

ASSET/LIABILITY STRESS TESTING

EMPLOYEES' RETIREMENT SYSTEM OF RHODE ISLAND

August 22, 2018

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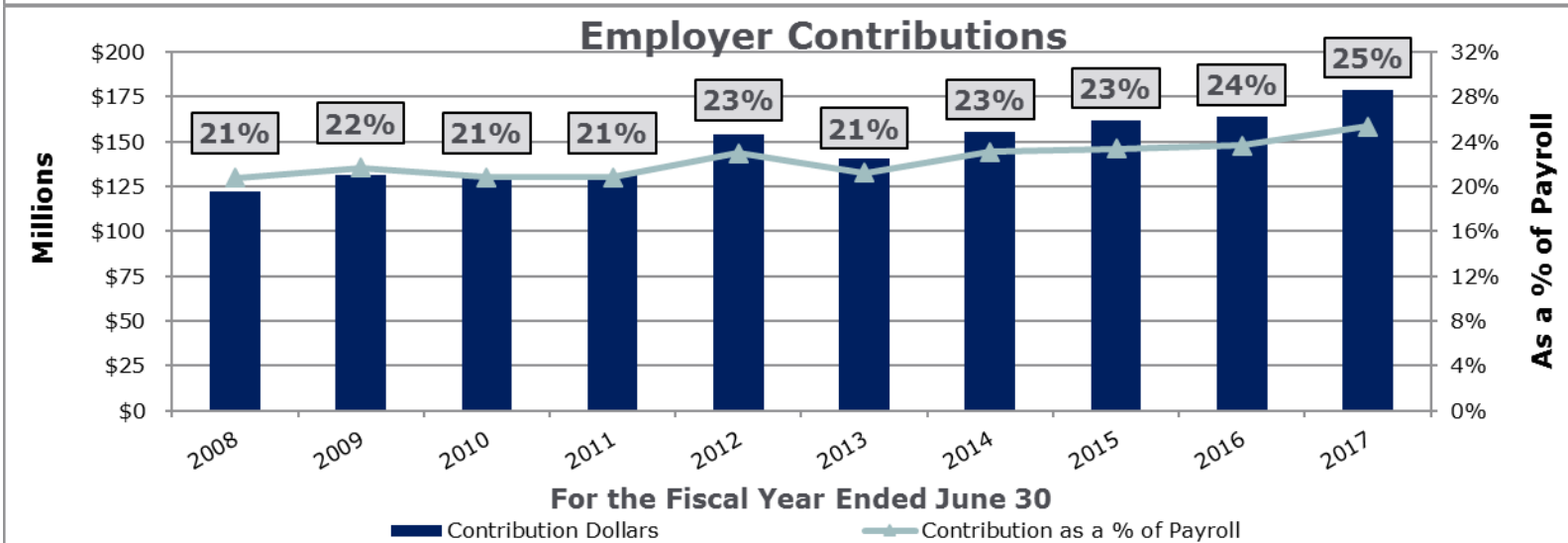
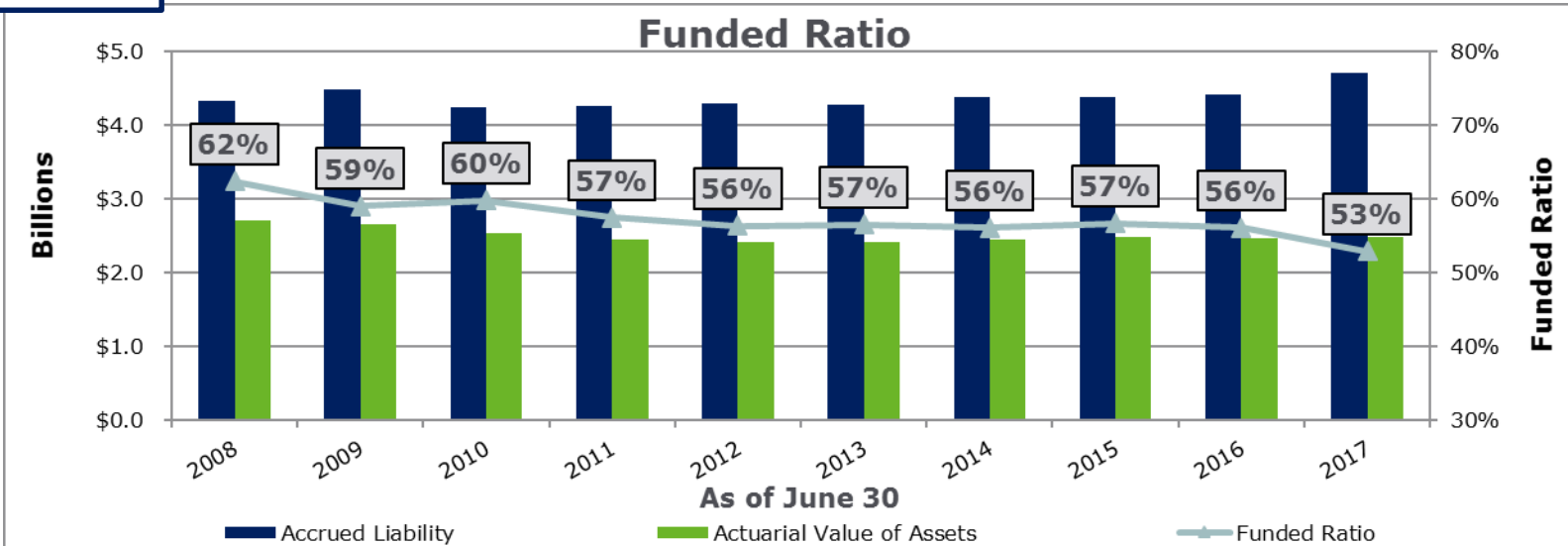
ASSET-LIABILITY OVERVIEW

NEPC, LLC

ASSET-LIABILITY OVERVIEW

| | Background | Goals for the Plan |
|---------------------------------------|--|---|
| <i>Asset-Liability Profile</i> | <ul style="list-style-type: none"> • Extracts insights from the expected progression of assets and liabilities, including funded ratio, benefit payments and contribution rate • Identifies any unique goals/constraints that should inform current and future asset allocation decisions | <ul style="list-style-type: none"> • Understand connection between funding policy and the expected timing of achieving full funding • See where the plan is headed under current assumptions <p><i>Analysis shown on slides 10-15</i></p> |
| <i>Scenario Analysis</i> | <ul style="list-style-type: none"> • Evaluates impact of regime changes and historical events on funded ratio and contribution rate • Recognizes environmental biases of each asset class within the portfolio • Focuses on low-probability, high severity economic environments (tail risks) | <ul style="list-style-type: none"> • Provide a perspective on the impact extreme market events may have on funded ratio and contribution rates <p><i>Analysis shown on slides 17-20</i></p> |
| <i>Stochastic Analysis</i> | <ul style="list-style-type: none"> • Translates possible return paths into funded ratio and contribution rate paths • Associates probabilities to possible funded ratio and contribution rate outcomes | <ul style="list-style-type: none"> • Compare expected results with optimistic and pessimistic results • Understand the value-at-risk with regard to funded ratio and contribution rate <p><i>Analysis shown on slides 22-23</i></p> |

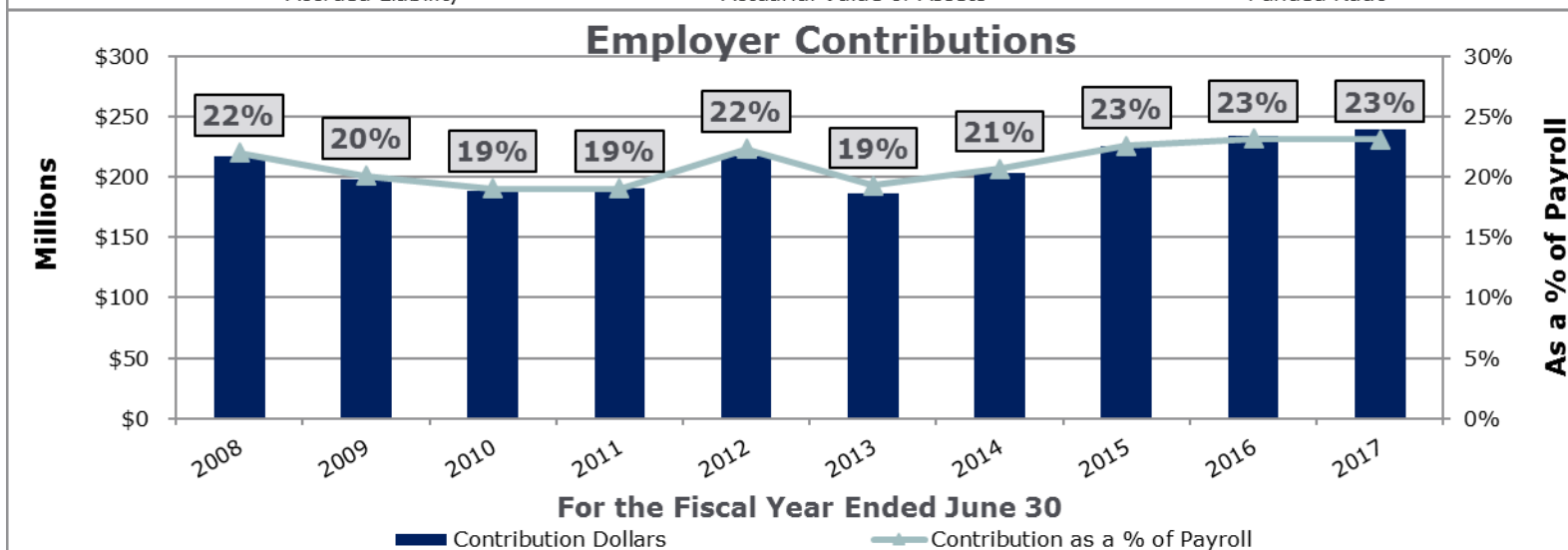
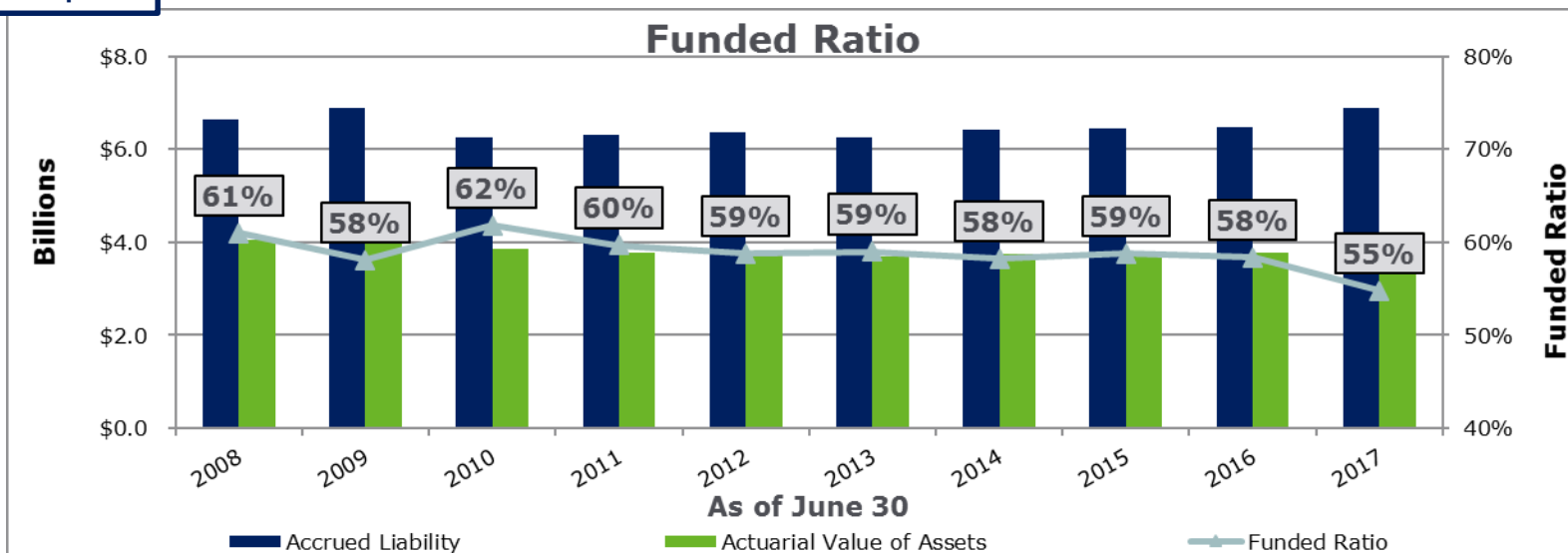
HISTORICAL REVIEW – STATE EMPLOYEES



Source: GRS



HISTORICAL REVIEW – TEACHERS



Source: GRS



PLAN OVERVIEW

| | June 30, 2017 Valuation Results | | June 30, 2018 NEPC Estimate | |
|---|------------------------------------|---------------|--------------------------------|---------------|
| | State Employees | Teachers | State Employees | Teachers |
| Market Value of Assets (MVA) | \$2,426 | \$3,696 | \$2,495 | \$3,778 |
| Actuarial Value of Assets (AVA) | \$2,486 | \$3,778 | \$2,518 | \$3,808 |
| Actuarial Accrued Liability (AAL) | \$4,698 | \$6,894 | \$4,757 | \$6,961 |
| Unfunded Actuarial Accrued Liability (UAAL) | \$2,213 | \$3,116 | \$2,239 | \$3,153 |
| Funded Ratio | 52.9% | 54.8% | 52.9% | 54.7% |
| Contribution Rate as % of Payroll | 24.87% | 23.13% | 25.75% | 23.51% |

