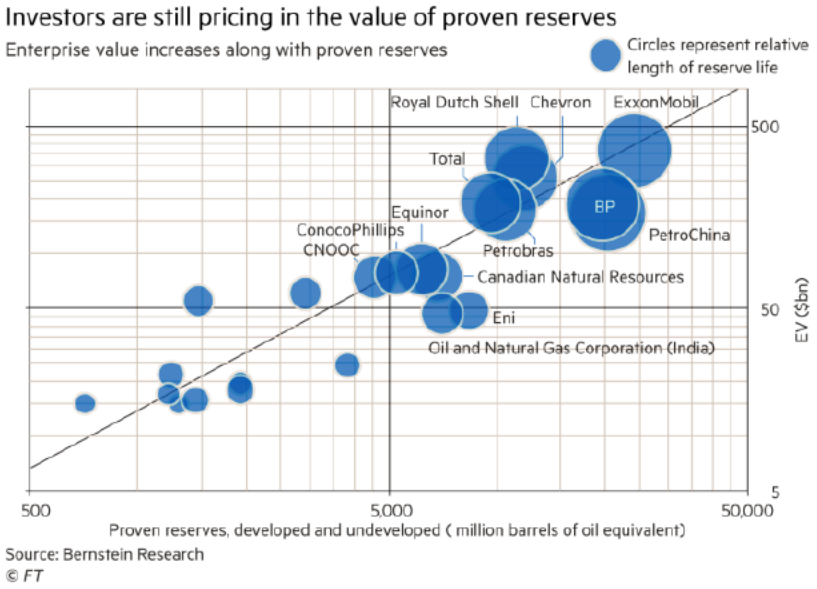
Assets can become stranded due to economic, physical, and regulatory factors. Economic stranding occurs when changes in the cost-benefit ratio make fossil fuels unattractive from an investment perspective. Physical stranding happens when assets cannot be reasonably accessed due to flood, drought, or distance, and the costs to extract become prohibitive. Regulatory stranding is the result of changes in policy or legislation.[2] Within the oil and gas industry, specific examples include resources in the ground awaiting production (i.e. reserves), exploration and development assets such as drilling rigs or seismic vessels, production and processing facilities, and distribution infrastructure (i.e. pipelines and tankers).[3]

A concept related to stranded assets is "reserve life" which measures the length of time it would take an O&G company to exhaust their fossil fuel reserves. For example, a higher reserve life implies a longer amount of time it would take for a company to utilize its reserves. The most exposed of the largest O&G companies today are BP, ExxonMobil, PetroChina, and Rosneft.

Fossil fuel reserve owners now grapple with substantial, quantifiable risk for investments valued on their books as assets that could become liabilities. Projects with high-carbon intensity and long reserve lives are expected to be the most significantly impaired. The following chart shows the proven reserves, reserve lives, and therefore, relative exposure of large oil and gas companies to stranded asset risk, and the correlation between proven reserves and enterprise value.

[1] Source Financial Times; Lex in Depth Stranded Assets, February 2020. https //www.ft.com/content/95efca74-4299-11ea-a43a-c4b328d9061c
[2] Source https //carbontracker.org/terms/stranded-assets/
[3] Source Ibid.

Figure II.8 – Value of Proven Reserves for Fossil Fuel Reserve Owners[1]



Fossil fuel companies could potentially lose billions in asset values if they own large reserves of oil, gas, and coal that would have to stay in the ground to avoid 1.5° C of global warming. For at least the past decade, concern has grown that the market might be mispricing the risks facing fossil fuel owners, and overvaluing fossil fuel listed companies.

As the implications of climate change have deepened and become more imminent, investment theories and models are emerging that seek to incorporate climate-related risks and opportunities. The mispriced risk discussion, as applied to fossil fuel reserve owners, has been complemented by the application of alternatives to modern portfolio theory and market-capitalization weighted indices to climate issues. In addition, forward-looking climate scenario analyses are rapidly evolving to further assess investment portfolio climate related risks, including potentially stranded assets.

Mispriced Risk Discussion and Modern Portfolio Theory

The mispriced risk of fossil fuel owners arguments suggest that long-term shifts to stricter carbon regulations and to cleaner energy have not been fully reflected in the assumptions of the value of fossil fuel reserves: many reserves that are currently assumed to have value may become worthless, or, "stranded".

The question of mispriced risk of stranded assets assumes that the markets do not fully account for these potential losses. As the transition to lower carbon economies has evolved, mispricing seems to be on the decline. This long-term shift reflects market changes including widespread attention to the issue, government climate policies being adopted, and low carbon opportunities becoming cost competitive and more mainstream. The most expensive projects and ones with the highest carbon intensity face the greatest risk of write-downs. Examples of developments already underway include 2020 reports by companies such as BP that announced a $20.0 billion write-down of its fossil fuel assets and downward revisions of their oil price expectations; BP also suggested that the demand for oil could

[1] Source Financial Times; Lex in Depth Stranded Assets, February 2020. https //www.ft.com/content/95efca74-4299-11ea-a43a-c4b328d9061c

have peaked in 2019. Total SE, a French oil and gas company, disclosed an $8.0 billion write-down in July 2020 of its carbon-heavy assets, which includes a ~$7.0 billion impairment for its Fort Mills oil sands project in Alberta.[1,2] Total stated that it will not approve any increases in capacity of these types of projects. BP and Royal Dutch Shell released statements to shareholders of potentially ~$40.0 billion of write-downs between them.[3] While there is increasing evidence that the risk of stranded fossil fuel reserves is more fully priced in, the long-term uncertainty over how quickly economies will evolve raises the concern that long-term potential declines in value for these assets has yet to fully occur.

Modern Portfolio Theory and the Capital Asset Pricing Model

If the stranded asset risks are mispriced long-term and market-wide, this would constrain the value of portfolio construction based on efficient markets, including the widely accepted market-capitalization weighted approach to building institutional investment portfolios. In this section, we briefly summarize the theoretical underpinnings of market-cap weighted investing, and alternatives that have developed that seek to address limits of this approach.

In the 1950s, Harry Markowitz described the risk-return tradeoff in portfolio construction through mean-variance analysis, developing the foundations for Modern Portfolio Theory ("MPT"). Throughout the 1960s, several economists built upon MPT and independently arrived at the Capital Asset Pricing Model ("CAPM") and the efficient frontier. The CAPM provides a theoretical required rate of return an investment should be expected to earn to be accretive to a market portfolio. By extension, William Sharpe also developed a model to measure risk-adjusted returns as expected return less the risk-free rate of return per unit of volatility, the Sharpe Ratio.

More recently, these theories have been used to justify investing in market-cap weighted equity indices as a proxy for exposure to the market portfolio. As the CAPM theoretically predicts an efficient risk-return profile for the market portfolio, an investor should be able to replicate a security's relative influence on market performance by purchasing shares proportionate to that security's size vs. the market, i.e. market-cap weighting.

The CAPM has drawn significant criticism as it relies heavily on assumptions that are not observable given real-world constraints. Critics cite its reliance on historical data to estimate future returns, the use of a constant risk factor, and an inability to incorporate different investor preferences as shortcomings of the model.

Alternatives to Capital Asset Pricing Model

In response to criticisms, several models have been proposed as improvements upon the market-cap weighted approach. The following discussion provides a brief overview of some leading alternative modeling strategies, and examples of their incorporation of climate risks such as carbon reserves and emissions.

- Tangency Portfolio
  - A rational investor's goal should be to maximize risk-adjusted returns as opposed to simply tracking the market portfolio. Therefore the efficient frontier used for a tangency portfolio should be constructed with the aim of providing the highest possible Sharpe ratio. Tangency models do not specifically account for stranded

[1] Source https://www.bloombergquint.com/business/oil-companies-wonder-if-it-s-worth-looking-for-oil-anymore
[2] Source https://theenergymix.com/2020/07/31/colossal-fossil-total-declares-9-3b-in-stranded-assets-in-alberta-tar-sands-oil-sands/
[3] Source https://www.bloomberg.com/news/articles/2020-07-29/total-takes-8-1-billion-writedown-as-pandemic-devalues-oil-gas

asset risk. Though such models may better align with an investor's goals, they can fall victim to any potential mispriced risk as a market-cap weighted portfolio.

- Factor-Based Models
  - One prominent extension of the CAPM is the Fama-French-Carhart four-factor model. In addition to the single-factor CAPM (Beta), the four-factor model includes variables to account for differences in size, value, and momentum to help explain stock returns. The different factors in this model can be weighted differently to increase or decrease exposure based on an investor's preferences, called tilts.
  - Another popular example of a factor-based model is smart beta. A hybrid of passive and active equity strategies, smart beta strategies start with a passive index foundation and use alternative weighting methods to take active tilts for factors such as volatility, liquidity, size, value, quality, or momentum, among others, seeking to exploit some market inefficiency. A number of quantitative managers now offer factor-based approaches that include climate and/or specific ESG factors as formal factors to enhance portfolio returns.
- Heuristic and Optimization Weighting
  - Heuristic approaches to index weighting are generally simple to apply and understand. Common heuristic approaches include equal weighting, diversity weights to prevent overexposure to any one company or industry, low volatility, equal contribution to risk, and equal weighting of risk clusters. Optimization approaches, by contrast, rely on the application of a mathematical function to a company's underlying financial data as an alternative to market capitalization to infer the size of a company and therefore index weight. The optimization approach is also known as "fundamental indexation". Four common metrics used in weighting an index under this approach are a company's dividends, cash flows, book value, and sales.
  - Many heuristic and optimization approaches have produced better risk-adjusted performance than passive market-cap weighted indexes. In an example of a climate related heuristic approach, The Journal of Portfolio Management found that within certain carbon reduction ranges, low volatility portfolios were able to achieve a lower carbon footprint without compromising their volatility reduction objectives.[1]

Portfolio construction alternatives to market-cap weighted indexes may provide prudent options to explore in weighting fossil fuel owners. However, alternatives that are dependent on the same underlying valuation of risks will be subject to the same issue of potential mispriced risk as that of market-cap weighted approaches.

Forward-Looking Models

Typical investment analysis relies on historical data. Because climate change risks require systemic change going forward, such models and analysis are often considered limited by their backward-looking approach. To address this issue, many forward-looking investment models have been developed that incorporate climate change. As time horizons lengthen to capture the long-term nature of climate change and the energy transition, it becomes increasingly difficult to estimate the impact of climate on companies. Therefore, uncertainty increases with longer time horizons. We summarize five

[1] Source https://jpm.pm-research.com/content/early/2020/01/18/jpm.2020.46.3.108

leading forward-looking models that incorporate climate change into their analysis below. Because all climate scenario methodologies are relatively new and exploratory in nature, we note the immense difficulty associated with trying to estimate and quantify changes in a still emerging space. There is a need for standards to be set around climate data. Though growing coordination and collaboration exists, such as with SASB and GRI, a lack of consistency in reported data makes the modeling process difficult.

We summarize the University of Waterloo's Climate Risk Matrix, MSCI ESG Research's Climate Value-at-Risk methodology, FTSE's TPI Climate Transition Index Series, GMO's proprietary framework, and Mercer's Framework for Sustainable Growth.

- University of Waterloo's Climate Risk Matrix[1] (Macro, industry-level)
  - The University employs a Task Force on Climate-Related Financial Disclosures ("TCFD") and Expert Panel on Sustainable Finance ("EPSF") to work with portfolio managers to determine the top 1–2 physical climate risk impacts that should be prioritized to minimize potentially adverse performance for their portfolios. The TCFD and EPSF develop the Climate Risk Matrix for their clients and assign a dollar-value impact using traditional valuation models including ratio analysis, discounted cash flows, economic value added, option pricing models, and "rules of thumb" valuation, which uses industry-specific metrics to value companies.
- MSCI ESG Research's Climate Value-at-Risk ("Climate VaR") methodology[2] (Bottom up, security-level)
  - The Climate VaR model is a quantitative model that runs scenario analyses based on climate risks and opportunities to quantify the future impact of climate risk on portfolio valuation. The MSCI ESG Research team applies its four-step framework of impact modeling, cost-benefit calculation, security valuation, and portfolio aggregation.
- FTSE's Transition Pathway Initiative's ("TPI") Climate Transition Index Series[3] (Bottom up, security-level)
  - TPI, an asset-owner led initiative focused climate change, and FTSE developed an index weighted by a constituent's relative exposure to the transition to a low-carbon economy. The index measures a company's exposure to green revenues, fossil fuel reserves, and carbon emissions and provides forward-looking views on management quality and the company's alignment with the Paris Agreement.
- Mercer's Framework for Sustainable Growth (Bottom up, portfolio-level)
  - Mercer guides fund managers through its three-step process to assess climate change investment risk and develop an approach to ESG issues. The three steps include a review of the client's investment beliefs, development of an investment policy as well as a stand-alone climate change strategy, and implementation. The forward-looking model builds on the assumptions developed through this three-step process to determine climate scenarios and climate risk factors, which serve as model inputs to calculate potential investment impacts for the portfolio.

[1] Source https://www.intactcentreclimateadaptation.ca/wp-content/uploads/2020/03/Factoring-Climate-Risk-into-Financial-Valuation.pdf

[2] Source https://www.msci.com/documents/1296102/16985724/MSCI-ClimateVaR-Introduction-Feb2020.pdf/f0ffd77-3278-e409-7a2a-bf1da9d53f30?t=1580472788213

[3] Source https://content.ftserussell.com/sites/default/files/support_document/FTSE%20TPI%20Climate%20Transition%20Index%20Series_Brochure_Jun2020_v1.pdf

- GMO's proprietary framework (Macro, country-level)
  - Because GMO does not believe in the consistency and reliability of third-party ESG scores, they developed their own assessment framework based on the ~50 most material ESG indicators. Depending on the scenario GMO wants to analyze, they select a few of the most relevant, significant indicators and charts the size of the potential business impact versus the probability of the adverse event occurring.

Meketa approaches climate scenario analysis as a macroeconomic model. The Meketa approach draws on other models to inform the types of scenarios we might examine. Other modeling efforts do not affect Meketa's modeling process or approach.

Overall, we find that climate change risks have become prominent and mainstream for global investors. Mispricing of fossil fuel reserves risk seem to be less pronounced as markets evolve to take into account the shift to a low carbon economy. Portfolio construction alternatives to market-cap weighted indexes in which an investor has confidence, may provide prudent options to explore in weighting fossil fuel owners, as market-cap weighted indexes have not always provided higher risk-adjusted returns than alternative strategies.

III. Fossil Fuel Exposure

During Phase 1, Meketa's research found that the varied nature of the approaches by global leading asset owners indicates that there is no conclusive, universally accepted strategy to guide divestment of fossil fuels. As a result, for this project, the Systems adopted a broad definition of fossil fuel reserve owners to analyze for potential prudent exclusion of securities issued by fossil fuel reserve owners: any publicly listed company in the global economy that owns commercial coal, oil, and gas reserves.

For Phase 2 analysis, Meketa updated the Systems holdings to June 30, 2020, from March 31, 2020. Figure III.1 shows the Systems' June 30, 2020 exposure to companies under an all-inclusive definition of fossil fuel reserve owners. Exclusions based on this definition would be in addition to Systems 2019 exclusion of 33 companies with 50% or more in revenues from thermal coal. Meketa drew on leading ESG data provider, ISS, to identify fossil fuel reserve owners. As shown in Figure III.1, combined, the three Systems held $[redacted] in [redacted] fossil fuel owners, [redacted]% of total Plan AUM, and [redacted]% of publicly listed AUM.

Figure III.1 – NYC Pension Systems Total Public Equity and Fixed Income Fossil Fuel Reserves Exposure[1]

NYC Pension Systems Total Public Equity and Fixed Income Fossil Fuel Reserves Exposure (As of June 30, 2020)	BERS	NYCERS	TRS	Systems
Total Public Equity and Fixed Income				
Total Plan AUM ($ mm)	6,873.6	70,212.1	82,345.5	159,431.1
Total Plan Publicly Listed AUM ($ mm)	5,828.0	57,184.9	69,433.1	132,446.0
Total FF Exposure ($ mm)	[redacted]	[redacted]	[redacted]	[redacted]
FF Percent of Total Plan AUM (%)	[redacted]	[redacted]	[redacted]	[redacted]
FF Percent of Total Plan Publicly Listed Assets (%)	[redacted]	[redacted]	[redacted]	[redacted]
FF Companies Represented	[redacted]	[redacted]	[redacted]	[redacted]
Total Equity				
Total Equity AUM ($ mm)	3,537.4	33,431.5	39,284.6	76,253.0
Total FF Exposure ($ mm)	[redacted]	[redacted]	[redacted]	[redacted]
FF Percent of Total Assets (%)	[redacted]	[redacted]	[redacted]	[redacted]
FF Companies Represented	[redacted]	[redacted]	[redacted]	[redacted]
Total Fixed Income				
Total Fixed Income AUM ($ mm)	2,290.6	23,753	30,149.0	56,193.0
Total FF Exposure ($ mm)	[redacted]	[redacted]	[redacted]	[redacted]
FF Percent of Total Assets (%)	[redacted]	[redacted]	[redacted]	[redacted]
FF Companies Represented	[redacted]	[redacted]	[redacted]	[redacted]

TRS and NYCERS held [redacted] and [redacted] fossil fuel companies in their respective total combined public equity and fixed income portfolios, as of June 30, 2020. BERS held [redacted] fossil fuel owners. As a percent of each System's total AUM, fossil fuel company holdings were [redacted]% for TRS, [redacted]% for NYCERS, and [redacted]% for BERS.

