PSERB Resolution 2025-14
Re: 2024 Stress Test Report
March 21, 2025

RESOLVED, that the Public School Employees' Retirement Board accepts the recommendation of the Finance and Actuarial Committee and adopts the 2024 Stress Test Report.

Pennsylvania Public School Employees' Retirement System

PSERS
Stress Testing Analysis

March 2025

Gallagher

Agenda

I. Project Overview

II. Scenario Analysis

III. Sensitivity Analysis

IV. Simulation Analysis

V. Liquidity Analysis

VI. Demographic Analysis

VII. Additional Stress Testing Scenarios

VIII. Appendices

Gallagher

Project Overview

Project Overview

Purpose

- Per Title 24, § 8510, stress testing of the Pennsylvania Public School Employees' Retirement System ("System") is needed for fiscal years beginning after June 30, 2022, and should include the following:

    - **Scenario analysis:** deterministic projections under "recognized industry standards"

    - **Sensitivity analysis:** impact of changes in the actuarially assumed rate of return on the System liabilities

    - **Simulation analysis:** stochastic projections covering a wide range of potential future outcomes, simulating the volatility of annual investment returns

Summary of Results

- Funded ratio based on the market value of assets (MVA) is expected to grow from 64% to above 69% over the next two years according to the simulation analysis.

- The results show a wide range of possible outcomes over the next 30 years. Contribution policy and investment policy should be monitored as System experience unfolds.

- Section 8502(j) of the Retirement Code requires an experience study and review of actuarial assumptions at least once in each five-year period. This lessens the likelihood of sustained periods of adverse deviations from the System assumptions as assumed in most of these analyses.

Scenario Analysis

Deterministic Projections
Core Scenarios

Scenario	Methodology
Baseline	Asset return for the next 30 years is equal to the System's expected return assumption (7.00%)
Excess Return	Asset return for the next 20 years is 2.00% higher (9.00%) than the System's expected return assumption, and for the following 10 years is equal to the System's expected return assumption (7.00%)
Low Return	Asset return for the next 20 years is 2.00% lower (5.00%) than the System's expected return assumption, and for the following 10 years is equal to the System's expected return assumption (7.00%)
Low Contribution	Asset return for the next 30 years is equal to the System's expected return assumption (7.00%) Contributions for the next 20 years are 80% of the actuarially determined employer contributions (ADEC), and for the following 10 years are equal to the full actuarially determined employer contributions

Funded Ratio: Actuarial Value of Assets (AVA) Basis
Core Scenarios
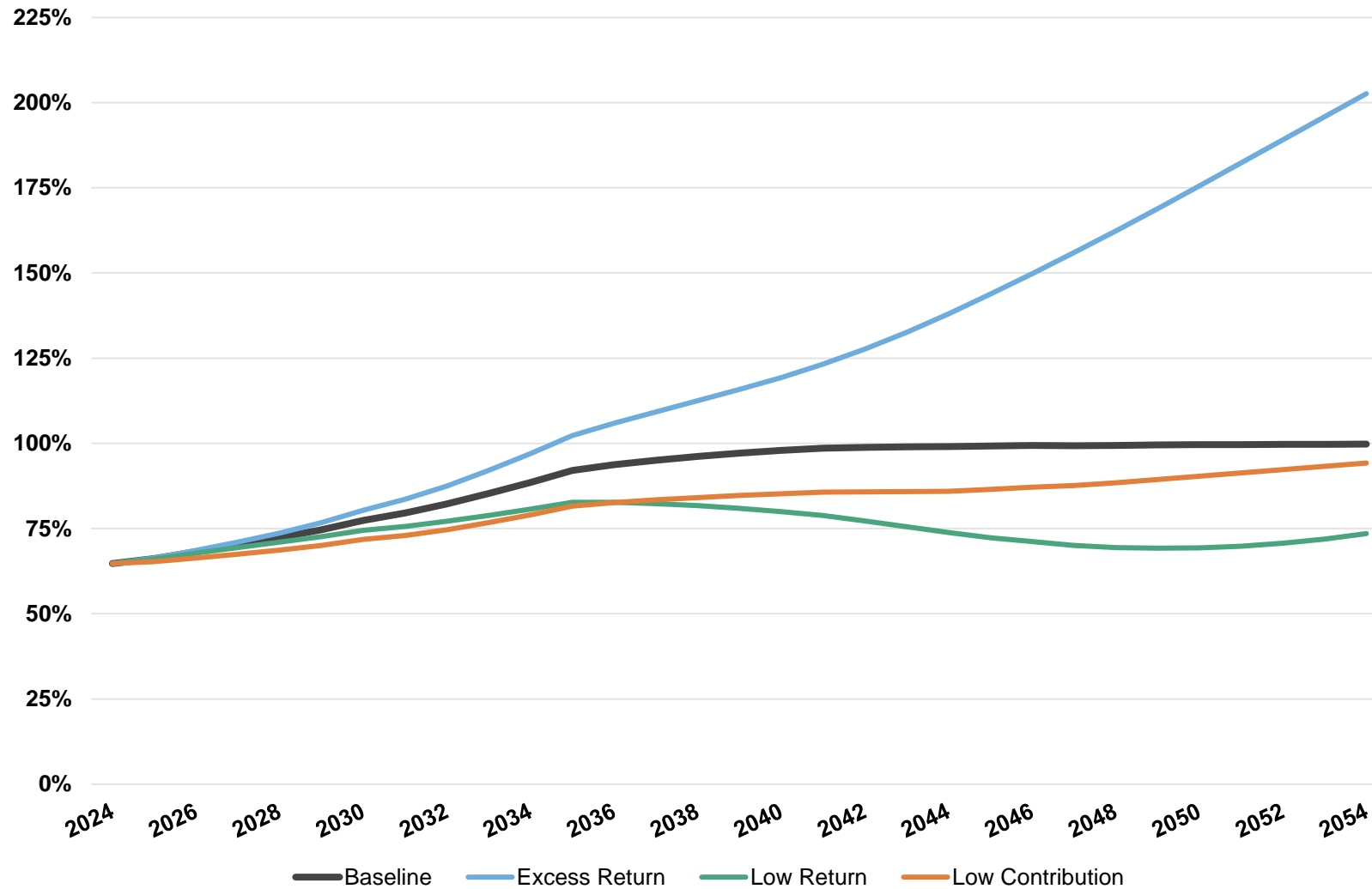
- Baseline (black line): Reach 100% funded soon after Act 120 liability is fully amortized.
- Excess Return (blue line): Higher than expected return accelerates the System reaching 100% funded. Projected to exceed 100% due to Act 120 minimum normal cost contribution.
- Low Return (green line): Projected to achieve the worst funded status due to the System experiencing lower than expected returns over the first 20 years.
- Low Contribution (orange line): Contributions lower than ADEC delay the System fully paying off the amortization bases. Therefore, the System does not approach 100% funded until after 30 years.

Actuarially Determined Employer Contribution (ADEC) Rate
Core Scenarios
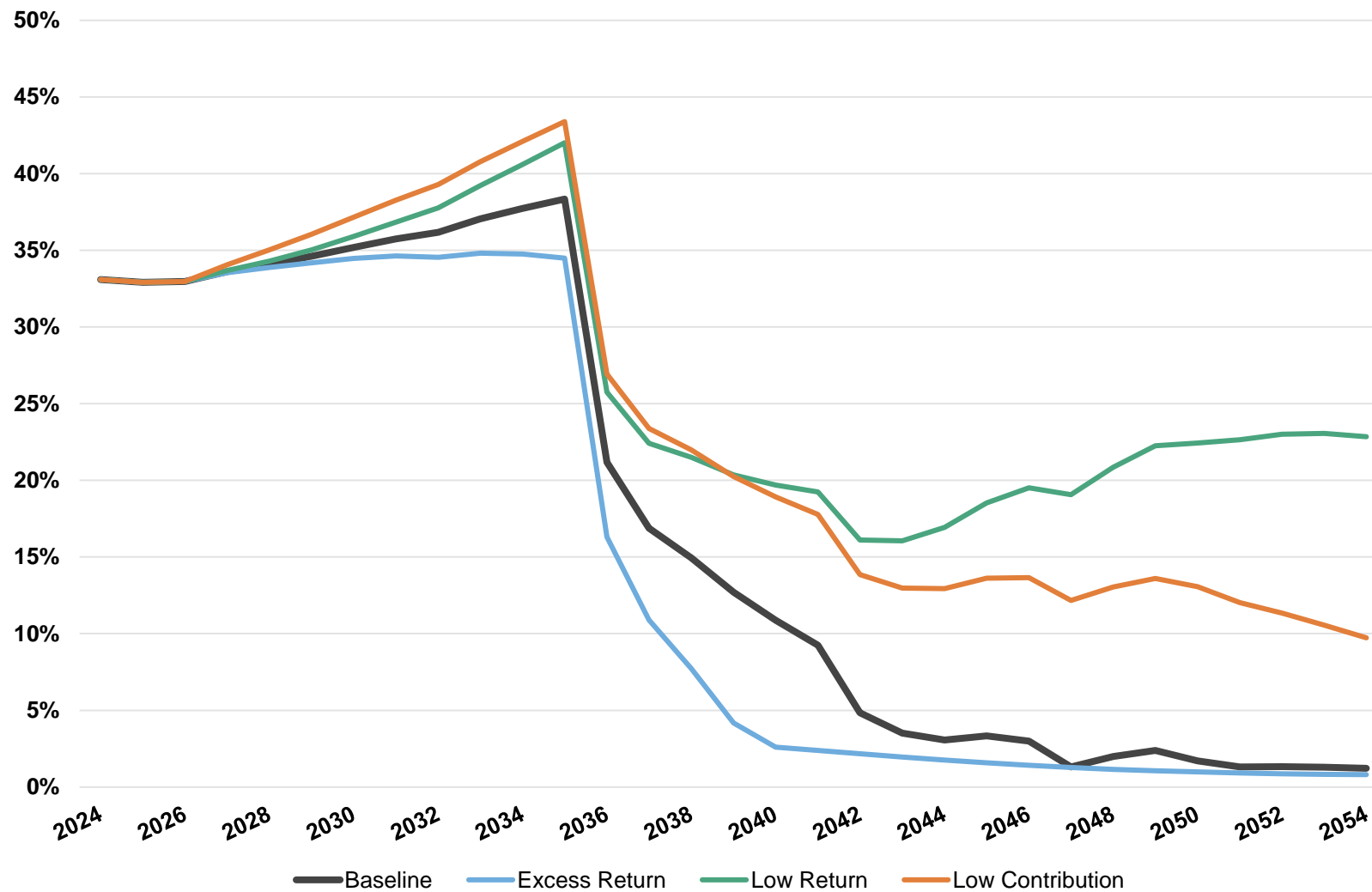
- The Act 120 liability will be fully amortized by fiscal year end (FYE) 2035 resulting in the ADEC rate under each scenario to decrease in 2036
- Baseline (black line): By the end of the projection period, ADEC rate will approach the Act 120 minimum normal cost contribution
- Excess Return (blue line): Higher than expected returns lowers ADEC rate and results in the System paying the Act 120 minimum normal cost contribution earlier than the baseline
- Low Return (green line): Contributions expected to increase until all asset losses are recognized and fully paid, which results in the highest ADEC rate over the projection period
- Low Contribution (orange line): Under-contributing equates to deferred contributions and a higher ADEC rate than the baseline

See Appendix A for actuarially determined employer contribution in dollars.

Summary of Scenario Analysis Results
Core Scenarios

Scenario	5 Years		10 Years		30 Years	
	Cumulative Employer Contributions* ($ Billions)	Funded Ratio (AVA)	Cumulative Employer Contributions* ($ Billions)	Funded Ratio (AVA)	Cumulative Employer Contributions* ($ Billions)	Funded Ratio (AVA)
Baseline	$27.2	74.7%	$58.0	88.6%	$85.6	99.8%
Excess Return	$27.1	76.7%	$56.5	97.0%	$73.4	202.6%
Low Return	$27.4	72.6%	$59.6	80.7%	$141.2	73.5%
Low Contribution	$27.7	70.0%	$61.2	79.0%	$123.1	94.2%

*Actuarially Determined Employer Contributions accumulated beginning as of 7/1/2024

Key Takeaways

- Contributions are slightly impacted by returns in the short term, but the impact is large over the course of 30 years

- Funded ratio is heavily impacted by both contributions and return, and a wide range of outcomes is displayed at the end of 30 years

Sensitivity Analysis

Estimated Net Pension Liability with Changes in the Discount Rate

($ Billions)	1% Decrease (6.00%)	Current Discount Rate (7.00%)	1% Increase (8.00%)
Estimated Net Pension Liability at 6/30/2024*	$56.1	$42.7	$31.3

*Estimated June 30, 2024, GASB 67 Net Pension Liability equals the Total Pension Liability minus the Fiduciary Net Position assuming a June 30, 2024, valuation date. Please refer to the June 30, 2024, GASB 67 report for the actual June 30, 2024, GASB 67 Net Pension Liability.

Simulation Analysis

What is Stochastic Modeling?