\$'s in millions

- **Estimated 8.0% return vs. 7.0% expected return for FY2018**
 - Investment gain has muted effect on funded ratio due to smoothing method
- **Contribution rate faces headwind due to phase-in of 2016 assumption changes**
 - Investment return assumption reduced from 7.5% to 7.0%
 - Updated mortality and other demographic assumptions
- **Funded ratio had been stable since 2011 until investment return assumption was decreased this past year**
 - Resulted in a 3% decrease in funded ratio for both plans as of June 30, 2017

PLAN OVERVIEW – ASSET ALLOCATION

| | Target Allocation |
|-----------------------------|-------------------|
| US Equities | 20.8% |
| Int'l Equities | 14.4% |
| Emerging Int'l Equities | 4.8% |
| Total Equity | 40.0% |
| Private Equity | 11.3% |
| Non-Core Real Estate | 2.3% |
| Opp. Private Credit | 1.5% |
| Private Growth | 15.1% |
| HY Infrastructure | 1.0% |
| REITs | 1.0% |
| Liquid Credit | 2.8% |
| Private Credit | 3.2% |
| Income | 8.0% |
| Treasury Duration | 4.0% |
| Systematic Trend | 4.0% |
| CPC | 8.0% |
| Core Real Estate | 3.6% |
| Private Infrastructure | 2.4% |
| TIPS | 1.0% |
| Natural Resources | 1.0% |
| Inflation Protection | 8.0% |
| Investment Grade Fixed | 11.5% |
| Abs. Return | 6.5% |
| Cash | 3.0% |
| Vol. Protection | 21.0% |
| Short-Term Tactical | 0.0% |
| Expected Return | |
| Standard Deviation | |
| Sharpe Ratio | |

| 5-7 Year Return Assumption | 30 Year Return Assumption |
|----------------------------|---------------------------|
| 5.4% | 7.6% |
| 7.5% | 7.7% |
| 9.0% | 9.2% |
| 8.0% | 9.5% |
| 7.0% | 7.5% |
| 5.2% | 6.3% |
| 7.3% | 7.5% |
| 6.5% | 6.8% |
| 4.1% | 5.5% |
| 6.5% | 7.5% |
| 2.0% | 3.5% |
| 6.2% | 6.3% |
| 5.7% | 6.5% |
| 6.0% | 6.3% |
| 3.3% | 3.8% |
| 4.8% | 5.5% |
| 2.7% | 3.8% |
| 5.8% | 6.3% |
| 2.0% | 2.7% |
| 2.3% | 3.0% |
| 6.3% | 7.4% |
| 11.7% | 11.7% |
| 0.37 | 0.40 |

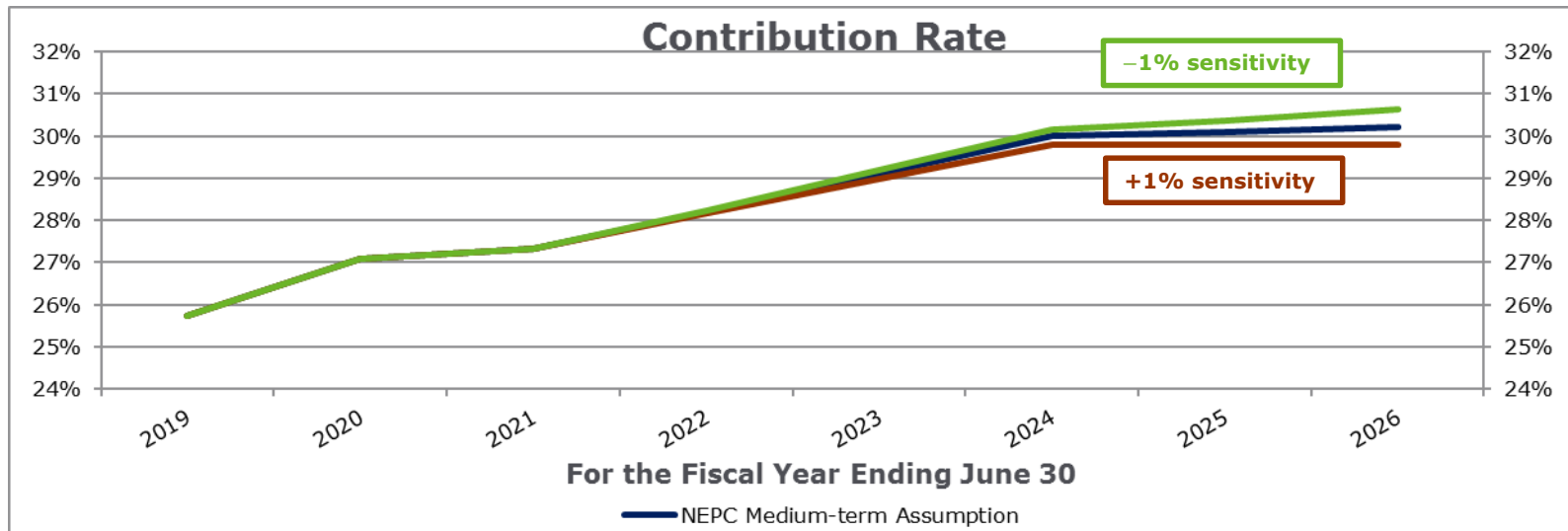
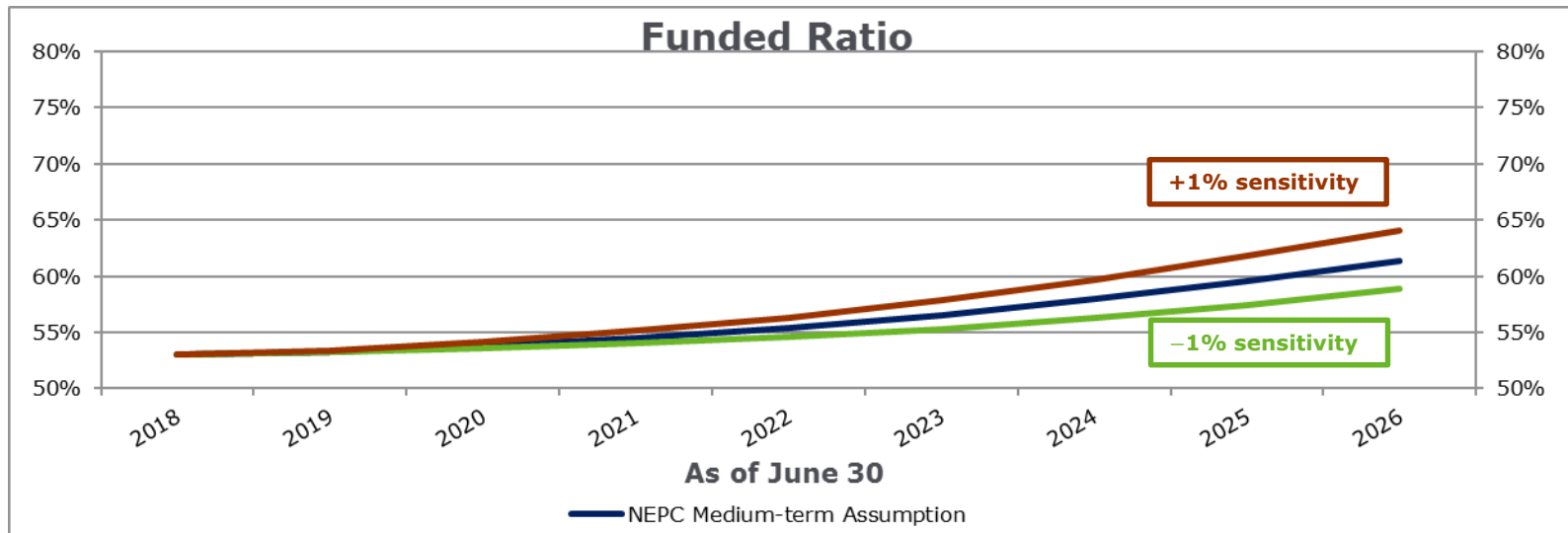
- **Current Target is a well diversified portfolio that meets the funding goals of the plan**
- **Current Target allocation is expected to produce an average return of 7.4% over the next 30 years**
 - Exceeds the actuarial rate of return of 7.00%
- **Due to current capital market headwinds, returns are expected to average 6.3% over the next 5-7 years**

DETERMINISTIC PROJECTIONS

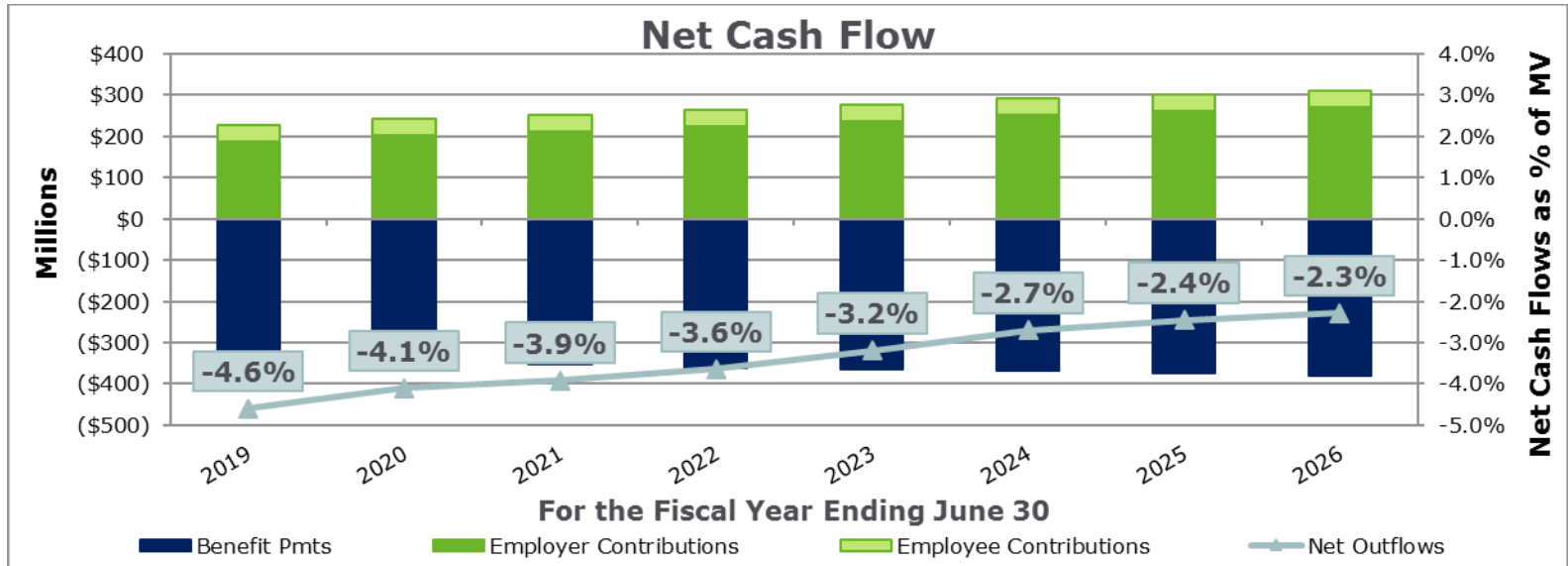
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MEDIUM-TERM – STATE EMPLOYEES