[1] Source BAM and ISS ESG.

To check the comprehensiveness of our coverage of fossil fuel reserve owners, we compared the ISS set of fossil fuel owners in the Systems to the set from MSCI and by Trucost. As shown in Appendix A-1, we found the ISS coverage inclusive of all fossil fuel reserve owners identified by MSCI and Trucost, barring three MSCI companies ([redacted]) for which ISS research finds no current fossil fuel ownership, due to recent changes at these companies. Among the [redacted] companies identified as fossil fuel reserve owners by ISS, MSCI data lacked [redacted]. As shown, most of the [redacted] were [redacted], although the list included a [redacted]. The ISS [redacted] companies not covered by MSCI included [redacted] companies that are subsidiaries of other parent companies. Trucost, which only works with data that is reported by companies, and does not model fossil fuel reserve ownership, lacked [redacted] of the [redacted] companies that ISS identified as fossil fuel reserve owners.

Each plan's largest exposure to fossil fuel reserve owners was in its equity portfolio. Combined, the Systems held $[redacted] in equities of fossil fuel companies ([redacted]% of combined equities), and $[redacted] in fixed income securities of fossil fuel companies ([redacted]% of the Systems Fixed Income portfolios). TRS held [redacted]% of its equity portfolio in fossil fuel reserve owners. NYCERS held [redacted]%, and BERS held [redacted]%. TRS held [redacted] companies representing [redacted]% of the TRS fixed income portfolio. NYCERS held fixed income securities of [redacted] fossil fuel companies that together represented [redacted]% of the NYCERS Fixed Income portfolio. BERS held [redacted] fossil fuel companies that accounted for [redacted]% of the BERS Fixed Income portfolio.

Figure III.2 illustrates the Systems exposure to more focused definitions of fossil fuel reserve owners. Figure III.2 indicates that the largest number of fossil fuel reserve owners in the Systems portfolios ([redacted] of the total [redacted]) are energy sector companies, as defined by the Global Industrial Classification System ("GICS").

The all-inclusive definition of fossil fuel reserve owners includes companies that generate 100% of their revenues from extraction of oil, gas, or coal, and companies that generate zero revenues from extraction. As shown in Figure III.2, [redacted] companies generated revenues greater than $0 from extraction of fossil fuels. Among the [redacted] companies with greater than 0% revenues from extraction, [redacted] companies generated greater than 10% revenue from extraction, and [redacted] generated greater than 50% revenues from extraction. Energy sector companies represented [redacted]% of all companies that generate revenues from extraction.

A second approach to defining fossil fuel reserve owners focuses on companies that generate revenues from using fossil fuels only for energy purposes. For example, oil and gas products are used to produce many products such as plastics, and rubber rather than to generate energy. Similarly, coal used for metallurgical purposes, such as steel-making, is distinguished from thermal coal, used for energy. Among the [redacted] fossil fuel reserve owners in the Systems portfolios as of June 30, 2020, [redacted] companies generated some revenues from using fossil fuels to create energy. This included [redacted] companies that generate revenues from thermal coal, and own no oil or gas reserves, as shown in Figure III.2.

Figure III.2 – Systems Fossil Fuel Reserve Owner Exposure[1]

Systems Total Public Equity and Fixed Income Fossil Fuel Reserve Owner Exposure (As of June 30, 2020)								
GICS Sector	All FF Companies	>0% Extractive Revenue	>10% Extractive Revenue	>50% Extractive Revenue	>0% For Energy Purpose Revenue	>0% Thermal Coal Revenue No Oil or Gas Reserves	>10% Thermal Coal Revenue No Oil or Gas Reserves	>50% Thermal Coal Revenue No Oil or Gas Reserves
Total Systems Plan AUM ($ mm)	[redacted]							
Total Systems Public Listed AUM ($ mm)								
Total FF Exposure ($ mm)								
FF Percent of Total Systems Plan AUM (%)								
FF Percent of Total Public Listed AUM (%)								
Total FF Companies Represented								
Energy								
[redacted]								

The Climate Action 100+ ("CA100+") and the Carbon Underground 200 ("CU200") offer two prominent lists of publicly traded companies that institutional investors refer to in developing strategies to address climate investment risks. The Climate Action 100+ identifies as an engagement target list, 100 'systemically important emitters,' accounting for two-thirds of annual global industrial emissions, alongside more than 60 others with significant opportunity to drive the clean energy transition. The Carbon Underground 200 identifies the top 100 coal and the top 100 oil and gas reserve holders globally, ranked by the potential carbon emissions.

We found the Systems exposure to fossil fuel owners included [redacted] CA100+ companies and [redacted] CU200 companies. [redacted] fossil fuel owners in the Systems portfolios were on both the CA100+ and the CU200 lists. These [redacted] companies represented market value of $[redacted] approximately [redacted] of the total $[redacted] Systems investments in fossil fuel owners.

[1] Source ISS DataDashboard.

IV. Climate and Financial Risk – Portfolio Analysis

To analyze the Systems fossil fuel reserve owner exposure and potential impact on the Systems investment portfolios, and to inform potential prudent divestment options, Meketa took a two pronged approach: portfolio-wide and company specific.

- First we assess the difference in the Systems portfolio carbon emissions exposure, comparing the actual June 30, 2020 publicly held investment portfolios to the portfolio if all fossil fuel reserve owners were excluded.
- Second, using forward-looking climate scenarios, we analyze the potential financial impact on the June 30, 2020 actual portfolios and on the portfolios if fossil fuel reserve owners are excluded.
- Third, we analyze key company level risk metrics that encompass four areas:
  - **Fossil Fuel Reserve Exposure**: Potential risk of capital expenditures being stranded under different climate scenarios, a key energy transition risk for fossil fuel reserve owners; For power and utility companies, we include a coal and a gas Relative Alignment with Beyond 2 Degree Scenario ("B2DS") measure.
  - **Energy Transition Management**: How well a company manages its exposure to energy transition risks and opportunities, thereby potentially lowering their energy transition risk.
  - **Financial Health Risk**: Financial health as an indication of how financially well-situated a company is to address future risks, including energy transition and physical climate risks.
  - **Physical Climate Risk**: Degree of potential physical climate risk exposure.

IV.A Portfolio Carbon Emissions Exposure

Defining Carbon Emissions

Greenhouse gases are measured as carbon dioxide equivalents ("CO_2-e"). In the measurement of CO_2-e, emissions are classified in three different 'Scopes':

- Scope 1: Direct emissions from sources that are owned or controlled by the company, typically resulting from combustion of hydrocarbons or emissions from chemical processes.
- Scope 2: Indirect emissions generated from purchased electricity, heat or steam, whose emission physically occurs at the facility where the electricity is generated (e.g., a utility-owned power plant).
- Scope 3: All other indirect emissions that include all supply chain emissions and emissions generated from the use of a product or service following its sale by the company.

In this report, we present measurements of Scope 1 + 2 emissions. Concentrating on Scope 1 and 2, and excluding Scope 3 emissions has benefits and limitations. Benefits of concentrating on Scope 1 and 2 emissions include that: they are under more direct control of the company reporting the emissions than Scope 3; can be more easily calculated or estimated; a markedly greater number of companies currently report Scope 1 and 2 emissions: and there is significantly less double counting of emissions.

A limitation of focusing only on Scope 1 and 2 emissions is that typically, Scope 3 emissions account for a substantial share of a company's total emissions. For example, ISS Scope 3 emissions, when added to Scope 1 + 2 emissions resulted in a minimum increase of over 130% in total emissions, indicating that Scope 3 emissions were larger than Scope 1 + 2 emissions combined.

A second limitation of excluding Scope 3 emissions is that the share of Scope 1 + 2 emissions in total emissions varies dramatically among economic sectors and among sub-industries within broad economic sectors. For the fossil fuel owners in this report, adding Scope 3 emissions increased total emissions for the energy sector companies by an estimated 887%; 269% for the industrials sector companies; 137% for the materials sector; and 135% for the utilities sector. Thus fossil fuel owners in the energy sector would be expected to register much higher Scope 1 + 2 + 3 emissions than fossil fuel owners in other economic sectors, as compared to the Scope 1 + 2 emissions shown here. (See Appendix B-1 for a more detailed discussion of the benefits and limits of Scope excluding Scope 3 emissions.)

Measuring Carbon Emissions

The emissions associated with investment portfolios may be measured in different ways. The Task Force on Climate-related Financial Disclosures ("TCFD") publishes recommendations for voluntary and consistent climate-related financial risk disclosures, identifies five measures, and recommends that asset owners use the weighted average carbon intensity as a measure of their investment portfolio's carbon exposure.

Figure IV.1 – Carbon Footprint Metrics Identified by Task Force on Climate-related Financial Disclosures [1]

Metric	Description	Formula
Weighted Average Carbon Intensity	Portfolio's exposure to carbon-intensive companies, expressed in tons CO_{2e}/$M revenue.	$\sum_{n}^{i}\left(\frac{\text{current value of investment}_i}{\text{current portfolio value}} * \frac{\text{issuer's Scope 1 and Scope 2 GHG emissions}_i}{\text{issuer's \$M revenue}_i}\right)$
Total Carbon Emissions	The absolute greenhouse gas emissions associated with a portfolio, expressed in tons CO_{2e}.	$\sum_{n}^{i}\left(\frac{\text{current value of investment}_i}{\text{issuer's market capitalization}_i} * \text{issuer's Scope 1 and Scope 2 GHG emissions}_i\right)$
Carbon Footprint	Total carbon emissions for a portfolio normalized by the market value of the portfolio, expressed in tons CO_{2e}/$M invested.	$\frac{\sum_{n}^{i}\left(\frac{\text{current value of investment}_i}{\text{issuer's market capitalization}_i} * \text{issuer's Scope 1 and Scope 2 GHG emissions}_i\right)}{\text{current portfolio value (\$M)}}$
Carbon Intensity	Volume of carbon emissions per million dollars of revenue (carbon efficiency of a portfolio), expressed in tons CO_{2e}/$M revenue.	$\frac{\sum_{n}^{i}\left(\frac{\text{current value of investment}_i}{\text{issuer's market capitalization}_i} * \text{issuer's Scope 1 and Scope 2 GHG emissions}_i\right)}{\sum_{n}^{i}\left(\frac{\text{current value of investment}_i}{\text{issuer's market capitalization}_i} * \text{issuer's \$M revenue}_i\right)}$
Exposure to Carbon-Related Assets	The amount or percentage of carbon related assets in the portfolio, expressed in $M or percentage of the current portfolio value.	$\frac{\sum \text{current value of investments in carbon-related assets}}{\text{current portfolio value}} * 100$

Source: TCFD, Implementing the Recommendations of the Task Force on Climate-related Financial Disclosures, June 2017.

[1] Source City and County of San Francisco Employees Retirement System ("SFERS") Fund Performance Impact of SFERS Investment Restrictions.

Meketa believes the weighted average Scope 1 + 2 carbon intensity is a useful indicator of the challenges that companies and portfolios face as decarbonization progresses. These measures do not capture all policy, transition, technology, and physical climate risks.

For this report, we show emissions measures for BERS, NYCERS and TRS June 30, 2020 actual portfolio and these portfolios ex-fossil fuel reserve owners. We include Scope 1 + 2 Weighted Average Emissions Intensity, alongside three other measures of carbon exposure.

Figure IV.2 reports the carbon exposures for each plan's public equity portfolio. As shown, excluding all fossil fuel reserve owners, results in the BERS Weighted Average Carbon Intensity registering approximately 10% lower than that of the actual portfolio. NYCERS and TRS ex- fossil fuel reserve owner portfolios show approximately 18% lower Weighted Average Carbon Intensity than their June 30, 2020 actual portfolios. For another measure of portfolio carbon emission, the Total Scope 1 + 2 emissions, excluding fossil fuel owners results in a drop in emissions for BERS of approximately 20%, for NYCERS of approximately 24%, and approximately 31% for TRS.

Figure IV.2 – Portfolio Carbon Emissions Intensity[1]

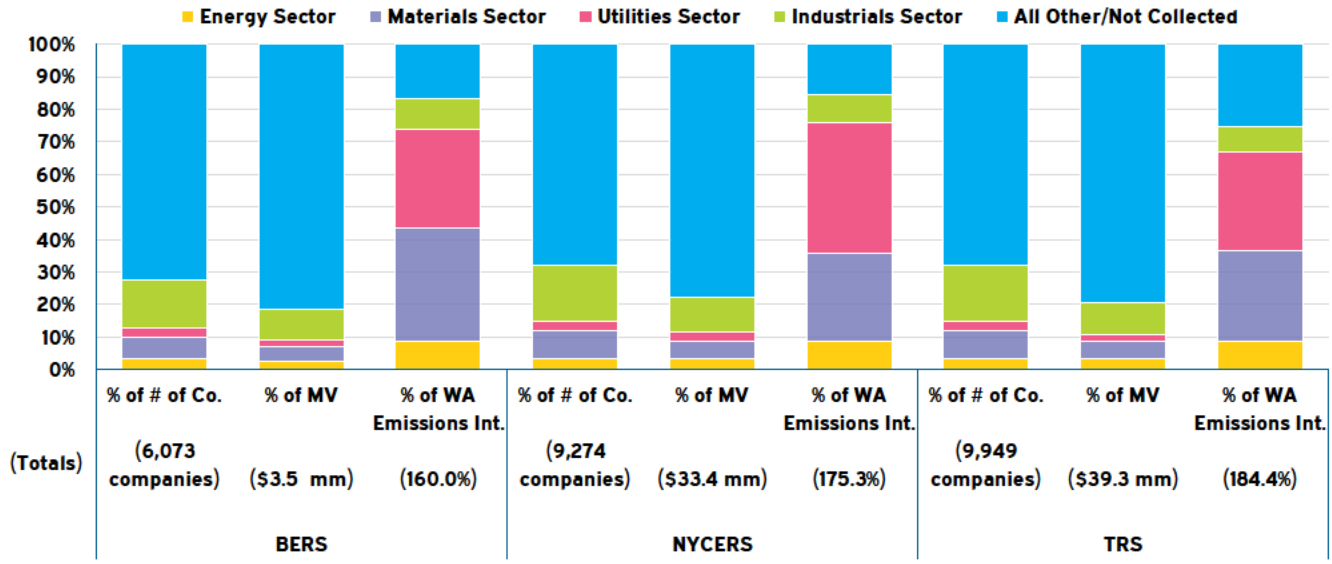
BERS, NYCERS and TRS
Total Public Equity Portfolio Actual and Without Fossil Fuel Reserve Owners ("FFRO")
Carbon Exposure
(As of June 30, 2020)

Pension Plan	Number of Companies	Market Value ($ mm)	Total Scope 1 + Scope 2 Emissions (millions tons CO_{2e})	Scope 1 + 2 Carbon Footprint (tons CO_{2e}/ $ mm invested)	Scope 1 +2 Emissions Intensity (tons CO_{2e}/ $ mm revenue)	Scope 1 + 2 WA Emissions Intensity (tons CO_{2e}/ $ mm revenue)
BERS Public Equity[2]	6,073	3,537.4	0.5	128.1	208.3	160.0
BERS Public Equity without FFRO[2]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
NYCERS Public Equity[3]	9,274	33,431.5	4.9	147.2	210.2	175.3
NYCERS Public Equity without FFRO[3]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
TRS Public Equity[4]	9,949	39,284.6	5.5	138.8	221.9	184.4
TRS Public Equity without FFRO[4]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

Four economic sectors dominate the exposure to Scope 1 + 2 emissions: Energy, Industrials, Materials and Utilities combined accounted for 83% of BERS, 84% of NYCERS, and 73% of TRS Public Equity Weighted Average Scope 1 + 2 Emissions Intensity, as shown in Figure IV.3. These four sectors combined account for less than 25% of each Plans Public Equity market value, and less than a third of each plan's Public Equity number of companies.

[1] Source ISS DataDesk. For detailed methodology, please refer to Appendix C-1.
[2] [redacted] of the total Systems market value were unmapped by ISS.
[3] [redacted] of the total Systems market value were unmapped by ISS.
[4] [redacted] of the total Systems market value were unmapped by ISS.

Figure IV.3 – Public Equity Weighted Average Emission Intensity in High Emissions Sectors[1]



As shown, the Utilities and Materials sectors accounted for the largest shares of each plan's Public Equity Emissions Intensity. The Energy and Industrials Sectors both contributed smaller shares. Excluding fossil fuel reserve owners primarily reduces the Energy Sector's Public Equity Weighted Average Scope 1 + 2 Emissions Intensity, as shown in Figure IV.4. This greater reduction in emissions intensity for the Energy sector reflects the fact that most fossil fuel reserve owners are Energy Sector companies.

