Maryland State Retirement and Pension System

MARYLAND
STATE RETIREMENT
and PENSION SYSTEM

Maryland Pension Risk Mitigation Act

Risk Assessment

January 2022

Introduction

In accordance with the State Personnel and Pensions Article § 21-116(e) (MSAR #11752), The Maryland Pension Risk Mitigation Act, the Board of Trustees is submitting an assessment of risk for the several Systems. The overarching risk to the System is a failure to meet pension obligations in full and on time. There are many potential causes for such a failure. This report will focus on risks associated with the investment program.

The Board of Trustees is charged with the responsibility of managing the assets of the Maryland State Retirement and Pension System. Investment policies are designed to support the fulfillment of the Board's mission to optimize risk-adjusted returns to ensure that sufficient assets are available to pay benefits to members and beneficiaries when due.

In pursuing this mission, the most powerful tool at the Board's disposal is its long-term strategic asset allocation policy. The strategic asset allocation policy establishes a mix of investment types (stocks, bonds, real estate, etc.) that collectively are modeled to produce the required return with the least risk over the horizon of the pension liabilities. The Board works with its independent investment consultant and staff to establish this long-term policy. Beyond this top-down approach, the Investment Division also contributes to the System's risk management process in its implementation of the strategic asset allocation.

A mix of techniques are utilized at both levels of the investment process. The Board of Trustees and the Investment Division regularly engage with other market participants, including public pension plan peers, financial institutions, and academia, to ensure the System's investment policies and procedures represent leading practices.

Collectively, the Board's strategic allocation and the implementation of that allocation by staff could lead to heightened risk of a funding shortfall if:

1. The collection of assets in the strategic asset allocation fail to achieve the expected returns
2. The collection of assets in the strategic asset allocation achieve the average return over long periods of time, but experience extreme negative returns in the near term, reducing the value of System assets
3. The implementation of the strategic asset allocation by Investment Division staff markedly underperforms the benchmark returns
4. The implementation of the strategic asset allocation does not maintain sufficient liquidity to make benefit payments

The System continues to make progress on its risk management practices including how it addresses climate risk. In addition to dedicating additional personnel and technological resources to risk management, the Board's strategic asset allocation work continues to evolve. From an opportunity standpoint, the System's portfolio is invested in companies that could benefit from the transition to a lower carbon economy. Consistent with the proxy voting policies and procedures detailed in the Investment Policy Manual, the System also addresses climate risk through its engagement and advocacy efforts. Recent highlights include:

1. *Human Capital*. The Investment Division added a Senior Risk Analyst to the team in the spring of 2021 and a new position, Senior Governance Manager, was created during the year as well. The

Senior Governance Manager will be an active member of the Investment Division. The individual will support the overall investment program by leading the Investment Division's governance activities and chairing the Environment, Social, and Governance Committee and the Diversity, Equity, and Inclusion Committee, among other responsibilities.

2. *Systems Infrastructure*. Staff recently procured BlackRock's Aladdin Risk system and began the software implementation project during the second half of 2021. Among other benefits, Aladdin offers a suite of headline ESG analytics, including carbon emissions data, from several third party vendors with the option to enable additional metrics at a future date.

3. *Strategic Asset Allocation*. Meketa Investment Group (Meketa) led the strategic asset allocation review in the summer of 2021. Climate analysis was a key input of the process for the first time. The Board adopted a policy mix that shared characteristics with the "climate sensitive" option and held up well in climate scenario analysis.

4. *Active Management and Sustainable Investments*. As part of its investment strategy, the System utilizes active management in public and private markets. Successful active management strategies are expected to benefit from trends, including the climate transition, that produce winners and losers. In public markets, Staff generally expects its active managers to overweight securities issued by companies better positioned to navigate the climate transition as compared to their respective benchmark indices. While benchmarking is more challenging in private markets, Staff maintains a similar expectation that the System's portfolio will include companies seeking to capitalize on the transition to a lower carbon economy. For example, Staff believes the largest future winners could be relatively small investments today in the System's venture capital portfolio. Representative portfolio themes include solar, commercial fusion energy research, and plant-based foods.

5. *Engagement and Advocacy*. As detailed in its ESG Risk Committee Report, which is due to be updated in February 2022, the System was an early signatory to the United Nations Principles of Responsible Investing (UNPRI) and is a member of the Ceres Investor Network on Climate Risk and Sustainability. The System is also a member of the Sustainability Accounting Standards Board (SASB) Alliance program, which promotes best practices in the disclosure and reporting of sustainability information. The Board of Trustees has adopted extensive proxy voting policies addressing ESG risks, and engages with corporations, regulatory agencies, lawmakers or associations to support the principles outlined in these policies. As an example, in the spring of 2021, the System joined other public pension plans by voting in favor of three director nominees seeking to promote change at Exxon due to the company's lack of action related to transition to favorable climate related transition process. The three nominees won seats on the Exxon board and contributed to Exxon adopting a long term strategic objective to reduce its carbon emissions.

Assessment of the System's Investment Risk

Strategic Asset Allocation

Periodically, the System conducts an asset allocation review that evaluates long-term expected returns for the System as well as a variety of different measures of risk. Meketa Investment Group (Meketa), the Board's general consultant, led the most recent strategic asset allocation review in September 2021 which explicitly addressed climate risk. In addition to presenting a "climate sensitive" policy option for consideration, Meketa applied four scenarios related to climate risk to all policy options considered.

The policy option recommended by Meketa and Staff, which was approved by the Board, shares key characteristics with the climate sensitive option and also incorporates beneficial aspects of the other policy options. Moreover, Staff and Meketa arrived at the recommendation policy mix by factoring in real world concerns such as capacity, implementation timelines, and transaction costs while recognizing the uncertainty associated with various models and assumptions.

Asset Allocation Policy Options

	Current Policy (%)	Recommended (%)	Liability Efficient (%)	Leverage (%)	Climate Sensitive (%)	Peer Average (%)
Growth/Equity	**50**	**50**	**46**	**48**	**46**	**55.5**
US Equity	16	15	15	15	12	26
Developed non-US Equity	10	9	8	9	9	12.5
Emerging Market Equity	11	10	9	9	8	6.5
Private Equity	13	16	14	15	17	10.5
Credit	**9**	**8**	**7**	**7**	**8**	**7.5**
High Yield, Bank Loans & EM Debt	5	4	3	3	8	4.5
Private Debt	4	4	4	4	0	3
Rate Sensitive	**19**	**21**	**18**	**23**	**18**	**17.5**
Cash & US Investment Grade Bonds	5	6	4	7	6	14
Long-term Government Bonds	10	10	10	10	8	2.5
TIPS	4	5	4	6	4	1
Real Assets	**14**	**15**	**21**	**20**	**20**	**14**
Real Estate	10	10	10	10	14	9
Natural Resources and Infrastructure	4	5	7	5	4	3
Commodities and Gold	0	0	4	5	0	1
Absolute Return	**8**	**6**	**8**	**8**	**8**	**5.5**
Expected Return (20 years)	*7.03*	*7.11*	*7.09*	*7.17*	*7.07*	*6.80*
Standard Deviation	*12.9*	*13.0*	*12.6*	*12.9*	*12.7*	*13.3*
Probability of 6.8% over 20 Years	*52.7*	*53.8*	*53.6*	*54.6*	*53.3*	*49.5*

Source: Meketa Investment Group

Regarding return objectives, the asset allocation review incorporates different considerations driving the System's long-term return requirements including factors such as its actuarial assumed rate of return, policy benchmark (i.e. market return of the strategic asset allocation assuming it could be invested passively), expected future inflation, projected cash flows, and liability status. This exercise analyzes the prospects for achieving the return objective using the System's existing asset classes, as well as any opportunities that may increase return or reduce risk by investing in new or alternative asset classes. In addition, the review compares the System's asset allocation to peer retirement systems. The expected return over a twenty-year horizon of the System's strategic allocation is 7.11%, based on Meketa's capital market expectations as published in their 2021 Asset Study of Assumptions.

The asset allocation review also analyzes numerous measures of risk including statistical and scenario-based approaches. These approaches help evaluate the risk that a period of underperformance could severely impact the existing pool of assets. These approaches include:

- Historical Scenarios Analysis: Assessing how the System would have performed in different historical scenarios with its current asset allocation. There are many different types of events that could result in sub-par returns for the System. In particular, extreme shocks such as the Global Financial Crisis and the Stagflation of the 1970s would have the most severe impact.