Using NEPC's 5-7 year Expected Return Assumption of 6.3%



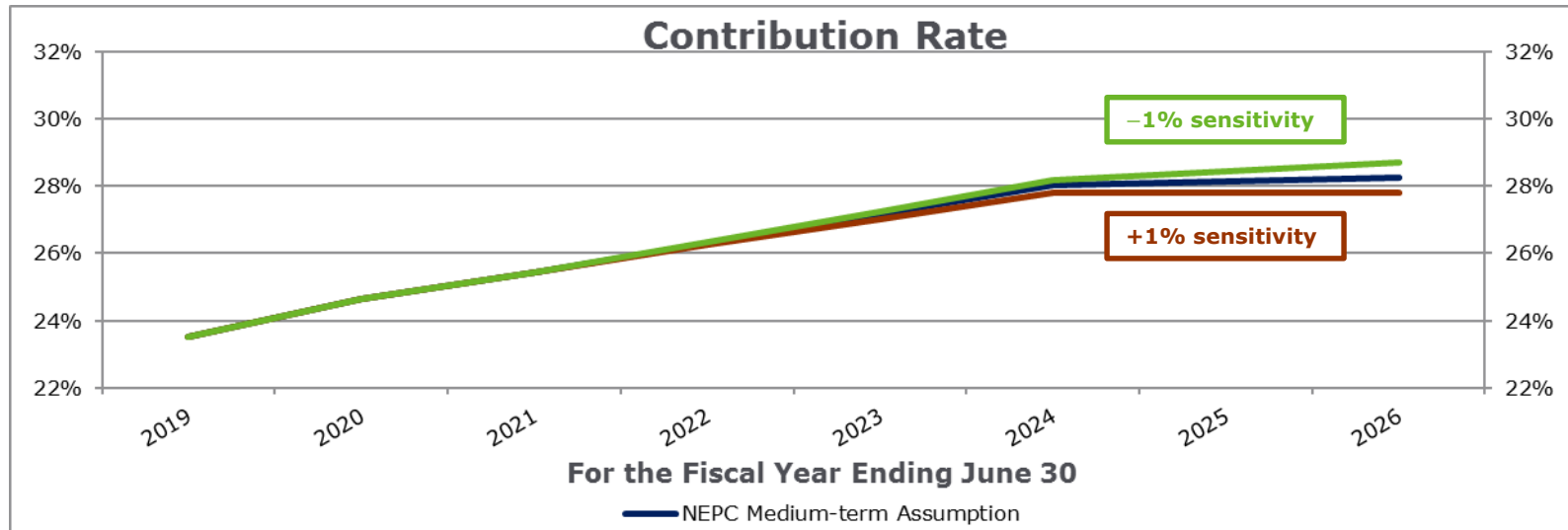
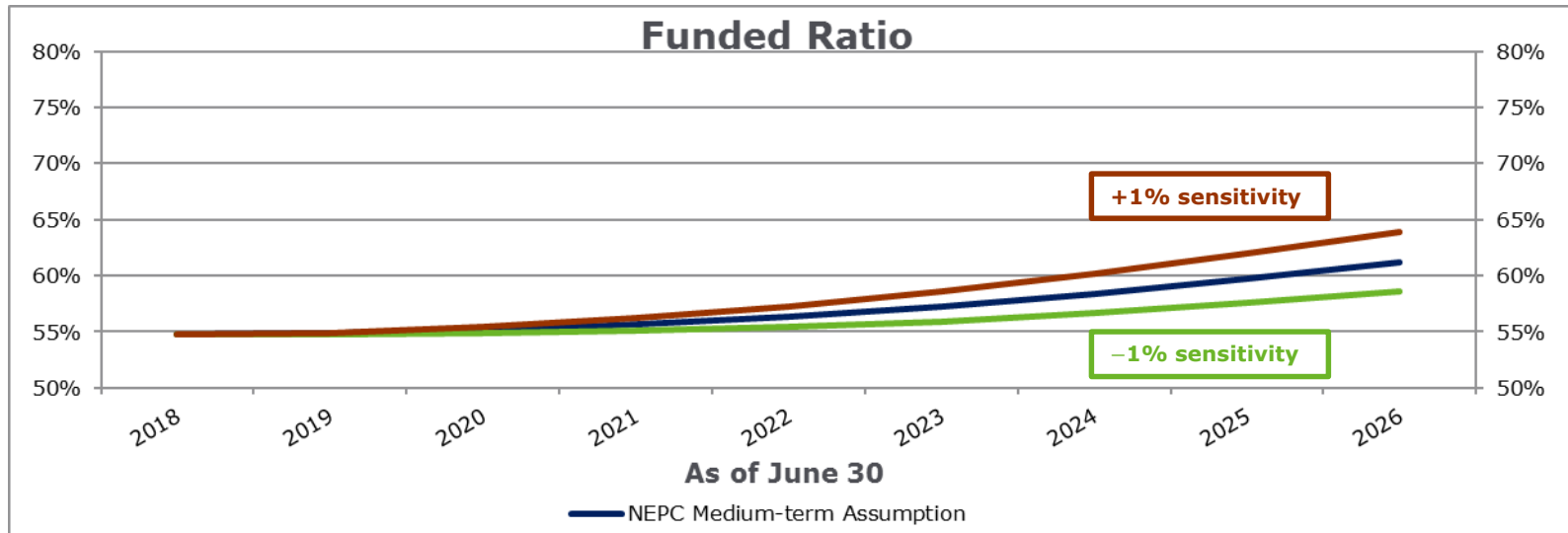
MEDIUM-TERM – STATE EMPLOYEES



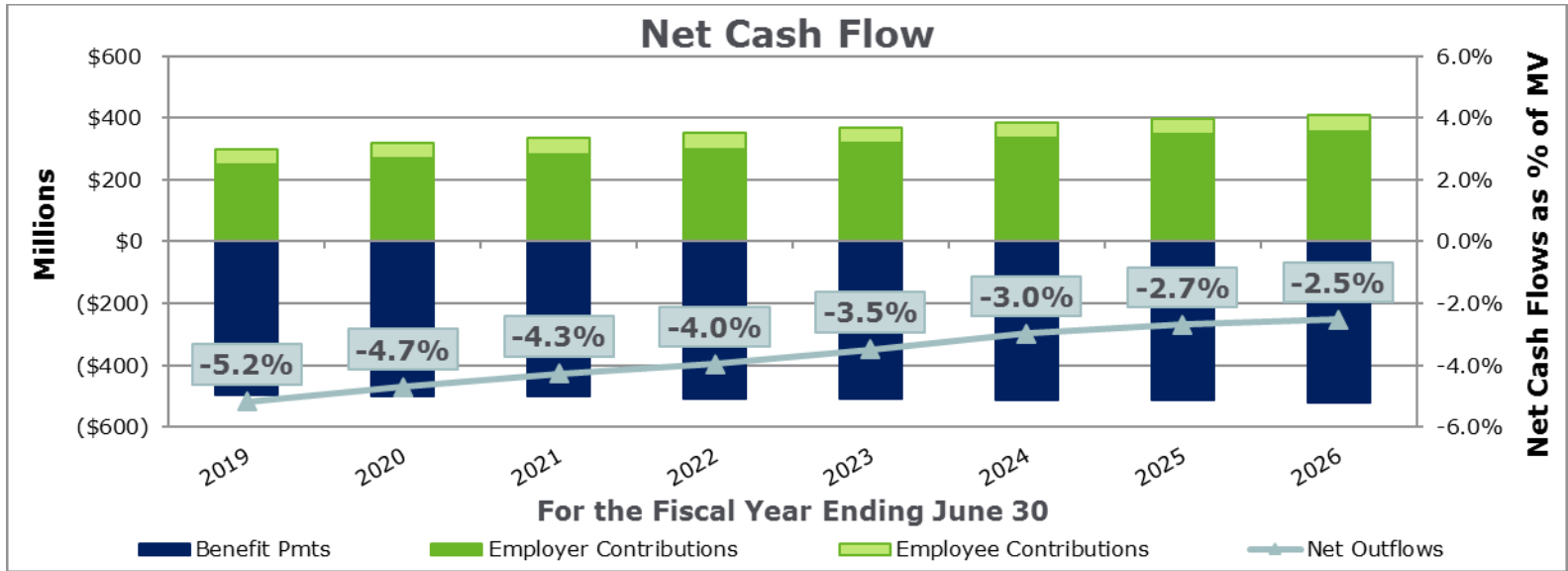
- **Funded ratio is projected to increase from 53% to 61% over the medium-term**
- **Contribution rates are projected to increase from 26% to 30% of payroll**
 - Increase due to phase-in of loss due to 2016 assumption changes
 - Once fully recognized, contribution rates are expected to level off beginning in FY 2024
- **Contributions are expected to increase faster than benefit payments, improving net cash flow from -5% to -2% of assets**

MEDIUM-TERM – TEACHERS

Using NEPC's 5-7 year Expected Return Assumption of 6.3%



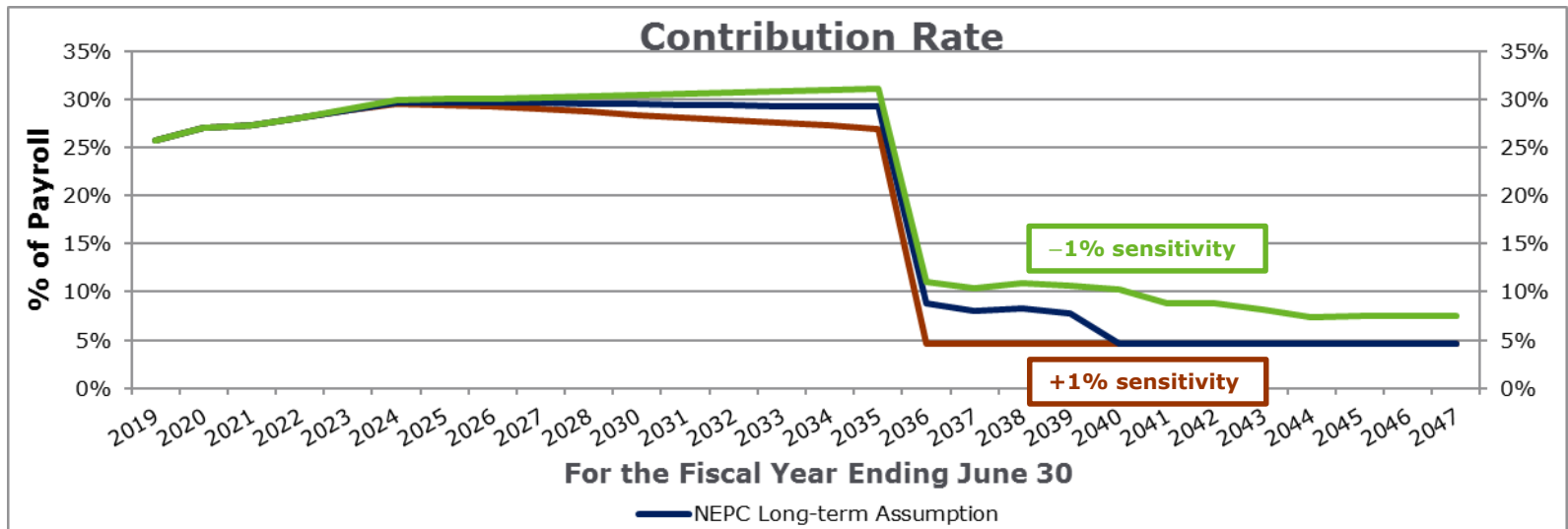
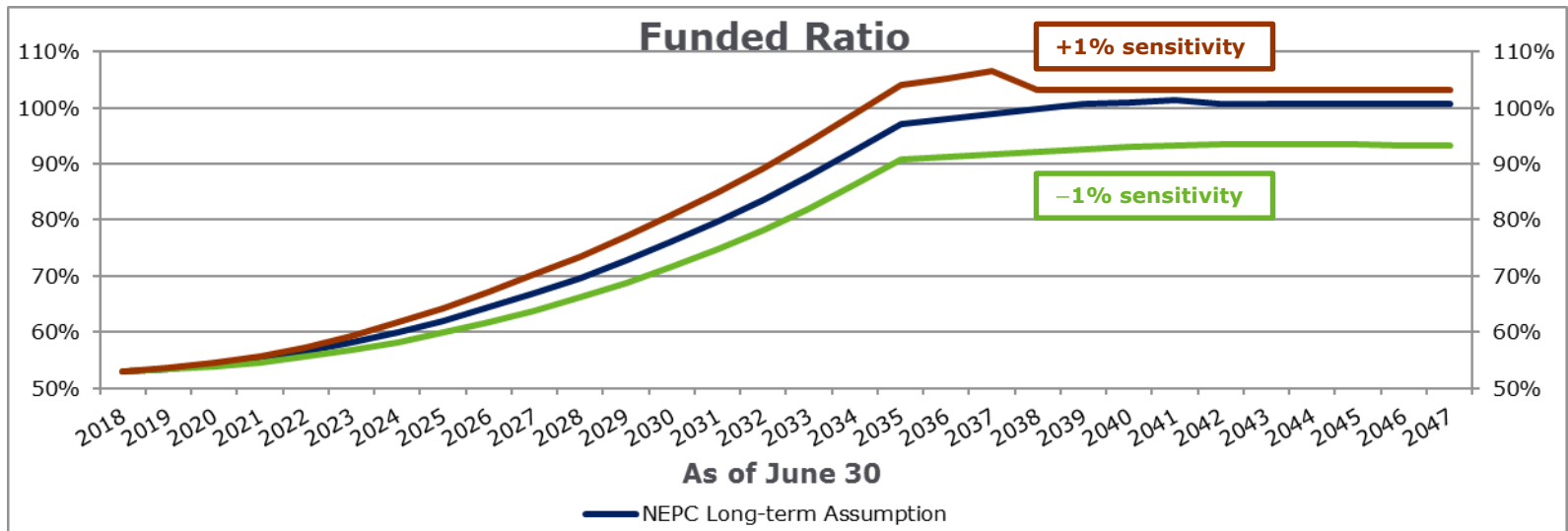
MEDIUM-TERM – TEACHERS



- **Funded ratio is projected to increase from 55% to 61% over the medium-term**
- **Contribution rates are projected to increase from 24% to 28% of payroll**
 - Increase due to phase-in of loss due to 2016 assumption changes
 - Once fully recognized, contribution rates are expected to level off beginning in FY 2024
- **Contributions are expected to increase faster than benefit payments, improving net cash flow from -5% to -3% of assets**