Figure IV.4 – Fossil Fuel Owners Share of Public Equity Weighted Average Emissions Intensity for Lead Emitting GICS Sectors[2]

Fossil Fuel Owners Share of Public Equity Weighted Average Emissions Intensity for Lead Emitting GICS Sectors (As of June 30, 2020)									
	BERS			NYCERS			TRS		
GICS Sector	FFRO % of # of Co.	FFRO % of MV	% Change in WA Emissions Int. w/o FFRO	FFRO % of # of Co.	FFRO % of MV	% Change in WA Emissions Int. w/o FFRO	FFRO % of # of Co.	FFRO % of MV	% Change in WA Emissions Int. w/o FFRO
Total Public Equity	[redacted]	[redacted]	-11.9	[redacted]	[redacted]	-14.7	[redacted]	[redacted]	-13.6
Energy Sector	[redacted]	[redacted]	-61.4	[redacted]	[redacted]	-71.4	[redacted]	[redacted]	-75.2
[redacted]	[redacted]	[redacted]	-4.8	[redacted]	[redacted]	-7.4	[redacted]	[redacted]	-6.6
[redacted]	[redacted]	[redacted]	-14.7	[redacted]	[redacted]	-15.7	[redacted]	[redacted]	-18.4
[redacted]	[redacted]	[redacted]	2.6	[redacted]	[redacted]	3.7	[redacted]	[redacted]	3.0

[1] Source ISS DataDesk.
[2] Source ISS DataDesk and Meketa Investment Group.

For BERS, the Total Public Equity Weighted Average Emissions Intensity would have been 11.9% lower with fossil fuel companies excluded. The Energy Sector drops -61.4%, [redacted] -4.8%, [redacted] -14.7%, and [redacted] -2.6%. Although [redacted] represent greater shares of Emissions Intensity than the Energy Sector or [redacted] Sector in the total public equity portfolios, [redacted] often purchase fossil fuels, rather than own fossil fuel reserves, as do [redacted] companies. (Appendices B-2, B-3 and B-4 provide Carbon exposure results by GICS sector for BERS, NYCERS, and TRS actual portfolios and excluding fossil fuel owners).

Carbon emissions are also concentrated by company, in addition to sector concentrations. For example the top 100 contributors to carbon emissions account for 73.4% of BERS, 65.7% of NYCERS, and 64% of TRS total carbon emissions (Appendix B-5). Among the top 100 emitters in each plan, [redacted] companies (BERS), [redacted], (NYCERS) and [redacted] (TRS) were Fossil Fuel Reserve Owners (Appendix B-5). These fossil fuel owners represented 18% (BERS), 19.5% (NYCERS), and 24.1% (TRS) contribution to each plans total emissions (Appendix B-5).

For the Systems Fixed Income portfolios, we calculated the Weighted Average Emissions Intensity of each plan's public Corporate Bonds. As shown in Figure IV.5, Corporate Bonds accounted for roughly 25% of each plan's total Fixed Income portfolio.

Figure IV.5 – Total Public Corporate Bonds Actual and Ex-Fossil Fuel Portfolios[1]

BERS, NYCERS and TRS
Total Public Corporate Bonds Actual and Ex-Fossil Fuel Portfolios
Carbon Exposure
(As of June 30, 2020)

Pension Plan	Number of Companies	Market Value ($ mm)	Scope 1 + 2 WA Emissions Intensity (tons CO_{2e}/ $ mm revenue)
BERS Public Corporate Bonds[2]	971	574.3	300.4
BERS Public Corporate Bonds without FFRO[2]	[redacted]	[redacted]	257.9
NYCERS Public Corporate Bonds[3]	1,401	6,377.7	319.7
NYCERS Public Corporate Bonds without FFRO[3]	[redacted]	[redacted]	290.9
TRS Public Corporate Bonds[4]	1,417	8,144.2	329.9
TRS Public Corporate Bonds without FFRO[4]	[redacted]	[redacted]	286.7

We concentrated on corporate bonds as the fixed income securities most directly linked to potential corporate carbon emission disclosures. Roughly 40% of the Fixed Income portfolios was invested in US government treasuries. The balance of these portfolios were invested in multiple sub-strategies of various fixed income instruments (asset backed securities, bank loans, receivables, collateralized mortgage obligations, etc.). As shown, excluding Corporate Bond securities of fossil fuel reserve owners, would have resulted in the BERS Corporate Bonds Weighted Average Carbon Intensity registering approximately 14% lower than that of the actual portfolio, NYCERS approximately 9% lower, and TRS approximately 13% lower than the actual Corporate Bond portfolios.

[1] Source ISS DataDesk. For detailed methodology, please refer to Appendix C-1.
[2] Corporate bond portfolio is approximately 25% of the total fixed income exposure.
[3] [redacted] of the total Systems market value were unmapped by ISS. Corporate bond portfolio is approximately 27% of the total fixed income exposure.
[4] [redacted] of the total Systems market value were unmapped by ISS. Corporate bond portfolio is approximately 27% of total fixed income exposure.

IV.B Climate Scenario Outcomes for Actual Portfolios

Introduction

Historically, climate change modeling within asset owner portfolios focused on "bottom-up" methods. These approaches generally take detailed information about individual companies and industries and aggregate them across an entire portfolio. While these methods are very granular, providing insights about current practices and exposures, they can yield results that are not easily translated to long-term, strategic decision making. Fiduciaries typically consider investment decisions across longer, multi-decade timespans. Bottom-up analysis provides a snapshot of a portfolio at a given time but can encounter difficulty forecasting into the future. Companies change, business practices change, consumers' tastes change. Though assumptions can be made about trends going forward, any long-term analysis will be dependent on the accuracy of those assumptions.

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

Base Macroeconomic Model

At a high level, Meketa's macroeconomic model generates a large number of "simulations" describing how different asset classes and macroeconomic factors could potentially behave over a particular forecast period given what we know about their past behavior. By examining groups of simulations that display characteristics being investigated (e.g., examining all simulations where global temperature rises by a given amount), we can draw conclusions about the paths of other asset classes and factors that are consistent with the topic of investigation. Beginning with the last available actual data, possible future values are projected by randomly selecting values consistent with the factor's past distribution of returns. Additionally, historical relationships among and between factors are also taken into account in each iteration of projected values. This process repeats to generate a sufficiently long simulation period. These simulations, along with re-centering adjustments in line with long-term capital market expectations, then determine asset class returns ultimately used for modeling.

Climate Change Modeling

By default, Meketa's model uses 32 factors to generate expected returns for 44 asset classes. To assess the impacts of climate change, we added: 1) a global land and ocean mean temperature factor. Monthly returns were generated over a 30-year time period beginning June 30, 2020 for each factor (approximately 3,000 simulations).

We selected simulations with: 1) temperatures that stayed beneath 1.5°C over the pre-industrial baseline through the end of the 30-year period and 2) temperatures within 0.25°C of temperatures consistent with a 3.0°C temperature rise by 2100. It is important to note that, given the non-deterministic nature of the model, we do not explicitly make additional assumptions in our scenarios. We do not pre-determine the path of public policy, consumer behavior, government intervention, etc. Instead, we use our simulations to represent a broad variety of different environments that represent varying behaviors economic actors may implement over different time periods that are consistent with the specified changes in temperature. By contrast with other climate forecast models, we do not require a strong view on the implementation details (or lack thereof) of climate change mitigation efforts. In contrast to many climate scenario analysis models, which assume specific technological and policy changes with each scenario, we allow for any combination of policy and technology changes that are consistent with the scenario under investigation, in this case various temperature changes. Provided that a suitable number of simulations are generated, most relatively common configurations of circumstances are represented in the model output.

We evaluated expected portfolio returns and risk for each plan's actual portfolio, including all fossil fuel reserve owners, in each scenario using groups of simulations consistent with different degrees of temperature increase.

Results & Discussion

In terms of average expected long-term risk and return, the various degrees of climate change had similar impacts across portfolios, as shown in Figure IV.6. Whether limiting global temperature rise to only 1.5°C or 3°C, expected return is lower than expected return absent climate change assumptions. Both alternative temperature scenario will entail social and economic changes consistent with either mitigating causes of climate change or grappling with the consequences of not doing so. The decline in expected return is greater in the 3°C temperature rise scenario across portfolios, roughly double the decline associated with restricting temperature rise to 1.5°C (approximately 0.4% versus 0.8%).

Under either a 1.5° C or 3.0° C climate change scenario, the Systems portfolios, including all fossil fuel reserve owners, would be expected to reduce future returns and increase portfolio volatility, to become less risk efficient.

Figure IV.6 – Climate Scenario Analysis: Actual Portfolios[1]

Climate Scenario Analysis: Actual Portfolios (As of June 30, 2020)	Base (%)	1.5 Degree (%)	3 Degree (%)
30-Year Expected Return (annualized)			
BERS	7.17	6.72	6.31
NYCERS	6.98	6.58	6.18
TRS	6.96	6.52	6.12
Standard Deviation			
BERS	11.73	12.22	13.41
NYCERS	11.22	11.49	12.57
TRS	11.13	12.13	13.28
Sharpe Ratio			
BERS	0.50	0.44	0.37
NYCERS	0.51	0.46	0.39
TRS	0.51	0.43	0.36

- **Period of Analysis**: Our analysis begins in June 2020, a period immediately after a sharp equity market recovery and continued fixed income market strength following a substantial downturn in equity markets and economic growth associated with the COVID-19 pandemic. Our modeling incorporates 1) extrapolation of recent trends and 2) reversion to mean expected long-term returns when generating simulations for analysis. If the starting point of the analysis were shifted, it is possible the relationship between the mean expected returns of the base and climate scenario portfolios would likely differ.
- **Point versus Range Estimates**: While we present average 30-year expected returns as a starting point for discussion, it is important to recognize that these figures merely represent a range of potential outcomes, as shown in Figures IV.7 and IV.8. Across portfolios, the middle 50% of return outcomes range from approximately 4% to over 8% annually.

[1] Source Meketa Investment Group.

Figure IV.7[1]

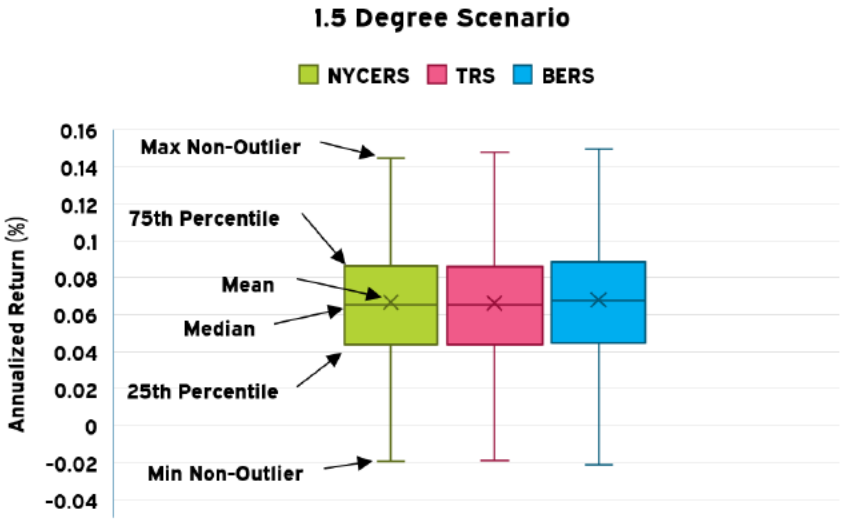
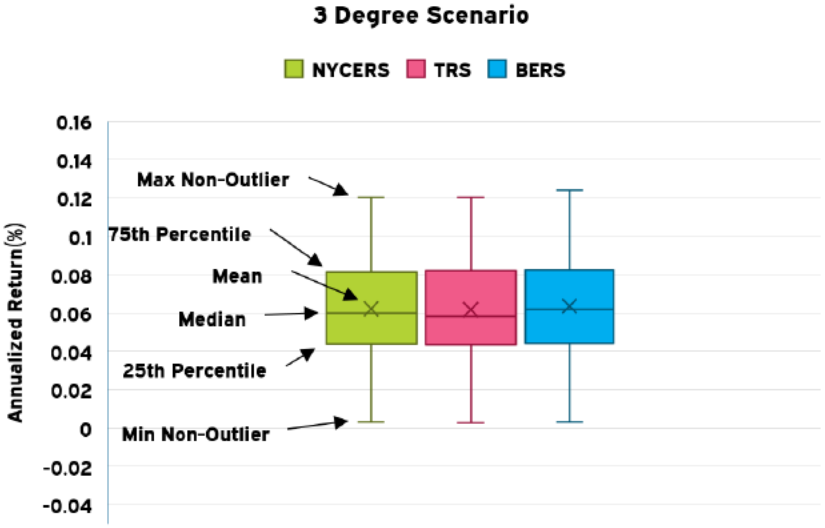


Figure IV.8[2]



Regarding risk, in both temperature rise scenarios, portfolio risk, as measured by standard deviation increases, rising more in the 3°C scenarios than the 1.5°C scenarios. The degree to which risk increases in each scenario varies more widely than observed among returns.

These trends in risk statistics indicate that the 1.5°C and 3.0°C scenarios represent more uncertain futures. The measures taken to mitigate climate change, or the impacts of ignoring climate change, are expected to cause increases in portfolio volatility. The greater volatility increase in the 3°C scenario could potentially be due to several factors: greater physical impacts of climate change, differential timing of policy and behavioral changes in response to climate change, etc. relative to the 1.5°C scenario or baseline.

[1] Source Meketa Investment Group.
[2] Source Meketa Investment Group.

The scenario outcomes suggest that climate change, whether mitigated (1.5°C scenario) or not strongly addressed (3.0°C scenarios), has the potential to reduce future returns and increase portfolio volatility. A common way to measure risk efficiency is the Sharpe ratio, a measure of the excess return of a portfolio over a risk-free asset per unit of volatility. With regard to the portfolios' risk efficiency (as measured by Sharpe ratio), the portfolios understandably become less risk efficient in general under each climate change scenario given decreased expected returns and increased risk.

V. Climate and Financial Risk Company Analysis

In this section we analyze each fossil fuel reserve owner's climate and financial risks. We use 11 metrics to identify each company's (1) fossil fuel reserve exposure risk, (2) energy transition management quality, (3) financial health and (4) physical climate risk. The set of metrics were selected to provide big picture analysis of the fossil fuel owners. The analysis does not seek to provide a full in-depth analysis of each company.

There are multiple approaches, and metrics, that might be used to analyze fossil fuel owner investment risks. The purpose of these metrics is to analyze existing potential climate and financial risks, including information on how companies are managing the energy transition risks, to inform potential prudent divestment options. For each metric, we selected a leading provider of that data. Given the limited availability of corporate climate data, for most of the metrics we analyze, data is unavailable for many of the [redacted] fossil fuel companies in the Systems investment portfolios. In general, data is more available for larger companies than it is for smaller companies. We expect that over time the climate data available on companies will continue to improve in quality; cover more companies; and that new metrics will evolve that may better capture climate risks that investors face.

In what follows, we first describe each metric, its purpose, and how it complements the other metrics used. Second, we describe the risk thresholds we used for each metric to identify higher, medium, and lower risk fossil fuel companies. Third, we summarize results for:

- The full set of [redacted] companies.
- All companies among the [redacted] that exhibited higher level fossil fuel reserve exposure, energy transition management, and financial risk across each metric for which there was data available for that company.
- The sub-set of [redacted] companies that have extraction and production revenues.
- The [redacted] integrated oil and gas companies.

Description of Metrics

The company level metrics we analyzed encompass four areas:

I. **Fossil Fuel Reserve Exposure**, potential risk of capital expenditures being stranded under different climate scenarios, a key energy transition risk for fossil fuel reserve owners.

II. **Energy Transition Management**, how well a company manages its exposure to energy transition risks and opportunities, thereby potentially lowering their energy transition risk.

III. **Financial Health Risk**, financial health as an indication of how financially well-situated a company is to address future risks, including energy transition and physical climate risks.

IV. **Physical Climate Risk**, degree of potential physical climate risk exposure.

Below, we briefly describe each metric, their purpose, and how they complement other risk metrics we use in this analysis. Please find the details for each metric in Appendix C-1.

I. Fossil Fuel Reserve Exposure

I.1) Projected Capital Expenditures Stranded in Sustainable Development Scenario ("SDS")

I.2) Projected Capital Expenditures Stranded in Beyond 2 Degree Scenario ("B2DS")

Purpose: To identify future upstream (exploration and production) oil & gas project opportunities, that will likely not be needed, based on price, and would likely be stranded, under different climate scenarios. Carbon Tracker provides these projections, which look only at unsanctioned, i.e. green field project, capital expenditures ("CapEx"). It is assumed that connected projects will go ahead. These estimates are an indication of how different companies are planning for new fossil fuel extraction. They do not include all potential stranded assets that a fossil fuel reserve owner may decide to write off.

Complement: Provides a measure of stranded fossil fuel reserves to complement other metrics that focus on how a company is managing the energy transition, what physical climate risk they face, and the overall financial health of the company.