- Extension of the actuarial valuation process

- 5,000 actuarial valuations simulations are performed for each of the 30 forecast years. Each of the 5,000 trials represents a different path that portfolio returns could take over 30 years in different economic and capital market environments

- Results are summarized and ranked for each metric

- Results are shown in bar graphs (see exhibit to the right) that display results from the highest value to the lowest value. The 95th percentile result represents the 250th highest value out of 5,000 values and the 5th percentile represents the 250th lowest value. In evaluating a result:

  - **For asset and funded percent metrics, the 95th percentile, represented as light green, is relatively favorable**

  - **For cost metrics, the relatively favorable light green will be on the bottom and represent the 5th percentile**

- Results shown are as of 6/30 of the displayed year
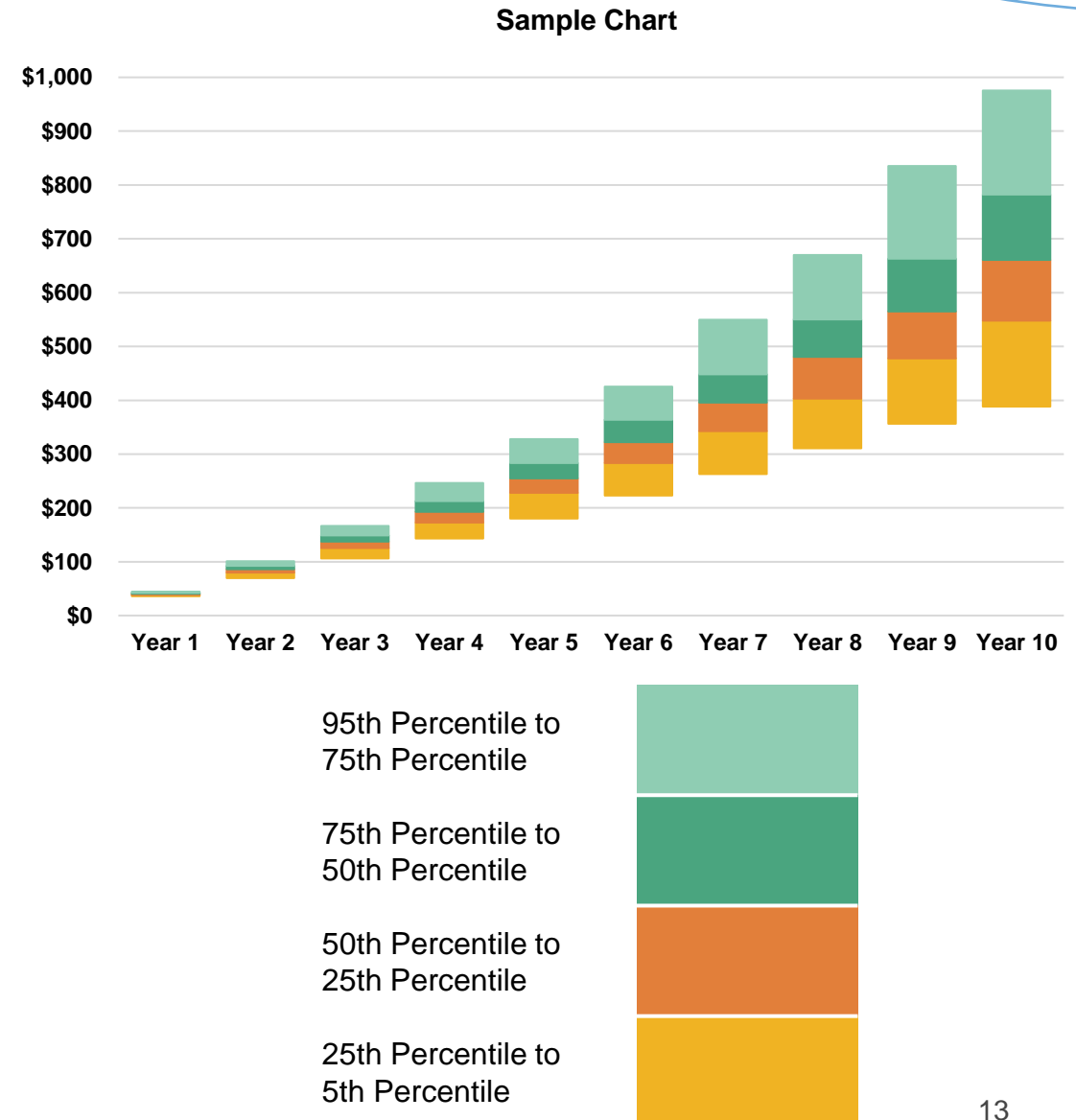
Sample Chart

95th Percentile to 75th Percentile

75th Percentile to 50th Percentile

50th Percentile to 25th Percentile

25th Percentile to 5th Percentile

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Asset/Liability Projection Stochastic Results
Market Value of Assets and Actuarial Liability Funded Ratio – Short-Term Risk
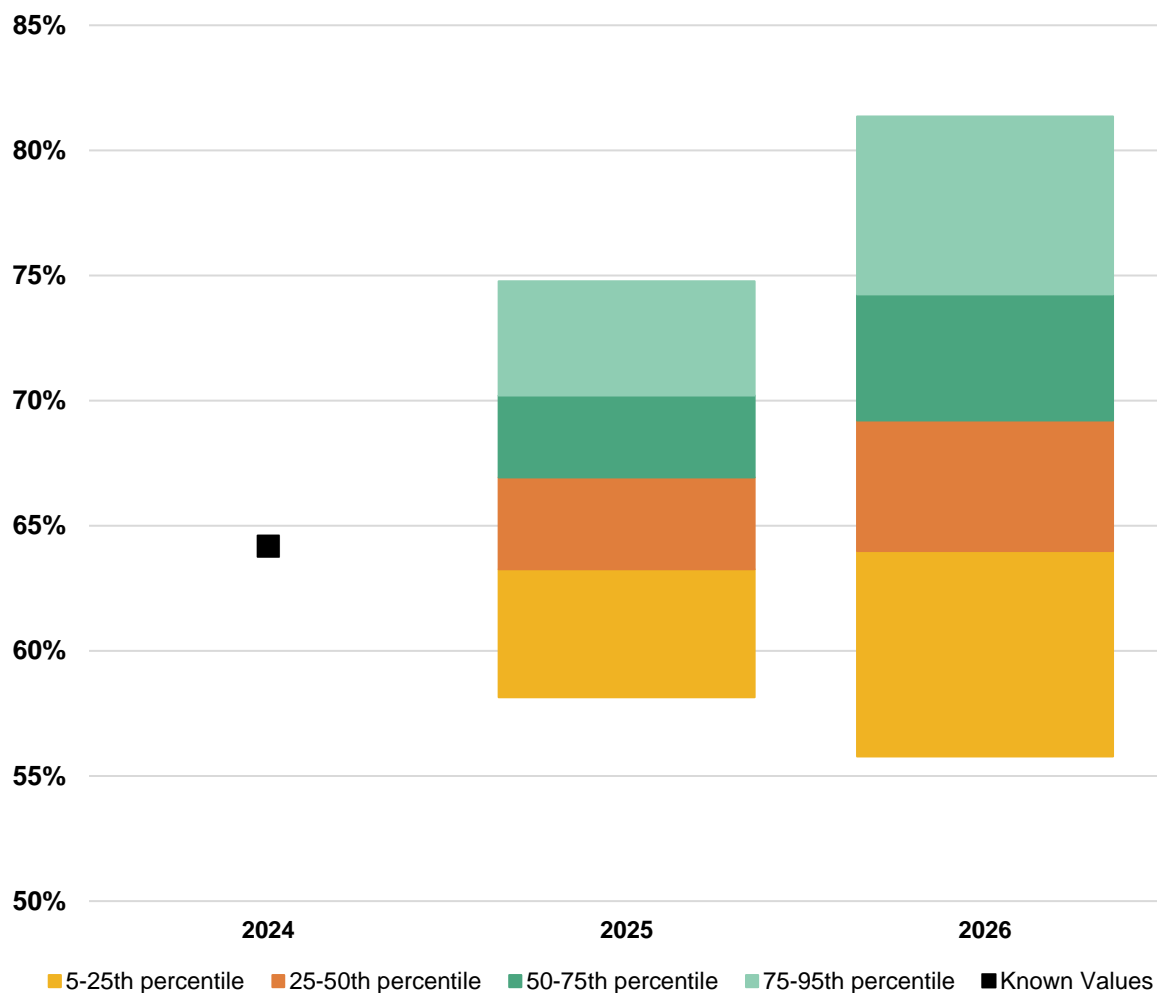
- The System is ~64% funded on a market value of assets basis as of 6/30/2024

- Over the next 2 years, economic factors can lead to a large range of possible funded ratios, ranging from just above 55% at the 5th percentile to over 80% at the 95th percentile
  - There is roughly a one-in-twenty chance the funded ratio will fall to 55% or lower, and another one-in-twenty chance it will be above 80%

Legend: 5-25th percentile | 25-50th percentile | 50-75th percentile | 75-95th percentile | Known Values

Asset/Liability Projection Stochastic Results
Market Value of Assets and Actuarial Liability Funded Ratio – Long-Term Trends
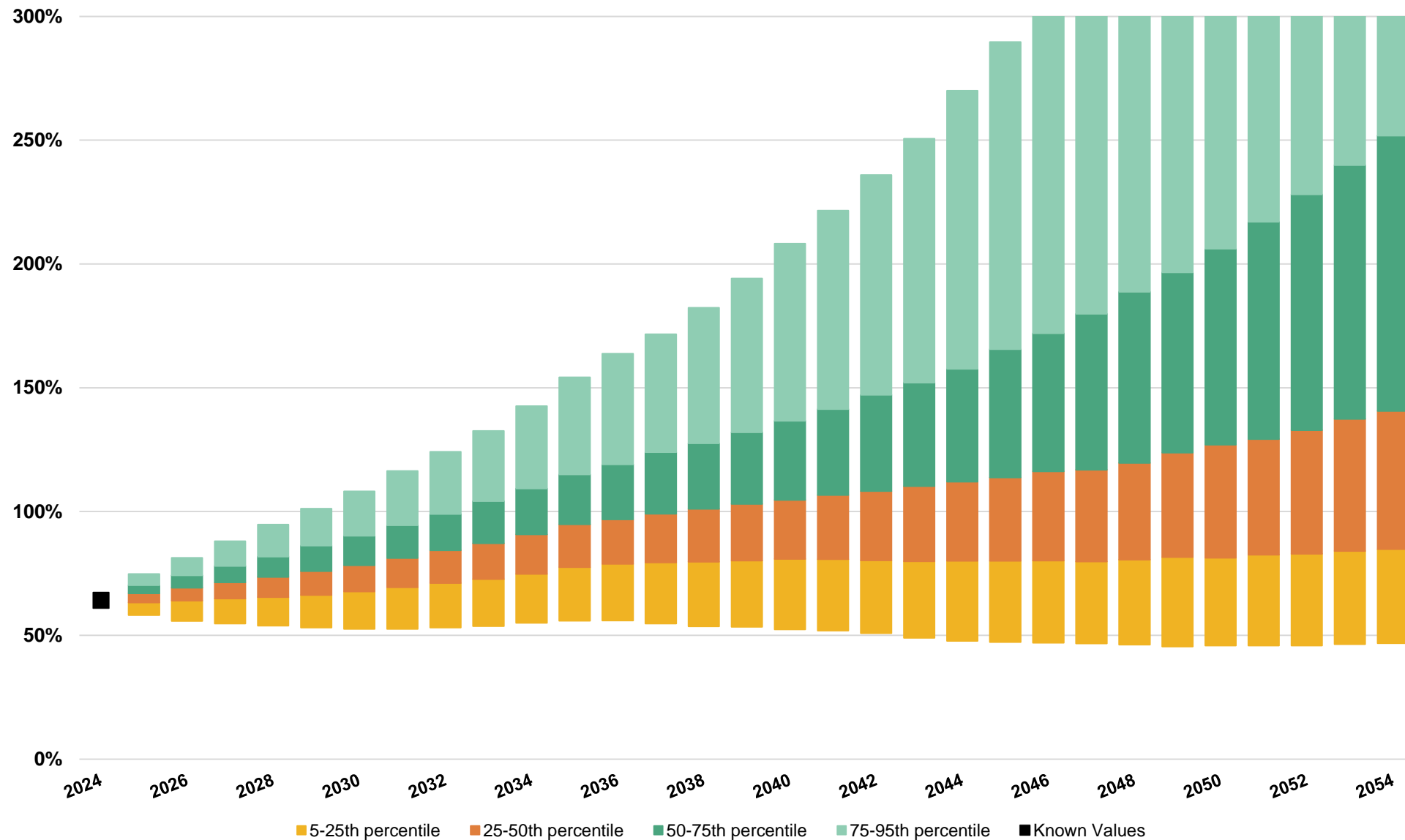
The System is ~140% funded on a market value of assets basis in 30 years at the median

- The 50th percentile result represents the median outcome and is where the orange bar meets the dark green bar

Legend: 5-25th percentile | 25-50th percentile | 50-75th percentile | 75-95th percentile | Known Values