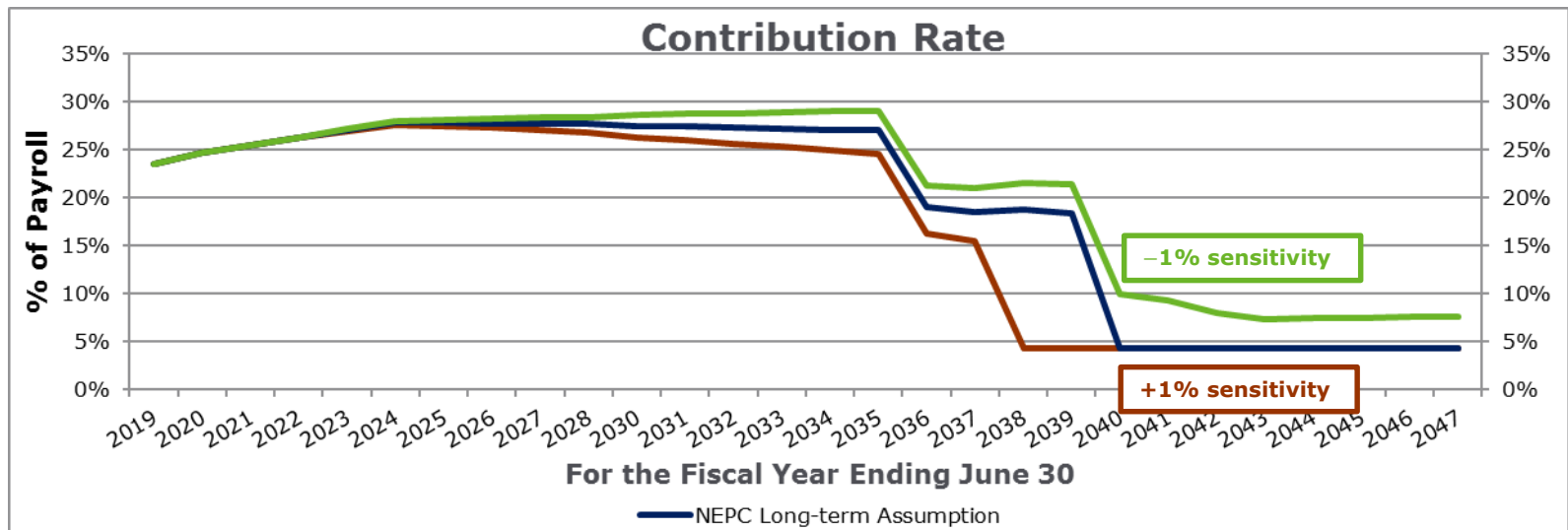
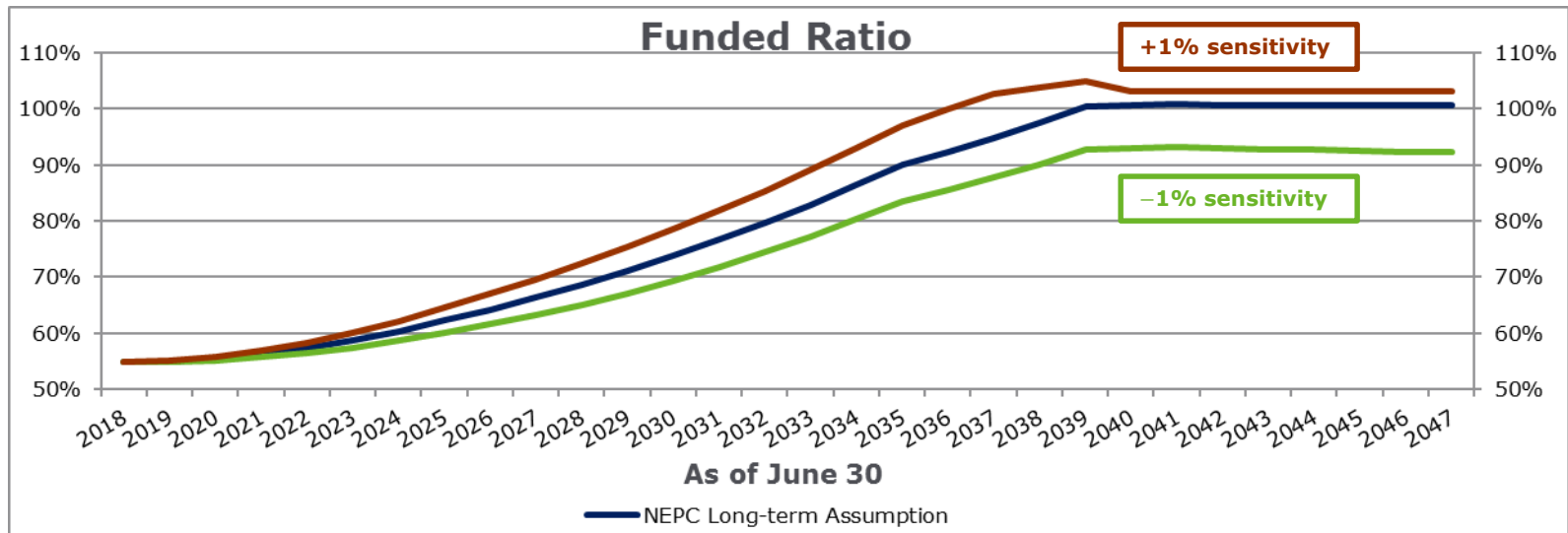
LONG-TERM – STATE EMPLOYEES

Using NEPC's 30 year Expected Return Assumption of 7.4%



LONG-TERM – TEACHERS

Using NEPC's 30 year Expected Return Assumption of 7.4%

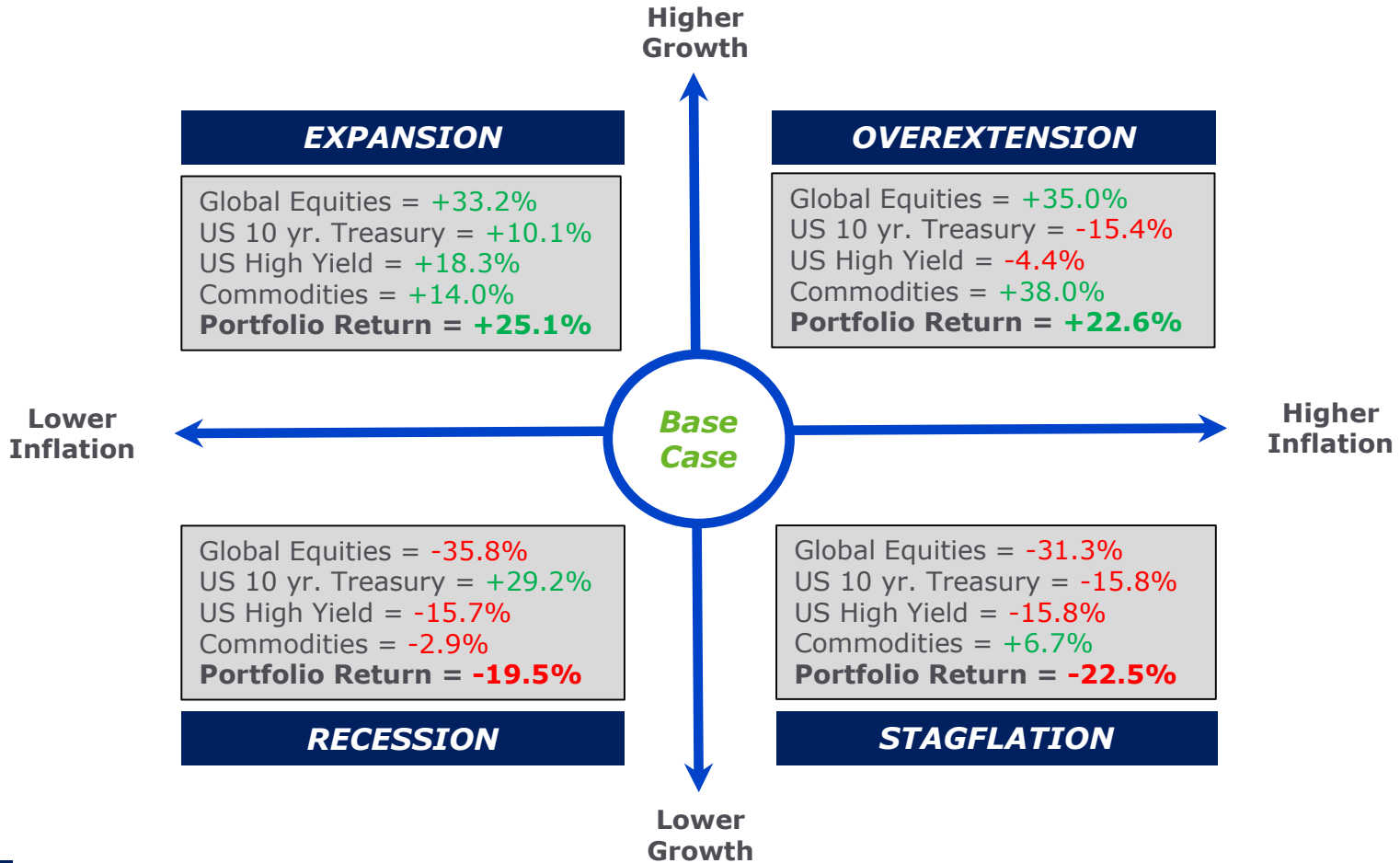


SCENARIO ANALYSIS

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SCENARIO ANALYSIS: REGIME CHANGES

- **NEPC Scenario Analysis tests the impact of regime changes and historical events on funded ratio and contribution rates**
 - Allows for a better understanding of risk exposures under contrasting inflation and economic growth regimes (non-consensus forecasts), and under past historical events that have shook markets



SCENARIO ANALYSIS: HISTORICAL EVENTS

- **NEPC Scenario Analysis tests the impact of regime changes and historical events on funded ratio and contribution rates**
 - Allows for a better understanding of risk exposures under contrasting inflation and economic growth regimes (non-consensus forecasts), and under past historical events that have shook markets

Historical Events

Assumptions

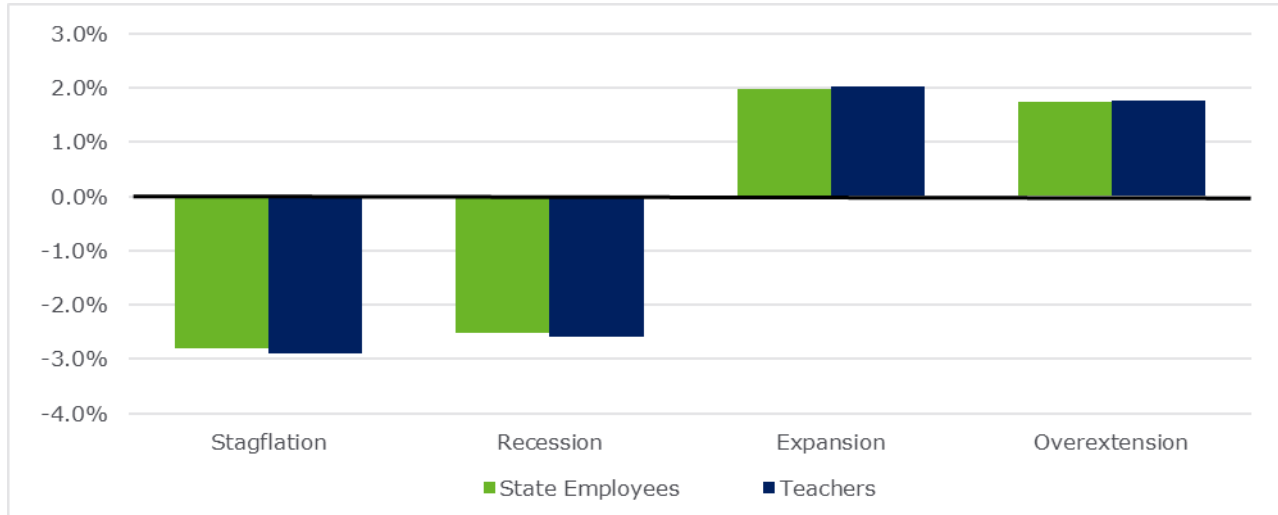
| Historical Event | Start | End | Global Equities | US 10 Yr. Treasury | US High Yield | Commodities | Portfolio |
|--------------------------------|----------|----------|-----------------|--------------------|---------------|-------------|-----------|
| Asian Financial Crisis | Jul-1997 | Oct-1998 | -1.4% | 22.2% | 3.6% | -26.3% | 4.7% |
| Black Monday | Oct-1987 | Oct-1987 | -18.0% | 8.7% | 3.8% | -1.8% | -8.0% |
| Bursting of Dot-Com Bubble | Mar-2000 | Sep-2001 | -39.9% | 17.0% | 1.0% | 5.5% | -13.6% |
| Global Financial Crisis | Jul-2007 | Mar-2009 | -57.3% | 23.2% | -27.7% | -34.7% | -30.5% |
| Japanese Asset Bubble Collapse | Dec-1989 | Oct-1990 | -17.1% | 1.6% | -8.0% | 34.9% | -6.6% |
| Taper Tantrum | May-2013 | Jul-2013 | -4.1% | -3.8% | -3.8% | -2.2% | -2.2% |
| USA Savings and Loan Crisis | Jan-1987 | Jan-1988 | 1.4% | -0.4% | 0.8% | 55.6% | 2.4% |



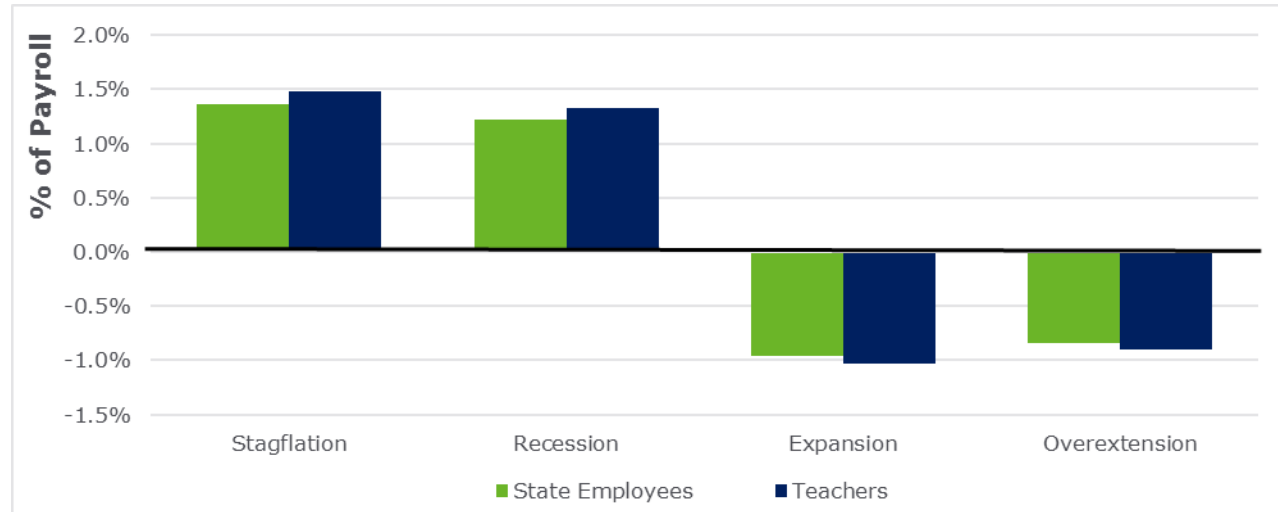
Historical returns are assumed to occur over a one year period. See Appendix for detailed return assumptions for each scenario.