Historical Negative Scenario Analysis
Cumulative Return

Scenario	Current Policy (%)	Recommended (%)	Liability Efficient (%)	Leverage (%)	Climate Sensitive (%)	Peer Average (%)
COVID-19 Market Shock (Feb 2020-Mar 2020)	-15.2	-13.8	-14.0	-14.4	-13.7	-18.4
Taper Tantrum (May - Aug 2013)	-1.5	-1.2	-1.2	-1.5	-1.7	-0.3
Global Financial Crisis (Oct 2007 - Mar 2009)	-23.6	-22.1	-21.5	-22.2	-21.7	-27.9
Popping of the TMT Bubble (Apr 2000 - Sep 2002)	-6.6	-5.4	-4.3	-3.6	-1.4	-12.4
LTCM (Jul - Aug 1998)	-8.0	-6.9	-6.7	-7.1	-6.7	-8.9
Rate spike (1994 Calendar Year)	1.6	0.9	1.8	1.8	1.0	2.6
Crash of 1987 (Sep - Nov 1987)	-9.3	-8.2	-7.7	-7.7	-7.1	-11.7
Strong dollar (Jan 1981 - Sep 1982)	3.8	4.8	4.2	3.5	7.1	3.2
Volcker Recession (Jan - Mar 1980)	-4.5	-4.2	-3.6	-4.3	-2.3	-4.1
Stagflation (Jan 1973 - Sep 1974)	-20.1	-19.1	-11.2	-11.4	-17.2	-20.5

Source: Meketa Investment Group

- Stress Testing: Estimating the possible risk of various changes in market conditions (e.g., interest rates, credit risk, currency fluctuations) by varying degrees. The largest market risk factors are equity market declines and widening credit spreads.

Stress Testing: Impact of Market Movements
Expected Return under Stressed Conditions

Scenario	Current Policy (%)	Recommended (%)	Liability Efficient (%)	Leverage (%)	Climate Sensitive (%)	Peer Average (%)
10-year Treasury Bond rates rise 100 bps	2.2	1.9	2.2	2.1	2.1	3.5
10-year Treasury Bond rates rise 200 bps	-3.1	-3.6	-2.9	-3.3	-2.7	-1.1
10-year Treasury Bond rates rise 300 bps	-7.8	-8.2	-7.6	-8.5	-6.3	-4.3
Baa Spreads widen by 50 bps, HY by 200 bp	1.0	1.1	1.0	0.9	1.1	0.5
Baa Spreads widen by 300 bps, HY by 1000 bp	-19.9	-18.9	-18.5	-19.3	-18.3	-21.6
Trade Weighted Dollar gains 10%	-3.7	-3.4	-3.4	-3.7	-2.8	-3.5
Trade Weighted Dollar gains 20%	-1.5	-1.1	-1.6	-1.8	-0.2	-1.2
U.S. Equities decline 10%	-5.5	-5.4	-4.9	-5.0	-5.0	-5.8
U.S. Equities decline 25%	-16.2	-15.7	-15.1	-15.7	-15.6	-17.1
U.S. Equities decline 40%	-24.4	-23.3	-23.1	-24.0	-23.1	-26.6

Source: Meketa Investment Group

- Inflation Stress Testing: Estimating the possible risk of various changes in market conditions (e.g., interest rates, credit risk, currency fluctuations) by varying degrees. The largest market risk factors are equity market declines and widening credit spreads.

Inflation Stress Testing: Impact of Market Movements
Expected Return under Inflationary Conditions

Scenario	Current Policy (%)	Recommended (%)	Liability Efficient (%)	Leverage (%)	Climate Sensitive (%)	Peer Average (%)
Inflation moderately higher than expected	-0.20%	-0.26%	-0.23%	-0.21%	-0.36%	-0.12%
Inflation meaningfully higher than expected	-1.01%	-1.17%	-1.15%	-1.13%	-1.44%	-0.98%
High Growth and Moderate Inflation	5.51%	5.08%	5.32%	5.28%	5.40%	6.39%
High Growth and High Inflation	5.64%	5.22%	5.73%	5.64%	5.83%	6.84%
Low Growth and Moderate Inflation	-2.89%	-2.66%	-2.46%	-2.54%	-2.54%	-2.79%
Low Growth and High Inflation	-2.60%	-2.37%	-1.94%	-2.06%	-2.00%	-2.19%
Brief, moderate inflation spike	-2.41%	-2.13%	-1.39%	-1.60%	-1.37%	-1.86%
Extended, moderate inflation spike	-5.57%	-5.09%	-3.83%	-4.19%	-3.94%	-5.20%
Brief, extreme inflation spike	-7.58%	-6.97%	-5.33%	-5.80%	-5.55%	-7.32%
Extended, extreme inflation spike	-9.60%	-8.87%	-6.87%	-7.43%	-7.23%	-9.53%

Source: Meketa Investment Group

- Value at Risk (VaR) and CVaR: Statistical measures of potential large drawdowns in the market value of investments. VaR is a measure of the risks to the System in the majority of potential outcomes, generally 67% to 99% of the time. The System's conditional value at risk (CVaR), evaluates the range of outcomes assuming the market is already outside the reasonably expected range. This is often described as a tail risk or black swan event. The System's one-month CVaR, as reflected in the below table, indicates the policy allocation could lose 9.4% of market value in a single month. This potential loss of 9.4% is an average of the worst 1% of cases, so it possible for an extreme outlying event to produce a greater loss.

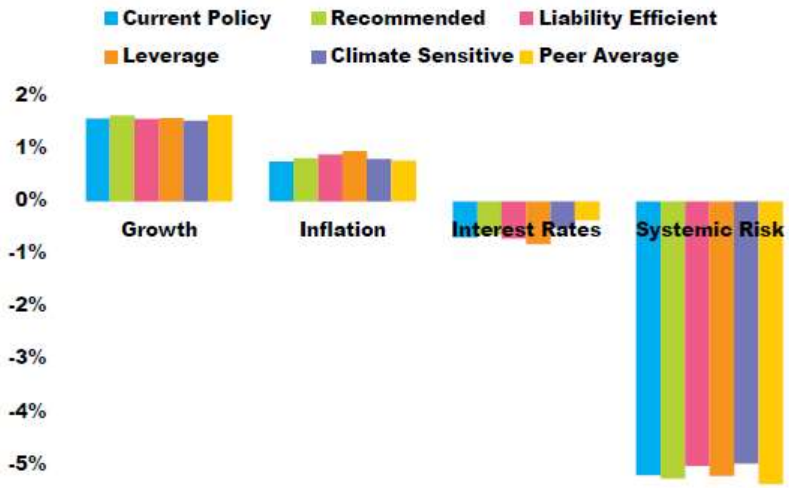
Conditional Value at Risk

Scenario	Current Policy	Recommended	Liability Efficient	Leverage	Climate Sensitive	Peer Average
CVaR (%):						
1 month	-9.3	-9.4	-9.0	-9.3	-9.2	-9.6
3 months	-15.3	-15.4	-14.8	-15.3	-15.0	-15.8
6 months	-20.4	-20.6	-19.8	-20.4	-20.1	-21.3
CVaR ($ mm):						
1 month	-5,805	-5,851	-5,641	-5,812	-5,725	-6,005
3 months	-9,542	-9,616	-9,257	-9,546	-9,401	-9,900
6 months	-12,784	-12,880	-12,379	-12,776	-12,583	-13,307

Source: Meketa Investment Group

- Economic Regime Management (ERM) Factor Sensitivity: A measure of the System's exposure to several economic risk factors (e.g., interest rate, growth, inflation). The largest risk exposure to the System is Systemic Risk, which was the main driver of the global financial crisis during the 2008-2009 period. Because most of the volatility of returns is a result of equity price risk, the System is also sensitive to changes in growth rates. Interest rate and inflation surprises have smaller impacts on the System.