Asset/Liability Projection Stochastic Results
Actuarial Value of Assets and Actuarial Liability Funded Ratio – Long-Term Trends
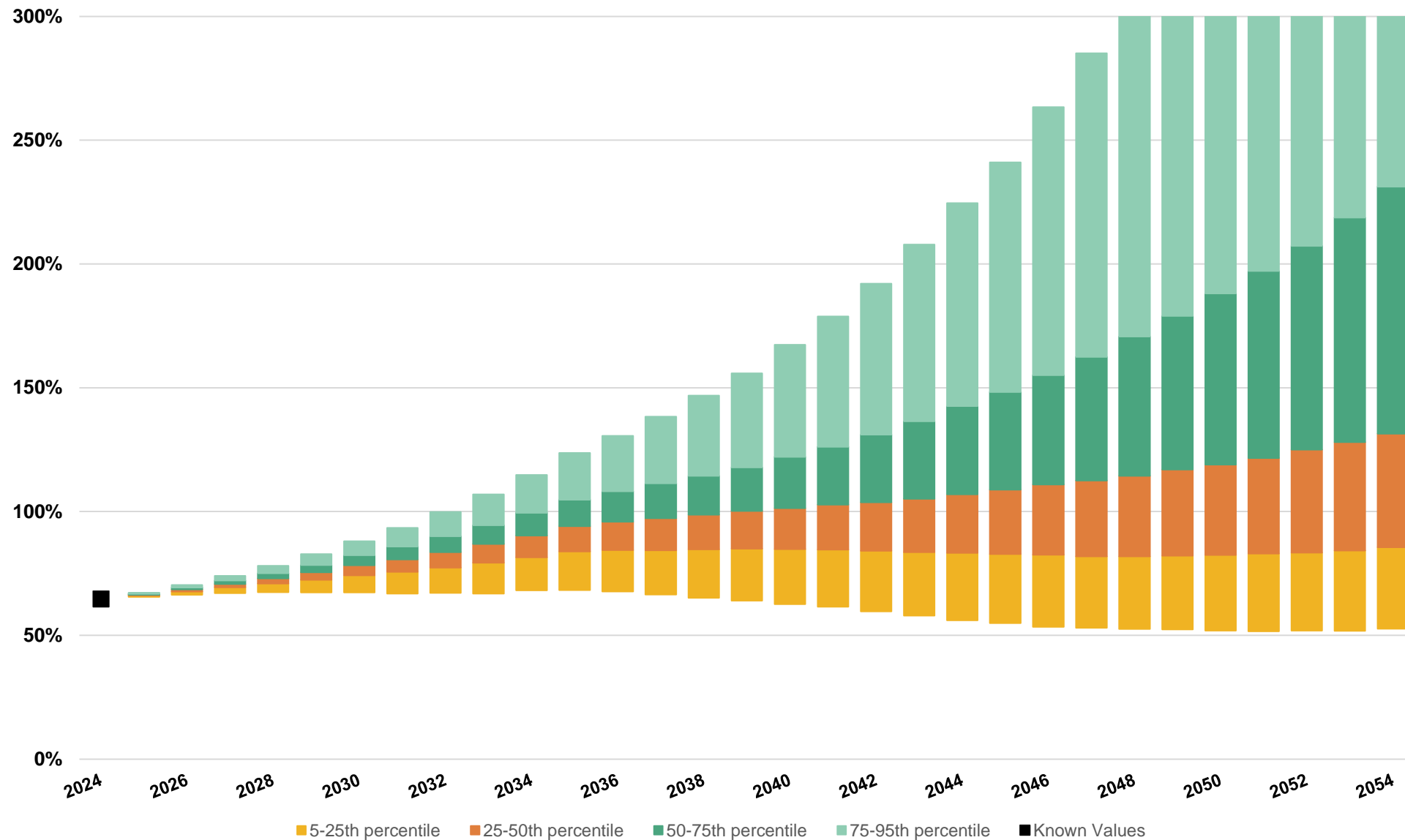
The System is ~130% funded on an actuarial value of assets basis in 30 years at the median

Trends are similar to MVA basis, but asset smoothing leads to less volatility

Legend: 5-25th percentile | 25-50th percentile | 50-75th percentile | 75-95th percentile | Known Values

Asset/Liability Projection Stochastic Results

Market Value of Assets and Actuarial Liability Funded Ratio
Actuarial Value of Assets and Actuarial Liability Funded Ratio

- At the median result, the System reaches full funding at 6/30/2038 on a market value basis

- In the most favorable scenarios, the funded ratio increases significantly. Changes to funding policy and investment policy in future years would impact the trajectory of these results

- In the least favorable scenarios (5th percentile), the funded ratio is approximately 46% in the long term on a market value basis and approximately 52% on an actuarial value basis

MVA	2024	2029	2034	2039	2044	2049	2054
95th Percentile	64.2%	101.2%	142.6%	194.2%	270.0%	389.7%	548.4%
75th Percentile	64.2%	86.3%	109.4%	132.0%	157.7%	196.6%	251.8%
50th Percentile	64.2%	76.0%	90.7%	103.1%	112.0%	123.8%	140.6%
25th Percentile	64.2%	66.3%	74.8%	80.2%	80.1%	81.6%	84.8%
5th Percentile	64.2%	53.2%	55.0%	53.4%	47.8%	45.5%	46.8%

AVA	2024	2029	2034	2039	2044	2049	2054
95th Percentile	64.8%	82.8%	114.8%	155.9%	224.6%	333.8%	497.7%
75th Percentile	64.8%	78.4%	99.5%	117.9%	142.6%	179.0%	231.3%
50th Percentile	64.8%	75.5%	90.3%	100.2%	106.9%	117.0%	131.5%
25th Percentile	64.8%	72.4%	81.5%	85.0%	83.3%	82.2%	85.6%
5th Percentile	64.8%	67.3%	68.1%	64.0%	56.0%	52.4%	52.6%

Asset/Liability Projection Stochastic Results

Employer Contribution Amount ($ Billions)

Expected employer contributions average ~$6B per year until 2036

At the median, contributions hit floor in 2043

Legend: 5-25th percentile | 25-50th percentile | 50-75th percentile | 75-95th percentile | Known Values

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Asset/Liability Projection Stochastic Results
Employer Contribution (Percentage of Payroll)
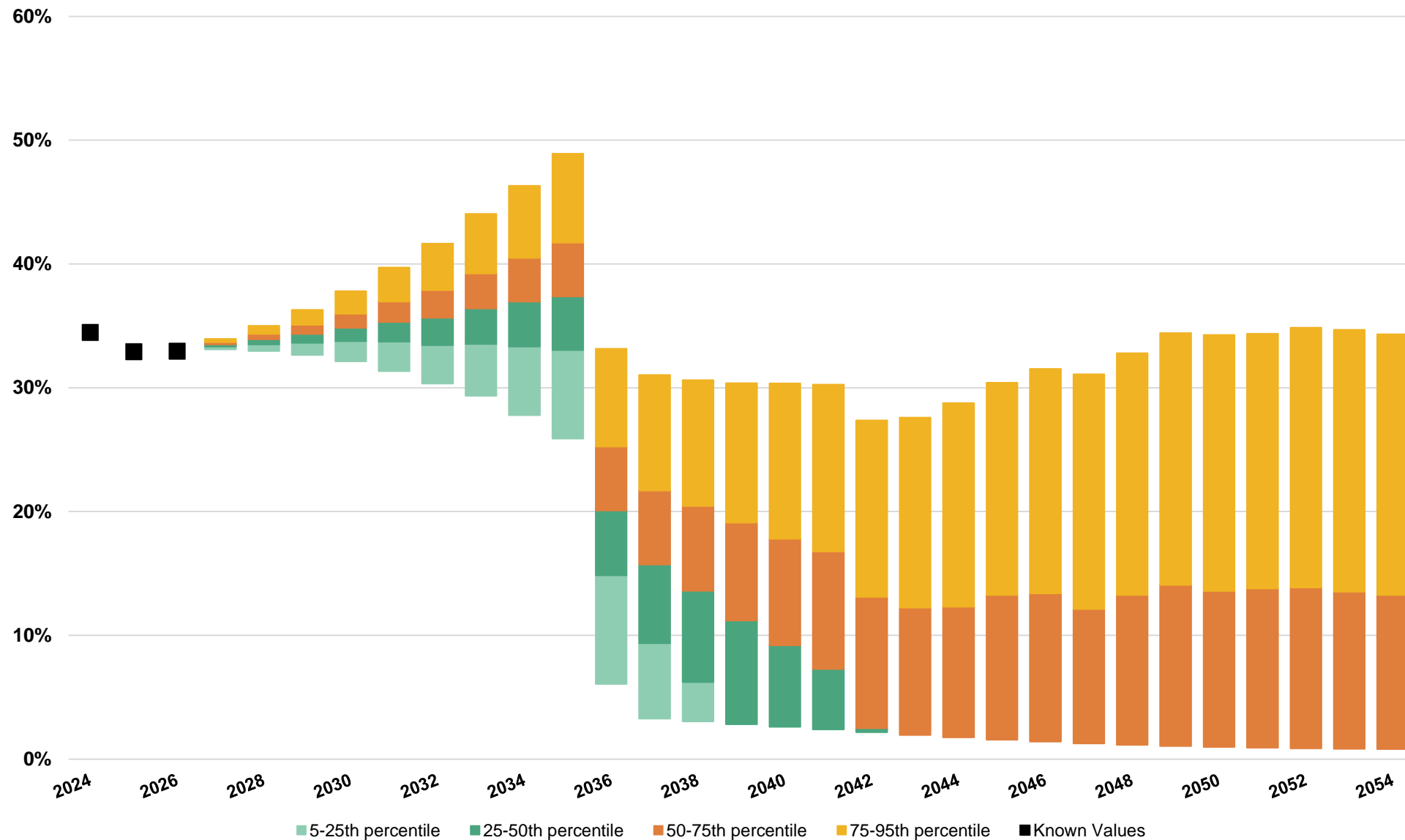
Expected employer contributions average ~35% of payroll per year until 2036

Legend: 5-25th percentile | 25-50th percentile | 50-75th percentile | 75-95th percentile | Known Values

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Asset/Liability Projection Stochastic Results
Employer Contributions

- Large base from the Act 120 fresh start is expected to be fully amortized by 2036, causing a large decrease in required contributions

- When the System is fully funded on an actuarial value of assets basis, contributions decrease as there is little to no unfunded liability to amortize

- Employer contributions reflect the Act 120 "floor" of the employer normal cost rate

($ Billions)	2024	2029	2034	2039	2044	2049	2054
95th Percentile	$5.3	$6.0	$8.0	$5.4	$5.3	$6.7	$7.4
75th Percentile	$5.3	$5.8	$7.0	$3.4	$2.3	$2.7	$2.8
50th Percentile	$5.3	$5.7	$6.4	$2.0	$0.3	$0.2	$0.2
25th Percentile	$5.3	$5.6	$5.7	$0.5	$0.3	$0.2	$0.2
5th Percentile	$5.3	$5.4	$4.8	$0.5	$0.3	$0.2	$0.2

Percentage of Payroll	2024	2029	2034	2039	2044	2049	2054
95th Percentile	34.5%	36.3%	46.3%	30.4%	28.8%	34.4%	34.3%
75th Percentile	34.5%	35.1%	40.5%	19.1%	12.3%	14.1%	13.3%
50th Percentile	34.5%	34.3%	37.0%	11.2%	1.8%	1.1%	0.8%
25th Percentile	34.5%	33.6%	33.3%	2.8%	1.8%	1.1%	0.8%
5th Percentile	34.5%	32.6%	27.8%	2.8%	1.8%	1.1%	0.8%

Summary of Stochastic Results

Portfolio Metrics			Financial Metrics						
			30-Year MVA Funding Ratio		30-Year PV of Employer Contributions* ($ Billions)		30-Year Total Employer Contributions* ($ Billions)		Expected Date of Full Funding
30-Year Geometric Return	Standard Deviation	Sharpe Ratio	Median	5th Percentile (Unfavorable)	Median	95th Percentile (Unfavorable)	Median	95th Percentile (Unfavorable)	
7.6%	9.87%	0.45	140.6%	46.8%	$50.4	$73.2	$85.6	$178.7	6/30/2038

*Employer Contributions accumulated beginning as of 7/1/2024

Key Takeaways

- Funded ratio is expected to gradually increase over the course of 30 years, with a 5th percentile downside near 46%

- Contributions vary greatly with asset performance, but large decreases are expected in 2036 due to large base from Act 120 fresh start becoming fully amortized

Liquidity Analysis

Asset/Liability Projection Stochastic Results
Net Cash Flow: Contributions less Benefit Payments ($ Billions)
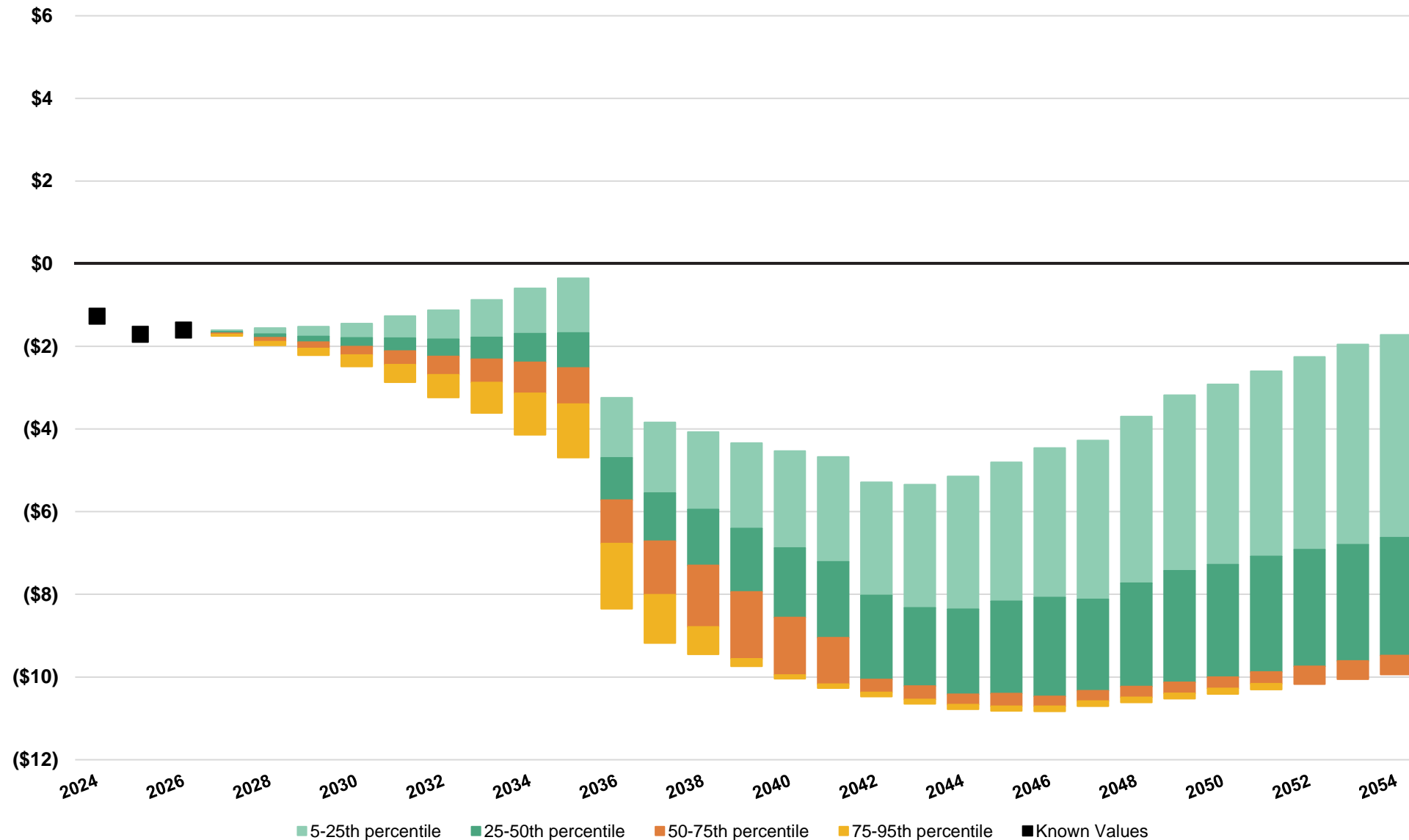
Throughout the 30-year projection period, benefit payments are expected to exceed contributions leading to a net negative cash flow.