REGIME CHANGE

Change in Funded Ratio

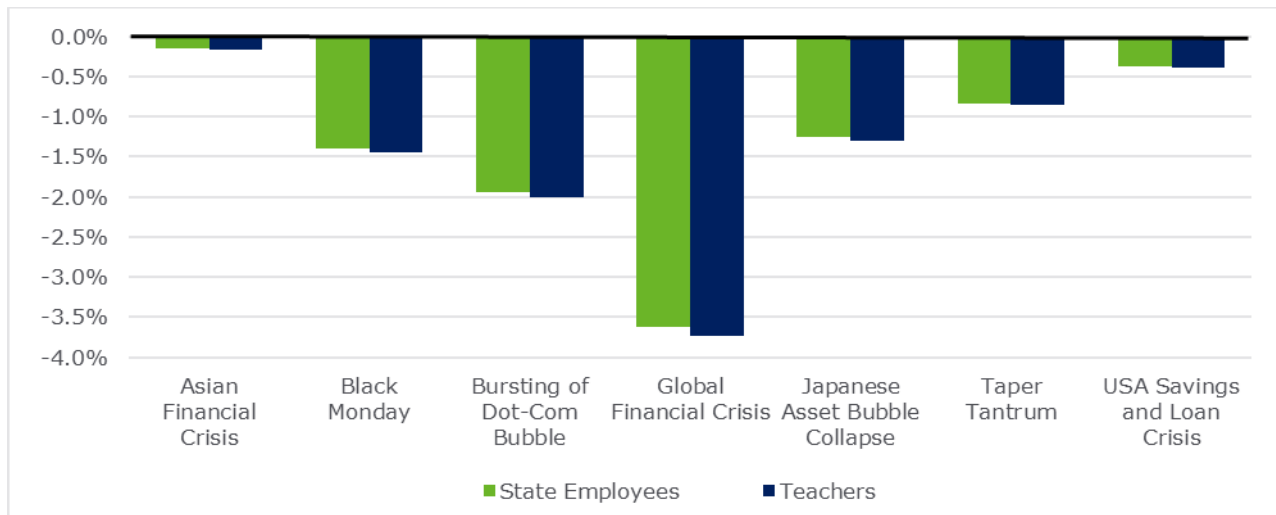


Change in Contribution Rate

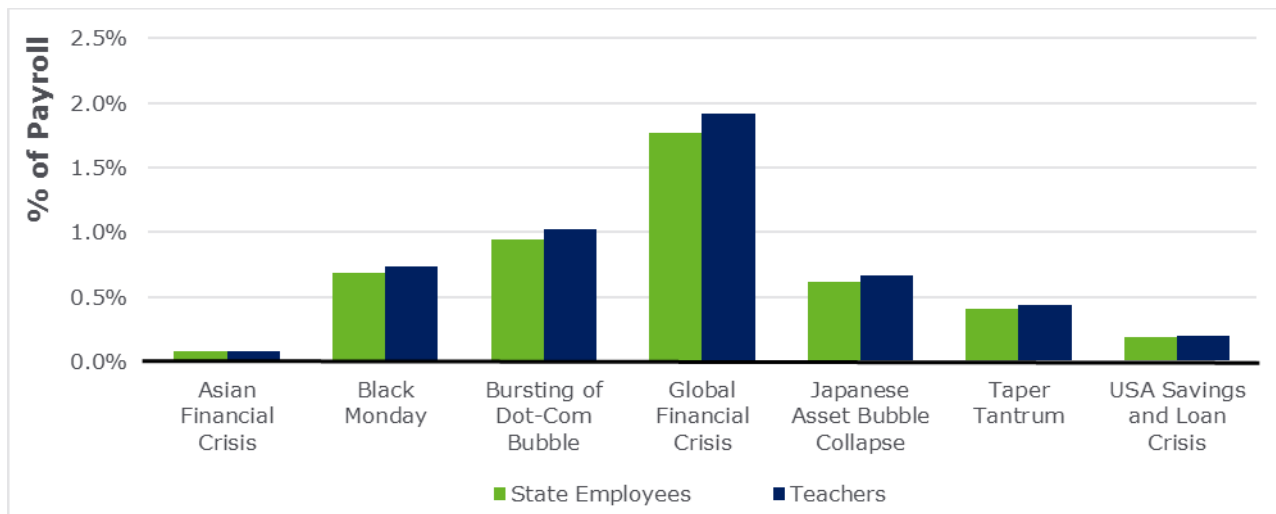


HISTORICAL EVENTS

Change in Funded Ratio



Change in Contribution Rate



Above changes reflect assumption that historical scenario returns occur over a one year period.

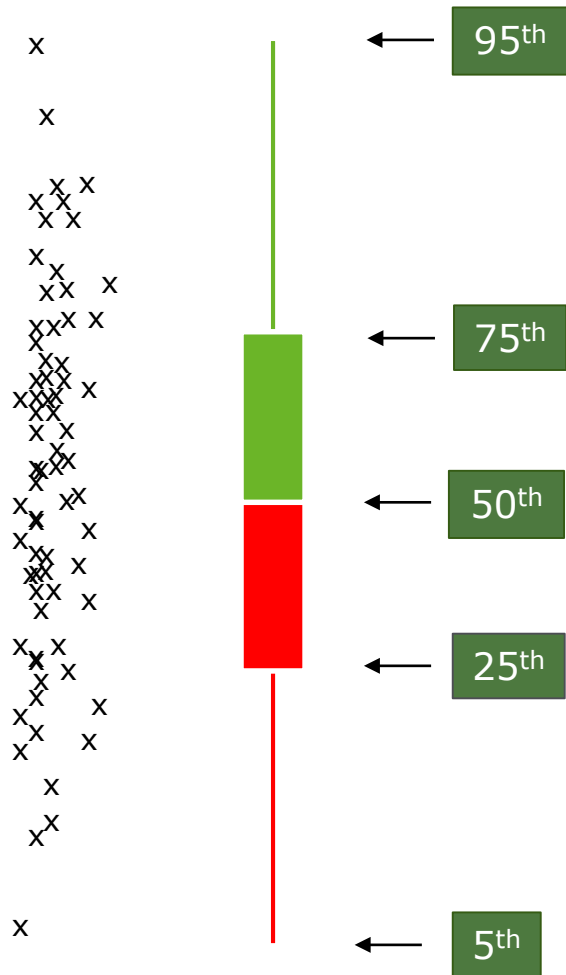


STOCHASTIC ANALYSIS

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INTERPRETING STOCHASTIC RESULTS

Model ranks 10,000 forecasts each year

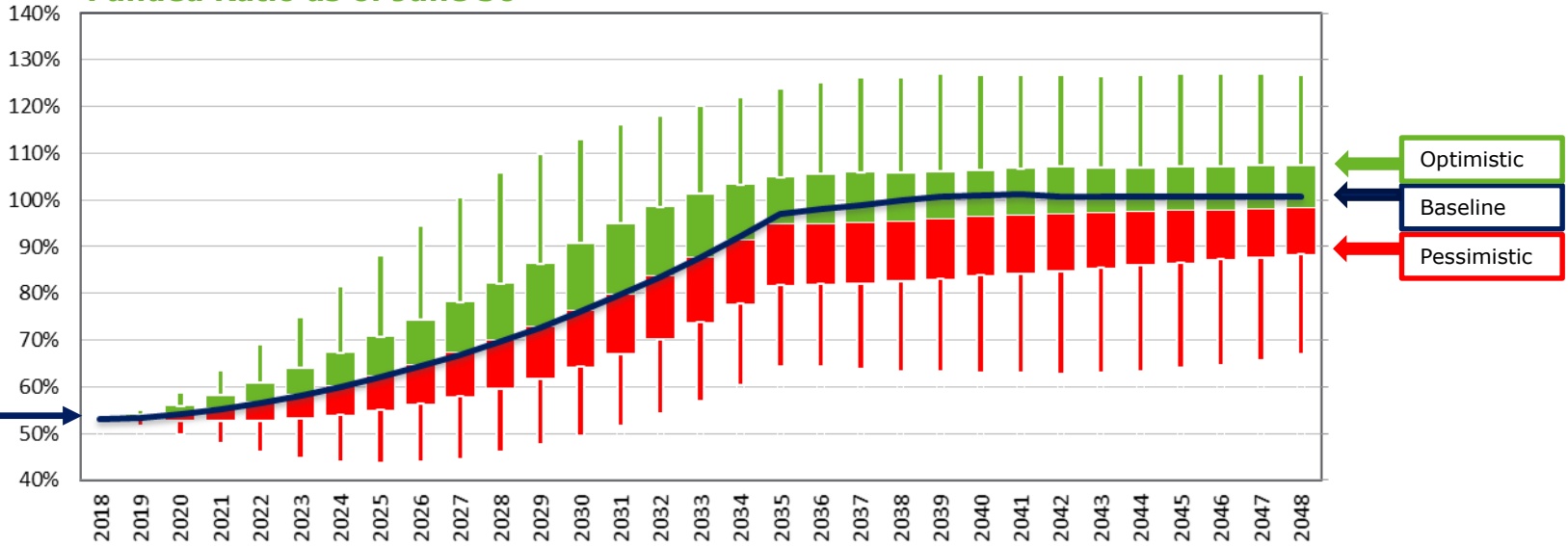


- **95th percentile**
 - Exceeded by only 5% of forecasts
 - Higher than 95% of forecasts
 - Highly optimistic range
- **75th percentile**
 - Exceeded by 25% of forecasts
 - Higher than 75% of forecasts
 - Optimistic range
- **50th percentile**
 - Exceeded by 50% of forecasts
 - Higher than 50% of forecasts
- **25th percentile**
 - Exceeded by 75% of forecasts
 - Higher than 25% of forecasts
 - Pessimistic range
- **5th percentile**
 - Exceeded by 95% of forecasts
 - Higher than only 5% of forecasts
 - Highly pessimistic range

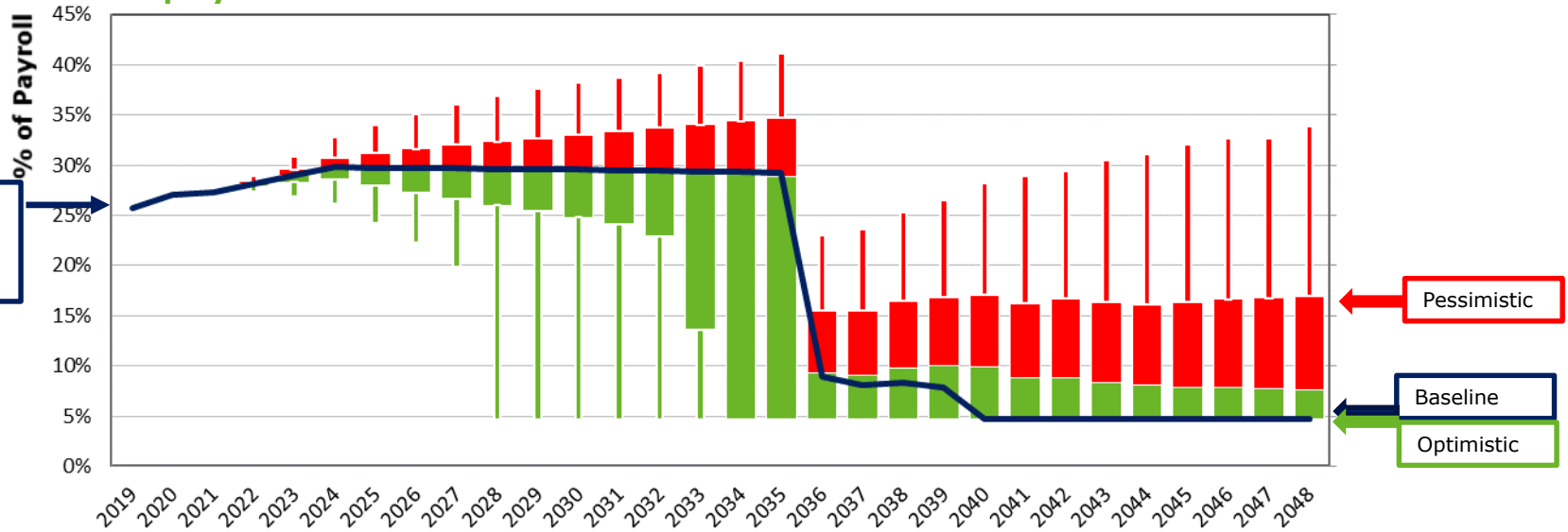
**The above interpretation is in the context of funded ratios. The key aspects of this interpretation would flip (i.e. green to red, optimistic to pessimistic and vice versa) in the context of contribution rates.*