ERM: Portfolio Sensitivity Comparison



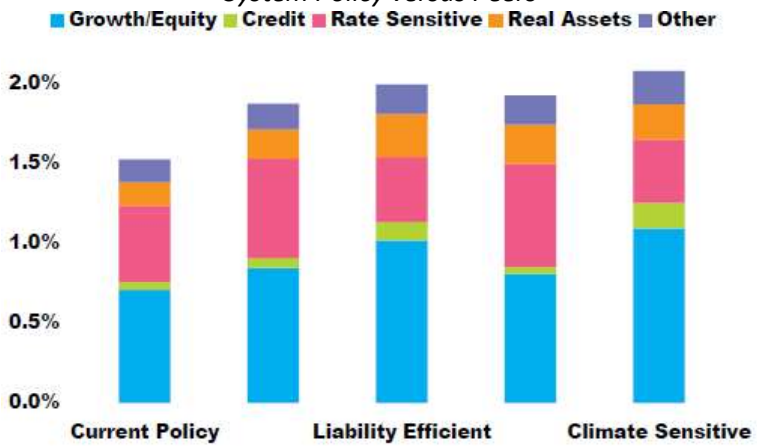
Source: Meketa Investment Group

- Tracking Error Attribution: Estimates the expected variation in performance versus peers over time. While not a direct risk to the System, it is important for Trustees to evaluate the asset allocation relative to the peer average. Tracking error is a metric that can be used to measure the variability of the System's returns versus the peer average. With the current asset allocation, the System can expect long-term variability of the difference between the System's return and the peer average return (tracking error) to average 1.87% per annum due to differences in asset allocation.

The vast majority of tracking error stems from the System's allocations to equities and rate sensitive fixed income differing from peers. Supplemental information in the report discusses the process of determining asset class expected returns and risk, as well as a comparison to peers' expected return forecasts. However, the System's expected return exceeds the expected peer return by 0.31% per annum and the variability of that return is higher. A good portion of the 1.87% tracking error is a result of the expected peer returns being lower and more volatile.

Sources of Tracking Error

System Policy versus Peers



Source: Meketa Investment Group

- Climate Risk: Meketa included climate scenario modeling as part of the asset allocation review. In addition to two temperature rising scenarios, policy and technology scenarios were modeled as well. The 1.5 degree scenario represents a fairly aggressive mitigation of climate change while 3 degrees is generally consistent with current emissions trends continuing with minimal mitigation. The policy scenario evaluates cases with rises in oil and natural gas prices consistent with a $100/tCO2 carbon tax implemented over the next decade while removing cases where fossil fuel reserve owners had increasing profits. The technology scenario evaluates cases with a 3% improvement (i.e., reduction) in carbon intensity of electricity generation over the next decade.

Climate Risk

Expected Return in Climate Stressed Scenarios

Scenario	Current Policy (%)	Recommended (%)	Liability Efficient (%)	Leverage (%)	Climate Sensitive (%)	Peer Average (%)
3 Degrees Celsius	6.54%	6.61%	6.62%	6.69%	6.78%	6.41%
1.5 Degrees Celsius	6.15%	6.21%	6.20%	6.30%	6.14%	6.09%
Policy	5.94%	5.96%	5.96%	5.98%	5.99%	5.84%
Tech	6.50%	6.53%	6.47%	6.50%	6.56%	6.39%

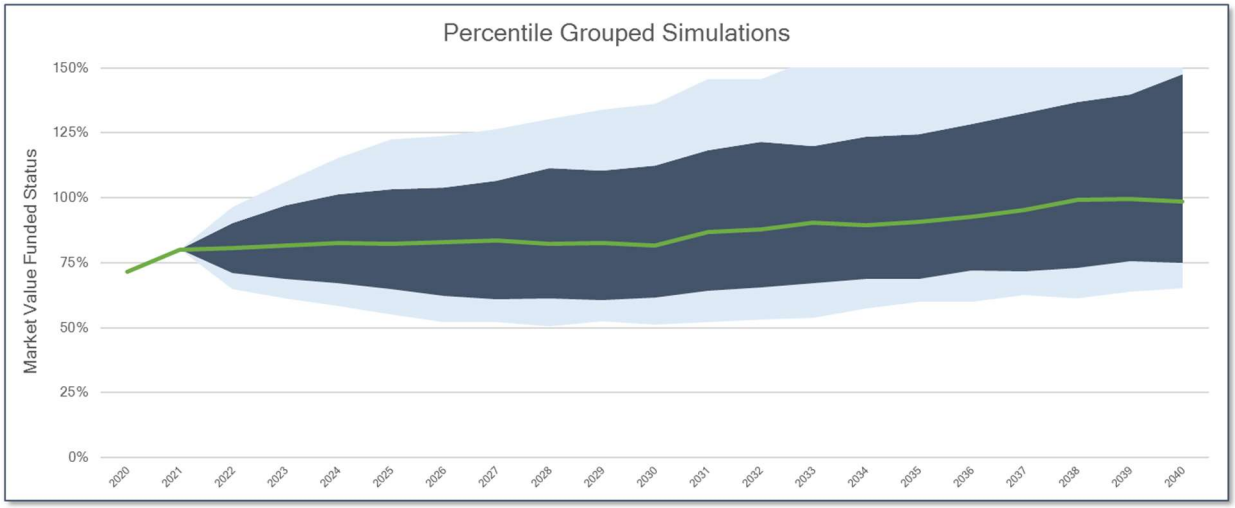
Source: Meketa Investment Group

Funded Status Stress Testing

Evaluating changes to the System's funded ratio based on both historical scenarios and stress tests, as well as varying the sequence of investment returns over time, an equity market downturn has the most serious negative impact on funded status. Additionally, because the System currently pays more in benefits than it receives in contributions from the employees and employers, the sequence of returns is important. That is, the System could earn its actuarial rate of return, on average, over the next twenty years but still find itself well short of its anticipated funded status. For example, if the System has weak returns in years 1-10 offset by stronger returns in the future, the System's ending funded status would be projected to be lower than if it produced its assumed rate of return in each year.

Meketa presented an asset-liability analysis at the during the strategic policy review in September 2021. Using simulations, Meketa looked at the range of asset market value outcomes based on the policy mix, projected benefit payments, funded status, and funding policy. Similarly, Meketa evaluated how simulated inflation environments will impact the System's liabilities. The graph below summarizes the asset and liability outcomes in terms of funded status. According to the simulations, there is a risk of funded status falling to 53% by year five if poor returns are realized. However, the median outcome suggests the funded status will be 98% by year 20 with average returns.

Simulation-based Stress Test of Funding Ratio

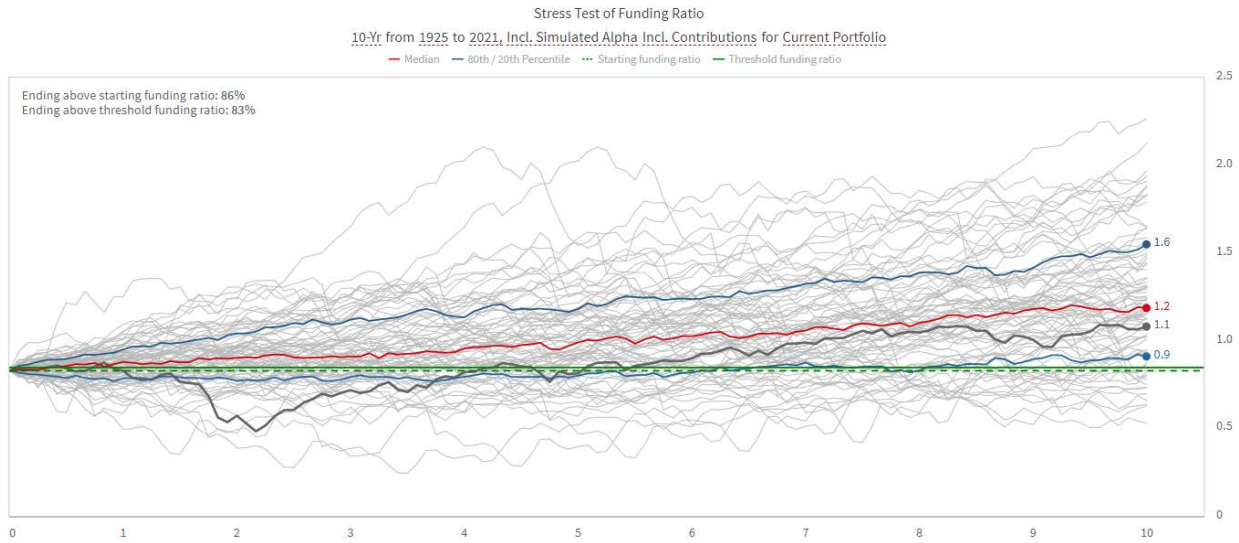


Source: Meketa Investment Group

To complement Meketa's analysis above, the Investment Division is also able to utilize a risk budgeting tool provided by one of the System's investment managers, Bridgewater Associates, to perform an asset-liability management analysis of the strategic policy. The chart below presents a stress test of the System's funding ratio using 10-year time horizons, re-sampled every two years, since 1925. According to this analysis, using historical asset class returns and historical cash yields, there is an 83% chance of ending the prospective 10-year period at 85% funded. As reported in the fiscal year 2020 Comprehensive Annual Financial Report, the System targets a funding ratio of 85% by 2030. As a note of caution, however, prospective returns are not anticipated to be of the same magnitude as those