I.3) Power and Utilities Relative Coal Alignment with B2DS to 2040

Purpose: To identify the fraction of a company's future coal portfolio that is aligned with the energy demands of B2DS. A company's coal phase-out schedule can either be in alignment with, behind or ahead of the B2DS schedule, where 100% = perfect alignment.

Complement: Provides a measure designed for power and utilities companies that complements the Potential Stranded CapEx metrics, and can be used to compare utility companies that own fossil fuel reserves to utility companies that purchase all of their fossil fuels. For utility sector companies, which are best compared to competitors on the grid they serve, many companies that do not own fossil fuel reserves rank as leading emitters compared to peers that may own fossil fuel reserves.

I.4) Power and Utilities Relative Gas Alignment with B2DS to 2050

Purpose: To identify the fraction of a company's future gas portfolio that is aligned with the energy demands of B2DS. A company's gas phase-out schedule can either be in alignment with, behind or ahead of the B2DS schedule, where 100% = perfect alignment.

Complement: Provides a measure designed for power and utilities companies that complements the Potential Stranded CapEx metrics, and can be used to compare utility companies that own fossil fuel reserves to utility companies that purchase all of their fossil fuels. For utilities sector companies, which are best compared to competitors on the grid they serve, many companies that do not own fossil fuel reserves rank as leading emitters compared to peers that may own fossil fuel reserves.

II. Energy Transition Management Risk

II.1) Transition Pathway Initiative ("TPI") Management Quality Score

Purpose: Assess a company's management/governance of greenhouse gas emissions and risks and opportunities arising from the low-carbon transition.

Complement: Provides a qualitative indicator of corporate strategy to complement the quantitative indicators of operational efficiency in managing carbon emissions and green revenue exposure.

Note: Because TPI coverage of fossil fuel reserve owners includes primarily larger companies, it is available for [redacted] of the [redacted] fossil fuel reserve owners. Meketa used a proxy measure of emissions reporting to provide some indication of transition management for companies not covered by TPI.

II.2) Operational Efficiency: Emissions Intensity – (tCO2e/$mm Revenues)

Purpose: Companies that operate more efficiently can be better positioned for carbon pricing, and potentially operational cost reductions. High emissions relative to revenue can identify companies that may be more vulnerable to changes in climate policy, including carbon pricing.

Complement: Provides a quantitative indicator of how operationally efficient a company is in managing its carbon emissions, to complement the management quality indicator, and the green revenues indicator.

II.3) Change in Operational Efficiency: Emissions Intensity Trend – (% change y/y)

Purpose: Assess changes in operations to manage carbon emissions. Companies demonstrating improvements in emissions intensity illustrate corporate strategy to reduce operational costs and manage potential future carbon pricing.

Complement: Complements the level of emissions intensity by indicating whether a company's emissions management is improving or deteriorating.

II.4) Green Revenues

Purpose: To indicate how much a company is shifting to generate revenues from products that are compatible with an energy transition away from fossil fuels.

Complement: Provides a quantitative indicator of a company's revenue shift to adjust to a low carbon economy.

III. Financial Risk – Financially healthy companies are likely to be better positioned for the long-term, including being better able to address climate related risks.

III.1) Altman Z-Score

Purpose: The Altman Z-Score is a credit-strength test developed in 1968 by Edward Altman that uses five financial ratios to predict whether a company has a high risk of insolvency.

Complement: Altman Z-Score complements measures of operating margin profits indication of the financial health of a company.

II.2) Economic Value Added/Sales Margin

Purpose: EVA/Sales measures the firm's economic profit margin net of operating and capital costs. Companies that generate strong EVA/Sales margins are more likely to be better positioned to address future risks.

Complement: EVA/Sales provides a complement to the Altman Z-Score as it is a measure of profitability after all capital costs. Thus, if EVA/Sales Margin is above zero, the firm is earning above its cost of capital, and through time should be able to continue to operate its business as economically viable.

IV. Physical Climate Risk

IV.1) Four Twenty Seven's physical risk score encompasses three components: Operations Risk, Supply Chain Risk, and Market Risk.

Purpose: To identify degree of physical climate risk faced by each company, compared to companies in its economic sector.

Complement: Physical Climate Risk complements the other climate risk metrics (Fossil Fuel Reserve and Energy Transition Management Risk), which focus on energy transition risks, and do not include physical climate risk.

Note: We have not found a satisfactory metric that measures fossil fuel reserve owner's management of physical climate risk. The TPI Management Quality Score addresses energy transition risks, and does not cover management of physical climate risk.

Risk Thresholds

For each metric, we established risk thresholds to categorize fossil fuel reserve owners each risk into three tiers. As shown in Figure V.1, with the broad definition of fossil fuel reserve owners, data for each variable is not available for all [redacted] companies. We sought to establish risk thresholds that appear meaningful at this juncture, to broadly distinguish risk levels among companies. These metrics provide some information. They are not meant to provide an in depth, detailed analysis of each company. We expect that adjustments to the risk thresholds outlined here may be appropriate as the global economy and climate change factors evolve.

Figure V.1 – Risk Thresholds for High, Medium, and Low Risk[1]

Systems Combined Company Climate and Financial Risk Metrics Thresholds for Tier 1 (Higher), Tier 2 (Medium) and Tier 3 (Lower) Risk (2020)					
Risk Variable	Systems (No. of Firms)	Systems Market Value ($ mm)	Tier 1 Risk	Tier 2 Risk	Tier 3 Risk
Total Fossil Fuel Reserve Owners	[redacted]	[redacted]			
Fossil Fuel Reserve Exposure Risk					
O&G Potential Stranded CapEx in SDS	[redacted]	[redacted]	≥ 50%	50% > *x* > 0%	0%
O&G Potential Stranded CapEx in B2DS	[redacted]	[redacted]	≥ 50%	50% > *x* > 0%	0%
Power & Utilities Coal B2DS Relative Alignment Index	[redacted]	[redacted]	1st & 2nd Quartiles	3rd Quartile	4th Quartile
Power & Utilities Gas B2DS Relative Alignment Index	[redacted]	[redacted]	1st & 2nd Quartiles	3rd Quartile	4th Quartile
Energy Transition Management Risk					
TPI or (for companies with no TPI score: if ISS found No Reporting = Tier 1 Risk; unrated if ISS found Reporting)	[redacted]	[redacted]	TPI 0-2 (if no TPI score, then if ISS found NO carbon reporting)	TPI 3	TPI 4-4*
Emissions Intensity (tons CO2e/$M revenue)	[redacted]	[redacted]	4th Quartile (top 25%) using TRS Portfolio Emissions Intensity Quartiles by GICS Sector.	3rd & 2nd Quartiles (middle 50%) using TRS Portfolio Emissions Intensity Quartiles by GICS Sector.	1st Quartile (bottom 25%) using TRS Portfolio Emissions Intensity Quartiles by GICS Sector.
2-Yr Percentage Change in Emissions Intensity (2016-2018)	[redacted]	[redacted]	4th Quartile (top 25%) using TRS Portfolio Emissions Intensity Change Quartiles by GICS Sector.	3rd & 2nd Quartiles (middle 50%) using TRS Portfolio Emissions Intensity Change Quartiles by GICS Sector.	1st Quartile (bottom 25%) using TRS Portfolio Emissions Intensity Change Quartiles by GICS Sector.
Green Revenue Share	[redacted]	[redacted]	0%	0%-20%	≥20%
Physical Climate Risk					
427 Company Physical Risk Score	[redacted]	[redacted]	≥75	75-25	≤25
Financial Risk					
Altman Z Score	[redacted]	[redacted]	≤1.8	1.8-3.0	≥3.0
Economic Value Added/Sales	[redacted]	[redacted]	≤0% for current margin. If any of last 3 years >0%, then yellow.	0.0%-6.7%	≥6.7%

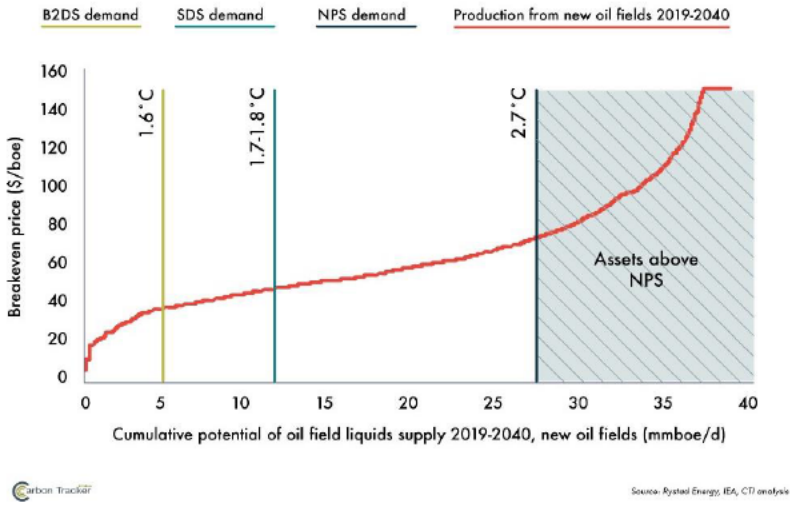
[1] Source Meketa Investment Group.

Fossil Fuel Exposure Risk

Potential Stranded Capital Expenditures. For both measures of potential stranded capital expenditures, we have data from Carbon Tracker on [redacted] of the [redacted] companies, representing a Systems value of $[redacted] as of June 30, 2020. Carbon Tracker's research concentrates on upstream oil and gas companies.

We provide estimates of potentially stranded Capital Expenditures ("CapEx") under two scenarios. We set risk thresholds based on the quartiles of Potential Stranded CapEx data. For Potential Stranded CapEx risk under both the Sustainable Development Scenario ("SDS") and Beyond 2 Degree Scenario ("B2DS") scenarios, we define Tier 1 risk as any company with >50% future Potential Stranded CapEx; Tier 2 risk as any company with between 50% and 0% Potential Stranded CapEx. Companies are categorized as Tier 3 Risk if they had 0% Potential Stranded CapEx. For this project, we defined Tier 1 by including the two highest risk quartiles, rather than, for example, the top quartile, and set the Tier 3 risk threshold at no risk. These definitions were selected to better reflect the Systems concern regarding stranded asset risk. As illustrated in Figure V.2, both measures capture Potential Stranded CapEx above and beyond existing projects, as defined as assets above the IEA's New Policies Scenario ("NPS") demand at 2.7 C and above climate expectations. Fossil fuel companies can, and do, write off reserves of projects that are already in production that are not included in these Potential Stranded CapEx estimates.

Figure V.2 – Unsanctioned Oil Fields Supply Cost Curve, 2019-2040



Power and Utilities Relative Coal and Gas Alignment with B2DS

The Coal and Gas Relative Alignment metrics are designed by Carbon Tracker to measure power and utilities company progress on reducing use of respectively coal and gas emissions in alignment with the Paris Accord, or B2DS. For this report, we include these measures as a complement to the Potential Stranded CapEx metrics to add additional insights appropriate for utilities companies. For both measures, we have data from Carbon Tracker on [redacted] of [redacted] fossil fuel companies, representing a Systems market value of $[redacted]. For both the coal and gas relative alignment metrics, we classify companies by quartiles based on the data. Tier 1 (higher risk) includes any companies in the 1st and 2nd highest risk quartiles. Tier 2 (medium risk) includes all companies that fall within the 3rd highest risk quartile. Tier 3 represents companies in the 4th (lowest risk) quartile. Those companies that have relatively lower alignment risk–are relatively better aligned with B2DS. As with the Potential Stranded CapEx measures, for this project, we set the risk thresholds for Tier 1 (higher risk) as the top two risk quartiles, rather than, for example, the top quartile, to better capture the Systems concern for these factors.

Energy Transition Management Risk

Our measures of energy transition management risk seek to provide general indicators of how each company is a managing overall energy transition strategy and reporting, operations, and revenues.

- **Transition Management Quality Score**. The Transition Pathway Initiative ("TPI") scores [redacted] of the [redacted] fossil fuel companies on their transition management quality. In total, including non-TPI scored companies that we identified through ISS as providing no emissions reporting, we ranked [redacted] of the [redacted] companies. The TPI Transition Management Score is based on 19 indicators which test whether a company has implemented a particular carbon management practice. The scores cover five levels: 0 (Unaware), 1 (Awareness), 2 (Building Capacity), 3 (Integrating into operational decision- making) 4 (Strategic assessment) and 4* (Satisfies all criteria, can be up to six additional indicators from level 4). Level 3 requires disclosure of operational GHG emissions, and setting emissions targets.

  For the purposes of this analysis, we identify companies as Tier 1 risk if they have TPI scores (0_2), Tier 2 risk if their TPI Management Quality score is 3, and Tier 3 risk if their TPI score is 4-4*. These risk thresholds are in line with the use of the TPI Management Quality Scores in the FTSE TPI Climate Transition Index that was adopted as an equity index by the London Pension Fund Authority.

  For every company that did not have a TPI Management Quality Score, we looked at ISS data to see whether they reported emissions. If a company does not have a TPI score and does not report emissions (through a corporate, sustainability report, or to the CDP, or through any other mechanism), we designate them as Tier 1 Risk. This is consistent with the lowest TPI scores, as the first steps in managing emissions are measuring and reporting. At this juncture, we feel it is important to acknowledge corporate reporting efforts, whether to the CDP or not. Because the CDP now charges companies to report to them, some companies choose to report through their own website or corporate or sustainability report where anyone can access their information for free. We were not confident that we had sufficient information on companies without a TPI Management Quality Score to distinguish between Tier 2 and Tier 3 risk levels for companies that provide some emissions reporting.

- **Emissions Intensity** provides a measure of energy transition management in a company's operations. Emissions intensity varies greatly by economic sector. For this analysis, we assess each company's Emissions Intensity as compared to other companies in their GICS sector, as evident in the full set of TRS portfolio companies. We employed a standard quartile approach, such that companies that register emissions intensity among the top 25% of the companies in their sector are Tier 1 Risk; companies among the middle 25%-75% of companies are designated Tier 2 risk, and companies in the lowest emissions intensity quartile are Tier 3 Risk.

- **Percentage Change in Emissions Intensity**. Changing a business model usually takes time. For companies for which we have emissions intensity data, we measured change over two years: 2016 -2018. While a 2-year period is not sufficient to see whether a company is on the right path, we feel this provides some important information on the direction of travel. In keeping with our approach to emissions intensity, we employed a standard quartile approach, such that companies that register percent change in emissions intensity among the top 25% of the companies in their sector are Tier 1 Risk; companies among the middle 25%-75% of companies were designated Tier 2 risk, and companies in the lowest percent change in emissions intensity quartile are Tier 3 Risk.

- **Green Revenue Share**. The ISS ESG Database provided green revenue share estimates on [redacted] of the [redacted] companies under review. ISS designates 5 categories of revenues in relation to mitigating climate change: revenues that make a significant contribution, limited contribution, neutral, limited obstruction, or significant obstruction. Green revenue share for this report is defined as any product or service that makes a significant or limited contribution to mitigating climate change. Because we find green revenues is a new, emerging category, and can be defined in many different ways, we compared the ISS definition to that of the FTSE/Russell definition of green revenues that is used in the FTSE Environmental Opportunities Index. Overall, we found that FTSE provided green revenue data on [redacted] companies, compared to the [redacted] from ISS. The correlation between the [redacted] companies that ISS and FTSE/Russell provided was [redacted]% between the ISS green revenue share (significant and limited contribution) and the FTSE/Russell green revenue share.

  To set risk thresholds, we adopted the 20% green revenue threshold that is used for inclusion in the FTSE Environmental Opportunities Index Series (only companies with 20% or more green revenues are included). The index series was launched in 2008. An independent advisory committee that oversees the methodology determined the 20% inclusion threshold. The group is chaired by Jack Ehnes, CEO of CalSTRS, and has representatives from asset managers and owners globally. At the time the 20% threshold was set, the objective was to find something that was less than "pure play" (i.e. 50%) but still reflected a meaningful level of exposure to the theme. The 20% threshold was proposed and approved by the Committee and has been in place ever since. For this project, we set Tier 1 (higher) risk as any company with 0% green revenue, Tier 2 (medium) risk as any company between 0% and 20% green revenue share. Any company with 20% or greater green revenues is classified as Tier 3 (lower) risk.

Financial Risk

- **Altman Z-Score**. The Altman Z-Score in this report covers [redacted] of the [redacted] companies, accounting for $[redacted] in the Systems market value as of June 30, 2020. The Altman Z-Scores were sourced from Bloomberg. We reviewed the data, and we thank Western Asset Management Company for double checking the scores for accuracy. To set risk thresholds for the Altman Z-Score, we used the standard threshold for insolvency: a score of 1.8 or below as indicator of high risk of insolvency, or Tier 1 risk; a score of 1.8-3.0 is classified as Tier 2 Risk, and a score of 3.0 or above is classified as Tier 3 Risk.
- **The EVA/Sales margin**, provided by ISS for [redacted] of the [redacted] companies accounts for $[redacted] in the Systems market value as of June 30, 2020. To set risk thresholds for the EVA/Sales margin, we used as a guide the average EVA/Sales over the last 10 years for the MSCI ACWI of 6.6%. If a company's EVA Margin is above zero the firm is earning above its cost of capital, and through time *should* be able to continue to operate its business as economically viable. Companies with an EVA/Sales equal to or below zero were designated as Tier 1 Risk, unless the company also had any of the previous three years EVA/Sales >0.0%, in which case they are classified as Tier 2 Risk. Tier 2 risk is designated as companies between 0.0% - 6.6% EVA/Sales, and companies with greater than 6.6% EVA/Sales are identified as Tier 3 risk. As reference, the 10-year EVA/Sales margin for the Russell 3000 was nearly identical, at 6.7%.