STOCHASTIC: STATE EMPLOYEES

Funded Ratio as of June 30

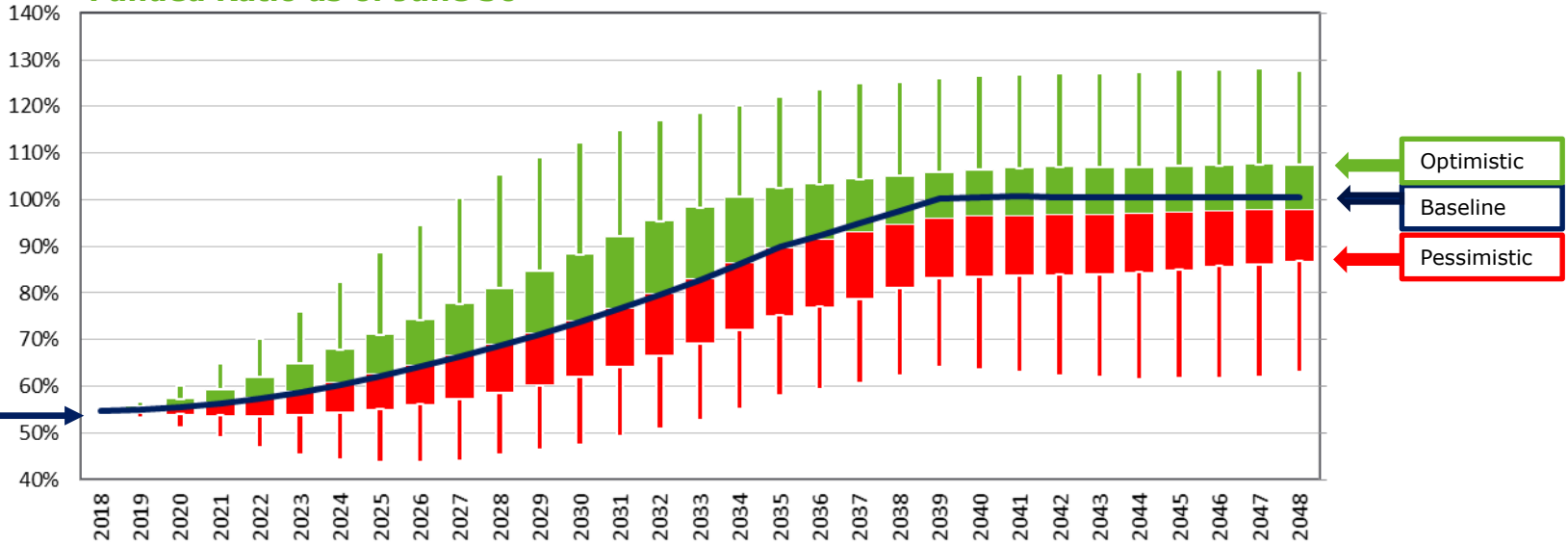


Employer Contribution Rate for Fiscal Year

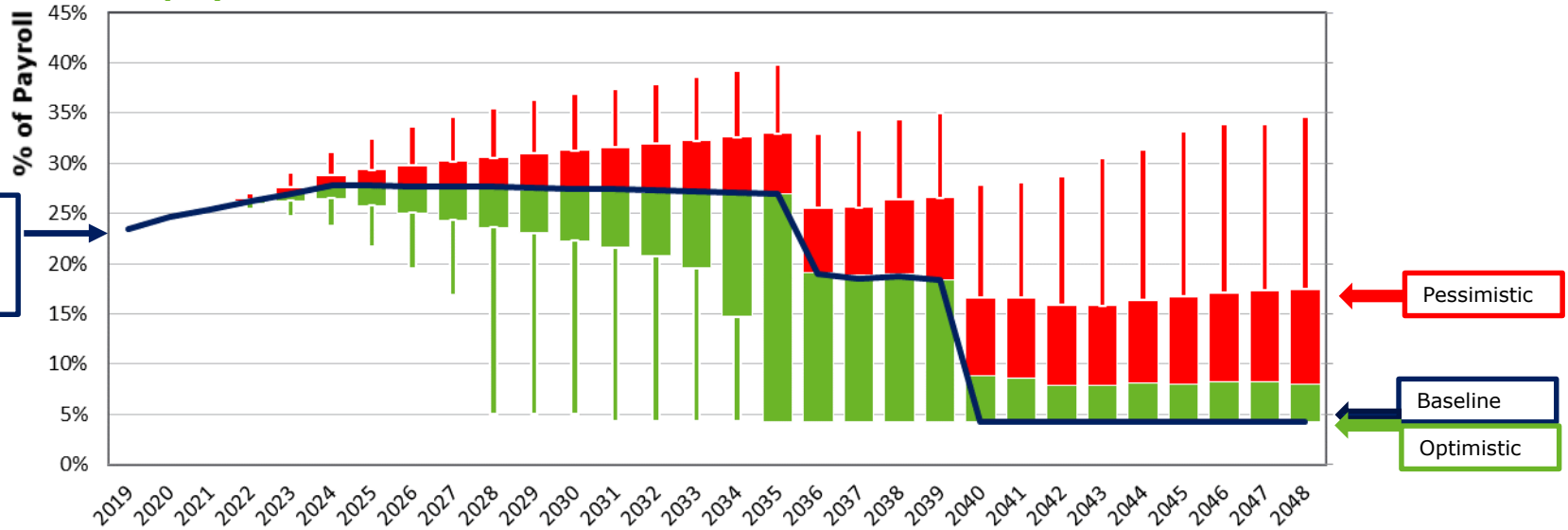


STOCHASTIC: TEACHERS

Funded Ratio as of June 30



Employer Contribution Rate for Fiscal Year



APPENDIX

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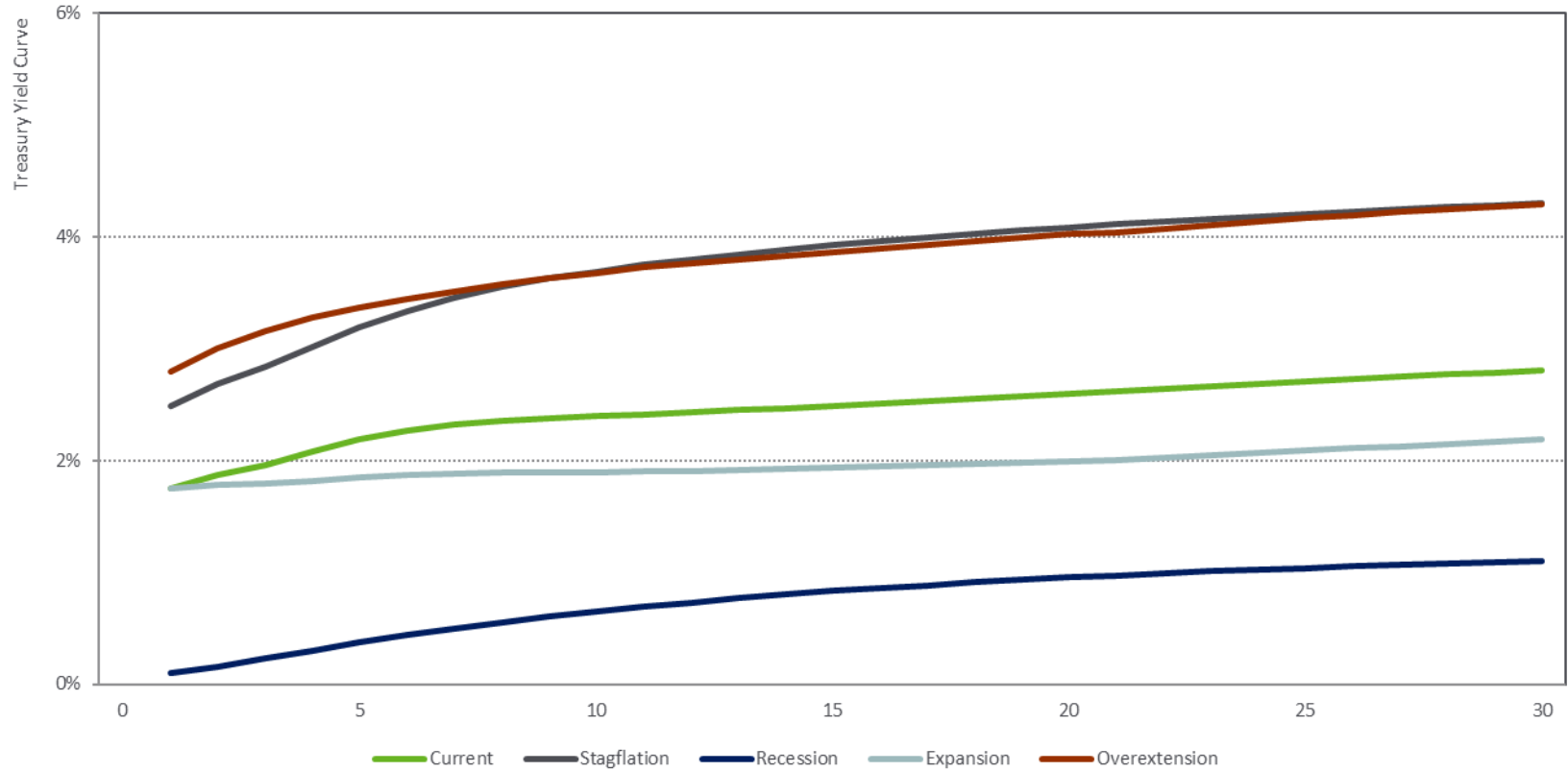
ASSUMPTIONS AND METHODOLOGY

- **Liability calculations follow a roll-forward methodology based on the June 30, 2017 actuarial valuation by GRS**
 - Accrued Liability and Normal Cost rolled forward each year
 - Discount rate is assumed to remain at 7.00% each year
 - Benefit payments as projected by the plan’s actuary
 - Accrued liability and benefit payments adjusted for differences in projected COLA vs. assumed COLA
 - Other than those described herein, all assumptions remain unchanged from the actuarial valuation report
- **Actual asset returns through June 30, 2018 (8.0% fiscal YTD)¹ were reflected, thereafter:**
 - 5-7 year return assumption of 6.3% for medium-term projections
 - 50 year return assumption of 7.4% for long-term projections
- **Employer contributions are based on the plan’s funding policy**
 - Employer normal cost plus amortization of the unfunded liability
 - Future gains and losses are laddered and amortized over 20 years
 - “Staggering” of losses due to 2016 assumption changes
 - Once 100% funded, all amortization bases are assumed to be fully amortized
 - Employer normal cost contribution will always be made (the effective minimum employer contribution)
- **Employee contribution rates are assumed to remain level**
- **Fiscal year contributions are budgeted based on the valuation year three years prior**
 - E.g., FYE 2020 contribution is determined by the FYE 2017 valuation



¹ Per June 30, 2018 Flash Report

REGIME CHANGES – YIELD CURVE SHIFTS



REGIME CHANGES – RETURN ASSUMPTIONS

| Asset Class | Stagflation | Recession | Expansion | Overextension |
|---|-------------|-----------|-----------|---------------|
| Cash | 2.1% | 1.0% | 1.7% | 2.3% |
| Treasuries | -12.9% | 25.9% | 9.4% | -12.7% |
| IG Corp Credit | -14.4% | 5.1% | 13.9% | -8.6% |
| MBS | -12.7% | 20.4% | 11.4% | -10.7% |
| TIPS | 4.0% | 9.8% | 0.6% | 12.9% |
| High-Yield Bonds | -15.8% | -15.7% | 18.3% | -4.4% |
| Global Bonds (Unhedged) | -20.0% | 40.0% | 14.5% | -19.6% |
| Global Bonds (Hedged) | -11.8% | 23.6% | 8.5% | -11.5% |
| EMD (External) | -16.7% | 9.8% | 15.6% | -10.9% |
| EMD (Local Currency) | -16.7% | 9.8% | 15.6% | -10.9% |
| Large Cap Equities | -26.8% | -30.6% | 28.3% | 29.9% |
| Small/Mid Cap Equities | -32.1% | -36.7% | 34.0% | 35.9% |
| Int'l Equities (Unhedged) | -32.1% | -36.7% | 34.0% | 35.9% |
| Int'l Equities (Hedged) | -27.5% | -31.5% | 29.2% | 30.8% |
| Int'l Sm Cap Equities (Unhedged) | -33.6% | -38.5% | 35.6% | 37.6% |
| Emerging Int'l Equities | -42.8% | -49.0% | 45.4% | 47.9% |
| Emerging Int'l Sm Cap Equities | -47.4% | -54.2% | 50.2% | 53.0% |
| Private Equity | -35.2% | -40.2% | 37.3% | 39.3% |
| Private Debt | -25.5% | -28.0% | 27.8% | 17.4% |
| Private Real Assets - Energy/Metals | -17.4% | -25.7% | 30.1% | 44.6% |
| Private Real Assets - Infrastructure/Land | -13.1% | -21.6% | 27.5% | 44.0% |
| Real Estate (Core) | -8.8% | -17.5% | 24.9% | 43.4% |