Legend: 5-25th percentile | 25-50th percentile | 50-75th percentile | 75-95th percentile | Known Values

Asset/Liability Projection Stochastic Results

Net Cash Flow: Contributions less Benefit Payments plus Returns ($ Billions)
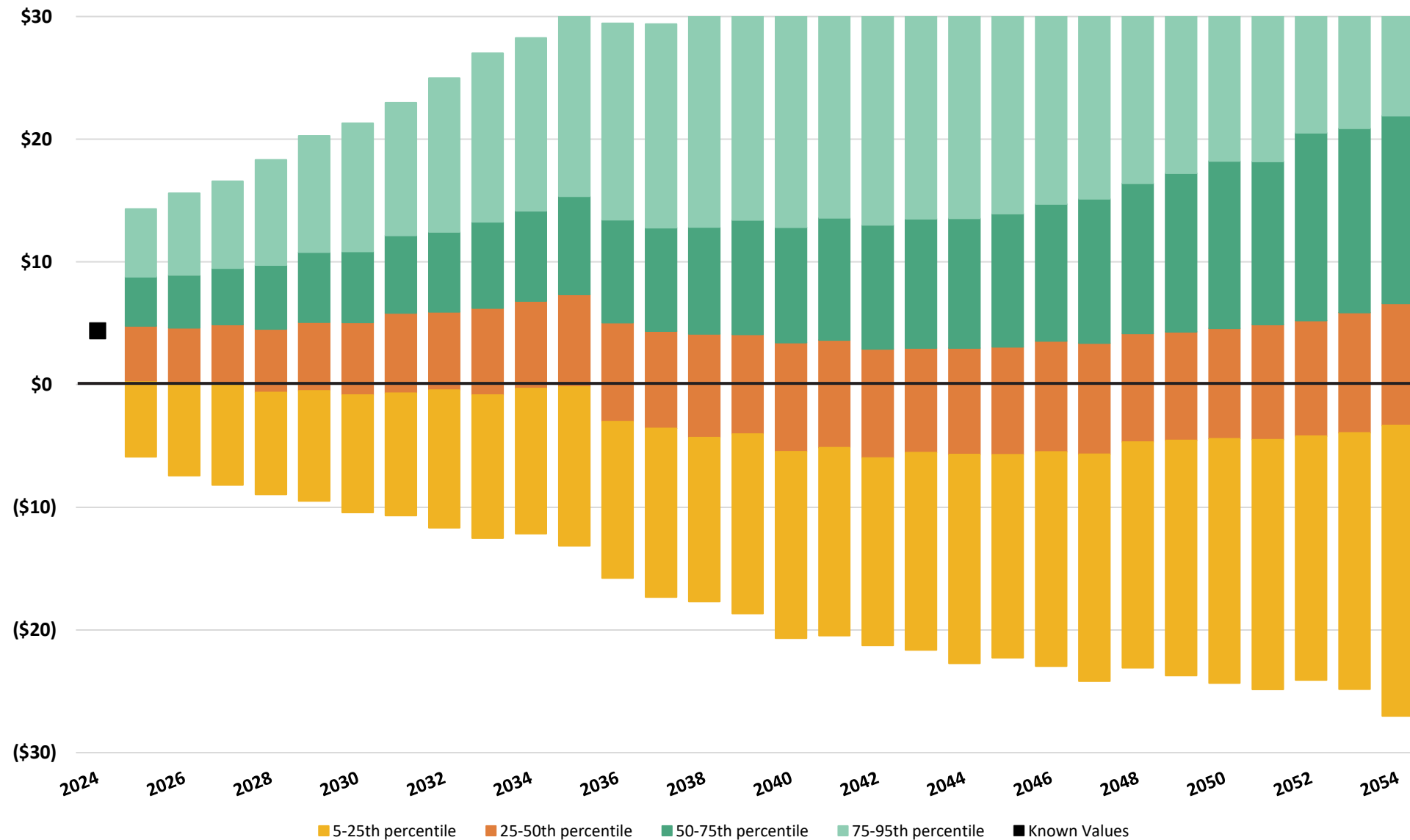
At the median, investment returns make up for the difference in contributions and benefit payments, resulting in net positive cash flow.

Approximately 70% of the System's returns are from investments that could be liquidated relatively quickly if needed to cover benefit payments

Legend: 5-25th percentile | 25-50th percentile | 50-75th percentile | 75-95th percentile | Known Values

Asset/Liability Projection Stochastic Results
Net Outflow: Benefit Payments less Contributions / Assets ($ Billions)
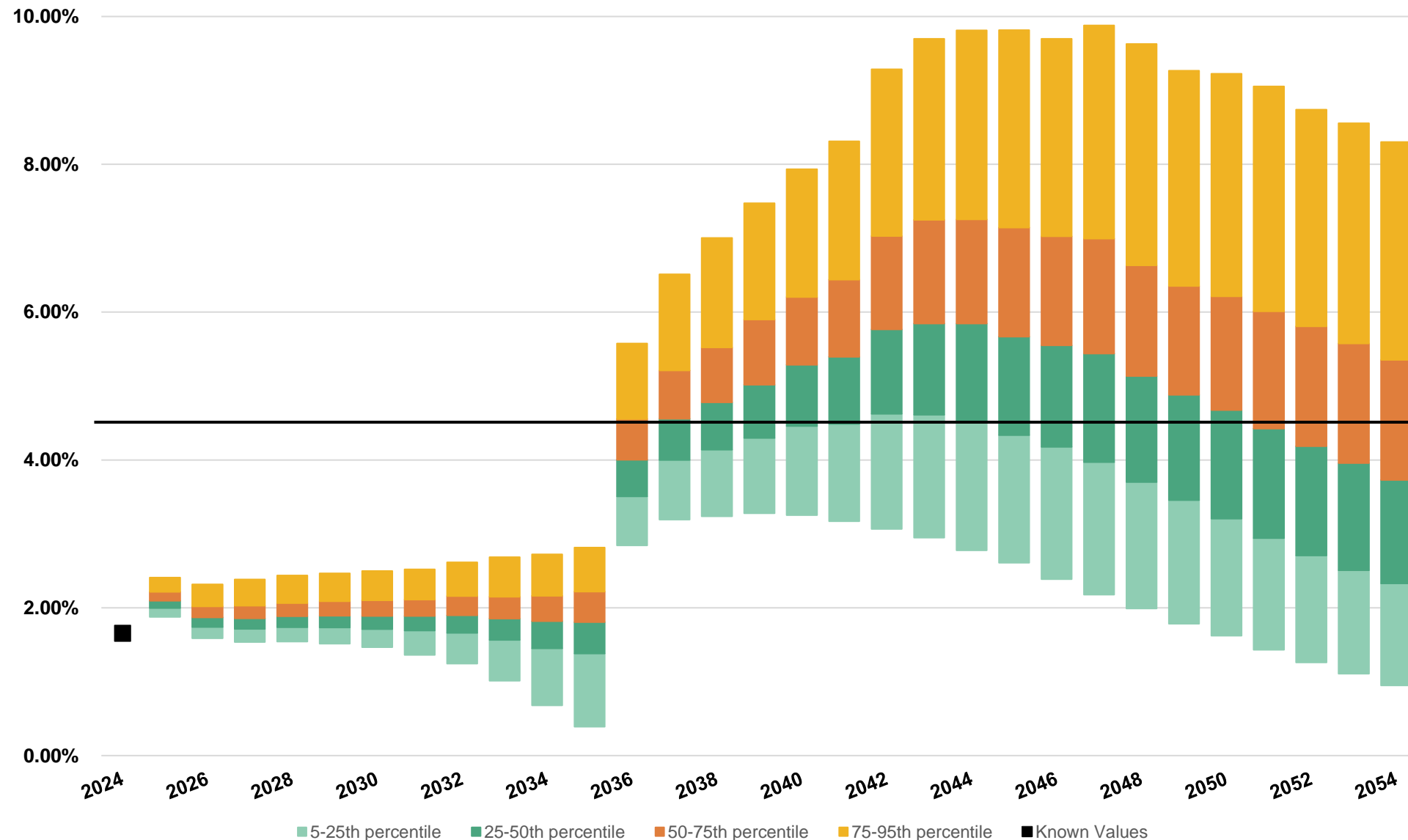
Assets are expected to return 7% nominal and 4.5% real (assuming 2.5% inflation)

If net outflow is below 4.5%, the System's assets would be expected to earn enough to fund the gap between contributions and benefit payments and maintain purchasing power

The net outflow is above 4.5% from 2038-2050 at the median indicating cash flows are not keeping up with inflation. However, the trend corrects itself in the later years of the projection as benefit payments decrease

Legend: 5-25th percentile | 25-50th percentile | 50-75th percentile | 75-95th percentile | Known Values

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Asset/Liability Projection Stochastic Results
Net Cash Flow

Contributions less Benefit Payments

($ Billions)	2024	2029	2034	2039	2044	2049	2054
95th Percentile	($1.3)	($1.5)	($0.6)	($4.3)	($5.1)	($3.2)	($1.7)
75th Percentile	($1.3)	($1.8)	($1.7)	($6.4)	($8.4)	($7.4)	($6.6)
50th Percentile	($1.3)	($1.9)	($2.4)	($7.9)	($10.4)	($10.1)	($9.5)
25th Percentile	($1.3)	($2.0)	($3.1)	($9.6)	($10.7)	($10.4)	($9.9)
5th Percentile	($1.3)	($2.2)	($4.1)	($9.7)	($10.8)	($10.5)	($9.9)

Contributions less Benefit Payments plus Returns

($ Billions)	2024	2029	2034	2039	2044	2049	2054
95th Percentile	$4.4	$20.3	$28.3	$31.5	$41.9	$56.4	$79.1
75th Percentile	$4.4	$10.8	$14.2	$13.4	$13.5	$17.2	$21.9
50th Percentile	$4.4	$5.1	$6.8	$4.1	$3.0	$4.3	$6.6
25th Percentile	$4.4	($0.5)	($0.3)	($4.0)	($5.7)	($4.5)	($3.3)
5th Percentile	$4.4	($9.5)	($12.2)	($18.7)	($22.7)	($23.7)	($27.0)

Net Outflow: Benefit Payments less Contributions / Assets

	2024	2029	2034	2039	2044	2049	2054
95th Percentile	1.7%	2.5%	2.7%	7.5%	9.8%	9.3%	8.3%
75th Percentile	1.7%	2.1%	2.2%	5.9%	7.3%	6.4%	5.4%
50th Percentile	1.7%	1.9%	1.8%	5.0%	5.8%	4.9%	3.7%
25th Percentile	1.7%	1.7%	1.5%	4.3%	4.5%	3.5%	2.3%
5th Percentile	1.7%	1.5%	0.7%	3.3%	2.8%	1.8%	1.0%

Demographic Analysis

Demographic Analysis Scenarios

Scenario	Methodology
Baseline	Projection is equal to the System's expected economic and demographic assumptions
Mortality	10% more deaths among healthy member annuitants than assumed over the first 10-year period, and for the following 20 years is equal to the System's expected mortality assumption
	10% fewer deaths among healthy member annuitants than assumed over the first 10-year period, and for the following 20 years is equal to the System's expected mortality assumption
Salary	Actual salary increases are 2% higher salary than assumed for the first 10-year period, and for the following 20 years is equal to the System's expected salary assumption
	Actual salary increases are 2% lower salary than assumed for the first 10-year period, and for the following 20 years is equal to the System's expected salary assumption