included in this analysis due in part to the current low level of interest rates. To be clear, this analysis is not a forecast but is a helpful starting point to evaluate the sensitivity to lower expected returns.

Historical Stress Test of Funding Ratio over 10-year Periods (1925-Present)



Source: Maryland State Retirement Agency, Bridgewater Associates

The below table expresses the ending funding ratios in terms of annualized total returns based on historical asset class performance and historical cash yields. Again, this information is not intended to serve as a forecast but as a basis for understanding the relationship between total returns and funding status over a 10-year timeframe.

Scenario Outcome	**Ending Funding Ratio**	**Annualized Total Return (Historical Cash)**
Median	1.2	9.6%
20th Percentile	0.9	7.4%
80th Percentile	1.6	12.7%

Source: Maryland State Retirement Agency, Bridgewater Associates

Climate Risk Analysis

Much like the broader industry, the System's ability to measure and model the effects of climate change evolves constantly. In addition to incorporating climate risk as part of the strategic asset allocation review, this section presents other ways in which climate risk can be analyzed in the context of the System's investment portfolio. Carbon footprint analysis is not new to the Risk Assessment this year, but a recent software procurement will bring about better analytics in the near future.

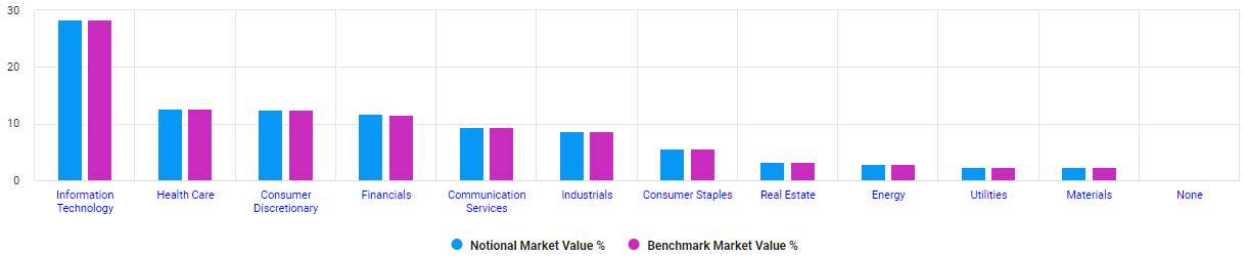
Estimating the impact of climate change on long-term risk and return forecasts across financial markets involves a meaningful degree of uncertainty. This year's report also includes additional perspectives from Bridgewater Associates and BlackRock to supplement the sector modeling from Meketa. These additional points of view are included in the report to show how different market participants approach the forecasting challenge. Going forward, the Investment Division will monitor the accuracy of the various forecasts and look for any changes/improvements in modeling techniques as the transition plays out.

Carbon Footprint Analysis – Maryland US Large Cap Equity Portfolio

As indicated in the Introduction, the Investment Division recently procured a new risk analytics software platform, BlackRock's Aladdin Risk. Aladdin Risk includes ESG metrics from a number of third-party vendors, allowing Staff to analyze climate risk in portfolios and benchmarks. At the time of writing, the software implementation project is not complete at the total System portfolio level. However, Staff is able to analyze certain portfolios at this time. The following analysis relates to the System's internally managed passive US large cap equity portfolio. Since this analysis is conducted on a passive strategy, there are no material differences from the benchmark. The intent of this reporting is to introduce the analytics rather than draw any meaningful conclusions about this particular portfolio's climate risk relative to its benchmark.

The first chart shows the sector allocation of the portfolio as compared to its benchmark, Russell 1000 Index. This snapshot allows Staff to observe the portfolio's exposure to sectors like energy and utilities that tend to be more carbon intensive. Given the passive strategy, there are no material overweights or underweights.

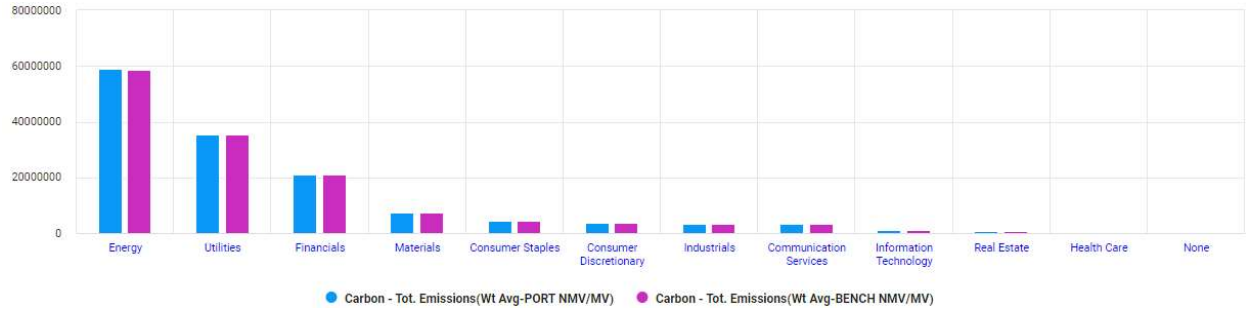
Sector Exposures



Source: Maryland State Retirement Agency, BlackRock

The Total Carbon Footprint metric from Sustainalytics is calculated as total Scope 1/direct and Scope 2/indirect emissions in CO2 equivalent metric tons. After energy and utilities, financials and materials have the largest carbon footprints while information technology, real estate, and health care show the lowest footprint on this basis.

Total Carbon Footprint – Sustainalytics



Source: Maryland State Retirement Agency, BlackRock, Sustainalytics

Carbon Intensity from Refinitiv for portfolio and benchmark sectors is shown below. This metric divides emissions by revenue to estimate firms' reliance on fossil fuels in generating economic activity. Utilities, energy, and materials report the highest carbon intensity. The lowest scores are observed in the communication services, information technology, health case, and financials sectors. The intensity score for financials is noteworthy given that it ranks third highest in terms of Sustainalytics' carbon footprint data.

Carbon Intensity – Refinitiv

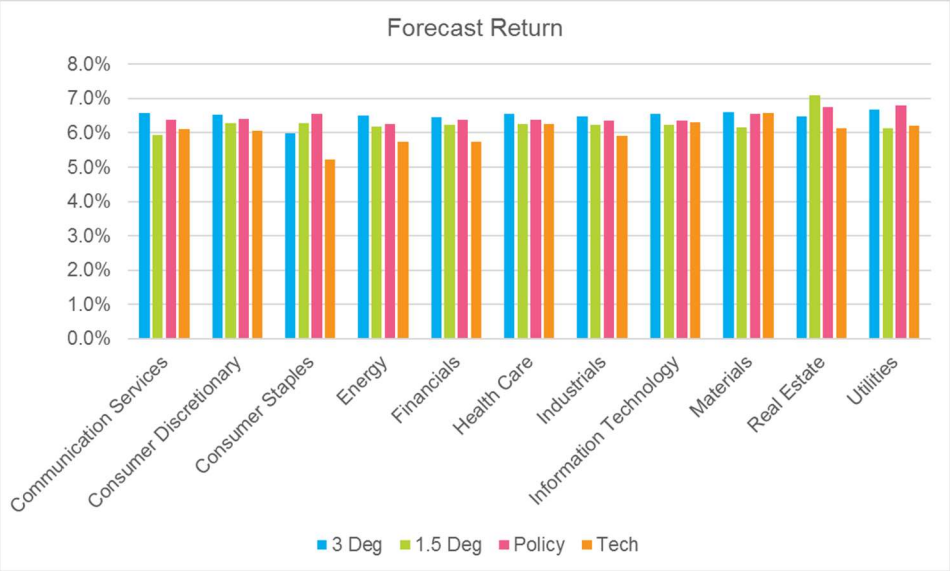
Source: Maryland State Retirement Agency, BlackRock, Refinitiv

As the Aladdin Risk implementation project concludes, the Investment Division looks forward to expanding this analysis across the entire public and private equity portfolios and the respective benchmark indices. Having access to multiple vendors' metrics in one platform will give the Investment Division a more diverse perspective as it seeks to understand how companies, and therefore sectors, countries, and ultimately the System's portfolio and benchmark, rank in terms of climate risk. Importantly, Aladdin Risk will also allow the Board and the Investment Division to track the evolution of these analytics over time to observe the transition to a lower carbon economy in real time.