Physical Climate Risk

- The physical climate risk scores from 427 covered [redacted] of the [redacted] fossil fuel reserve companies. For this project, we provide the overall company scores. The scores can range from 0 risk to highest risk, 100. We designated companies with a score of 75-100 as Tier 1 risk; 25-75 as Tier 2 risk, and 0-25 as Tier 3 risk.

Systems Overview of Results

This section summarizes our findings for the [redacted] fossil fuel companies' climate and financial risk metrics. These companies together represented $[redacted] in Systems market value, or [redacted]% of the Systems total Plan AUM, and [redacted]% of the Systems Publicly Listed AUM.

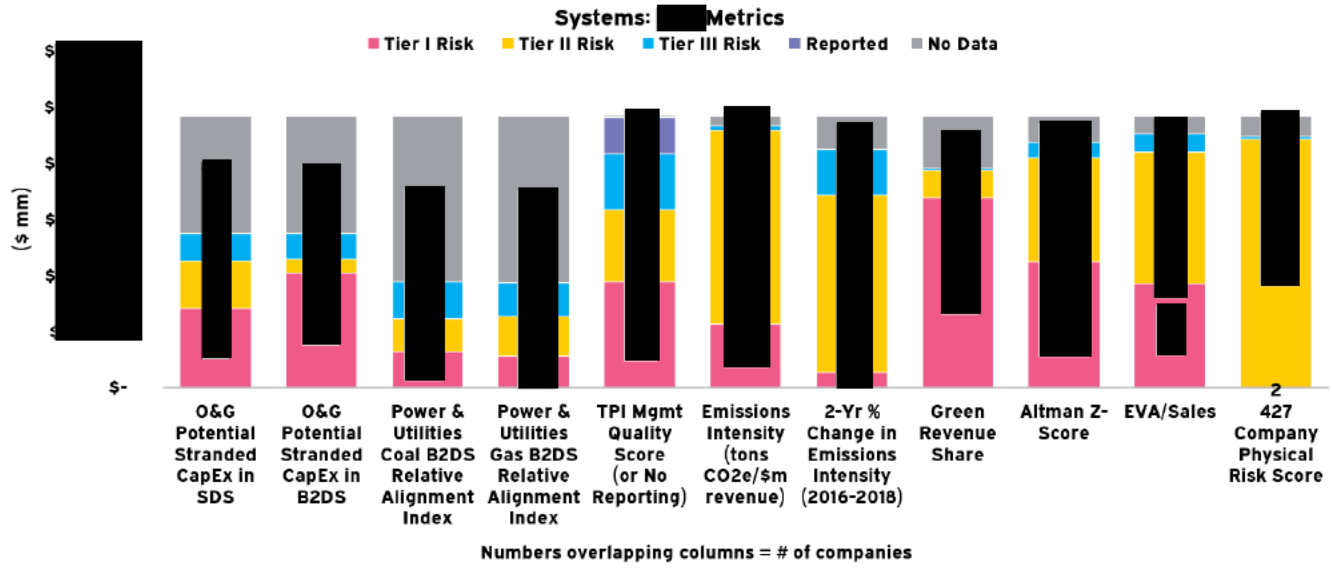
Fossil Fuel Reserve Exposure Risk

Fifty percent of the fossil fuel owners exhibited Tier 1 (higher) risk in one or more of the fossil fuel reserve exposure risk metrics, while at most 25% were categorized as Tier 3 (lower) risk.

- As shown in Figure V.3, the [redacted] companies for which we had Potential Stranded CapEx data, combined, had a Systems market value of $[redacted], or approximately [redacted]% of the $[redacted] in market value for the full set of [redacted] fossil fuel companies. Tier 1 (higher risk) was evident for over half of the companies in B2DS and slightly over one third of the companies in SDS for which we had data. A material number of companies were categorized as Tier 3 (lower risk). Tier 3 risk included any company with 0% of their projected capital expenditures expected to be stranded. Roughly 20% (B2DS) and 25% of the companies (SDS) for which we had data exhibited Tier 3.

Fifty percent of the fossil fuel owners exhibited Tier 1 (higher) risk, and at most 25% were categorized as Tier 3 (lower) risk in one or more of the fossil fuel reserve exposure risk metrics.

Figure V.3 –Systems Metrics Bar Chart[1]



[1] Sources BAM, ISS, Bloomberg, Carbon Tracker, TPI, and 427.

- The [redacted] companies for which we had Power and Utilities Coal and Gas B2DS Relative Alignment Data represented $[redacted] in Systems market value, or [redacted]% of the Systems market value for all [redacted] fossil fuel companies. As shown in Figure V.3, Tier 1 (higher risk) was evident in respectively 50% (coal) and 40% (gas) of the companies in relative alignment. Respectively, 25% of the companies (coal) and 14% (gas) exhibited Tier 3 (lower risk).

Energy Transition Management Risk

The four metrics we used to indicate transition management risk show that by two metrics (Emissions Intensity and Green Revenue Share), greater than a majority of the fossil fuel companies exhibit Tier 1 higher risk; nearly 50% based on TPI Score or (Emissions Reporting), and less than 25% based on the percentage change in Emissions Intensity. Only a handful were categorized as Tier 3 (lower risk).

- **TPI Management Quality Score** (or ISS Emissions Reporting) covers [redacted] companies that represented [redacted]% of the Systems market value exposure to all [redacted] fossil fuel reserve owners. The results for the [redacted] companies includes [redacted] companies that had TPI scores and [redacted] additional companies without TPI scores where we relied on ISS data on whether a company reports emissions to further identify Tier 1 risk companies. The TPI Score (or ISS Emissions Reporting) metric identified 46% of the companies as Tier 1 risk, and 7% as Tier 3 Risk. We left unranked [redacted] companies that had no TPI score but were identified by ISS as companies that provide some emissions reporting. Because these companies report some emissions data, they would not be categorized as Tier 1 risk, and, with more information, would identified as either Tier 2 or Tier 3 risk.
- **Emissions Intensity** metrics were available for [redacted] companies that represented $[redacted], or [redacted]% of the Systems Market Value for the [redacted] fossil fuel reserve companies. Among these, [redacted]% of the companies were identified as Tier 1 risk, while [redacted]% exhibited Tier 3 Emissions Intensity risk.
- **The % Change in Emissions Intensity** metrics were available for [redacted] companies representing [redacted]% of the Systems market value for all [redacted] fossil fuel companies. Among these, [redacted] companies were classified as Tier 1 risk.
- **Green Revenue Share** data was available for [redacted] companies representing $[redacted], or [redacted]% of the Systems market value for all [redacted] fossil fuel companies. Most of the companies for which we had data showed little or minimal revenue transition to green revenues, resulting in 82% of the companies showing Tier 1 risk (0% green revenues). [redacted] companies, representing $[redacted] in the Systems market value, met the 20% threshold for green revenue share to be classified as Tier 3 risk.

For Emissions Intensity and Green Revenue Share), greater than 50% of the fossil fuel companies exhibit Tier 1 (higher) risk.

Financial Risk

The financial risk metrics show greater than a majority of fossil fuel reserve owners face financial hardships. These results reflect the financial data was as of June 30, 2020, in the midst a significant economic downturn, and near-term upheaval for fossil fuel energy consumption.

More than 50% of fossil fuel reserve owners face Tier 1 financial hardships.

- The Altman Z-Score was available for [redacted] companies, representing $[redacted] in Systems market value, or [redacted]% of the Systems market value for all [redacted] fossil fuel reserve owners. Among these, 68% of the companies were classified as Tier 1 risk, or likely facing insolvency. Ten percent of the fossil fuel owners were on healthy financial footing, even in the midst of the current economic downturn, as indicated by the Altman Z Score.
- EVA/Sales was available for [redacted] companies representing $[redacted] in Systems market value, or [redacted]% of the Systems market value for all [redacted] fossil fuel reserve owners. Similar to the Altman Z, the EVA/Sales margin showed 69% of the companies for which we had data as Tier 1 risk–generating economic value added less than they are making in sales. Even during the current economic downturn, 12% of the fossil fuel companies generated Tier 3 EVA/Sales Risk–economic value at or above the ACWI 10-year average.

Physical Climate Risk

- Physical Climate Risk scores were available for [redacted] companies representing $[redacted] in Systems market value, or [redacted]% of the Systems market value for all [redacted] fossil fuel reserve owners. The physical climate risk scores indicate that the vast majority, [redacted]% of the [redacted] companies for which we had data, exhibit Tier 2 physical climate risk. [redacted] companies were classified as Tier 1 Physical Climate Risk.

Fossil Fuel Companies with All Tier 1 or All Tier 3 Climate and Financial Risks

Among the [redacted] companies, we found no companies registered all Tier 3 (lower risk), across all climate and financial risk metrics for which data was available. We found [redacted] companies ($[redacted] Systems market value), or [redacted] of the Systems market value for all [redacted] fossil fuel reserve owners, classified as Tier 1 risk in all categories for which we had data, outside of physical climate risk. As shown in Figure V.4, among the Systems [redacted] companies with Tier 1 risk in all categories, the single fossil fuel company largest exposure was $[redacted] invested in [redacted]. For metrics where data was available: [redacted] did not report emissions, had $0 green revenues; higher level emissions intensity and percent change in emissions intensity; an Altman Z-below [redacted], and an EVA/Sales below [redacted]. For [redacted], we had no Fossil Fuel Reserve Exposure data, and no TPI score.

Figure V.4 – Fossil Fuel Companies with Tier 1 Climate and Financial Risk[1]

Fossil Fuel Companies with Tier 1 Energy Transition and Financial Risk													
			Fossil Fuel Reserve Exposure Risk				Energy Transition Management Risk				Financial Risk		Physical Climate Risk
Issuer	Combined ($ mm)	GICS Sector	O&G Potential Stranded CapEx in SDS (%)	O&G Potential Stranded CapEx in B2DS (%)	Power & Utilities Coal B2DS Relative Alignment Index (%)	Power & Utilities Gas B2DS Relative Alignment Index (%)	TPI Mgmt Quality Score (or No Reporting)[2]	Green Revenue Share (%)	Emissions Intensity (tons CO_{2e}/$m revenue)	2-Yr % Change in Emissions Intensity (2016-2018) (%)	Altman Z- Score	EVA/ Sales (%)	427 Company Physical Risk Score
[redacted]													

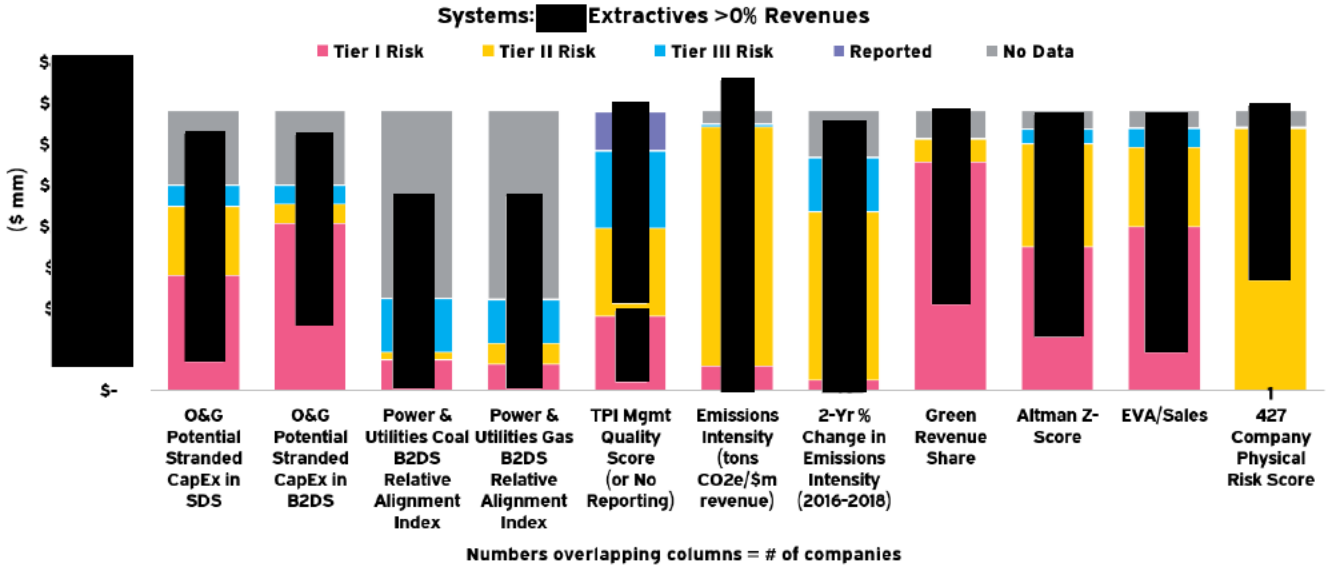
[1] Sources BAM, ISS, Bloomberg, Carbon Tracker, TPI, and 427.

[2] NR = No Reporting.

Extraction and Production Company Results

In this section we present results for the [redacted] companies that have extraction and production revenues, representing $[redacted] in Systems market value. As shown in Figure V.5, more than a 50% of the companies exhibited Fossil Fuel Reserve Exposure Tier 1 Risk by one or more of the four metrics for which we had data for a company. For financial risk metrics, more than two-thirds of the companies for which we had data were classified as Tier 1 risk in each metric, a higher percentage of companies than for all [redacted] fossil fuel owners. Among the Transition Management measures, 46% were classified as Tier 1 TPI Management Quality (or Reporting Emissions) Risk; 87% green revenue share risk. The majority of both Emissions Intensity and % Change in Emissions Intensity were categorized as Tier 2 risk.

Figure V.5 –267 Companies with >0% Extraction and Production Revenues[1]



Regarding Tier 3 (lower) risk there were few companies that classified as Tier 3 transition management risk. Seven percent of the companies were classified as Tier 3 risk, receiving a TPI Management Quality Score of 4 or 4+; [redacted] companies, generated greater than 20% green revenues to be classified as Tier 3, lower risk. A higher percentage, roughly one third of the fossil fuel companies exhibited Tier 1 Emissions Intensity Risk.

[1] Sources BAM, ISS, Bloomberg, Carbon Tracker, TPI, and 427.

Results for the [redacted] Integrated Oil Companies

In this section, we highlight results for the [redacted] integrated oil and gas companies. As shown in Figure V.6, [redacted] companies were classified as Tier 1 risk for Potential Stranded CapEx in either the B2DS or SDS scenario. [redacted] companies are Tier 1 risk in both scenarios. Data is available for every company for every metric among these large integrated oil companies, except for the Power and Utilities Coal and Gas Relative Alignment metrics, which are designed to capture energy transition risk of utility companies. Regarding Potential Stranded CapEx, [redacted] register as Tier 1 risk under both the Sustainable Development Scenario and the B2DS, indicating that more than 50% of the projected CapEx could be stranded under either scenario. [redacted] companies ([redacted]) are classified as Tier 1 risk under the B2DS projection, but drop to Tier 2 risk in SDS.

Figure V.6 – The [redacted] Integrated Oil Companies Climate and Financial Risk Indicators[1]

[redacted] Integrated Oil Companies Climate and Financial Risk Indicators														
			Fossil Fuel Reserve Exposure Risk				Energy Transition Management Risk				Financial Risk		Physical Climate Risk
Issuer	Combined ($ mm)	GICS Sector	O&G Potential Stranded CapEx in SDS (%)	O&G Potential Stranded CapEx in B2DS (%)	Power & Utilities Coal B2DS Relative Alignment Index (%)	Power & Utilities Gas B2DS Relative Alignment Index (%)	TPI Mgmt Quality Score (or No Reporting)	Green Revenue Share (%)	Emissions Intensity (tons CO_2/$m revenue)	2-Yr % Change in Emissions Intensity (2016-2018) (%)	Altman Z- Score	EVA/ Sales (%)	427 Company Physical Risk Score
[redacted]			34.4	57.1	100.0	100.0	4*	0.0	181.2	-41	1.2	-8.8	38.8
			31.9	60.0	100.0	56.3	3	0.0	396.6	-36	2.5	-12.7	47.1
			13.5	22.9	NA	NA	3	0.0	NA	NA	2.3	-1.1	50.9
			52.8	87.1	NA	NA	4	0.0	556.8	-51	2.3	-18.9	33.1
			59.7	74.9	NA	NA	4*	2.0	227.6	-34	1.4	-14.5	29.5
			55.3	91.5	0.0	100.0	3	0.0	443.9	-31	2.9	-7.0	42.5
			49.3	79.8	46.3	0.0	3	0.0	1825.7	-27	1.8	-5.1	31.1
			24.8	74.2	NA	NA	2	0.0	226.0	-33	3.6	1.8	32.0
			55.7	69.7	52.5	59.2	4	NA	212.6	-39	1.6	-3.7	42.8
			57.4	67.0	100.0	93.3	4*	3.5	238.8	-44	1.0	-5.2	31.6

The financial risk metrics indicate that every company except [redacted] showed an EVA/Sales below 0%, or Tier 1 risk. [redacted] registers as Tier 3 Altman Z risk, and Tier 2 EVA/Sales Risk. The [redacted] all show Tier 1 EVA/Sales risk, but Tier 2 Altman Z risk. These results reflect the financial strength of these [redacted] companies to weather economic and energy fluctuations. Based on our June 30 2020 financial data, [redacted] showed as Tier 1 Altman Z risk and Tier 1 EVA/Sales risk.