Funded Ratio: Actuarial Value of Assets (AVA) Basis
Mortality & Salary Sensitivities
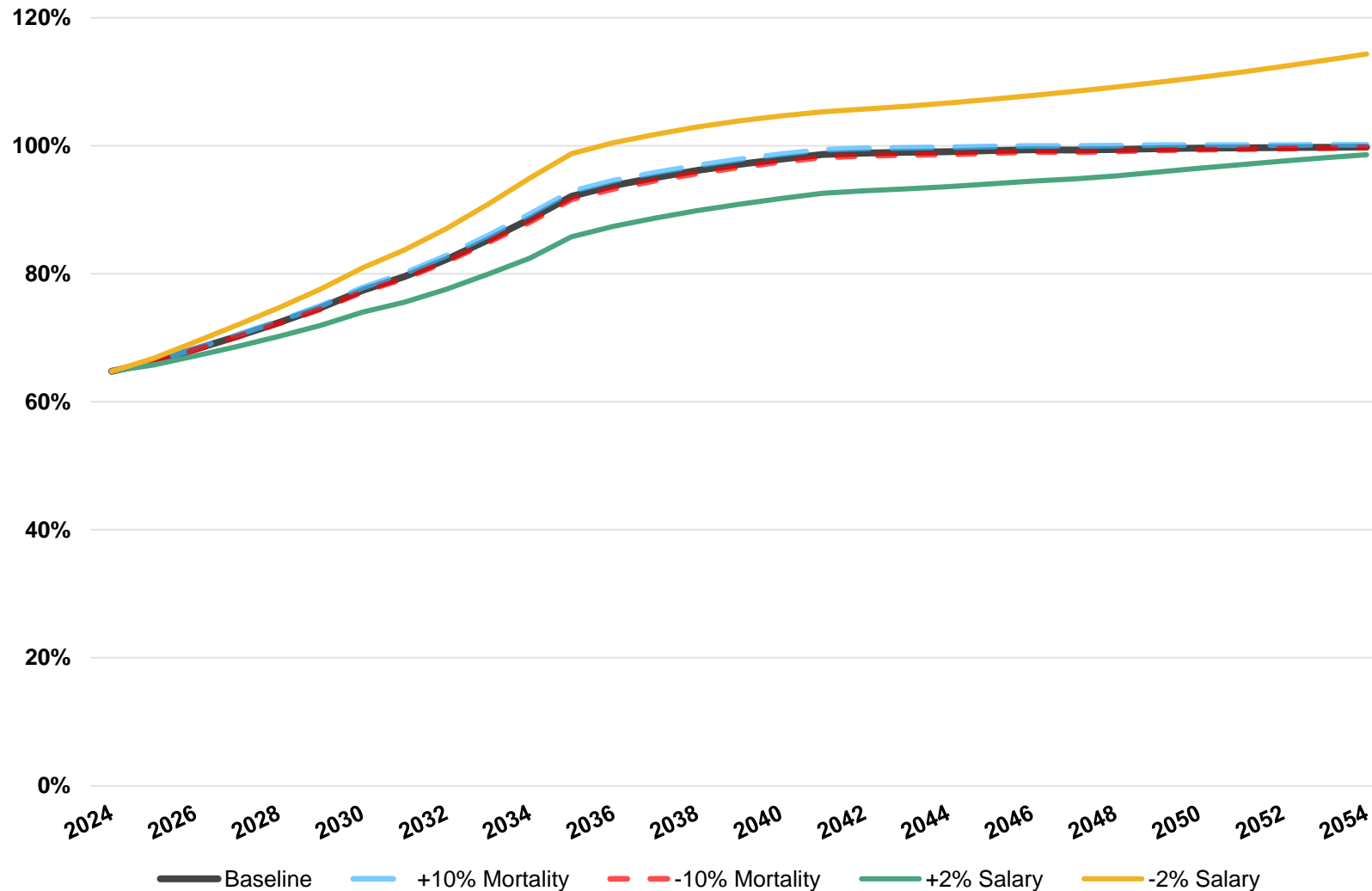
Compared to Baseline (black line):

- Mortality experience (dashed lines) among healthy member annuitants has a relatively low impact on the System's funded status
- Salary experience (solid lines) among continuing active members has a greater influence on the System's funded status

Legend: Baseline, +10% Mortality, -10% Mortality, +2% Salary, -2% Salary

Actuarially Determined Employer Contribution (ADEC) Rate
Mortality & Salary Sensitivities
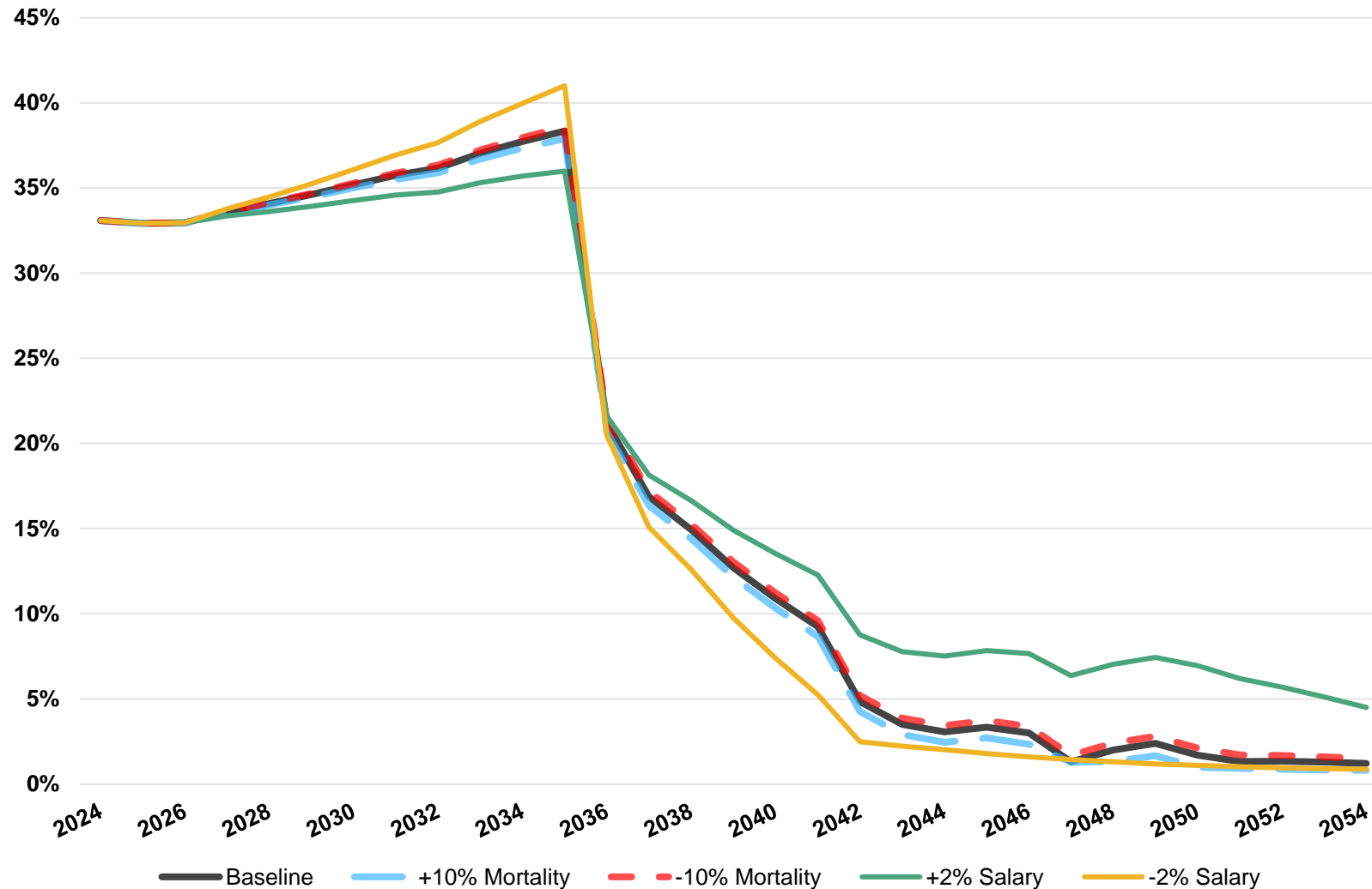
Compared to Baseline (black line):

- Mortality experience (dashed lines) among healthy member annuitants has a relatively low impact on the ADEC rate
- Salary experience (solid lines) among continuing active members greatly influences the System's liability and ADEC rate

Legend: Baseline — +10% Mortality — -10% Mortality — +2% Salary — -2% Salary

See Appendix A for actuarially determined employer contribution in dollars.

Summary of Demographic Analysis Results

Scenario	5 Years		10 Years		30 Years	
	Cumulative Employer Contributions* ($ Billions)	Funded Ratio (AVA)	Cumulative Employer Contributions* ($ Billions)	Funded Ratio (AVA)	Cumulative Employer Contributions* ($ Billions)	Funded Ratio (AVA)
Baseline	$27.2	74.7%	$58.0	88.6%	$85.6	99.8%
Higher Mortality	$27.2	75.0%	$57.8	89.3%	$83.4	100.1%
Lower Mortality	$27.3	74.5%	$58.2	88.1%	$87.1	99.7%
Higher Salary	$27.7	71.9%	$60.9	82.4%	$109.9	98.6%
Lower Salary	$26.8	77.6%	$55.3	94.9%	$74.5	114.3%

*Actuarially Determined Employer Contributions accumulated beginning as of 7/1/2024

Key Takeaways

- Higher or lower than expected mortality over a 10-year period has minimal impact on the System

- Higher or lower than expected salary over a 10-year period has a greater impact on both employer contributions and funded ratio

Additional Stress Test Scenarios

Additional Stress Test Scenarios
Investment & Contribution Sensitivities

Scenario	Methodology
Baseline	Asset return for the next 30 years is equal to the System's expected return assumption (7.00%)
Excess Contribution	Asset return for the next 30 years is equal to the System's expected return assumption (7.00%) Contributions in year 1 are $500M plus the actuarially determined contribution, and for the remainder of the projection are equal to the actuarially determined contributions
One-Time Large Investment Loss	Asset return in year 1 is -20% and for the remainder of the projection is equal to the System's expected return assumption (7.00%)
Ongoing Low Return & Low Contributions	Asset return for the next 20 years is 2.00% lower (5.00%) than the System's expected return assumption, and for the following 10 years is equal to the System's expected return assumption (7%) Contributions for the next 20 years are 80% of the actuarially determined contributions, and for the following 10 years are equal to the full actuarially determined contributions
One-Time Large Investment Loss & Low Contribution	Asset return in year 1 is -20.00% and for the remainder of the projection is equal to the System's expected return assumption (7.00%) Contributions in year 1 are 80% of the actuarially determined contributions and for the remainder of the projection are equal to the full actuarially determined contributions

Funded Ratio: Actuarial Value of Assets (AVA) Basis
Investment & Contribution Sensitivities
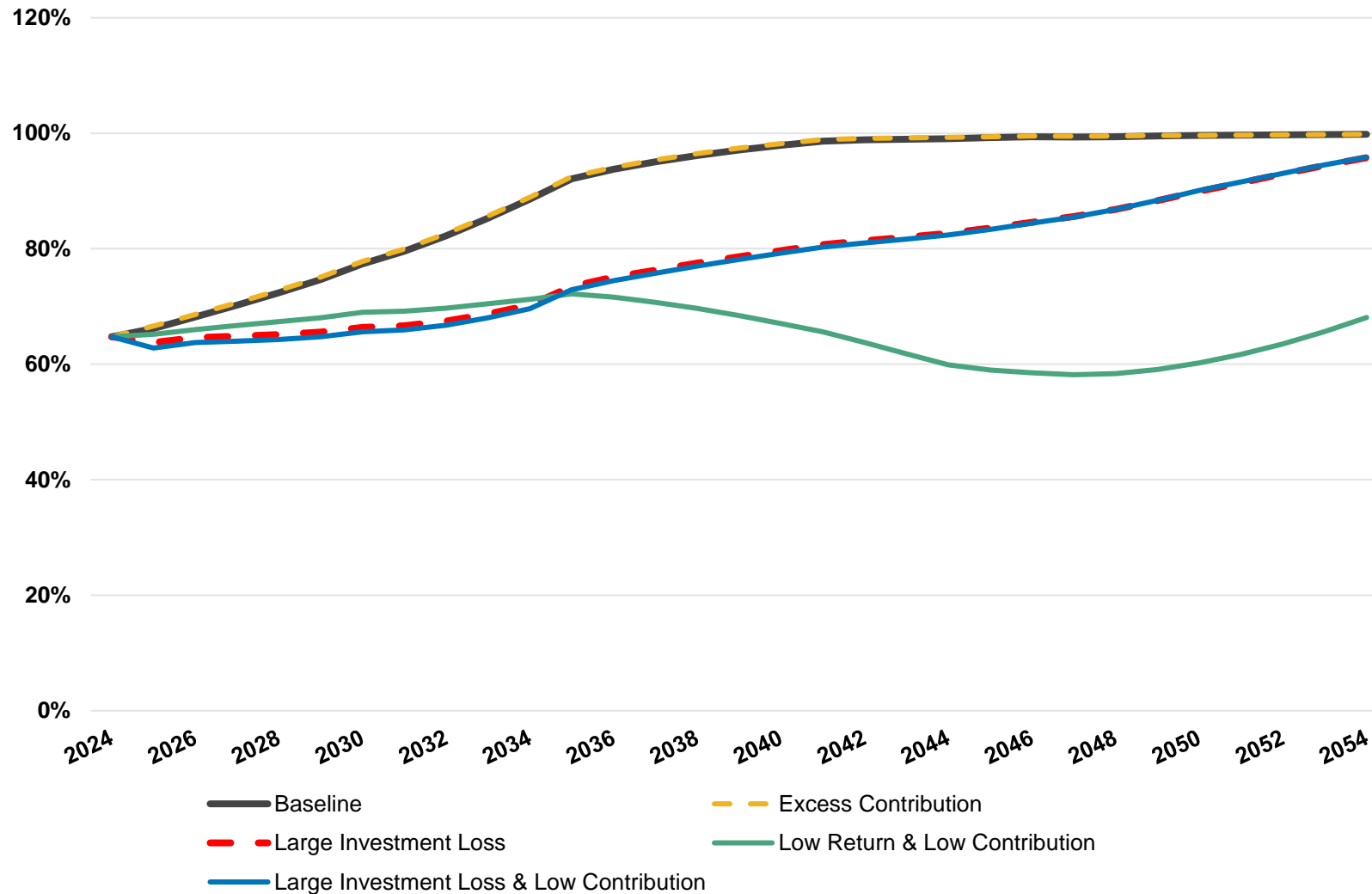
Compared to Baseline (black line):

- Excess Contributions (yellow dashed line): A one-time additional contributions of $500M slightly improves the funded status in the near term but has minimal impact long term
- Large Investment Loss (red dashed line): Immediately decreases the funded status but gradually improves it over time as ADEC is made
- Low Return & Low Contribution (green line): Combination of low return and contributing lower than the full ADEC results in the System's funded status improving minimally over a 30-year period
- Large Investment Loss & Low Contribution (blue line): Immediately decreases the funded status but gradually improves it over time as ADEC is made

Legend:
— Baseline
— — Excess Contribution
- - - Large Investment Loss
— Low Return & Low Contribution
— Large Investment Loss & Low Contribution

Actuarially Determined Employer Contribution (ADEC) Rate
Investment & Contribution Sensitivities

The Act 120 liability will be fully amortized by fiscal year end 2035 resulting in the ADEC rate under each scenario to decrease in 2036

Compared to Baseline (black line):

- Excess Contributions (yellow dashed line): One-time additional contribution of $500M slightly decreases the ADEC rate
- Large Investment Loss (red dashed line): Immediately increases the ADEC rate resulting in an overall higher ADEC rate due to the amount of time to fully amortize the large initial loss
- Low Return & Low Contribution (green line): Immediately increases the ADEC rate. After 2035, the scenario has the highest ADEC rate long term compared to all scenarios due to lower-than-expected returns and not contributing ADEC rate
- Large Investment Loss & Low Contribution (blue line): Immediately increases the ADEC rate causing an overall higher ADEC rate due to the amount of time to fully amortize the large initial loss

See Appendix A for actuarially determined employer contribution in dollars.