Meketa Investment Group – US Public Equity Sector Climate Change Analysis

The Investment Division has been working with Meketa on climate change modeling for the last several years. As described in prior Risk Assessments, Meketa's model runs 185 million simulations to generate a range of possible impacts of climate change on the System's portfolio over a ten-year horizon. The analysis estimates financial impacts across 35 risk factors in 44 asset classes that interact both directly and indirectly. In prior analyses, Meketa has examined the impact of a 2°C increase in global average temperature and a commensurate level of carbon dioxide emissions over the subsequent ten years.

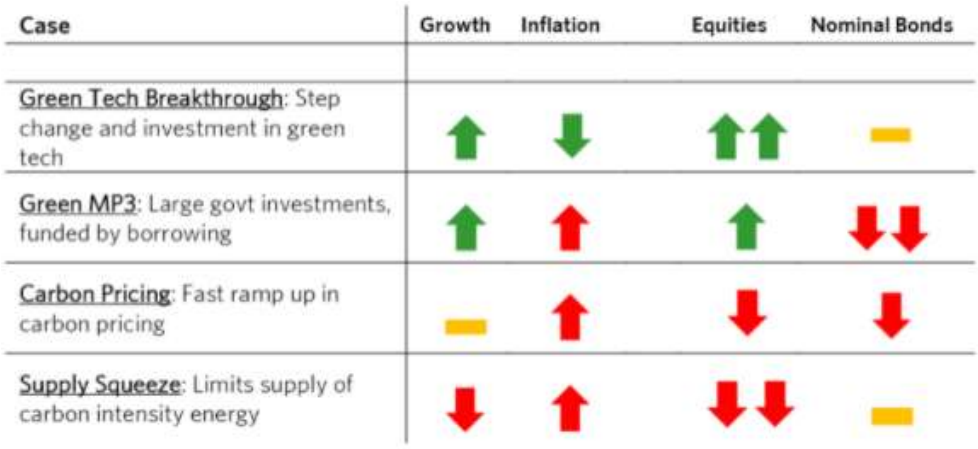
This year's analysis includes four climate scenarios – 3°C temperature increase/minimal mitigation, 1.5°C temperature increase/heavy mitigation, policy/carbon tax, and technology/carbon intensity reduction – as shown above in the section on strategic asset allocation. The following chart applies the scenarios across sectors of the US public equity market. Meketa's baseline return expectation for US stocks is 7.0% over the next ten years. In general, sector forecasts are lower in each scenario as compared to the base case for domestic equities, consistent with the lower-than-base case returns shown in the climate risk analysis included in the strategic asset allocation section above.



Source: Meketa Investment Group

Bridgewater Client Observatory – Stress Testing Your Portfolio against a Climate Transition

- Bridgewater has provided an interactive tool that allows clients to evaluate the impact of four potential climate transition scenarios.
- As shown in the following graphic, each scenario brings about different projections for growth, inflation, and asset prices.



Source: Bridgewater Associates

- Staff applied Bridgewater's climate transition scenario analysis to the strategic policy mix adopted in the fall of 2021 as well as a peer asset allocation and a 60/40 portfolio. The below table provides the results of the analysis. Based on Bridgewater's assumed return and risk forecasts, the System's policy mix has the highest expected total return over the next decade. The four climate scenarios demonstrate similar impacts across the four portfolios.

Portfolio	**Expected Total Return**	**Green Tech Estimated Impact**	**Green MP3 Estimated Impact**	**Carbon Pricing Estimated Impact**	**Supply Squeeze Estimated Impact**
MSPRS	7.2%	+0.5%	+0.3%	-0.6%	-0.9%
Peer average	6.8%	+0.5%	+0.3%	-0.7%	-0.9%
60/40	5.7%	+0.5%	+0.2%	-0.6%	-0.9%

Source: Maryland State Retirement Agency, Bridgewater Associates, Meketa Investment Group (peer average)

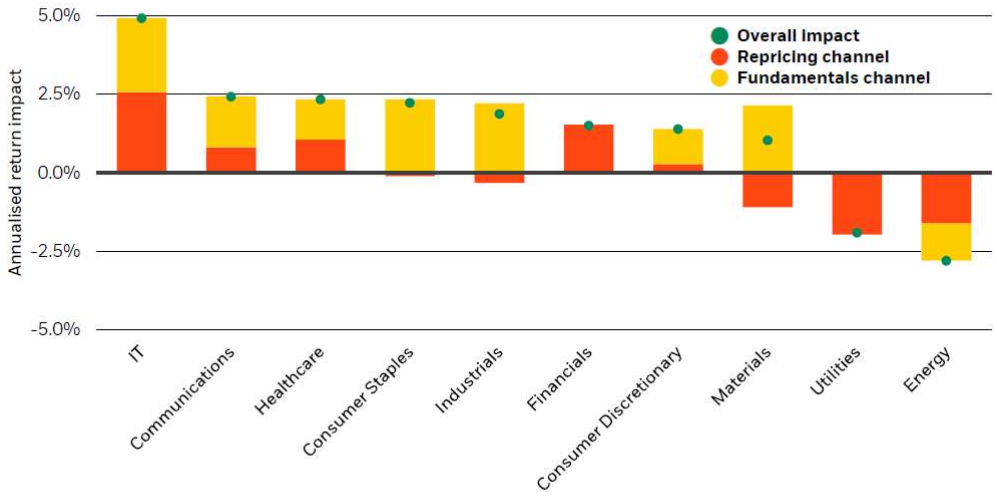
- Bridgewater's analysis is designed to reflect the implications of a rapid (6-12 month) pricing-in of the five year policy and economic implications of each climate scenario. While the market could price in the implications of each scenario over a longer time period, such as a decade or more, this analysis provides Staff with a useful tool to stress test the climate risk of its policy mix under different regimes.

BlackRock Investment Institute – Climate Change – Turning investment risk into opportunity

- BlackRock models climate change in terms of physical damage, energy transition, and public policy and their impact of macroeconomic variables such as GDP. While their "green transition" framework includes elements of the various scenarios developed by Meketa and Bridgewater, BlackRock expects the impact will be a net positive globally albeit with regional and sector differences. This optimistic viewpoint contrasts with Meketa's scenario analysis that generally points to lower returns across US equity sectors.
- "Our CMAs reflect our view that the green transition to a low carbon economy, consistent with the Paris Agreement goals, will deliver an improved outlook for growth and risk assets relative to doing nothing."
- "Macro variables such as GDP would be different in a world that is transitioning to a low carbon future, meaning traditional risk premia for all asset classes will change."
- "One consequence of shifting societal preferences is that the price investors are willing to pay for assets perceived to be sustainable is changing, driving differentiated returns."
- "Profitability across sectors will be impacted with knock on effects for other variables such as credit default and downgrade assumptions. There will be sectoral winners and losers underpinning why we believe a sectoral approach to sustainable investing is additive to a regional one."
- "Uncertainty is a key element of our framework and is built into our CMAs. No one yet knows what a low carbon world looks like. The transition may play out over several years, if not decades."
- "We believe climate change will drive greater dispersion of returns at a sector level than at the asset class level. We see sectors as the relevant unit of investment analysis and if we allow sector granularity in our portfolio construction, buying assets at the sector level rather than at an index based regional level, the impacts on strategic asset preferences can be material."