REGIME CHANGES – RETURN ASSUMPTIONS

(CONTINUED)

| Asset Class | Stagflation | Recession | Expansion | Overextension |
|----------------------------------|-------------|-----------|-----------|---------------|
| Commodities | 6.7% | -2.9% | 14.0% | 38.0% |
| Long Treasuries | -24.4% | 39.3% | 12.4% | -23.8% |
| Long Credit | -33.9% | 3.4% | 23.8% | -23.5% |
| 20+ YR STRIPS | -33.7% | 64.1% | 19.2% | -34.2% |
| High-Yield Municipal Bonds | -14.6% | 1.6% | 14.6% | -7.9% |
| Municipal Bonds (1-10 yr) | -13.7% | 15.5% | 11.6% | -10.6% |
| Short Treasuries (1-3 yr) | -2.9% | 9.3% | 4.2% | -2.7% |
| Short Credit (1-3 yr) | -4.3% | -11.5% | 8.7% | 1.4% |
| Short HY (1-3 yr) | -5.8% | -32.3% | 13.2% | 5.5% |
| Global I/L | 4.0% | 9.8% | 0.6% | 12.9% |
| Municipal Bonds | -13.7% | 15.5% | 11.6% | -10.6% |
| Bank Loans | -12.2% | -12.4% | 15.0% | -3.1% |
| US 10 yr Treasuries | -15.8% | 29.2% | 10.1% | -15.4% |
| Global 10 yr Sovereigns (Hedged) | -15.8% | 29.2% | 10.1% | -15.4% |
| Hedge Funds - Long/Short | -12.3% | -14.8% | 15.0% | 16.1% |
| Hedge Funds - Credit | -6.8% | -7.4% | 10.0% | -1.1% |
| Hedge Funds - Macro | -5.0% | -2.4% | 9.6% | 7.5% |
| MLPs | -30.6% | -35.0% | 32.4% | 34.2% |
| REITs | -32.1% | -36.7% | 34.0% | 35.9% |
| Non-US Cash | 2.1% | 1.0% | 1.7% | 2.3% |
| Non-US Leverage Cost | 2.4% | 1.2% | 1.9% | 2.5% |
| Non-Core Real Estate | -11.5% | -22.8% | 32.6% | 56.7% |



HISTORICAL EVENTS - DESCRIPTIONS

| Historical Event | Start | End | Description |
|--------------------------------|-------------|-------------|---|
| Asian Financial Crisis | 1-Jul-1997 | 5-Oct-1998 | This period of financial crisis gripped much of Asia beginning in July 1997 and raised fears of a worldwide economic meltdown due to financial contagion. |
| Black Monday | 19-Oct-1987 | 20-Oct-1987 | Refers to the global stock market crash on Monday 19 October 1987. The crash began in Hong Kong and spread to Europe before hitting the United States after other markets had already declined by a significant margin. This event is the largest one-day percentage decline of the Dow Jones at -22.6%. |
| Bursting of Dot-Com Bubble | 21-Mar-2000 | 20-Sep-2001 | A speculative bubble (referred to as the dot-com boom) which developed roughly from 1995–2000 during which stock markets in industrialized nations saw their equity founding (and, in many cases, spectacular failure) of a group of new Internet-based companies commonly referred to as dot-coms. The collapse took place over 2000-2001.value rise rapidly from growth in the more new Internet sector and related fields. The period was marked by the |
| Global Financial Crisis | 16-Jul-2007 | 9-Mar-2009 | The financial crisis of 2007-2008 is considered by many economists to be the worst financial crisis since the Great Depression of the 1930s. It was triggered by a liquidity shortfall in the United States banking system. It resulted in the collapse of large financial institutions, the bailout of banks by national governments, and downturns in stock markets around the world. It contributed to the failure of key businesses, declines in consumer wealth estimated in the trillions of US dollars, substantial financial commitments incurred by governments, and a significant decline in economic activity. |
| Japanese Asset Bubble Collapse | 29-Dec-1989 | 1-Oct-1990 | Abundance of money in banks and ease in obtaining loans and credit, combined with financial deregulation, overconfidence and euphoria about the economic prospects, and monetary easing implemented by the Bank of Japan in late 1980s resulted in aggressive speculation, particularly in the Tokyo Stock Exchange and the real estate market. The Nikkei stock index hit its all-time high on December 29, 1989 when it reached an intra-day high of 38,957.44 before closing at 38,915.87. The Japanese asset price bubble's collapse occurred gradually rather than catastrophically and the subsequent years 1991 to 2000 is referred to as the Lost Decade. |
| Taper Tantrum | 22-May-2013 | 5-Jul-2013 | Refers to the 2013 surge in U.S. Treasury yields, which resulted from the Federal Reserve's use of tapering to gradually reduce the amount of money it was feeding into the economy. |
| USA Savings and Loan Crisis | 2-Jan-1987 | 4-Jan-1988 | The US savings and loan crisis occurred in 1987 with the failure of about 747 out of the 3,234 savings and loan associations in the United States. The total cost of the crisis is estimated to have be \$160.1 billion, about \$124.6 billion of which was directly paid for by the U.S. government and the remainder of the bailout was paid for by charges on savings and loan accounts. This contributed to the large budget deficits of the early 1990s. |

HISTORICAL EVENTS – RETURN ASSUMPTIONS

| Asset Class | Japanese Asset | | | | | | |
|---|------------------------|--------------|----------------------------|-------------------------|-----------------|---------------|-----------------------------|
| | Asian Financial Crisis | Black Monday | Bursting of Dot-Com Bubble | Global Financial Crisis | Bubble Collapse | Taper Tantrum | USA Savings and Loan Crisis |
| Cash | 7.2% | 0.1% | 8.9% | 4.6% | 6.2% | 0.0% | 5.5% |
| Treasuries | 19.1% | 6.1% | 17.1% | 19.1% | 2.9% | -2.5% | 0.9% |
| IG Corp Credit | 17.0% | 7.0% | 17.2% | -4.1% | 3.6% | -4.6% | 0.4% |
| MBS | 11.9% | 6.1% | 18.2% | 15.8% | 5.8% | -3.0% | 2.7% |
| TIPS | 7.3% | 5.1% | 20.3% | 6.7% | -1.3% | -5.8% | -16.8% |
| High-Yield Bonds | 3.6% | 3.8% | 1.0% | -27.7% | -8.0% | -3.8% | 0.8% |
| Global Bonds (Unhedged) | 14.9% | 6.1% | 8.2% | 6.6% | 4.7% | -2.3% | 0.9% |
| Global Bonds (Hedged) | 13.7% | 6.1% | 14.9% | 10.0% | 1.7% | -2.3% | 0.9% |
| EMD (External) | -19.1% | 5.6% | 13.3% | -8.8% | 0.1% | -7.4% | 0.7% |
| EMD (Local Currency) | -21.2% | 5.6% | 8.5% | -8.4% | 0.1% | -7.8% | 0.7% |
| Large Cap Equities | 11.9% | -16.6% | -33.1% | -54.6% | -10.4% | -1.2% | 5.8% |
| Small/Mid Cap Equities | -10.6% | -21.0% | -41.9% | -58.1% | -13.2% | 1.0% | 7.4% |
| Int'l Equities (Unhedged) | 4.4% | -19.1% | -46.5% | -59.3% | -30.0% | -7.2% | -4.8% |
| Int'l Equities (Hedged) | 3.1% | -19.1% | -43.1% | -53.7% | -33.1% | -7.2% | -4.8% |
| Int'l Sm Cap Equities (Unhedged) | 4.6% | -20.0% | -31.6% | -62.9% | -31.4% | -5.4% | -5.0% |
| Emerging Int'l Equities | -52.3% | -15.2% | -47.7% | -57.4% | -7.7% | -12.5% | -3.8% |
| Emerging Int'l Sm Cap Equities | -55.5% | -16.9% | -52.8% | -62.7% | -8.5% | -11.9% | -4.2% |
| Private Equity | -11.8% | -15.9% | -40.0% | -30.0% | 3.0% | 2.9% | 6.0% |
| Private Debt | 12.0% | 4.0% | -9.0% | -22.0% | 0.0% | 2.7% | -6.0% |
| Private Real Assets - Energy/Metals | -22.0% | -2.0% | 19.0% | 0.0% | 15.0% | 0.0% | 6.0% |
| Private Real Assets - Infrastructure/Land | -13.0% | -5.0% | 25.0% | -17.0% | -10.0% | 1.6% | 7.0% |
| Real Estate (Core) | 21.0% | 1.8% | 18.0% | -30.0% | 2.0% | 2.8% | 8.0% |

HISTORICAL EVENTS – RETURN ASSUMPTIONS

(CONTINUED)

| Asset Class | Asian Financial | | Bursting of Dot-Com Bubble | Global Financial Crisis | Japanese Asset Bubble | | USA Savings and Loan Crisis |
|----------------------------------|-----------------|--------------|----------------------------|-------------------------|-----------------------|---------------|-----------------------------|
| | Crisis | Black Monday | | | Collapse | Taper Tantrum | |
| Commodities | -26.3% | -1.8% | 5.5% | -34.7% | 34.9% | -2.2% | 55.6% |
| Long Treasuries | 32.0% | 16.8% | 16.8% | 26.3% | -2.2% | -7.4% | -4.4% |
| Long Credit | 21.6% | 13.4% | 16.0% | -7.0% | 1.5% | -8.3% | -1.1% |
| 20+ YR STRIPS | 46.8% | 24.9% | 21.5% | 46.4% | -7.2% | -10.7% | -10.2% |
| High-Yield Municipal Bonds | 10.6% | 5.8% | 11.1% | -24.8% | -0.5% | -6.1% | 0.9% |
| Municipal Bonds (1-10 yr) | 11.4% | 6.6% | 14.6% | 8.6% | 2.7% | -4.1% | 3.2% |
| Short Treasuries (1-3 yr) | 10.6% | 2.1% | 14.8% | 11.5% | 5.1% | -0.3% | 3.9% |
| Short Credit (1-3 yr) | 10.3% | 3.0% | 15.6% | 4.0% | 5.8% | -0.6% | 3.4% |
| Short HY (1-3 yr) | 7.8% | -0.3% | 28.4% | -15.6% | 10.4% | -1.7% | 3.9% |
| Global I/L | 7.3% | 5.1% | 20.3% | -1.0% | -1.3% | -3.3% | -16.8% |
| Municipal Bonds | 11.1% | 6.6% | 14.9% | 4.1% | 2.9% | -4.0% | 1.5% |
| Bank Loans | 6.2% | 3.0% | 9.3% | -26.1% | -5.2% | -0.9% | 1.7% |
| US 10 yr Treasuries | 22.2% | 8.7% | 17.0% | 23.2% | 1.6% | -3.8% | -0.4% |
| Global 10 yr Sovereigns (Hedged) | 22.2% | 8.7% | 17.0% | 6.5% | 1.6% | -1.8% | -0.4% |
| Hedge Funds - Long/Short | 1.2% | -8.2% | -3.8% | -17.6% | 3.7% | -0.6% | 5.6% |
| Hedge Funds - Credit | -3.0% | 1.9% | 11.9% | -26.2% | -0.9% | -1.1% | 3.1% |
| Hedge Funds - Macro | 17.3% | -3.2% | 27.3% | 5.3% | 1.4% | -2.5% | 4.4% |
| MLPs | 4.6% | -18.9% | 49.6% | -51.2% | -11.9% | -3.5% | 6.6% |
| REITs | 11.0% | -21.0% | 35.2% | -70.3% | -19.5% | -10.2% | -10.7% |
| Non-US Cash | 7.2% | 0.1% | 8.9% | 4.6% | 6.2% | 0.0% | 5.5% |
| Non-US Leverage Cost | 7.3% | 0.1% | 8.4% | 5.6% | 6.3% | 0.0% | 7.1% |
| Non-Core Real Estate | 25.0% | 0.7% | 18.0% | -50.0% | 2.0% | 2.8% | 6.3% |

2018 CAPITAL MARKET ASSUMPTIONS

| Geometric Expected Return | | | |
|-------------------------------------|---------------------------------|--------------------------------|-------------------|
| Asset Class | 5-7 Year Return Forecast | 30 Year Return Forecast | Volatility |
| Large Cap Equities | 5.25% | 7.50% | 17.50% |
| Small/Mid Cap Equities | 5.75% | 7.75% | 21.00% |
| Int'l Equities (Unhedged) | 7.50% | 7.75% | 21.00% |
| Int'l Small Cap Equities (Unhedged) | 7.75% | 8.00% | 22.00% |
| Emerging Int'l Equities | 9.00% | 9.25% | 28.00% |
| Emerging Int'l Small Cap Equities | 9.25% | 9.50% | 31.00% |
| Private Equity | 8.00% | 9.50% | 23.00% |
| Core Bonds* | 2.75% | 3.75% | 5.99% |
| High Yield | 3.75% | 5.50% | 13.00% |
| Bank Loans | 4.50% | 5.50% | 9.00% |
| EMD External | 4.25% | 5.00% | 13.00% |
| EMD Local Currency | 6.00% | 6.50% | 13.00% |
| Private Debt | 6.50% | 7.50% | 13.00% |
| TIPS | 3.25% | 3.75% | 6.50% |
| Commodities | 4.75% | 5.50% | 19.00% |
| REITS | 6.50% | 6.75% | 21.00% |
| Core Real Estate | 5.75% | 6.50% | 13.00% |
| Non-Core Real Estate | 7.00% | 7.50% | 17.00% |
| Private Real Assets: Energy/Metals | 8.00% | 7.75% | 21.00% |
| Cash | 2.00% | 2.75% | 1.00% |
| GAA** | 5.12% | 5.85% | 7.28% |
| Risk Parity** | 5.50% | 6.91% | 11.98% |
| Hedge Funds*** | 5.83% | 6.34% | 9.07% |