Summary of Scenario Analysis Results

Scenario	5 Years		10 Years		30 Years	
	Cumulative Employer Contributions* ($ Billions)	Funded Ratio (AVA)	Cumulative Employer Contributions* ($ Billions)	Funded Ratio (AVA)	Cumulative Employer Contributions* ($ Billions)	Funded Ratio (AVA)
Baseline	$27.2	74.7%	$58.0	88.6%	$85.6	99.8%
One-Time Excess Contribution	$27.1	75.1%	$57.7	88.9%	$84.5	99.8%
One-Time Large Investment Loss	$28.2	65.6%	$64.3	70.2%	$143.0	95.8%
One-Time Large Investment Loss & Low Contribution	$28.5	64.8%	$64.9	69.6%	$145.1	95.8%
Ongoing Low Return & Low Contributions	$27.8	68.0%	$62.7	71.2%	$179.0	68.1%

*Actuarially Determined Employer Contributions accumulated beginning as of 7/1/2024

Key Takeaways

- One-time additional contribution has minimal impact on long-term employer contributions and funded ratio

- One time investment losses and/or one-time contribution lower than the ADEC impacts both employer contributions and funded ratio in the short term, but does not have a significant impact on the long term funded status

- Ongoing low returns and contributions lower than the ADEC heavily impacts both employer contributions and funded ratio

Appendix A

Actuarially Determined Employer Contribution ($Billions)
Core Scenarios
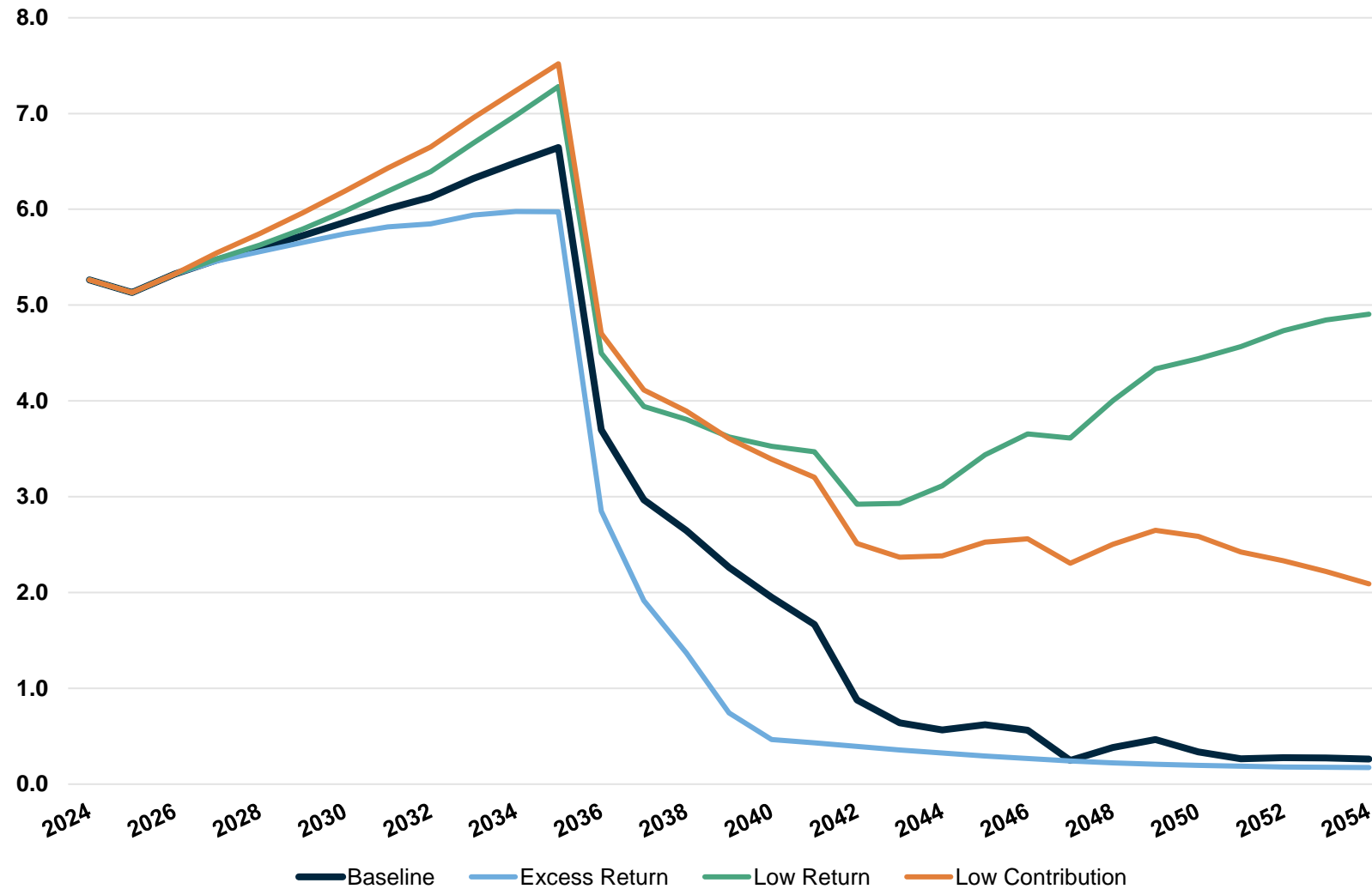
- The Act 120 liability will be fully amortized by fiscal year end (FYE) 2035 resulting in the ADEC under each scenario to decrease in 2036
- Baseline (black line): By the end of the projection period, ADEC will approach the Act 120 minimum normal cost contribution
- Excess Return (blue line): Higher than expected returns will accelerate the System starting to only pay the Act 120 minimum normal cost contribution compared to the baseline
- Low Return (green line): Contributions expected to increase until all asset losses are recognized and fully paid, which results in the highest ADEC over the projection period
- Low Contribution (orange line): Under-contributing equates to deferred contributions and a higher ADEC than the baseline

Actuarially Determined Employer Contribution ($Billions)
Mortality & Salary Sensitivities
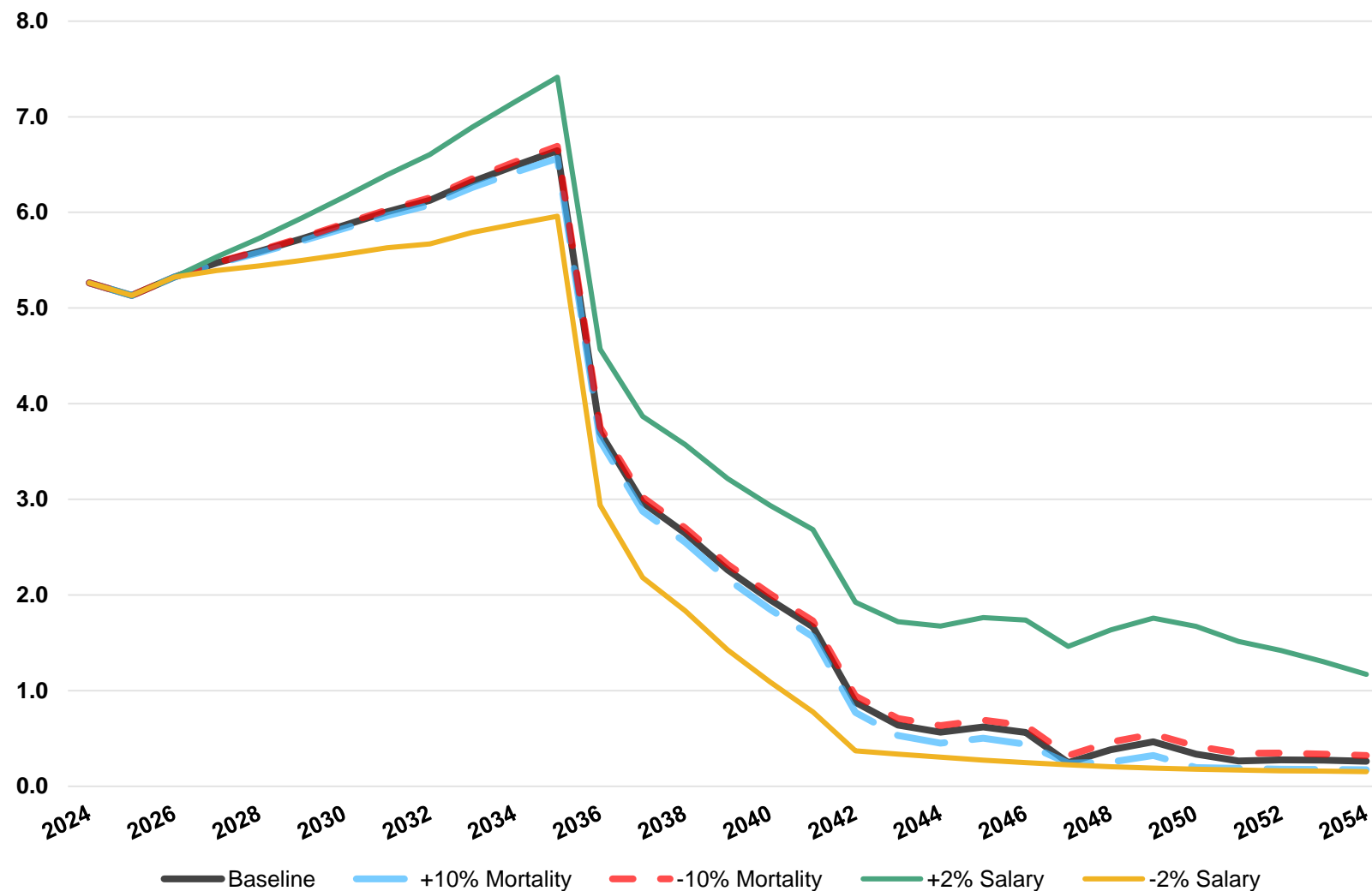
Compared to Baseline (black line):

- Mortality experience (dashed lines) among healthy member annuitants has a relatively low impact on the ADEC
- Salary experience (solid lines) among continuing active members greatly influences the System's liability and ADEC

Legend: Baseline — +10% Mortality — -10% Mortality — +2% Salary — -2% Salary

See Appendix A for actuarially determined employer contribution in dollars.