Total return impact

Estimated 5-year expected return differential for U.S. sectors in green transition vs. no action, February 2021



This information is not intended as a recommendation to invest in any particular asset class or strategy or as a promise - or even estimate - of future performance. Sources: BlackRock Investment Institute, with data from Refinitiv Datastream and Bloomberg, February 2021. Notes: The chart shows the difference in five-year U.S. dollar expected returns for the highest sub-category of MSCI USA sectors under two economic scenarios - a green transition and a no-climate-action scenario. The difference in expected return is attributable to repricing – the return impact of changing cost of capital - and fundamentals – or the return impact of changing earnings per share growth.

Implementation Risk Management

Once the Board of Trustees establishes the System's strategic asset allocation, the Chief Investment Officer, working with investment staff, specialty consultants and asset managers, is responsible for implementation. To capture the different types of risks associated with the implementation process, the Investment Division estimates tracking error, which measures the variability in the difference between realized and benchmark returns, broken down according to three distinct phases of the investment process as follows:

1. Allocation risk – the risk that results from an over- or under-weight position in a particular asset class
2. Style risk – the risk that results from assigning a benchmark to a manager that is different from a particular asset class benchmark
3. Selection risk – the risk that results from a manager building a portfolio of securities that is different from the constitution of the assigned benchmark

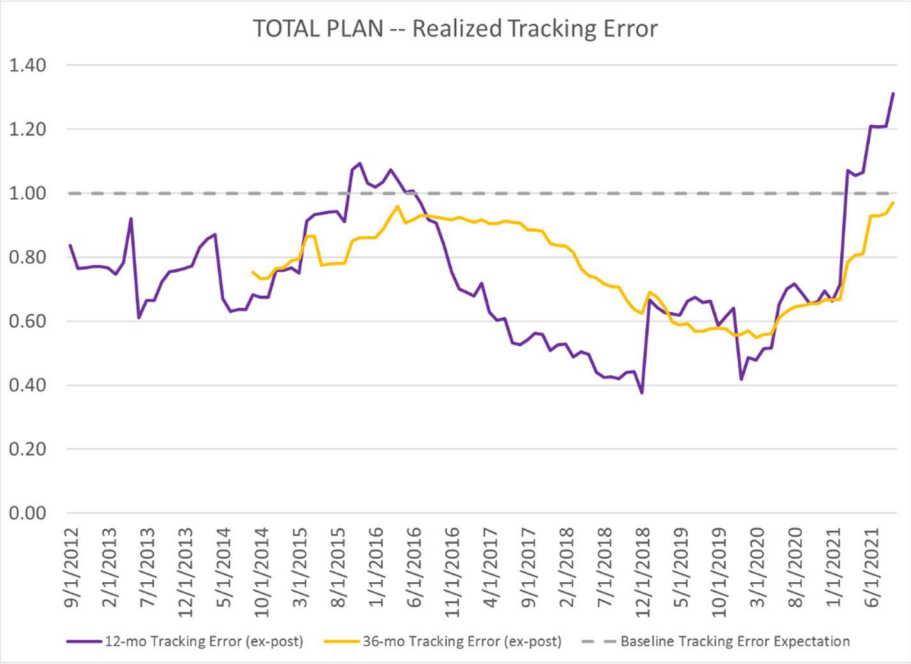
The System's portfolio produces an estimated tracking error, or "total active risk," of 0.86% versus the strategic policy index as of 6/30/2021, meaning that approximately 67% of the time, the realized return will be within a range of +/- 0.86% around the expected outperformance above the benchmark return. The vast majority – nearly 80% – of total active risk can be attributed to security selection decisions, a function of the Investment Division's belief that markets exhibit varying degrees of efficiency across asset classes and geographies, providing opportunities for skilled investors to add value. Selection risk within the Growth asset class, which includes public and private equity, constitutes the bulk of overall selection risk.

Total Active Risk (basis points)

Asset Class	Allocation risk (bps)	Selection risk (bps)	Style risk (bps)	Total active risk (bps)
Public Equity	5	25	13	43
Private Equity	0	44	0	44
Nominal FI	-1	1	0	1
Inflation FI	0	0	0	0
US Credit	0	-4	0	-4
Non-US Credit	0	0	0	0
Real Estate	0	3	0	3
NR & Infra	2	-2	0	0
Commodities	0	0	0	0
Absolute Return	0	2	0	2
Multi Asset	0	-1	2	0
Cash	-1	0	0	-1
Total Plan Overlays	-2	0	0	-2
Total System Portfolio	**4**	**68**	**14**	**86**

Source: Maryland State Retirement Agency

To contextualize this estimate of tracking error, the following chart displays historical realized tracking error. Realized tracking error steadily decreased since the beginning of 2016 due in part to a market regime characterized by low volatility before turning marginally higher in 2018. Subsequently, the economic shock related to the global pandemic in 2020 brought about higher market volatility that fed through into the System's realized tracking error. As the world economy continues to deal with fallout from the public health crisis, realized tracking error is firmly above the 1.0% baseline expectation.



Source: Maryland State Retirement Agency

- Liquidity Analysis: Another area where the combination of strategic asset allocation and implementation could create undue risk is liquidity. Meketa, evaluates the System's ability to continue to meet its cash needs amidst a weak equity market scenario. Even in an extremely negative scenario, such as the Global Financial Crisis, the System would still maintain ample liquidity to meet its near-term obligations. The System has sufficient liquid assets to cover expected net outflows and private markets contributions. In years two through ten, however, the System would need to sell some of its assets that have decreased in value by 10% or more ("Assets Sold in Duress") in order to meet its obligations, assuming it rebalanced to its target allocations.

Liquidity Stress Test

Metric	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Ending Market Value ($bn)	68.5	68.2	52.0	47.3	44.9	42.2	43.0	43.7	44.2	44.6	44.9
Net flows ($bn)	-	(1.8)	(2.0)	(2.2)	(2.4)	(2.7)	(2.8)	(2.9)	(3.0)	(3.1)	(3.2)
Net Flows as % of Market Value	0%	-2.6%	-2.9%	-4.2%	-5.1%	-5.9%	-6.6%	-6.7%	-6.9%	-7.1%	-7.3%
Private Market Contributions ($bn)		5.2	2.6	3.5	2.7	2.5	2.4	2.8	2.3	2.4	2.6
Private Market Distributions ($bn)		1.7	0.9	2.5	3.3	3.7	4.4	4.6	4.0	3.5	4.1
Net Flows from Contrib. & Distrib. ($bn)		(3.5)	(1.6)	(1.0)	0.5	1.2	2.0	1.8	1.7	1.1	1.5
Net Liquidity Needs ($bn)		(5.3)	(3.6)	(3.2)	(1.8)	(1.5)	(0.8)	(1.1)	(1.3)	(2.0)	(1.7)
Assets Sold in Duress ($bn)		-	(1.5)	(2.0)	(2.1)	(2.9)	(3.5)	(1.6)	(1.6)	(1.6)	(1.6)
Percentage of Outflows sold in duress	0%	0%	41.1%	63.4%	71.4%	75.8%	72.6%	33.7%	33.1%	36.9%	34.1%
Percentage of Assets sold in duress	0%	0%	2.2%	3.9%	4.4%	6.5%	8.2%	3.7%	3.6%	3.5%	3.6%
Remaining liquid Market Value ($bn)	50.7	44.1	31.7	26.9	25.1	23.6	26.2	28.5	29.8	30.4	31.1
Total Illiquid Assets ($bn)	17.8	24.1	20.3	20.3	19.8	18.6	16.8	15.2	14.4	14.2	13.8
Percentage of Illiquid Assets	26.0%	35.3%	39.0%	43.0%	44.1%	44.0%	39.0%	34.7%	32.5%	31.9%	30.8%
Portfolio Return	0%	2.2%	-20.9%	-4.9%	0.0%	0.0%	8.5%	8.3%	8.1%	8.0%	7.9%

Notes: Returns in Years 1, 2 and 3 reflect asset class returns from the 4th Quarter 2007, Calendar Year 2008, and 1st Quarter 2009, respectively. Years 4 and 5 assume 0% returns in all asset classes.
Source: Meketa Investment Group

Review of Recent Studies and Actions

Maryland State Retirement Agency staff conducted a review of recent studies and actions with respect to portfolio risks with the goal of identifying leading practices not currently employed that could be recommended for inclusion in the Investment Policy Manual.