Regarding Energy Transition Management Risk, [redacted] companies, [redacted] all garner top TPI scores of 4-4*, indicating their companies have in place and are implementing a coherent energy transition strategy. The TPI Management Quality score for [redacted] was 3, or Tier 2 Risk. The Tier 1 (higher) TPI risk company [redacted]

[redacted] companies had 0% green revenues, or Tier 1 Risk. [redacted] both show Tier 2 Green revenue risk, indicating they have modest green revenue shares. Regarding Emissions Intensity, [redacted] showed Tier 2 Emissions Intensity risk. [redacted] showed Tier 3 Emissions Intensity Risk. The [redacted] for which we have two-year percent change in emissions intensity, all registered as Tier 2 risk on this metric.

[1] Sources BAM, ISS, Bloomberg, Carbon Tracker, TPI, and 427.

VI. Conclusions

Global markets have begun to undergo enormous change as the transition to renewable energy accelerates and physical climate risks escalate. More and more governments, corporations, and investors are actively increasing their support for an energy transition and seeking ways to mitigate physical climate risks. The climate policies of governments and of corporations are shifting to sharply curtail the use of fossil fuels, and low carbon alternatives are becoming cost competitive. The risks facing fossil fuel reserve owners are increasingly evident in the long-term decline of the traditional energy sector's market share and in the relatively poor financial health of over half the universe of fossil fuel owners. Escalating climate risks, including the risks of investment in fossil fuel reserve owners, are materially affecting investor returns and risk.

Mispricing of fossil fuel reserves risk seems to be less pronounced as markets evolve to take into account the shift to a low carbon economy. This long term shift reflects changes including the widespread attention to this issue; government climate policies being adopted; and low carbon alternatives becoming cost competitive and more mainstream. Portfolio construction alternatives to market-cap weighted indexes in which an investor has confidence, may provide prudent options to explore in weighting fossil fuel owners, as market-cap weighted indexes have not always provided higher risk-adjusted returns than alternative strategies.

Data availability is an essential element of investment analysis. In general, we found sufficient, but far from complete quality climate data available, with more data available for larger companies than for smaller companies. We expect that over time: the quality of climate data available on companies will continue to improve; the coverage of companies will continue to expand; and climate metrics will be refined, and newly developed, that potentially enhance our ability to analyze the climate risks that investors face.

As of June 30, 2020, the Systems were invested in [redacted] publicly listed fossil fuel owners, representing $[redacted], or [redacted]% of the Systems total market value, and [redacted]% of the Systems Public Equity and Fixed Income asset classes. Equity investments in fossil fuel owners accounted for $[redacted] and $[redacted] was invested in Fixed Income securities. We find that all [redacted] fossil fuel reserve owners contributed to the Systems exposure to emissions intensity by 10% - 20%.

We utilized both 1.5° C. and 3° C. future climate scenarios to assess the potential performance and risk impact on the Systems actual portfolios, including all fossil fuel reserve owners. We find under both scenarios, climate change has the potential to reduce, long term returns and increase portfolio volatility.

This analysis concludes with a company risk analysis that provides a more granular assessment of the [redacted] companies being considered for potential prudent divestment. Broadly, the company analysis indicates that companies have varying degrees of exposure to potential stranded assets and to transition risk. Some companies exhibited the potential stranded asset, transition management qualities, and financial health likely to underpin a successful transition to a low carbon economy. However, the majority of the companies exhibited high potential risk for economic disruption from a low carbon transition. In all, the analysis suggests that there are prudent divestment options that may help insulate the Systems from the increasing risks facing reserve owners while protecting return. The next and final report will analyze how tailored divestment options could affect portfolio performance.

VII. Appendices

A. Fossil Fuel Exposure

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C. Climate and Financial Risk Company Analysis

1. Risk Metrics Details
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3. Risk Metrics for All [redacted] Fossil Fuel Reserve Companies

A. Fossil Fuel Exposure

Appendix A-1:
MSCI, Trucost vs. ISS Definition of Fossil Fuel:
Number of Companies, Market Value, Market Cap, and GICS Exposure[1]

Fossil Fuel Reserve Owners Identified by MSCI - Absent from ISS (As of June 30, 2020)		
Company	Value Invested ($ mm)	Market Cap 2Q20 ($ mm)
[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]

Fossil Fuel Reserve Owners Identified by ISS - Absent from MSCI (As of June 30, 2020)			
MSCI - GICS Sector/Cap Size[2,3,4]	# of Issuers	Value Invested ($ mm)[5]	Market Cap 2Q20 ($ mm)
TruCost Grand Total ($ mm)[6]		[redacted]	
MSCI Grand Total ($ mm)			
[redacted]			

[1] Source ISS DataDesk.
[2] Mid cap - Market cap is anywhere between $2 billion and $10 billion.
[3] Small cap - Market cap is less than $2 billion.
[4] Issuers with missing market cap values are either subsidiaries (noted by an "*" asterisk) with market cap being available within their parent company or ISS was unable to extract the value.
[5] The "Value Invested" metric is the holdings value across all three plans BERS, TRS, and NYCERS. This is for both equity and fixed income.
[6] TruCost company details not available due to confidentiality agreements.

Fossil Fuel Reserve Owners Identified by ISS - Absent from MSCI (As of June 30, 2020)			
MSCI - GICS Sector/Cap Size[2,3,4]	# of Issuers	Value Invested ($ mm) [5]	Market Cap [redacted] ($ mm)
[redacted]			

Fossil Fuel Reserve Owners Identified by ISS - Absent from MSCI (As of June 30, 2020)			
MSCI - GICS Sector/Cap Size[2,3,4]	# of Issuers	Value Invested ($ mm)[5]	Market Cap [redacted] ($ mm)
Not Available	23	141	
[redacted]			

* Subsidiary.

Appendix A-2:
BERS – Total Public Equity and Fixed Income
Fossil Fuel Reserve Owner Exposure[1]

BERS Total Public Equity and Fixed Income Fossil Fuel Reserve Owner Exposure (As of June 30, 2020)								
GICS Sector	All FF Companies	>0 For Energy Purpose Revenue	>0% Extractive Revenue	>10% Extractive Revenue	>50% Extractive Revenue	>0% Thermal Coal Revenue No Oil or Gas Reserves	>10% Thermal Coal Revenue No Oil or Gas Reserves	>50% Thermal Coal Revenue No Oil or Gas Reserves
Total Systems Plan AUM ($ mm)	[redacted]							
Total Systems Public Listed AUM ($ mm)								
Total FF Exposure ($ mm)								
FF Percent of Total Systems Plan AUM (%)								
FF Percent of Total Public Listed AUM (%)								
Total FF Companies Represented								
Energy								
[redacted]								

[1] Source ISS DataDashboard.

Appendix A-3:
NYCERS – Total Public Equity and Fixed Income Fossil Fuel Reserve Owner Exposure[1]

NYCERS Total Public Equity and Fixed Income Fossil Fuel Reserve Owner Exposure (As of June 30, 2020)								
GICS Sector	All FF Companies	>0 For Energy Purpose Revenue	>0% Extractive Revenue	>10% Extractive Revenue	>50% Extractive Revenue	>0% Thermal Coal Revenue No Oil or Gas Reserves	>10% Thermal Coal Revenue No Oil or Gas Reserves	>50% Thermal Coal Revenue No Oil or Gas Reserves
Total Systems Plan AUM ($ mm)	[redacted]							
Total Systems Public Listed AUM ($ mm)								
Total FF Exposure ($ mm)								
FF Percent of Total Systems Plan AUM (%)								
FF Percent of Total Public Listed AUM (%)								
Total FF Companies Represented								
Energy								

[1] Source ISS DataDashboard.

Appendix A-4:
TRS – Total Public Equity and Fixed Income
Fossil Fuel Reserve Owner Exposure[1]

TRS Total Public Equity and Fixed Income Fossil Fuel Reserve Owner Exposure (As of June 30, 2020)								
GICS Sector	All FF Companies	>0 For Energy Purpose Revenue	>0% Extractive Revenue	>10% Extractive Revenue	>50% Extractive Revenue	>0% Thermal Coal Revenue No Oil or Gas Reserves	>10% Thermal Coal Revenue No Oil or Gas Reserves	>50% Thermal Coal Revenue No Oil or Gas Reserves
Total Systems Plan AUM ($ mm)	[redacted]							
Total Systems Public Listed AUM ($ mm)								
Total FF Exposure ($ mm)								
FF Percent of Total Systems Plan AUM (%)								
FF Percent of Total Public Listed AUM (%)								
Total FF Companies Represented								
Energy								
[redacted]								

[1] Source ISS DataDashboard.

Appendix A-5:
BERS – Top 10 Contributing Companies to Overall Share of Carbon Emissions[1,2]

Top 10 Contributing Companies to Overall Share of Carbon Emissions (Tons CO_{2e}) BERS Equity Plan						
Issuer Name	Market Value ($ mm)	Share of Carbon Emissions (Tons CO_{2e})	Percentage Contribution to Total Emissions (%)	Country of Incorporation	GICS Sector	Fossil Fuel Reserve Owner (Yes/No)
[redacted]						

[1] Data as of 2018.
[2] Source ISS DataDesk. For detailed methodology, please refer to Appendix C-1.

Appendix A-6:
NYCERS – Top 10 Contributing Companies to Overall Share of Carbon Emissions[1,2]

Top 10 Contributing Companies to Overall Share of Carbon Emissions (Tons CO_{2e}) NYCERS Equity Plan						
Issuer Name	Market Value ($ mm)	Share of Carbon Emissions (Tons CO_{2e})	Percentage Contribution to Total Emissions (%)	Country of Incorporation	GICS Sector	Fossil Fuel Reserve Owner (Yes/No)
[redacted]						

[1] Data as of 2018.
[2] Source ISS DataDesk. For detailed methodology, please refer to Appendix C-1.

Appendix A-7:
TRS – Top 10 Contributing Companies to Overall Share of Carbon Emissions[1,2]

Top 10 Contributing Companies to Overall Share of Carbon Emissions (Tons CO_{2e})
TRS Equity Plan

Issuer Name	Market Value ($ mm)	Share of Carbon Emissions (Tons CO_{2e})	Percentage Contribution to Total Emissions (%)	Country of Incorporation	GICS Sector	Fossil Fuel Reserve Owner (Yes/No)
[redacted]						

[1] Data as of 2018.
[2] Source ISS DataDesk. For detailed methodology, please refer to Appendix C-1.

B. Climate and Financial Risk Impact on Portfolio

Appendix B-1:
Benefits and Limitations of Scope 1, 2 and 3 Emissions

In this report, we present measurements of Scope 1 + 2 emissions. Concentrating on Scope 1 and 2, and excluding Scope 3 emissions has benefits and limitations.

One benefit of focusing on Scope 1 and 2 emissions is that both Scope 1 and 2 emissions are under more direct control of the company generating and reporting the emissions. Thus companies have better direct control to potentially lower Scope 1 and 2 emissions than they do over Scope 3. For example, an oil and gas company selling gasoline for use in transportation produces Scope 3 emissions from the consumers of their gasoline. The company does not have direct control of the emissions efficiency of vehicles in which their gas is used, and thus no control over these Scope 3 emissions. As the energy transition progresses, it may be argued that, to the degree that fossil fuel reserve owners increase their production and sale of renewable energy products for example, they can potentially have greater control over reducing their total Scope 3 emissions.

A second benefit of concentrating on Scope 1 and 2 emissions is that currently a significantly greater number of companies report Scope 1 and 2 emissions, while Scope 3 emissions are just beginning to be reported. For example, among the ISS climate database of 29,000 issuers, 5,473 companies report Scope 1 and 2 emissions, and only 1,441 companies report Scope 3 emissions. Similarly, MSCI finds that as of March 2020, only 18% of constituents of the MSCI ACWI IMI reported Scope 3 emissions. MSCI found even lower percentages of Scope 3 reporting for the individual Scope 3 categories.[1]

A third benefit of focusing on Scope 1 and 2 emissions is that including Scope 3 emissions can result in significant double-counting across companies within an investment portfolio. For example, if a utility buys all its gas from one oil and gas company, a portion of the Scope 3 emissions of that oil and gas company, would also be counted as emissions for the utility, both for powering its own operations, and for the utility's Scope 3 emissions from the use by its customers of the gas it sells. If both the oil and gas and the utility company are in the same investment portfolio, the portfolio's total carbon emissions would include emissions that were counted twice, once for the oil and gas company, and again for the utility. Similarly, a gallon of gasoline burned to drive a car will be counted as Scope 3 emissions for the oil and gas company, and for the automaker that sold the car to the consumer. Providing a precise decoupling of emissions among all companies is nearly impossible.

There are wide-ranging approaches to address the issue of double-counting of emissions in an investment portfolio. For example, in the recent EU regulation, and specifically the climate benchmarks, it is recommended not to de-duplicate for double counting, using the following argumentation.

> "In the context of this report and with the particular emphasis put on the risk reduction objective of investors using climate benchmarks, the TEG does not particularly recommend any management of double counting. Indeed, the same amount of emissions can be considered as a proxy – even if very imperfect – for financial risks related to climate change even if counted

[1] Scope 3 Emissions Seeing the Full Picture, MSCI, September 17, 2020 blog

> several times. Also, decarbonizing an investment is always a 'relative' exercise, be it relative to an investable universe or relative to itself – self-decarbonization. As soon as the same assumptions are applied, double counting does not represent an issue when decarbonizing. Reducing overall emissions including Scope 3 with no management of double counting therefore serves both the needs of global decarbonization and risks reduction objectives from investors."[1]

As an alternative, data providers are developing ways to use "de-duplication multipliers" to estimate Scope 1 + 2 + 3 emissions of an investment portfolio. For example, in September 2020, MSCI released its initial method to adjust for double counted emissions. MSCI calculates a market-wide de-duplication multiplier of approximately 0.205 by looking at the roughly 12,000 companies in the MSCI master climate-risk.[2] ISS has used in the past an approach that looks at specific ratios between different subsectors to implement double-counting measures, based on the composition of the portfolio. For example the ratio of double counting between utilities and car manufacturers might be X, and between energy and utilities Y.

A key limitation of excluding Scope 3 emissions are that typically, Scope 3 emissions account for a substantial share of a company's total emissions. For example, ISS Scope 3 emissions, when added to Scope 1 + 2 emissions resulted in a minimum increase of over 130% in total emissions, indicating that Scope 3 emissions were larger than Scope 1 + 2 emissions combined. Similarly, MSCI reports that the Scope 3 emissions of the integrated oil and gas industry (measured by the constituents of the MSCI ACWI Index) are more than six times the level of its Scope 1 + 2 emissions. Thus, our measures of the Systems portfolio Scope 1 + 2 emissions likely represent significantly less than half of the Systems total Scope 1 + 2 + 3 emissions.

A second limitation of excluding Scope 3 emissions is that the ratio of Scope 1 + 2 emissions to Scope 3 emissions varies dramatically among economic sectors and within broad economic sectors, such as the energy sector. For example, for the fossil fuel owners in this report, adding Scope 3 emissions increased total emissions for the energy sector companies by 887%, 269% for [redacted], 137% for [redacted], and 135% for [redacted], as calculated by ISS. Thus our Scope 1 + 2 emissions intensity data comparing individual fossil fuel reserve owners, would materially shift if Scope 1 + 2 + 3 were measured. Fossil fuel owners in the energy sector would be expected to register relatively much higher Scope 1 + 2 + 3 emissions than other sectors, compared to their relative numbers based on Scope 1 + 2 emissions.

[1] Source TEG Final Report on Benchmarks and Benchmarks' ESG Disclosures, EU Technical Expert Group on Sustainable Finance, September, 2019.

[2] Scope 3 Emissions Seeing the Full Picture, MSCI, September 17, 2020 blog.