Actuarially Determined Employer Contribution ($Billions)

Investment & Contribution Sensitivities
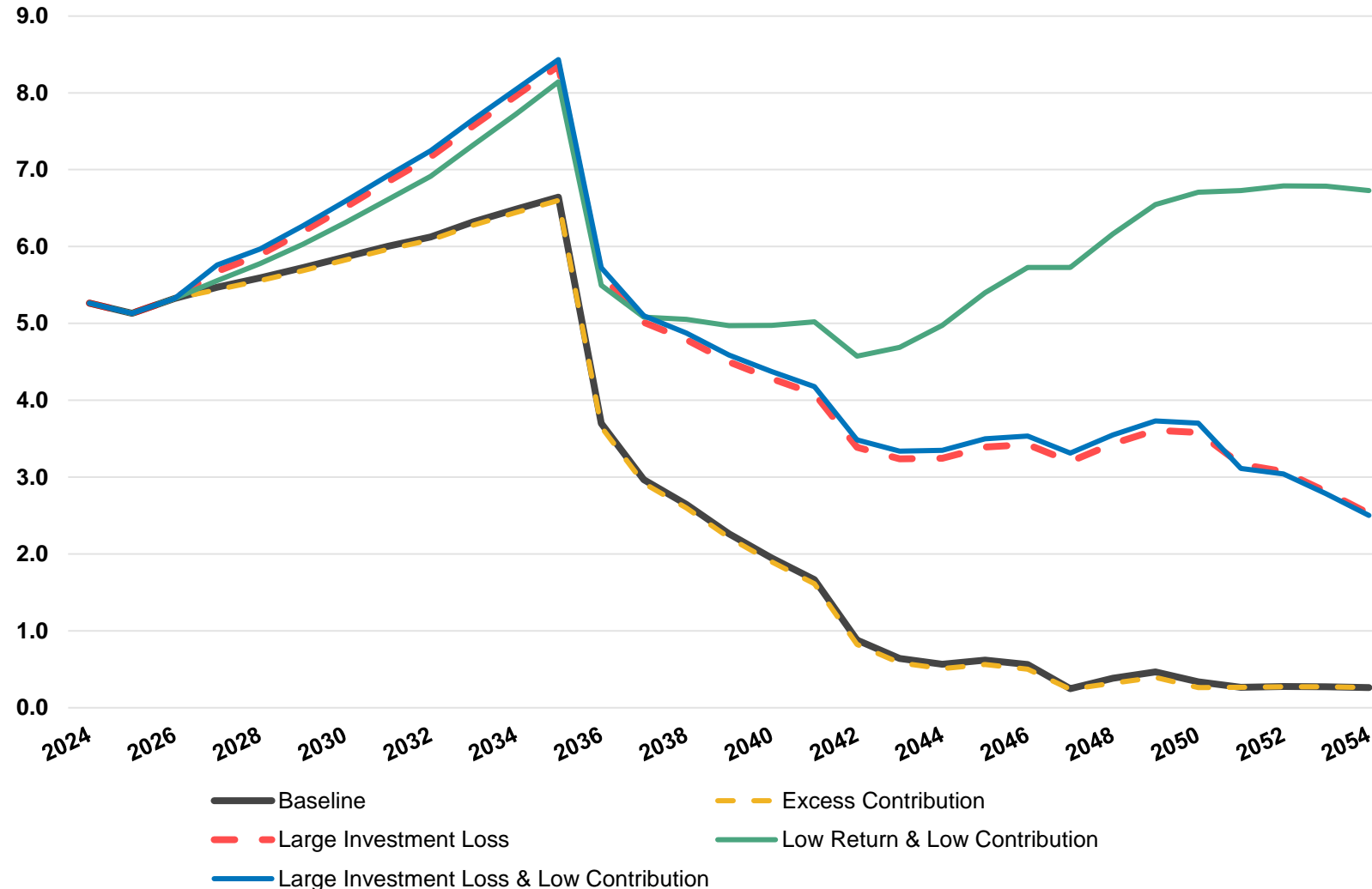
The Act 120 liability will be fully amortized by fiscal year end 2035 resulting in the ADEC under each scenario to decrease in 2036
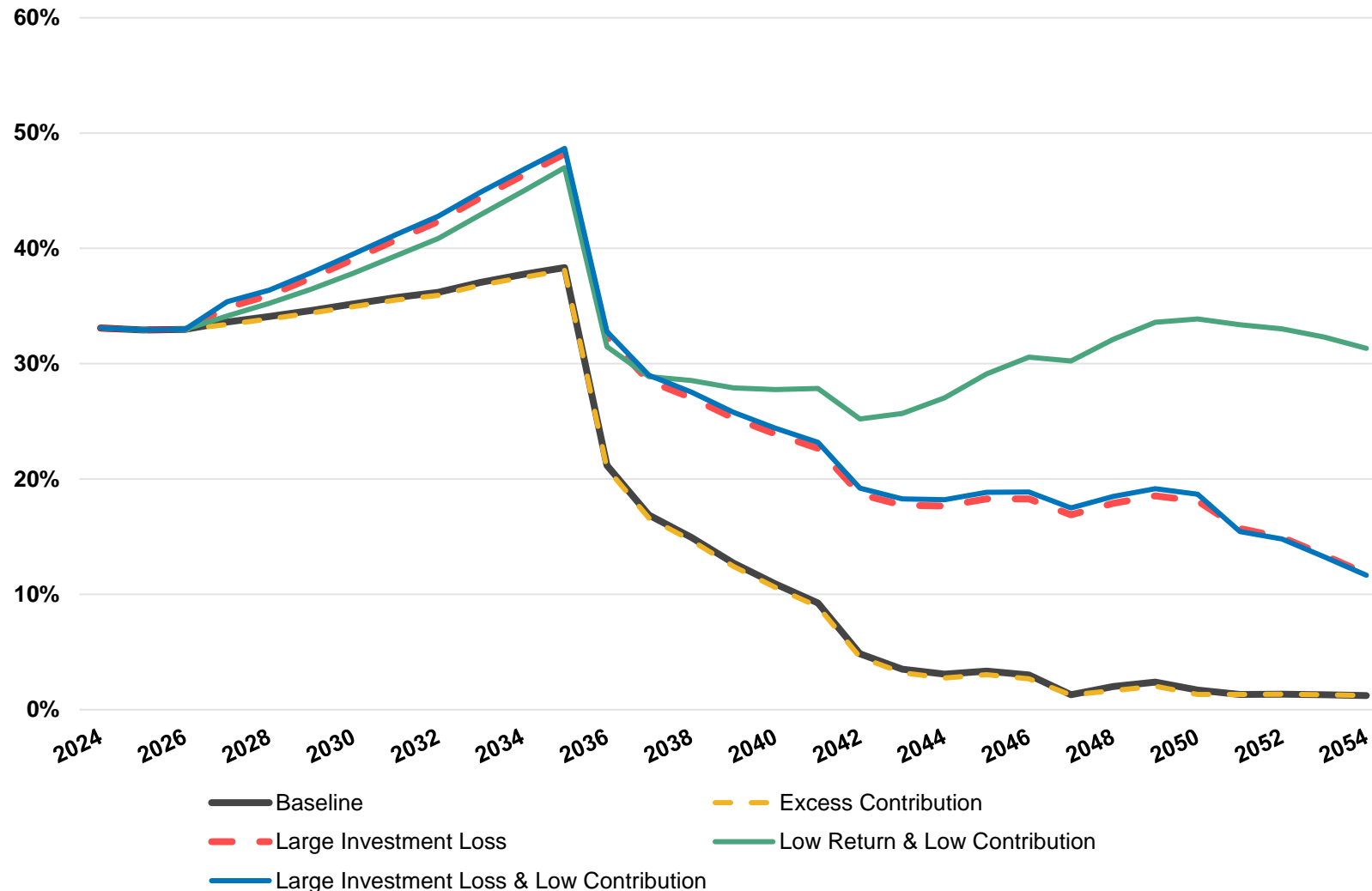
Compared to Baseline (black line):

- Excess Contributions (yellow dashed line): One-time additional contribution of $500M slightly decreases the ADEC
- Large Investment Loss (red dashed line): Immediately increases the ADEC rate resulting in an overall higher ADEC rate due to the amount of time to fully amortize the large initial loss
- Low Return & Low Contribution (green line): Immediately increases the ADEC. After 2035, the scenario has the highest ADEC long term compared to all scenarios due to lower-than-expected returns and not contributing ADEC
- Large Investment Loss & Low Contribution (blue line): Immediately increases the ADEC rate causing an overall higher ADEC rate due to the amount of time to fully amortize the large initial loss

Appendix B

Title 24 | § 8510. Stress Test of System

A. General rule: The board shall conduct an annual stress test of the System and submit the results of the stress test to the Governor, the General Assembly and the Independent Fiscal Office no later than January 1 of each year. The stress test shall include a scenario analysis, simulation analysis and sensitivity analysis. The board shall disclose in the report of the stress test results which industry standards were used and whether any changes to industry standards have been made.

B. Report by Independent Fiscal Office.--No later than March 1 of each year, the Independent Fiscal Office shall produce a report summarizing the results of the stress test, including a calculation of the ratio of projected employer pension contributions to projected State revenues under a scenario analysis.

C. Definitions.--As used in this section, the following words and phrases shall have the meanings given to them in this subsection unless the context clearly indicates otherwise:

"Scenario analysis." Projections of assets, liabilities, unfunded actuarial accrued liabilities, the change in unfunded actuarial accrued liabilities, employer contributions, benefit payments, service costs, payroll and calculations of the ratios of assets to liabilities, employer contributions to payroll and operating cash flow to assets in sufficient number as determined prudent by the board as informed by recognized industry standards.

"Sensitivity analysis." The following:

1. Estimates of the total normal cost and employer normal cost for new employees, calculated using various investment return assumptions in sufficient number as determined prudent by the board as informed by recognized industry standards.

2. Estimates of the unfunded actuarial accrued liability and unfunded liability, calculated using various annual assumed rates of return in sufficient number as determined prudent by the board as informed by recognized industry standards.

"Simulation analysis." Projections of the range of required employer contributions for each of the next 20 years, based on analysis that simulates the volatility of annual investment returns above and below the assumed rate of return, applying methodology determined prudent by the board as informed by recognized industry standards.

(Nov. 25, 2020, P.L.1237, No.128, eff. 60 days)

2020 Amendment. Act 128 added section 8510. Section 7(1) of Act 128 provided that the addition of section 8510 shall apply to fiscal years beginning after June 30, 2022.

Portfolio Analysis
Current Long-Term Policy

- Return, standard deviation, and Sharpe Ratio statistics are calculated using Gallagher's October 2024 Capital Market Assumptions

- Asset allocation is based on the allocation plan as of June 30, 2024, shown in the PSERS Financial Statements

Asset Class/Metric	Asset Allocation Plan
US Large Cap Equity	18.0%
Global Equity ex US	12.0%
Private Equity	12.0%
Total Equity	**42.0%**
Aggregate Bonds	6.0%
Emerging Market Debt	1.0%
Long Government	8.0%
US High Yield	3.5%
TIPS	9.0%
Private Debt	6.0%
Total Fixed Income	**33.5%**
Infrastructure	10.0%
Commodities	5.0%
Direct Real Estate	7.0%
REITs	2.5%
Total Real Assets	**24.5%**
Total Plan	**100.0%**
30-Year Geometric Return	**7.6%**
Standard Deviation	**9.9%**
Sharpe Ratio	**0.45**