This year's review focuses on the divestment plans of several United States public pension plans to illustrate the array of approaches adopted by the System's peers in managing climate risk. Establishing a divestment strategy involves many considerations some of which are listed here:

- Defining a fossil fuel company
- Identifying high risk industry subgroups
- Incorporating asset classes beyond public equity
- Managing human resources and reporting costs
- Establishing climate beliefs
- Adapting to legislative and regulatory changes
- Active versus passive management
- Internal versus external management
- Balancing engagement and advocacy goals
- Conducting fiduciary analysis
- Dealing with forecast uncertainty
- Implementing sustainable investment programs

Given this assortment of issues, it is not surprising that a universally-accepted best practice remains somewhat elusive. As unique constraints play a key role in establishing risk and return objectives, the varied approaches to divestment suggest a similar theme is at play in managing climate risk. While there is no one-size-fits-all solution, the System engages in many similar practices as those described below – even without an outright divestment policy – and remains keenly focused on improving its climate risk management solutions going forward.

Baltimore City Retirement Systems[1]

- An ordinance concerning "Retirement Systems – Precluded Investment and Divestment – Fossil Fuel Companies" was adopted by the Baltimore City Council on 6/21/2021
- Covers "actively managed separate accounts" (i.e., does not include index funds, private equity funds, hedge funds, real estate funds, or any other commingled/passive funds)
- "Fossil fuel companies" are defined as those members of the Carbon Underground 200 Index or any successor index
- New investments in fossil fuel companies are prohibited
- The board of trustees will review holdings at least every six months to identify investments in fossil fuel companies
- Divestment shall be completed by 7/1/2026 in annual increments of 20% of the exposure to fossil fuel companies in actively managed separate accounts as of 1/1/2022

[1] https://baltimore.legistar.com/LegislationDetail.aspx?ID=4918058&GUID=11F71D0D-C54E-4684-9539-61159ECCB467&Options=&Search=

- The board must determine in good faith that any action related to the ordinance is consistent with fiduciary duty its responsibilities as required by law
- The board will provide notice to fossil fuel companies identified for divestment, will allow time for a response, and may exempt the company from divestment account if demonstrable criteria is evident
- Divestment requirements and investment prohibitions do not apply if a company can demonstrate that it:
    - Has stopped exploring for new hydrocarbons
    - Contractually agrees not to develop or sell 80% of its proven fossil fuel reserves
    - Has ceased lobbying activities related to preserving fossil fuel subsidies, tax break, or its competitive advantage versus renewable energy
- The board will provide an annual report to the mayor and city council addressing:
    - Fossil fuel company holdings in actively managed separate accounts
    - Divestment action
    - Description of delayed divestment decisions
    - A calculation of the administrative costs of compliance with the above provisions

Maine Public Employees Retirement System[2]

- "An Act To Require the State To Divest Itself of Assets Invested in the Fossil Fuel Industry" was approved by Governor Janet Mills on 6/16/2021 which, according to Reclaim Finance, makes Maine the first jurisdiction in North America pass legislation addressing divestment from all fossil fuel companies
    - Divestment must be complete by 1/1/2026 and must be in accordance with sound investment criteria and consistent with fiduciary obligations
    - "Fossil fuel" means coal, petroleum, natural gas or any derivative of coal, petroleum or natural gas that is used for fuel
    - "Fossil fuel company" means any company that:
        - (1) Is among the 200 publicly traded companies with the largest fossil fuel reserves in the world;
        - (2) Is among the 30 largest public company owners in the world of coal-fired power plants;
        - (3) Has as its core business the construction or operation of fossil fuel infrastructure;
        - (4) Has as its core business the exploration, extraction, refining, processing or distribution of fossil fuels; or
        - (5) Receives more than 50% of its gross revenue from companies that meet the definition under subparagraph (1), (2), (3) or (4).
    - "Fossil fuel infrastructure" means oil or gas wells, oil or gas pipelines and refineries; oil, coal or gas-fired power plants; oil and gas storage tanks; fossil fuel export terminals; and any other infrastructure used exclusively for fossil fuels.
    - The Board of Trustees of MainePERS will report all holdings of public markets and private equity investments on its website

[2] https://reclaimfinance.org/site/en/2021/06/20/mainepers-under-legislative-pressure-to-divest-from-fossil-fuels-a-great-first-but-doubts-remain/

- Beginning 1/1/2022, the board will issue an annual ESG report
- Progress on divestment will be communicated to the Maine legislature each year beginning with the report on 1/1/2023

New York City Retirement Systems[3]

- According to the Institute for Energy Economics and Financial Analysis (IEEFA), Meketa Investment Group and BlackRock "undertook this research under contract to advise on the divestment plans of the New York City Employees' Retirement System (NYCEDRS), the Teachers Retirement System (TRS) and the Board of Education Retirement System (BERS), which had set goals for divestiture but wanted advice on how to develop and implement an orderly divestment process."
- Meketa Investment Group evaluated investment and fiduciary implications of divesting from securities issued by fossil fuel reserve owners for three of the five city systems: the Board of Education Retirement System of the City of New York (BERS), New York City Employees' Retirement System (NYCERS), and the Teachers' Retirement System of the City of New York (TRS)
  - Phase one
    - How are global leading asset owners managing fossil fuel reserves and climate investment risk?
    - What are common approaches to defining fossil fuel reserves companies? What exposure do BERS, NYCERS, and TRS have to these companies?
    - "We found no clear, widely accepted 'best practice.'"
    - "Despite an industry-wide appreciation of the inherent risks posed by the fossil fuel sector, no universal consensus has developed on how best to selectively screen and define fossil fuel risk."
    - "The varied nature of the approaches demonstrates that there is no conclusive, universally accepted strategy to guide research into divestment of fossil fuels. As a result, for this project, we recommend that the Systems undertake a universal evaluation of fossil fuel reserve owners to understand the Systems' total exposure to fossil fuel reserve owners and the risks they pose. An examination of all companies that own reserves is consistent with the Boards' resolutions to evaluate prudent strategies to divest from securities issued by fossil fuel reserve owners."
    - "We propose a broad definition as the universe of fossil fuel reserve owners to analyze for potential prudent exclusion: any publicly listed company in the global economy that owns proven fossil fuel reserves."
  - Phase two
    - Presentation of Meketa's estimate of the Systems' exposure to fossil fuel reserve owners and a review of the related climate and financial risks
    - "In general, we found sufficient, but far from complete, quality climate data…"
    - "Whether limiting global temperature rise to 1.5°C or 3°C, expected return is lower than expected returns absent climate change assumptions."

[3] https://ieefa.org/major-investment-advisors-blackrock-and-meketa-provide-a-fiduciary-path-through-the-energy-transition/

        - Metrics included in the analysis:
            - Fossil fuel reserve exposure including potential stranded capex and power, utility, goal, and gas relative Paris alignment
            - Transition management risk including transition management initiative management quality scores, green revenue shares, emissions intensity, and percentage change in emissions intensity
            - Financial health including Altman z-score and economic value added/sales
            - Physical climate risk scores
        - "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."
    - Phase three
        - "We find the Systems can prudently divest from fossil fuel reserve owners using a variety of approaches. Meketa's research indicates that the System may be best served using a data-driven approach to divestment to help insulate the Systems from the increasing risks faced by fossil fuel reserves owners while protecting return."