Appendix B-2:
BERS[1]

BERS Total Public Equity Carbon Exposure With Fossil Fuel Owners (As of June 30, 2020)						
GICS Sector	Number of Companies	Market Value ($ mm)[2]	Total Scope 1 + Scope 2 Emissions (tons CO_{2e})	Scope 1+2 Carbon Footprint (tons CO_{2e}/ $m invested)	Scope 1 +2 Emissions Intensity (tons CO_{2e}/ $m revenue)	Scope 1 + 2 WA Emissions Intensity (tons CO_{2e}/ $m revenue)
Total BERS Public Equity	6,073	3,537.4	453,234.0	128.1	208.3	160.0
Energy	[redacted]	[redacted]	67,395.6	19.1	445.3	14.0
[redacted]	[redacted]	[redacted]	160,176.0	45.3	1064.8	55.9
[redacted]	[redacted]	[redacted]	94,327.0	26.7	2120.7	48.3
[redacted]	[redacted]	[redacted]	67,564.6	19.1	193.9	15.1
[redacted]	[redacted]	[redacted]	15,664.9	4.4	42.2	5.2
[redacted]	[redacted]	[redacted]	10,147.3	2.9	68.3	3.3
[redacted]	[redacted]	[redacted]	2,484.9	0.7	14.7	4.1
[redacted]	[redacted]	[redacted]	12,273.6	3.5	37.5	3.2
[redacted]	[redacted]	[redacted]	15,042.6	4.3	51.6	6.0
[redacted]	[redacted]	[redacted]	6,379.8	1.8	49.9	2.1
[redacted]	[redacted]	[redacted]	1,777.8	0.5	39.2	2.8
[redacted]	[redacted]	[redacted]	NA	NA	NA	NA

[1] Source ISS DataDesk. For detailed methodology, please refer to Appendix C-1.

[2] [redacted] of the total market value was unmapped by ISS.

BERS Total Public Equity Excluding Fossil Fuel Reserves Carbon Exposure (As of June 30, 2020)[1]						
GICS Sector	Number of Companies	Market Value ($ mm)[2]	Total Scope 1 + Scope 2 Emissions (tons CO_{2e})	Scope 1+2 Carbon Footprint (tons CO_{2e}/ $m invested)	Scope 1 +2 Emissions Intensity (tons CO_{2e}/ $m revenue)	Scope 1 + 2 WA Emissions Intensity (tons CO_{2e}/ $m revenue)
Total BERS Public Equity	5,895	3,399.7	350,043.0	103.0	178.0	141.0
Energy	[redacted]	[redacted]	23,419.0	6.9	458.8	5.4
[redacted]	[redacted]	[redacted]	134,113.8	39.4	1142.8	53.2
[redacted]	[redacted]	[redacted]	67,705.4	19.9	1991.4	41.2
[redacted]	[redacted]	[redacted]	65,395.4	19.2	219.9	15.5
[redacted]	[redacted]	[redacted]	15,658.7	4.6	42.2	5.4
[redacted]	[redacted]	[redacted]	10,147.3	3.0	68.3	3.4
[redacted]	[redacted]	[redacted]	2,484.9	0.7	14.7	4.2
[redacted]	[redacted]	[redacted]	7,918.7	2.3	25.3	1.1
[redacted]	[redacted]	[redacted]	15,042.6	4.4	51.6	6.3
[redacted]	[redacted]	[redacted]	6,379.8	1.9	49.9	2.2
[redacted]	[redacted]	[redacted]	1,777.5	0.5	39.2	2.9
[redacted]	[redacted]	[redacted]	NA	NA	NA	NA

[1] Source ISS DataDesk. For detailed methodology, please refer to Appendix C-1.

[2] [redacted] of the total market value was unmapped by ISS.

Appendix B-3:
NYCERS[1]

NYCERS Total Public Equity Carbon Exposure With Fossil Fuel Owners (As of June 30, 2020) GICS Sector	Number of Companies	Market Value ($ mm)[2]	Total Scope 1 + Scope 2 Emissions (tons CO_{2e})	Scope 1+2 Carbon Footprint (tons CO_{2e}/ $m invested)	Scope 1 +2 Emissions Intensity (tons CO_{2e}/ $m revenue)	Scope 1 + 2 WA Emissions Intensity (tons CO_{2e}/ $m revenue)
Total NYCERS Public Equity	9,274	33,431.5	4,921,621.1	147.2	210.2	175.3
Energy	[redacted]	[redacted]	723,047.1	21.6	386.9	15.5
[redacted]			1,656,551.0	49.6	947.0	47.0
			1,232,681.3	36.9	2,173.1	70.8
			738,773.5	22.1	194.3	14.6
			151,179.8	4.5	40.7	4.4
			133,733.1	4.0	60.4	4.4
			30,913.0	0.9	15.8	3.4
			64,770.0	1.9	18.2	2.7
			137,937.6	4.1	51.7	7.5
			33,384.8	1.0	32.5	1.5
			18,649.9	0.6	64.6	3.5
			NA	NA	NA	NA

[1] Source ISS DataDesk. For detailed methodology, please refer to Appendix C-1.

[redacted] of the total market value was unmapped by ISS.

NYCERS
Total Public Equity Excluding Fossil Fuel Reserves
Carbon Exposure
(As of June 30, 2020)[1]

GICS Sector	Number of Companies	Market Value ($ mm)[2]	Total Scope 1 + Scope 2 Emissions (tons CO_{2e})	Scope 1+2 Carbon Footprint (tons CO_{2e}/ $m invested)	Scope 1 +2 Emissions Intensity (tons CO_{2e}/ $m revenue)	Scope 1 + 2 WA Emissions Intensity (tons CO_{2e}/ $m revenue)
Total NYCERS Public Equity	9,047	31,888.5	3,592,162.7	112.7	170.3	149.5
Energy	[redacted]	[redacted]	215,782.1	6.8	355.8	4.4
[redacted]			1,186,299.8	37.2	900.4	43.5
			930,712.8	29.2	2,044.3	59.7
			724,931.4	22.7	212.5	15.2
			150,883.4	4.7	40.7	4.6
			133,733.1	4.2	60.4	4.6
			30,913.0	1.0	15.8	3.5
			28,939.5	0.9	8.4	0.9
			137,937.6	4.3	51.7	7.8
			33,384.8	1.1	32.5	1.6
			18,645.2	0.6	64.6	3.7
			NA	NA	NA	NA

[1] Source ISS DataDesk. For detailed methodology, please refer to Appendix C-1.

[2] [redacted] of the total market value was unmapped by ISS.

Appendix B-4:
TRS[1]

TRS Total Public Equity Carbon Exposure With Fossil Fuel Owners (As of June 30, 2020) GICS Sector	Number of Companies	Market Value ($ mm)[2]	Total Scope 1 + Scope 2 Emissions (tons CO_{2e})	Scope 1+2 Carbon Footprint (tons CO_{2e}/ $m invested)	Scope 1 +2 Emissions Intensity (tons CO_{2e}/ $m revenue)	Scope 1 + 2 WA Emissions Intensity (tons CO_{2e}/ $m revenue)
Total TCRS Public Equity	9,949	39,284.1	5,453,488.7	138.8	221.9	184.4
Energy	[redacted]	[redacted]	867,635.3	22.1	406.3	16.1
[redacted]			2,004,913.2	51.0	1,022.2	51.1
			1,204,934.6	30.7	2,246.5	55.8
			772,140.8	19.7	201.1	14.4
			146,574.9	3.7	40.9	4.9
			110,713.3	2.8	58.6	3.7
			33,998.3	0.9	17.3	23.1
			92,321.0	2.4	22.4	2.9
			151,470.3	3.9	53.2	7.4
			47,723.9	1.2	40.1	1.8
			21,063.2	0.5	41.0	3.1
			NA	NA	NA	NA

[1] Source ISS DataDesk. For detailed methodology, please refer to Appendix C-1.

[2] [redacted] of the total market value were unmapped by ISS.

TRS Total Public Equity Excluding Fossil Fuel Reserves Carbon Exposure (As of June 30, 2020)[1]						
GICS Sector	Number of Companies	Market Value ($ mm)[2]	Total Scope 1 + Scope 2 Emissions (tons CO_{2e})	Scope 1+2 Carbon Footprint (tons CO_{2e}/ $m invested)	Scope 1 +2 Emissions Intensity (tons CO_{2e}/ $m revenue)	Scope 1 + 2 WA Emissions Intensity (tons CO_{2e}/ $m revenue)
Total TCRS Public Equity	9,689	37,369.7	3,849,166.8	103.0	175.3	159.4
Energy	[redacted]	[redacted]	222,212.8	5.9	359.7	4.0
[redacted]			1,512,529.5	40.5	1,014.9	47.8
			812,228.4	21.7	1,878.4	45.6
			743,858.5	19.9	213.4	14.8
			145,792.8	3.9	40.9	5.1
			110,713.3	3.0	58.6	3.9
			33,998.3	0.9	17.3	24.3
			47,579.5	1.3	12.0	1.0
			151,470.3	4.1	53.2	7.8
			47,723.9	1.3	40.1	1.9
			21,059.5	0.6	41.0	3.3
			NA	NA	NA	NA

[1] Source ISS DataDesk. For detailed methodology, please refer to Appendix C-1.

[2] [redacted] of the total market value were unmapped by ISS.

Appendix B-5:
Top Carbon Emitters Share of Emissions Intensity[1]

Top Contributing Companies to Overall Share of Carbon Emissions (Tons CO_{2e})					
Number of Companies	Market Value ($ mm)	Share of Carbon Emissions (millions tons CO_{2e})	Percentage Contribution to Total Emissions (%)	Number of Companies that are FFRO	Percentage Contribution of FFRO to Total Emissions (%)
BERS Equity[2]	3,537.4	0.5	100.0	[redacted]	22.8
10	45.6	0.1	29.8		6.0
100	288.8	0.3	73.4		18.1
NYCERS Equity[3]	33,431.5	4.9	100.0		25.3
10	347.6	1.1	21.5		8.1
100	2,681.4	3.2	65.7		19.5
TRS Equity[4]	39,284.1	5.5	100.0		29.4
10	373.4	1.1	20.5		9.1
100	2,903.0	3.5	64.0		24.1

[1] Data as of 2018. Source ISS DataDesk. For detailed methodology, please refer to Appendix C-1.
[2] Emissions data not collected for 427 of the total 5,649 companies.
[3] Emissions data not collected for 598 of the total 9,274 companies.
[4] Emissions data not collected for 626 of the total 9,949 companies.

C. Climate and Financial Risk Company Analysis

Appendix C-1:
Risk Metrics Details

Metric	Oil and Gas Extraction and Production Potential Stranded CapEx in SDS
Data Source	Carbon Tracker Initiative
Definition of Metric	Percent of projected unsanctioned oil & gas CapEx through 2030 that does not fit inside IEA's Sustainable Development Scenario ("SDS") of CapEx up to New Policies Scenario ("NPS").
Description of Metric	Carbon Tracker's analysis focuses on supply costs; it is assumed that the lowest cost projects will be most competitive in a low demand world. CapEx spent on higher cost projects runs a greater risk of failing to deliver adequate returns and being wasted. This metric allows investors to understand whether a company's fossil fuel generation is aligned with the temperature goal in the Paris Agreement and the extent its coal and gas capacity is at risk from becoming financially or economically obsolete. Potential CapEx/supply is capped at the level of the International Energy Agency ("IEA")'s central New Policies Scenario (which assumes no further policy action on climate beyond that already announced, rather than full supply and considered by the IEA to be consistent with a 50% chance of 2.7°C warming). In effect, this assumes that projects above this level are already heavily discounted by investors. Carbon tracker focuses on the delta from this level down to the carbon-constrained scenarios. Ignoring higher cost projects makes the results more conservative, but also means that not all opportunities to destroy value are reflected.
Data Collection	Analysis uses the climate benchmark scenarios developed by the International Energy Agency ("IEA") with the 1.6°C Beyond 2 Degrees Scenario ("B2DS") and the 1.7-1.8°C Sustainable Development Scenario ("SDS"). IEA scenarios are sourced from the World Energy Outlook 2018 and Energy Technology Perspectives 2017.

Metric	Oil and Gas Extraction and Production Potential Stranded in B2DS
Data Source	Carbon Tracker Initiative
Definition of Metric	Percent of projected unsanctioned oil & gas CapEx through 2030 that does not fit inside IEA's Beyond 2 Degree Scenario ("B2DS") of CapEx up to New Policies Scenario ("NPS").
Description of Metric	Carbon Tracker's analysis focuses on supply costs; it is assumed that the lowest cost projects will be most competitive in a low demand world. CapEx spent on higher cost projects runs a greater risk of failing to deliver adequate returns and being wasted. This metric allows investors to understand whether a company's fossil fuel generation is aligned with the temperature goal in the Paris Agreement and the extent its coal and gas capacity is at risk from becoming financially or economically obsolete. Potential CapEx/supply is capped at the level of the International Energy Agency ("IEA")'s central New Policies Scenario (which assumes no further policy action on climate beyond that already announced, rather than full supply and considered by the IEA to be consistent with a 50% chance of 2.7°C warming). In effect, this assumes that projects above this level are already heavily discounted by investors. Carbon tracker focuses on the delta from this level down to the carbon-constrained scenarios. Ignoring higher cost projects makes the results more conservative, but also means that not all opportunities to destroy value are reflected.
Data Collection	Analysis uses the climate benchmark scenarios developed by the International Energy Agency ("IEA") with the 1.6°C Beyond 2 Degrees Scenario ("B2DS") and the 1.7-1.8°C Sustainable Development Scenario ("SDS"). IEA scenarios are sourced from the World Energy Outlook 2018 and Energy Technology Perspectives 2017.

Metric	Power and Utilities Relative Coal Alignment with B2DS to 2040
Data Source	Carbon Tracker Initiative
Definition of Metric	The fraction of a company's future coal portfolio that is aligned with the energy demands of B2DS. A company's coal phase-out schedule can either be in alignment with, behind or ahead of the B2DS schedule, where 100% = perfect alignment.
Description of Metric	The alignment is calculated by summing up the total coal capacity under a Below 2 Degrees scenario for each year between 2018 and 2040 and dividing that by the total coal capacity under a Business as Usual scenario (i.e. the current plans of the company).
Data Collection	Disclosure information from company websites, annual report climate scenarios, and sustainability reports.

Metric	Power and Utilities Relative Gas Alignment with B2DS to 2050
Data Source	Carbon Tracker Initiative
Definition of Metric	The fraction of a company's future gas portfolio that is aligned with the energy demands of B2DS. A company's gas phase-out schedule can either be in alignment with, behind or ahead of the B2DS schedule, where 100% = perfect alignment.
Description of Metric	The alignment is calculated by summing up the total gas capacity under a Below 2 Degrees scenario for each year between 2018 and 2040 and dividing that by the total gas capacity under a Business as Usual scenario (i.e. the current plans of the company).
Data Collection	Disclosure information from company websites, annual report climate scenarios, and sustainability reports.

Metric	TPI Management Quality
Data Source	Transition Pathway Initiative ("TPI")
Definition of Metric	TPI evaluates and tracks the quality of companies' governance/management of their greenhouse gas emissions and of risks and opportunities related to the low-carbon transition. The Management Quality score assess how well –prepared companies are for the low-carbon transition. It aims to evaluate what the transition to a low-carbon economy looks like for companies with a high impact on climate change. The companies are rated on a 0-4 scale, with 4 being the lowest risk.
Description of Metric	Management Quality describes companies' carbon management practices, in other words their governance of greenhouse gas emissions and the risks and opportunities arising from the low-carbon transition. For example, Management Quality indicators include whether a company has a climate-change policy in place, to what extent it discloses its emissions, and whether the company has allocated board responsibility for climate change.
Data Collection	TPI works with the company directly and utilizes the FTSE Russell, where appropriate.

Metric	Emission Intensity (intensity metric of emissions per USD invested)
Data Source	ISS
Definition of Metric	Carbon Intensity is presented as an intensity metric of emissions per USD invested, attributing an investment's share of emissions to the investor. This metric displays how many tons of CO2e an investor would finance in relation to the respective ownership in a certain company or portfolio. Carbon emissions of a company can be used to measure the carbon footprint of the company. Scope 1 emissions refer to all direct GHG emissions, or in other words, emissions from sources that are owned or controlled by the operating company. Scope 2 emissions refer to all indirect GHG emissions stemming from the consumption of purchases electricity, heat or steam. Scope 3 emissions are all indirect emissions not covered in Scope 2. This includes both upstream and downstream supply chains such as the extraction and production of purchased materials and fuels, flight emissions, waste disposal investments, etc. Importantly, reporting of Scope 3 emissions is not mandatory under the GHG Protocol.
Description of Metric	$$\frac{\sum_i^n \frac{Investering\ i\ selskapet_i}{Market\ Cap\ of\ Comapny_i} \times Total\ Emissions\ of\ Company_i}{Total\ Investment\ (Portfolio)}$$ This metric displays how many tons of CO2e an investor would finance in relation to the respective ownership in a certain company or portfolio. The metric describes the carbon intensity of an investment amount. A company's share of emissions is determined by the value of shares held based on the company's market cap. For this to be accurate, it is important to control for the date of measurement and financial information used.
Data Collection	ISS ESG collects all publicly available self-reported greenhouse gas emissions data. Common sources include Corporate Sustainability Reports, CDP, Bloomberg Surveys, Investor Relations and other company communication and manually researched data. Once self-reported emissions data from all available sources is collected, the data is then tested for trustworthiness through a combination of quantitative and qualitative analysis.