Gallagher October 2024 Capital Market Assumptions

Summary of Expected Returns and Standard Deviations

Asset Class	1st Year Arithmetic Mean	10th Year Arithmetic Mean	10 Years Arithmetic Mean	10 Years Geometric Mean	10 Years Standard Deviation	20th Year Arithmetic Mean	20 Years Arithmetic Mean	20 Years Geometric Mean	20 Years Standard Deviation	30th Year Arithmetic Mean	30 Years Arithmetic Mean	30 Years Geometric Mean	30 Years Standard Deviation
Global Equity	9.1%	7.5%	7.7%	6.5%	16.4%	9.2%	8.5%	7.2%	16.9%	8.5%	8.7%	7.4%	17.0%
US All Cap Equity	9.1%	7.2%	7.3%	6.1%	16.3%	9.6%	8.4%	7.1%	16.8%	9.2%	8.8%	7.5%	16.9%
US Large Cap Equity	8.9%	7.1%	7.1%	6.0%	16.2%	9.7%	8.4%	7.1%	16.9%	9.3%	8.8%	7.5%	16.9%
US Mid Cap Equity	10.6%	8.8%	8.9%	7.6%	17.5%	9.7%	9.0%	7.6%	17.8%	9.2%	9.1%	7.7%	17.8%
US Small Cap Equity	11.5%	9.5%	9.7%	8.1%	19.5%	10.0%	9.7%	7.9%	19.7%	9.1%	9.7%	7.9%	19.6%
Low Volatility Equity	7.1%	6.0%	6.2%	5.8%	9.2%	7.3%	6.7%	6.3%	9.4%	7.0%	6.9%	6.5%	9.4%
Global Equity ex US	9.9%	8.6%	8.9%	7.2%	20.1%	9.2%	9.1%	7.2%	20.7%	8.0%	9.2%	7.3%	20.7%
MSCI EAFE Equity	9.2%	8.4%	8.9%	7.1%	20.2%	8.6%	8.9%	7.0%	20.8%	7.5%	9.0%	7.0%	20.8%
MSCI Emerging Markets Equity	13.4%	10.7%	10.5%	7.4%	28.0%	12.4%	11.3%	7.8%	28.6%	10.9%	11.6%	8.0%	28.6%
Private Equity	15.2%	12.0%	12.1%	9.1%	27.3%	12.0%	11.9%	8.6%	27.7%	11.7%	12.0%	8.6%	27.7%
Direct Real Estate	4.5%	7.1%	6.6%	6.3%	9.1%	6.4%	6.7%	6.3%	9.2%	6.8%	6.7%	6.4%	9.3%
REITs	6.3%	7.5%	7.0%	5.4%	19.7%	8.1%	7.6%	5.9%	20.0%	7.8%	7.7%	6.0%	20.0%
Infrastructure	8.1%	8.2%	8.4%	7.7%	12.9%	8.7%	8.3%	7.6%	12.9%	8.3%	8.3%	7.6%	12.9%
Hedge Funds	6.5%	5.4%	5.7%	5.3%	9.3%	5.6%	5.6%	5.2%	9.5%	5.6%	5.6%	5.2%	9.4%
Commodities	11.1%	5.4%	6.3%	4.4%	26.4%	6.1%	6.2%	4.0%	26.8%	5.3%	6.1%	3.7%	27.4%
Aggregate Bonds	3.5%	4.6%	4.2%	4.1%	4.5%	4.9%	4.4%	4.3%	4.6%	4.6%	4.5%	4.5%	4.5%
Global Aggregate Bonds	2.7%	4.0%	3.6%	3.5%	5.6%	4.2%	3.8%	3.6%	5.6%	4.0%	3.9%	3.8%	5.7%
Short Government	3.9%	3.9%	3.9%	3.8%	2.4%	4.0%	3.9%	3.9%	2.5%	3.9%	3.9%	3.9%	2.6%
Short Corporate	4.2%	4.6%	4.4%	4.3%	2.5%	4.7%	4.5%	4.4%	2.6%	4.6%	4.5%	4.5%	2.7%
Short Credit	4.2%	4.5%	4.3%	4.3%	2.5%	4.7%	4.4%	4.4%	2.6%	4.5%	4.5%	4.4%	2.6%
Short Government/Credit	3.9%	4.1%	4.0%	3.9%	2.4%	4.2%	4.0%	4.0%	2.5%	4.1%	4.1%	4.0%	2.6%
Intermediate Government	3.4%	4.3%	4.0%	4.0%	3.7%	4.4%	4.2%	4.1%	3.8%	4.2%	4.2%	4.2%	3.8%
Intermediate Corporate	3.4%	5.2%	4.7%	4.6%	4.4%	5.4%	4.9%	4.8%	4.5%	5.1%	5.1%	5.0%	4.6%
Intermediate Credit	3.4%	5.1%	4.6%	4.5%	4.3%	5.3%	4.8%	4.8%	4.4%	5.0%	5.0%	4.9%	4.4%
Intermediate Government/Credit	3.4%	4.6%	4.2%	4.2%	3.8%	4.7%	4.4%	4.3%	3.9%	4.5%	4.5%	4.4%	4.0%
Core Government	2.9%	4.8%	4.3%	4.1%	5.6%	4.9%	4.5%	4.3%	5.7%	4.5%	4.6%	4.4%	5.8%
Core Corporate	2.6%	5.7%	4.9%	4.7%	6.1%	6.0%	5.3%	5.1%	6.3%	5.5%	5.5%	5.3%	6.4%
Core Credit	2.7%	5.6%	4.8%	4.6%	6.1%	5.8%	5.2%	5.0%	6.2%	5.4%	5.4%	5.2%	6.3%
Core Government/Credit	2.8%	5.1%	4.5%	4.3%	5.7%	5.3%	4.7%	4.6%	5.8%	4.8%	4.9%	4.7%	5.8%
Long Government	4.7%	5.2%	4.3%	3.8%	10.7%	5.5%	4.7%	4.1%	10.9%	4.4%	4.9%	4.3%	11.0%
Long Corporate	3.3%	6.2%	5.0%	4.5%	10.0%	6.7%	5.5%	5.0%	10.3%	5.7%	5.8%	5.3%	10.4%
Long Credit	3.4%	6.1%	4.9%	4.5%	9.8%	6.6%	5.5%	5.0%	10.0%	5.6%	5.7%	5.2%	10.1%
Long Government/Credit	3.9%	5.6%	4.6%	4.2%	9.4%	6.0%	5.1%	4.6%	9.7%	5.0%	5.3%	4.8%	9.7%
STRIPS	6.2%	6.3%	4.8%	3.6%	16.6%	7.0%	5.4%	4.0%	17.4%	4.9%	5.8%	4.4%	17.5%
TIPS	5.5%	4.6%	4.6%	4.3%	7.5%	5.1%	4.7%	4.5%	7.6%	4.7%	4.8%	4.5%	7.6%
Mortgage-Backed Securities	3.5%	4.6%	4.1%	4.0%	3.9%	4.9%	4.3%	4.3%	4.0%	4.5%	4.5%	4.4%	3.9%
US High Yield	4.4%	9.7%	8.1%	7.4%	12.7%	10.1%	8.9%	8.1%	13.3%	9.4%	9.2%	8.3%	13.3%
Emerging Market Debt	7.9%	6.8%	7.0%	6.5%	10.4%	6.9%	7.0%	6.5%	10.3%	7.0%	7.1%	6.6%	10.4%
Global ex-US Debt	2.2%	3.6%	3.2%	2.9%	8.4%	3.7%	3.3%	3.0%	8.4%	3.6%	3.5%	3.2%	8.4%
Private Debt	9.4%	8.4%	8.5%	8.2%	8.4%	8.3%	8.6%	8.3%	8.4%	8.1%	8.5%	8.2%	8.4%
Cash	4.0%	3.0%	3.2%	3.2%	1.6%	3.2%	3.2%	3.2%	1.7%	3.2%	3.2%	3.2%	1.7%
Inflation	2.4%	2.3%	2.4%	2.4%	2.9%	2.3%	2.4%	2.4%	3.1%	2.3%	2.4%	2.3%	3.2%
Inflation – Wages	3.6%	3.5%	3.5%	3.5%	0.8%	3.5%	3.5%	3.5%	0.8%	3.5%	3.5%	3.5%	0.8%
Medical Trend – Professional	4.1%	4.2%	4.2%	4.1%	1.3%	4.4%	4.2%	4.2%	1.3%	4.4%	4.3%	4.3%	1.3%
Medical Trend – Hospital	5.9%	5.8%	5.7%	5.7%	1.8%	6.0%	5.8%	5.8%	1.9%	5.9%	5.8%	5.8%	1.9%

Gallagher October 2024 Capital Market Assumptions

Summary of 30-Year Correlations

*Correlations are rounded to the nearest tenth; a correlation shown of 1.0 does not always imply perfect correlation

	Global Equity	US All Cap Equity	US Large Cap Equity	US Mid Cap Equity	US Small Cap Equity	Low Volatility Equity	Global Equity ex US	MSCI EAFE Equity	MSCI Emerging Markets Equity	Private Equity	Direct Real Estate	REITs	Infrastructure	Hedge Funds	Commodities	Aggregate Bonds	Global Aggregate Bonds	Short Government	Short Corporate	Short Credit	Short Government/Credit	Intermediate Government	Intermediate Corporate	Intermediate Credit	Intermediate Government/Credit	Core Government	Core Corporate	Core Credit	Core Government/Credit	Long Government	Long Corporate	Long Credit	Long Government/Credit	STRIPS	TIPS	Mortgage-Backed Securities	US High Yield	Emerging Market Debt	Global ex-US Debt	Private Debt	Cash	Inflation	Inflation - Wages	Medical Trend - Professional	Medical Trend - Hospital
Global Equity	1.0																																												
US All Cap Equity	0.9	1.0																																											
US Large Cap Equity	0.9	1.0	1.0																																										
US Mid Cap Equity	0.9	0.9	0.9	1.0																																									
US Small Cap Equity	0.8	0.9	0.8	0.9	1.0																																								
Low Volatility Equity	0.7	0.7	0.7	0.6	0.6	1.0																																							
Global Equity ex US	0.9	0.7	0.7	0.7	0.7	0.5	1.0																																						
MSCI EAFE Equity	0.8	0.6	0.6	0.6	0.6	0.4	0.9	1.0																																					
MSCI Emerging Markets Equity	0.8	0.8	0.8	0.7	0.7	0.5	0.8	0.6	1.0																																				
Private Equity	0.9	0.9	0.9	0.8	0.8	0.7	0.7	0.6	0.7	1.0																																			
Direct Real Estate	0.2	0.2	0.2	0.2	0.2	0.2	0.1	0.1	0.2	0.2	1.0																																		
REITs	0.5	0.5	0.5	0.5	0.5	0.4	0.4	0.3	0.4	0.5	0.1	1.0																																	
Infrastructure	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0																																
Hedge Funds	0.6	0.6	0.6	0.5	0.5	0.4	0.4	0.4	0.5	0.6	0.1	0.3	0.0	1.0																															
Commodities	0.2	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.2	0.1	0.1	0.0	0.1	1.0																															
Aggregate Bonds	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.4	1.0																													
Global Aggregate Bonds	0.2	0.1	0.1	0.1	0.1	0.1	0.2	0.1	0.2	0.1	0.1	0.1	0.0	0.1	0.2	0.5	1.0																												
Short Government	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.4	0.2	1.0																											
Short Corporate	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.1	0.1	0.4	0.9	0.5	1.0																										
Short Credit	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.1	0.1	0.4	0.9	0.5	1.0	1.0																									
Short Government/Credit	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.1	0.1	0.4	1.0	1.0	1.0	1.0	1.0																								
Intermediate Government	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.1	0.4	1.0	0.5	1.0	0.9	0.9	1.0																							
Intermediate Corporate	0.2	0.2	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.2	0.1	0.1	0.0	0.1	0.1	0.4	1.0	0.5	0.9	0.9	0.9	0.9	1.0																						
Intermediate Credit	0.2	0.2	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.2	0.1	0.1	0.0	0.1	0.1	0.4	1.0	0.5	0.9	0.9	0.9	0.9	1.0	1.0																					
Intermediate Government/Credit	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.1	0.1	0.4	1.0	0.5	0.9	0.9	0.9	1.0	1.0	1.0	1.0																				
Core Government	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.1	0.4	1.0	0.5	0.9	0.9	0.9	1.0	0.9	0.9	1.0	1.0																			
Core Corporate	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.1	0.2	0.2	0.1	0.1	0.0	0.1	0.1	0.4	0.9	0.5	0.8	0.9	0.9	0.8	1.0	1.0	0.9	0.9	1.0																		
Core Credit	0.2	0.2	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.2	0.1	0.1	0.0	0.1	0.1	0.4	1.0	0.5	0.8	0.9	0.9	0.8	1.0	1.0	0.9	0.9	1.0	1.0																	
Core Government/Credit	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.1	0.1	0.4	1.0	0.5	0.9	0.9	0.9	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0															
Long Government	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.1	0.4	0.9	0.5	0.7	0.7	0.8	0.9	0.8	0.9	0.9	0.9	0.9	0.9	0.9	1.0														
Long Corporate	0.2	0.3	0.3	0.3	0.2	0.2	0.2	0.2	0.2	0.2	0.1	0.2	0.0	0.2	0.4	0.9	0.5	0.7	0.8	0.8	0.7	0.8	0.9	0.9	0.9	0.8	1.0	1.0	0.9	0.9	1.0													
Long Credit	0.2	0.2	0.2	0.3	0.2	0.2	0.2	0.1	0.2	0.2	0.1	0.1	0.0	0.1	0.4	0.9	0.5	0.7	0.8	0.8	0.7	0.8	0.9	0.9	0.9	0.9	1.0	1.0	0.9	0.9	1.0	1.0												
Long Government/Credit	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.1	0.4	0.9	0.5	0.8	0.8	0.8	0.8	0.9	0.9	0.9	0.9	0.9	1.0	1.0	1.0	1.0	1.0	1.0	1.0											
STRIPS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.9	0.5	0.7	0.7	0.7	0.7	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.9	1.0	0.9	0.9	1.0	1.0										
TIPS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.9	0.7	0.3	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.7	0.6	0.6	0.6	0.6	1.0										
Mortgage-Backed Securities	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.4	0.9	0.5	0.9	0.8	0.8	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.8	0.8	0.9	0.9	0.6	1.0									
US High Yield	0.7	0.7	0.7	0.7	0.6	0.5	0.5	0.4	0.5	0.6	0.2	0.4	0.0	0.4	0.3	0.6	0.5	0.4	0.6	0.6	0.5	0.5	0.7	0.7	0.6	0.5	0.7	0.7	0.6	0.5	0.8	0.6	0.5	0.3	0.5	1.0								
Emerging Market Debt	0.3	0.2	0.2	0.2	0.2	0.2	0.4	0.3	0.5	0.2	0.0	0.2	0.0	0.2	0.2	0.0	0.4	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.2	0.1	0.0	0.0	0.2	1.0								
Global ex-US Debt	0.2	0.1	0.1	0.1	0.1	0.1	0.2	0.1	0.2	0.1	0.0	0.1	0.0	0.1	0.1	0.2	0.9	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.1	0.2	0.2	0.5	1.0						
Private Debt	0.4	0.4	0.4	0.3	0.3	0.3	0.3	0.2	0.3	0.4	0.1	0.2	0.0	0.2	0.0	-0.1	0.0	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	0.0	-0.1	-0.1	0.0	0.0	-0.1	-0.1	-0.1	-0.1	0.2	0.1	0.0	1.0					
Cash	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.1	0.2	0.4	0.2	0.6	0.6	0.6	0.6	0.4	0.4	0.4	0.4	0.3	0.2	0.3	0.2	0.2	0.1	0.2	0.4	0.2	0.0	0.1	0.0	0.0	0.1	1.0				
Inflation	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.7	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.1	1.0						
Inflation – Wages	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.5	0.1	0.1	0.3	0.3	0.3	0.3	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.3	0.2	0.1	0.0	0.0	0.0	0.5	0.7	1.0			
Medical Trend – Professional	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.1	0.0	0.0	0.2	0.1	0.3	0.3	0.3	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.1	0.0	0.0	0.5	0.1	0.4	1.0						
Medical Trend – Hospital	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.2	0.1	0.3	0.3	0.3	0.3	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.3	0.2	0.1	0.0	0.0	0.5	0.6	0.8	0.6	1.0			

Actuarial Assumptions and Methods

- Except as noted herein, the projections provided were prepared using the same data, actuarial methods, assumptions, and applicable ASOPs and disclosures that were used for the June 30, 2024 actuarial valuation, found in the December 19, 2024 Board presentation, and the following assumptions for future valuations:
  - The active workforce size is assumed to remain constant; and
  - Future new employees have similar characteristics (age/gender/salary) to new employees for the period July 1, 2021 through June 30, 2024. Among new school employees hired on or after July 1, 2024, 98% will become Class T-G members, 1% will elect Class T-H membership, and 1% will elect Class DC participation.

- Key assumptions:
  - Expected Rate of Return on Assets: 7.00%
  - Payroll Growth: 3.25%
  - Average Salary Increase: 4.50%
  - Inflation: 2.50%

- The projections reflect the ACT 5 risk-sharing provisions for TE/TF/TG/TH members. We caution that the System assets and projected unfunded accrued liability amortization schedules reflect the under/over contribution from the basic member rate resulting from the assumed asset returns, the corresponding System accrued liabilities do not reflect the decrease/increase in the affected members' contribution rates. Stress-testing for future alternative System returns that are different from the assumed 7.00% per annum may also affect the projected System liabilities due to the shared-risk member contributions due to incidence of return of contributions for non-vested members, Option 4 lump sum withdrawals, etc. The expected impact of this is minimal.

- Asset figures reflect actual market asset value of $76.493 billion as of June 30, 2024.

- The health insurance premium assistance assets and liabilities have been excluded from this analysis.

- Please see the June 30, 2023 actuarial valuation report for all other actuarial assumptions and methods.

Additional Information

Gallagher

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