Divestment strategy	**Definition**	**Benefits**	**Drawbacks**
Option 1	All fossil fuel reserve owners	Relatively simple and least expensive to monitor, more opportunities for engagement	More likely to divest from lower risk companies that are successfully transitioning
Option 2	Fossil fuel reserve owners that show at least one higher risk level in at least two of three risk categories: fossil fuel exposure, energy transition management quality, and financial health	Reliant on company risk criteria, more likely to focus divestment on higher risk companies	More complex and expensive, fewer opportunities for engagement
Option 3	Fossil fuel reserve owners with >10% extractives revenue or >10% thermal coal revenue	Focuses on companies with material exposure to specific types of reserves, more likely to focus divestment on higher risk companies	More complex and expensive, fewer opportunities for engagement

- BlackRock Sustainable Investing evaluated investment and fiduciary implications of divesting from securities issued by fossil fuel reserve owners for the Teachers' Retirement System of the City of New York (TRS)
    - Phase one

        - Overview of fossil fuel divestment landscape
        - Peer institution divestment research and implementation strategies
        - TRS exposure to fossil fuel reserve owners
        - "Of investors explicitly measuring the impact of fossil fuel divestment on financial performance (4 of 13 respondents), no investors found significant negative performance from divestment, but rather, have reported neutral to positive results."
    - Phase two
        - Two proposed approaches to inform divestment strategy using BlackRock tools:
            - Carbon Price Sensitivity tool measures the impact of a carbon pricing scheme on a company's earnings and security valuation
            - Low Carbon Transition Readiness scores provide a forward-looking trajectory or preparedness for the low carbon transition
    - Phase three
        - Defines three strategies for divestment and measures the impact using historical performance, transaction costs, and tracking error
        - "Overall, the relatively minimal impact on historical performance, transaction costs, and active risk in all three of the reviewed may serve as a suitable divestment strategy."

Additional considerations should be given to formulating a forward-looking investment thesis about the transition to a low carbon economy, allowing for dynamic updates based on the actual transition experience, and defining how the chosen divestment approach fits into the organization's broader climate strategy.

<u>New York State Common Retirement Fund</u>[4]

- Climate Action Plan adopted 2019
    - CRF Climate Beliefs
    - Identification & Assessment
        - Exposure to high impact sectors across asset classes
        - RFIs for advanced climate assessments
        - Define/prioritize asset class specific metrics and minimum standards to evaluate transition readiness and resiliency for companies in high impact sectors beginning with thermal coal companies
        - Exposure to sustainable strategies and climate solutions by asset class
        - Develop asset class specific evaluation tools score manager performance in addressing climate risks and opportunities
        - Hire staff dedicated to evaluating manager ESG implementation
        - Annual measurement of carbon footprint
    - Investment & Divestment
        - Sustainable Investment-Climate Solutions Program (similar to Emerging Manager Program)
        - Senior Sustainable Investment Officer

[4] https://www.osc.state.ny.us/files/reports/special-topics/pdf/progress-report-climate-action.pdf

        - Build on current $10 billion commitment to SICP and set goal of doubling it to $20 billion over the next decade
        - Divestment evaluation within high impact sectors beginning with thermal coal
        - Ongoing education for CRF staff
        - Partnerships with other asset owners or entities such as New York Green Bank
    - Engagement & Advocacy
        - Use transition-readiness and resiliency metrics in shareholder engagement
        - Collaborate with peers
        - Communicate CRF Climate Beliefs to companies
        - Communicate CRF Climate Action Plan to managers and consultants
        - Watch list of manager with low climate scores
        - Work with vendors to integrate climate risks and opportunities into index constructions methodologies
        - Public policy advocacy
        - Communicate climate initiatives to CRF members and the public
- Climate Action Plan Progress Report released in April 2021
    - Assessments
        - As of 12/31/2020, holdings in fossil fuel producers was $3.2 billion across public equity and corporate fixed income portfolios
        - In global equities, emissions intensity was 16.6% lower than its benchmark due in part to a $4 billion investment in a low-emissions index that features 75% lower intensity than the benchmark
        - The corporate fixed income portfolio reported emissions intensity 22% lower than its benchmark
        - CRF entered a new partnership in 2021 that will provide Carbon Value at Risk reporting going forward
        - Use of data from corporate reporting, non-profits, academia, and specialized vendors
        - Upgraded ESG scorecard for external managers and joined Global Real Estate Sustainability Benchmark
        - Partnership with Impax Asset Management to address physical risks
    - Investment and Divestment
        - CRF has deployed more than $11 billion to SICS Program including investments in solar-related asset backed securities, green bonds, as well as sustainable infrastructure and real estate
        - CRF will explore global equity climate index strategies in 2021
        - Of the 27 thermal coal companies identified for the CRF watch list, staff concluded that 22 companies failed to meet minimum standards resulting in restriction/divestment
        - Of the nine oil sands companies identified for the CRF watch list, staff concluded that seven companies failed to meet minimum standards resulting in restriction/divestment
        - Next, CRF will evaluate the transition readiness of companies in the shale oil and gas, integrated oil and gas, and energy midstream

- Engagement and Advocacy
    - Participant in initiatives such as Climate Action 100+, the Ceres Investor Network on Climate Risk, and the Carbon Disclosure Project non-disclosure campaign
    - CRF filed three proposals at companies – and secured agreements – related to increased renewable energy use at production facilities
    - Flour Corp agreed to adopt GHG reduction targets after CRF filed a shareholder proposal that it ultimately withdrew
    - CRF is the lead investor in the Climate Action 100+ American Electric Power engagement group
    - In 2020, CRF enhanced its proxy voting guidelines to reflect its views on transition readiness and reporting transparency as it pertains to support of director nominees

CRF began to engage with its top public markets external managers on climate risk, engagement, and TCFD reporting and will expand this effort going forward

New York State Teachers' Retirement System[5]

- The NYSTRS board adopted an initial climate change action plan at its meeting on 12/28/2021. In addition, the board published its "Update to the Legislature Regarding NYSTRS' Deliberative Process to Address Climate Risk and Opportunities."
- The initial action plan calls for:
    - Thermal coal divestment in internally managed and externally managed passive public equity portfolio
    - Restriction of additional public equity investments in certain carbon-intensive fossil fuel holdings based on position size, potential CO2 emissions, and revenue thresholds related to oil and gas and oil sands reserves
    - Engagement efforts
    - Revised proxy-voting policies
    - Investment Advisory Group membership to support Sustainability Accounting Standards Board
- Additional action plan items include:
    - Due diligence on oil sands industry
    - Divestment policy
    - Climate-friendly investment opportunities
    - Fixed income and private equity climate analysis

[5] https://www.nystrs.org/About-Us/Press-Room/Headlines/NYSTRS-Board-Adopts-Climate-Change-Action-Plan

Recommendation of Best Practices for the Investment Policy Manual

The Board of Trustees regularly reviews and updates the Investment Policy Manual in consultation with the Investment Division. Several recent revisions have been made to enhance the policies and procedures with respect to risk management, as well as corporate governance and proxy voting. The risk management section provides the purpose, asset allocation, analytical measures, non-market risks, liquidity risk, counterparty risk, and leverage risk.

In addition, the corporate governance and proxy voting section addresses the following topics:

1. Board of Directors
2. Shareholder Rights and Defenses
3. Capital/Restructuring
4. Compensation
5. Social/Environmental Issues
    a. Animal Rights
    b. Consumer Issues
    c. Climate Change and the Environment
    d. Diversity
    e. General Corporate Issues
    f. International Issues, Labor Issues, and Human Rights
    g. Sustainability
6. Routine/Miscellaneous

After reviewing the System's risk management processes in comparison with the leading practices of peers and new research from academic literature, it appears the System engages in leading practices concerning the evaluation and management of risks associated with the investment of System assets.

The most recent review of the System's practices by the United Nations-supported Principles for Responsible Investment (UN PRI) serves as evidence. As UN PRI advised, "On an individual basis, per the PRI Summary Scorecard Data, MSRPS has improved significantly across all assessed categories since 2017. Notably, in the strategy and governance module, Maryland has improved from a C to an A rating since 2017." UNPRI also noted that the System scores better than average in seven of ten categories when compared to a peer group of ten other state, county, and city retirement funds using 2020 PRI reporting.

The Investment Policy Manual is a living document that is revised regularly. Given the pace of change in matters pertaining to climate risk over the last few years, from actions of the System's peer plans to the Investment Division's organizational structure as well as the quality of analytics in the marketplace, the next review of the Investment Policy Manual will be an appropriate time to revise language and strengthen policies where necessary. Furthermore, the Board of Trustees and the Investment Division will monitor the divestment plans underway at state pension peers as it pertains to fiduciary duty and other implementation issues that may arise.