Metric	2-Yr Percentage Change in Emissions Intensity
Data Source	ISS
Definition of Metric	The change represents the percent change over two years (2016-2018) of a company's emission intensity. Companies that demonstrate improvements in intensity can demonstrate these strategies through a reduction of Scope 1 and Scope 2 emissions over two years.

Metric	Green Revenues (SDG Solutions Assessment)
Data Source	ISS
Definition of Metric	Revenues from any product or service that make significant or limited contribution to mitigating climate change/Total Company Revenues. For the purposes of this report, we define Green Revenues as the combined category of Limited Contribution and Significant Contribution. ISS provided us with Green Revenue data as of June 24, 2020. In addition, as a form of verification, we ran the System's names against the FTSE (Fiscal Year 2018) Company Green Revenues. Of the 72 shared names, between the two data sets, we found a 77% correlation.
Description of Metrics	The Green Revenues (Environmental Objective) has an objective to stabilize greenhouse gas concentrations in the atmosphere at a level that would hold the increase in the global average temperature well below 2°C or even 1.5°C above preindustrial levels. All Objective Scores range on a scale from -10.0 (i.e. 100% of net sales are generated with products/services classified as having a significant obstructing impact) to 10.0 (i.e. 100% of net sales are generated with products/services classified as having a significant contributing impact) with an underlying classification into five broad categories as follows with product examples: • Significant Obstruction – Oil and coal-based energy – Related key components and services • Limited Obstruction – Combustion engines and vehicles – Cruise ships; road/air transport – Key services to oil/coal production – Conventional palm oil – Conventional ruminal meat • No (Net) impact – Natural gas-related products/services – Majority of other products/services • Limited Contribution – Rail transport – Bus transport – Alternative drives – Nuclear power – LEDs • Significant Contribution – Solar and wind power – Small-scale hydropower – Insulating materials – Battery technology
Data Collection	The main sources are a company's most recent Annual Report and Segment Reporting. Further relevant information on products and services can be derived from the company's website or other documents such as Sustainability Reports or Investor Presentations. These different sources are taken into account in order to present a realistic picture of a company's product portfolio and its sustainability impacts.

Metric	Altman Z-Score
Data Source	Bloomberg
Definition of Metric	A numerical measurement used to predict the likelihood of a business going bankrupt.
Description of Metric	The Altman Z-Score is a credit-strength test developed in 1968 by Edward Altman. Using five financial ratios related to profitability, leverage, liquidity, solvency and activity, it is used to predict whether a company has a high risk of insolvency. It is calculated as follows: The original formula was created for publicly traded manufacturing companies. Z-Score = 1.2(A) + 1.4(B) + 3.3(C) + 0.6(D) + 1.0(E) Where: A = Working Capital (Current Assets – Current Assets) / Total Assets (Measures liquidity of firm) B= Retained Earnings / Total Assets (measures accumulated profits compared to assets) C= Earnings Before Interest & Taxes (EBIT) / Total Assets (measures how much profit the firm's assets are producing) D= Market Value of Equity (Mkt. Cap. + Preferred Stock) / Total Liabilities (compares the company's value versus its liabilities) E= Sales / Total Assets (efficiency ratio – measures how much the company's assets are producing in sales) Z-Score Results: Z-Score of < 1.81 represents a company in distress Z-Score between 1.81 and 2.99 represents the "caution" zone Z-Score of over 3.0 represents a company with a safe balance sheet

Metric	Economic Value Added/Sales
Data Source	ISS
Definition of Metric	A measure of company profitability in excess of the cost of capital, where an EVA/Sales margin above 0% indicates a firm is earning above its cost of capital, operating its business as economically viable.
Description of Metric	Economic Value Added/Sales ("EVA/Sales") is a measure of profitability after all capital costs. It is an estimate for a firm's true economic profit. If the margin is above zero, the firm is earning above its cost of capital and through time should be able to continue to operate its business as economically viable. Using the EVA as a measurement for all sources and uses of capital allows for a more accurate picture of operations, specifically with asset heavy fossil fuel operators. Without these adjustments and charges, a true view of profitability is unable to be achieved. As a formula, EVA is NOPAT, or net operating profit after taxes, less a capital charge that one computes by multiplying the firm's capital base by its cost of capital. EVA = NOPAT – A Capital Charge EVA = NOPAT – Cost of Capital x Capital

Metric	Physical Climate Risk Scores
Data Source	427
Definition of Metric	Company Physical Climate Risk Score incorporates supply chain, operations, and market physical climate risks, and may range from 0 (least risk) to 100 (highest risk).
Description of Metric	Four Twenty Seven's physical risk score comprises three key components: Operations Risk, Supply Chain Risk, and Market Risk. Each dimension of risk is scored on a scale of 0 to 100, from the least exposed (low score) to the most exposed (high score). Scores are normalized so companies' climate risk can be compared across diverse portfolios. Assessing the Physical Climate risk score leverages global climate change data to provide asset-level risk assessments of corporations and score the exposure to climate change impacts of public companies. Four Twenty Seven provides a view of each company's exposure to the physical impacts of climate change across its value chain.
Data Collection	Four Twenty Seven sources its climate data from a curated ensemble of 5 climate models from CMIP 5 (IPCC data), downscaled by NASA (NASA Earth Exchange Global Daily Downscaled Projections) to 0.25 degrees = 25 x 25km for heat and precipitation. Sea level rise and flood exposure is assessed at the parcel level (90x90m) and water risk is assessed at the watershed level. Four Twenty Seven sources its company data from a variety of data providers.

Background Metric	Carbon Reserves Revenues
Data Source	ISS
Definition of Metric	The share of revenue a company derives from its exposure to fossil fuels (thermal coal, oil, and gas) is a quantitative measure used to measure the company's involvement in fossil fuel reserves. It allows investors to capture involvement for companies beyond industry sector classification. Knowing the percent of revenues from fossil fuels plays a key role in assessing how material fossil fuels are assumed to be in the company's business. ISS ESG's fossil fuel revenue data covers both direct operations as well as operations that are ≥20% owned by the company (including subsidiaries, joint ventures, associates, and affiliates). These revenue shares are attributed in proportion to ownership.
Description of Metric	The revenue factors provide the minimum and maximum percentage for the company's involvement in the production of fossil fuels through extraction, refining & processing, and electricity generation for the most recent fiscal year.
Data Collection	Sources of data include annual reports, regulatory filings, sustainability reports, press releases, investor presentations, company websites, and other company disclosures. Third-party information such as government sources, industry databases, and reputable newspapers are cross-referenced as supplemental to company disclosures. ISS ESG combines all these sources to estimate fossil fuel revenues as accurately as possible based on the available disclosure. The data is updated annually based on the latest publicly available information. To ensure transparency, ISS ESG clearly indicates when revenue data is company disclosed and when it is estimated/calculated.

Background Metric	Carbon Reserves Data
Data Source	ISS
Definition of Metric	Carbon reserves (coal, oil, and gas reserves) data identifies the physical fossil fuel reserves owned by a company. Knowing how much carbon reserves a company possesses plays a key role in assessing the climate risks associated with investments in fossil fuels, including stranded asset risk. ISS ESG data on carbon reserves covers fossil fuel projects that are ≥10% owned by the company either directly or indirectly through subsidiaries/joint ventures/associates/affiliates.
Description of Metric	Fossil fuel projects refer to projects that explore for or produce fossil fuels. Fossil fuel reserves are usually accounted for on a project level given their geologic nature. Companies own interests in fossil fuel reserves that are discovered in these fossil projects. The ISS layers of ownership are not confined to any limit, but the ultimate ownership percentage is limited to 10% minimum. In the following example, Company A's ownership in Company D is 80%*50%*50%=20%, which is above 10%, so Company A would be flagged for fossil fuel reserves in ISS database (so would Company B and Company C). This ownership chain can get longer, but what ultimately matters is the percentage of equity stake the ultimate parent company has over the subsidiary in question. ISS applies a 10% minimum threshold for fossil fuel reserves owners, mainly because, given the complexity of exploring for and extracting fossil fuels, it is common for multiple companies to join forces and divide up the ownership to below 10%. Given the large amount of reserves at stake, a 10% interest can be huge in itself. ISS ESG identifies companies that own carbon reserves under the following categories: • Coal reserves (proven, probable) • Oil reserves (1P, 2P, 3P, contingent, prospective) • Natural gas reserves (1P, 2P, 3P, contingent, prospective) • Bitumen reserves (1P, 2P, 3P, contingent, prospective) • Natural gas liquids reserves (1P, 2P, 3P, contingent, prospective) 1P = proven reserves 2P = proven AND probable reserves 3P = proven AND probable AND possible reserves
Data Collection	Sources of data include annual reports, regulatory filings, sustainability reports, press releases, investor presentations, company websites, and other company disclosures. Third-party information such as government sources, industry databases and reputable newspapers are cross referenced as supplemental to company disclosures. ISS ESG combines all these sources to estimate fossil fuel revenues as accurately as possible based on the available disclosure. The data is updated annually based on the latest publicly available information. To ensure transparency, ISS ESG clearly indicates when revenue data is company disclosed and when it is estimated/calculated.

Appendix C-2:
Systems Overview of Results

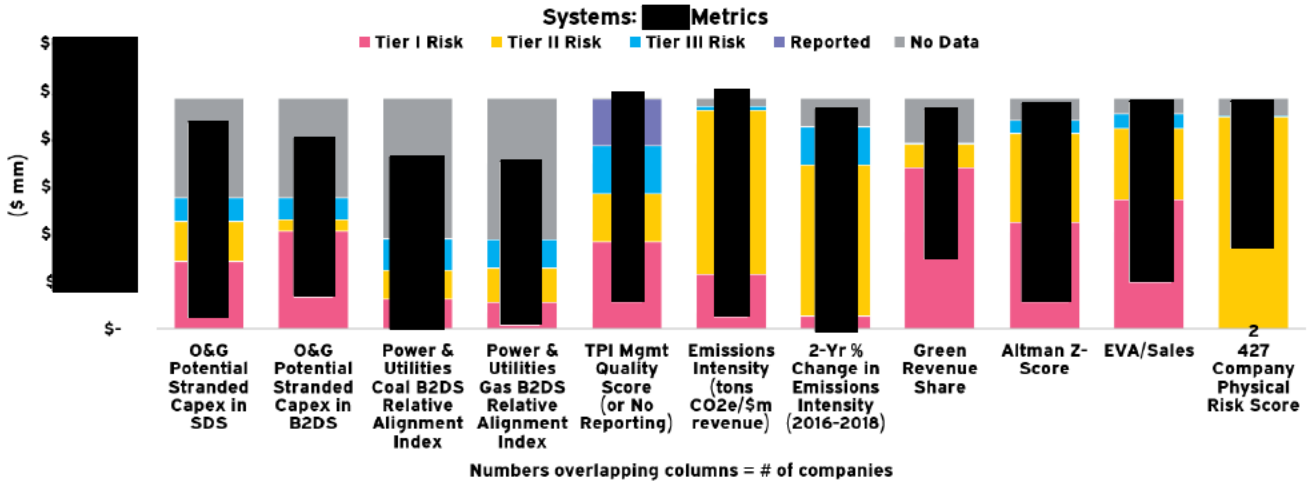
This section summarizes our findings for the [redacted] fossil fuel companies' climate and financial risk metrics. These companies together represented $[redacted] in Systems market value, or [redacted]% of the Systems total Plan AUM, and [redacted]% of the Systems Publicly Listed AUM.

Fossil Fuel Reserve Exposure Risk

The [redacted] companies for which we had Potential Stranded CapEx data had a Systems market value of $[redacted], approximately [redacted]% of the $[redacted] in market value for the full set of [redacted] fossil fuel companies. Tier 1 (higher risk) was evident in [redacted] companies in B2DS and [redacted] companies in SDS, as shown in Figure V.3. Tier 1 risk includes all companies for which at least 50% of their projected capital expenditures are expected to be stranded. Respectively [redacted] companies (B2DS) and [redacted] companies (SDS) exhibited Tier 2 (medium risk). There were respectively [redacted] companies (B2DS) and [redacted] companies (SDS) that exhibited Tier 3 (lower risk). Tier 1 risk included any company with 0% of their projected capital expenditures expected to be stranded.

The [redacted] companies for which we had Power and Utilities Coal and Gas B2DS Relative Alignment Data represented $[redacted] in Systems market value, or [redacted]% of the Systems market value for all [redacted] fossil fuel companies. For these metrics, Tier 1 (higher risk) includes all companies in the top 1st and 2nd quartiles of risk. Tier 2 (medium risk) and Tier 3 (lower risk) represent respectively all companies with 3rd quartile and 4th quartile risk.

Figure V.3 – Bar Charts of Systems Metrics[1]



As shown in Figure V.3, Tier 1 (higher risk) was evident in [redacted] companies in coal relative alignment, and [redacted] companies in gas relative alignment. Respectively [redacted] companies ([redacted]) and [redacted] companies (gas) exhibited Tier 2 (medium risk). There were respectively [redacted] companies (coal) and [redacted] companies (gas) that exhibited Tier 3 (lower risk).

[1] Sources BAM, ISS, Bloomberg, Carbon Tracker, TPI, and 427.

Energy Transition Management Risk

- TPI Management Quality Score (or ISS Emissions Reporting) covers [redacted] companies that represented $[redacted], [redacted]% of the Systems market value exposure to all [redacted] fossil fuel reserve owners. The results included [redacted] of the [redacted] companies that had TPI scores. The TPI Score (or ISS Emissions Reporting) metric identified [redacted] companies ($[redacted] Systems market value) as Tier 1 risk, [redacted] companies ($[redacted] market value) as Tier 2 Risk. [redacted] fossil fuel reserve owners ($[redacted] market value) exhibited Tier 3 (lower risk) because they were scored as a 4 or 4* by TPI in their transition management An additional [redacted] companies, representing $[redacted] in market value, had no TPI score but were identified by ISS as companies that provide some reporting on emissions.
- Emissions Intensity metrics were available for [redacted] companies that represented $[redacted], or [redacted]% of the Systems Market Value for the [redacted] fossil fuel reserve companies. Among these, respectively [redacted] companies ($[redacted] market value), and [redacted] companies ($[redacted] market value) were identified as Tier 1 and Tier 2 risk. [redacted] companies ($[redacted] market value) exhibited Tier 3 Emissions Intensity risk.
- The % Change in Emissions Intensity metrics were available for [redacted]
- $[redacted] or [redacted]% of the Systems market value for all [redacted] fossil fuel companies. Among these, [redacted] companies ($[redacted] market value) were identified as Tier 1 risk; [redacted] companies ($[redacted] exhibited Tier 2 risk, and [redacted] companies ($[redacted] market value) showed Tier 1 risk.
- Green Revenue Share data was available for [redacted] companies representing $[redacted], or [redacted]% of the Systems market value for all [redacted] fossil fuel companies.. Most of the companies for which we had data showed little or minimal revenue transition to green revenues. The [redacted] Tier 1 risk companies totaled $[redacted] in market value. An additional [redacted] companies ($[redacted] market value show Tier 2 green revenue share risk. Four companies, representing $[redacted] market value, met the 20% threshold for green revenue share to be classified as Tier 3 risk.

Financial Risk

The financial risk metrics show most owners of fossil fuel reserves facing financial hardships. These results reflect the financial data was as of June 30, 2020, in the midst a significant economic downturn, and near-term upheaval for fossil fuel energy consumption.

- The Altman Z-Score was available for [redacted] companies, representing $[redacted] in Systems market value, or [redacted]% of the Systems market value for all [redacted] fossil fuel reserve owners. Among these, [redacted] companies ($[redacted]) were classified as Tier 1 risk, or likely facing insolvency. An additional [redacted] companies ($[redacted] market value) registered Tier 2 Risk levels, above high risk for insolvency, but below Tier 3, which in an indicator of solid financial status. [redacted] of the [redacted] companies, as indicated by the Altman Z-Score were on healthy financial footing, even in the midst of the current economic downturn.
- EVA/Sales was available for [redacted] companies representing $[redacted] in Systems market value, or [redacted]% of the Systems market value for all [redacted] fossil fuel reserve owners. Similar to the Altman Z, the EVA/Sales margin showed [redacted] companies ($[redacted] market value) as Tier 1 risk – generating economic value added less than they are making in sales. Another

[redacted] companies [redacted] market value) exhibited Tier 2 EVA/Sales Risk-generating economic value below the 10-year MSCI ACWI average. Even during the current economic downturn, [redacted] fossil fuel companies ($[redacted] market value) generated Tier 3 EVA/Sales Risk – economic value at or above the ACWI 10-year average.

Physical Climate Risk

- Physical Climate Risk scores were available for [redacted] companies representing $[redacted] in Systems market value, or [redacted]% of the Systems market value for all [redacted] fossil fuel reserve owners. The physical climate risk scores indicate that the vast majority, [redacted] companies ($[redacted] market value) exhibit Tier 2 physical climate risk. Thirteen companies ($[redacted] market value) registered Tier 1 risk, and 2 companies ($[redacted]) were classified as Tier 1 Physical Climate Risk.