*Assumption based on market weighted blend of index components

**Based on a handful of different manager strategies using a blend of index components

***Hedge Funds is a calculated blend of 40% Equity, 40% Credit and 20% Macro-related strategies

2018 5-7 YEAR RETURN FORECASTS

| Geometric Expected Return | | | |
|----------------------------------|-------------|-------------|------------------|
| Asset Class | 2018 | 2017 | 2018-2017 |
| Cash | 2.00% | 1.75% | +0.25% |
| Treasuries | 2.25% | 2.00% | +0.25% |
| IG Corp Credit | 3.50% | 3.75% | -0.25% |
| MBS | 2.50% | 2.25% | +0.25% |
| Core Bonds* | 2.75% | 2.65% | +0.10% |
| TIPS | 3.25% | 3.00% | +0.25% |
| High-Yield Bonds | 3.75% | 4.75% | -1.00% |
| Bank Loans | 4.50% | 5.25% | -0.75% |
| Non-US Bonds (Unhedged) | 0.50% | 1.00% | -0.50% |
| Non-US Bonds (Hedged) | 0.73% | 1.09% | -0.36% |
| EMD External | 4.25% | 4.75% | -0.50% |
| EMD Local Currency | 6.00% | 6.75% | -0.75% |
| Large Cap Equities | 5.25% | 5.75% | -0.50% |
| Small/Mid Cap Equities | 5.75% | 6.00% | -0.25% |
| Int'l Equities (Unhedged) | 7.50% | 7.25% | +0.25% |
| Int'l Equities (Hedged) | 7.82% | 7.57% | +0.25% |
| Emerging Int'l Equities | 9.00% | 9.50% | -0.50% |
| Private Equity | 8.00% | 8.25% | -0.25% |
| Private Debt | 6.50% | 7.25% | -0.75% |
| Core Real Estate | 5.75% | 6.00% | -0.25% |
| Commodities | 4.75% | 4.75% | - |
| Hedge Funds** | 5.83% | 5.95% | -0.12% |

* Core Bonds assumption based on market weighted blend of components of Aggregate Index (Treasuries, IG Corp Credit, and MBS).

** Hedge Funds is a calculated blend of 40% Equity, 40% Credit, 20% Macro-related strategies.



2018 5-7 YEAR RETURN FORECASTS - CONTINUED

| Geometric Expected Return | | | |
|-----------------------------------|-------------|-------------|------------------|
| Asset Class | 2018 | 2017 | 2018-2017 |
| Short Treasuries | 2.25% | 2.00% | +0.25% |
| US 10 Yr. Treasury | 2.25% | 2.00% | +0.25% |
| Long Treasuries | 2.00% | 1.75% | +0.25% |
| 20+ Year STRIPS | 1.75% | 1.50% | +0.25% |
| Short Credit | 2.75% | 2.75% | - |
| Long Credit | 4.00% | 4.25% | -0.25% |
| Long Government/Credit* | 3.26% | 3.33% | -0.07% |
| Non-US Cash** | 0.50% | 0.25% | +0.25% |
| Non-US Inflation-Linked Bonds | 1.75% | 1.00% | +0.75% |
| Short High Yield | 4.25% | 5.00% | -0.75% |
| Municipal Bonds (1-10 Year) | 2.50% | - | - |
| High Yield Municipal Bonds | 3.75% | 4.25% | -0.50% |
| Global Equity* | 6.88% | 7.21% | -0.33% |
| MLPs | 7.25% | 7.00% | +0.25% |
| REITs | 6.50% | 6.50% | - |
| Real Assets (Liquid)** | 5.87% | 5.92% | -0.05% |
| Non-Core Real Estate | 7.00% | N/A | N/A |
| Private Real: Energy/Metals | 8.00% | 8.25% | -0.25% |
| Private Real: Infrastructure/Land | 6.00% | 6.00% | - |
| Hedge Funds - Long/Short | 6.25% | 6.25% | - |
| Hedge Funds - Credit | 5.00% | 5.25% | -0.25% |
| Hedge Funds - Macro | 6.25% | 6.25% | - |

* Assumption based on market weighted blend of index components

** Custom weighted blend of underlying asset classes



2018 VOLATILITY FORECASTS

| Volatility | | | |
|---------------------------|--------|--------|-----------|
| Asset Class | 2018 | 2017 | 2018-2017 |
| Cash | 1.00% | 1.00% | - |
| Treasuries | 5.50% | 5.50% | - |
| IG Corp Credit | 7.50% | 7.50% | - |
| MBS | 7.00% | 7.00% | - |
| Core Bonds* | 5.99% | 6.03% | -0.04% |
| TIPS | 6.50% | 6.50% | - |
| High-Yield Bonds | 13.00% | 13.00% | - |
| Bank Loans | 9.00% | 9.00% | - |
| Non-US Bonds (Unhedged) | 10.00% | 8.50% | +1.50% |
| Non-US Bonds (Hedged) | 4.50% | 5.00% | -0.50% |
| EMD External | 13.00% | 13.00% | - |
| EMD Local Currency | 13.00% | 15.00% | -2.00% |
| Large Cap Equities | 17.50% | 17.50% | - |
| Small/Mid Cap Equities | 21.00% | 21.00% | - |
| Int'l Equities (Unhedged) | 21.00% | 21.00% | - |
| Int'l Equities (Hedged) | 18.00% | 18.00% | - |
| Emerging Int'l Equities | 28.00% | 28.00% | - |
| Private Equity | 23.00% | 23.00% | - |
| Private Debt | 13.00% | 14.00% | -1.00% |
| Core Real Estate | 13.00% | 15.00% | -2.00% |
| Commodities | 19.00% | 19.00% | - |
| Hedge Funds** | 9.07% | 8.74% | -0.33% |

* Core Bonds assumption based on market weighted blend of components of Aggregate Index (Treasuries, IG Corp Credit, and MBS).

** Hedge Funds is a calculated blend of 40% Equity, 40% Credit, 20% Macro-related strategies.



2018 VOLATILITY FORECASTS - CONTINUED

| Volatility | | | |
|-----------------------------------|--------|--------|-----------|
| Asset Class | 2018 | 2017 | 2018-2017 |
| Short Treasuries | 2.50% | 2.50% | - |
| US 10 Yr. Treasury | 7.50% | 7.50% | - |
| Long Treasuries | 12.00% | 12.00% | - |
| 20+ Yr. STRIPS | 19.00% | 19.00% | - |
| Short Credit | 3.50% | 3.50% | - |
| Long Credit | 12.00% | 13.00% | -1.00% |
| Long Government/Credit* | 11.26% | 12.01% | -0.75% |
| Non-US Cash** | 1.00% | 1.00% | - |
| Non-US 10 Yr. Sovereigns** | 6.50% | 6.50% | - |
| Non-US Inflation-Linked Bonds (H) | 5.50% | 6.00% | -0.50% |
| Short High Yield | 8.50% | 9.00% | -0.50% |
| Municipal Bonds (1-10 Year) | 5.50% | - | - |
| Global Equity* | 18.22% | 18.26% | -0.04% |
| MLPs | 19.00% | 20.00% | -1.00% |
| REITs | 21.00% | 21.00% | - |
| Real Assets (Liquid)** | 13.06% | 12.83% | +0.23% |
| Non-Core Real Estate | 17.00% | N/A | N/A |
| Private Real: Energy/Metals | 21.00% | 21.00% | - |
| Private Real: Infrastructure/Land | 12.00% | 14.00% | -2.00% |
| Hedge Funds - Long/Short | 11.00% | 11.00% | - |
| Hedge Funds - Credit | 9.50% | 9.50% | - |
| Hedge Funds - Macro | 9.50% | 9.50% | - |

* Assumption based on market weighted blend of index components

** Custom weighted blend of underlying asset classes



2018 30 YEAR RETURN FORECASTS

| Geometric Expected Return | | | |
|----------------------------------|-------------|-------------|------------------|
| Asset Class | 2018 | 2017 | 2018-2017 |
| Cash | 2.75% | 3.00% | -0.25% |
| Treasuries | 3.25% | 3.50% | -0.25% |
| IG Corp Credit | 4.75% | 5.00% | -0.25% |
| MBS | 3.25% | 3.50% | -0.25% |
| Core Bonds* | 3.75% | 4.00% | -0.25% |
| TIPS | 3.75% | 3.75% | - |
| High-Yield Bonds | 5.50% | 5.75% | -0.25% |
| Bank Loans | 5.50% | 6.00% | -0.50% |
| Non-US Bonds (Unhedged) | 2.50% | 2.75% | -0.25% |
| Non-US Bonds (Hedged) | 2.77% | 2.87% | -0.10% |
| EMD External | 5.00% | 5.75% | -0.75% |
| EMD Local Currency | 6.50% | 6.50% | - |
| Large Cap Equities | 7.50% | 7.50% | - |
| Small/Mid Cap Equities | 7.75% | 7.75% | - |
| Int'l Equities (Unhedged) | 7.75% | 7.75% | - |
| Int'l Equities (Hedged) | 8.14% | 8.14% | - |
| Emerging Int'l Equities | 9.25% | 9.50% | -0.25% |
| Private Equity | 9.50% | 9.50% | - |
| Private Debt | 7.50% | 8.00% | -0.50% |
| Core Real Estate | 6.50% | 6.50% | - |
| Commodities | 5.50% | 5.50% | - |
| Hedge Funds** | 6.34% | 6.47% | -0.13% |

* Core Bonds assumption based on market weighted blend of components of Aggregate Index (Treasuries, IG Corp Credit, and MBS).

** Hedge Funds is a calculated blend of 40% Equity, 40% Credit, 20% Macro-related strategies.

2018 30 YEAR RETURN FORECASTS - CONTINUED

| Geometric Expected Return | | | |
|-----------------------------------|-------------|-------------|------------------|
| Asset Class | 2018 | 2017 | 2018-2017 |
| Short Treasuries | 3.00% | 3.00% | - |
| US 10 Yr. Treasury | 3.50% | 3.50% | - |
| Long Treasuries | 3.50% | 3.75% | -0.25% |
| 20+ Yr. STRIPS | 3.50% | 3.75% | -0.25% |
| Short Credit | 3.75% | 3.75% | - |
| Long Credit | 5.25% | 5.75% | -0.50% |
| Long Government/Credit* | 4.62% | 5.04% | -0.42% |
| Non-US Cash** | 2.00% | 2.00% | - |
| Non-US 10 Yr. Sovereigns** | 2.50% | 2.50% | - |
| Non-US Inflation-Linked Bonds | 3.00% | 2.75% | +0.25% |
| Short High Yield | 5.25% | 5.75% | -0.50% |
| Municipal Bonds (1-10 Year) | 3.25% | - | - |
| Global Equity** | 8.24% | 8.35% | -0.11% |
| MLPs | 7.50% | 7.50% | - |
| REITs | 6.75% | 6.75% | - |
| Real Assets (Liquid)** | 6.75% | 6.79% | -0.04% |
| Non-Core Real Estate | 7.50% | N/A | N/A |
| Private Real: Energy/Metals | 7.75% | 7.75% | - |
| Private Real: Infrastructure/Land | 6.25% | 6.00% | +0.25% |
| Hedge Funds - Long/Short | 7.25% | 7.25% | - |
| Hedge Funds - Credit | 5.25% | 5.50% | -0.25% |
| Hedge Funds - Macro | 6.25% | 6.25% | - |

* Assumption based on market weighted blend of index components

** Custom weighted blend of underlying asset classes



2018 CORRELATIONS

| | Large Cap Equities | Small/Mid Cap Equities | Int'l Equities (Unhedged) | Int'l Small Cap Equities (Unhedged) | Emerging Int'l Equities | Emerging Int'l Small Cap Equities | Private Equity | Core Bonds* | High Yield | Bank Loans | EMD External | EMD Local Currency | Private Debt | TIPS | Commodities | REITS | Core Real Estate | Non-Core Real Estate | Private Real Assets: Energy/Metals | Cash | Hedge Funds** | |
|-------------------------------------|--------------------|------------------------|---------------------------|-------------------------------------|-------------------------|-----------------------------------|----------------|-------------|------------|------------|--------------|--------------------|--------------|-------|-------------|-------|------------------|----------------------|------------------------------------|------|---------------|--|
| Large Cap Equities | 1.00 | | | | | | | | | | | | | | | | | | | | | |
| Small/Mid Cap Equities | 0.90 | 1.00 | | | | | | | | | | | | | | | | | | | | |
| Int'l Equities (Unhedged) | 0.70 | 0.65 | 1.00 | | | | | | | | | | | | | | | | | | | |
| Int'l Small Cap Equities (Unhedged) | 0.70 | 0.75 | 0.90 | 1.00 | | | | | | | | | | | | | | | | | | |
| Emerging Int'l Equities | 0.65 | 0.65 | 0.70 | 0.70 | 1.00 | | | | | | | | | | | | | | | | | |
| Emerging Int'l Small Cap Equities | 0.60 | 0.70 | 0.70 | 0.75 | 0.90 | 1.00 | | | | | | | | | | | | | | | | |
| Private Equity | 0.70 | 0.75 | 0.60 | 0.60 | 0.45 | 0.45 | 1.00 | | | | | | | | | | | | | | | |
| Core Bonds* | 0.10 | 0.08 | 0.10 | 0.08 | 0.03 | 0.03 | 0.10 | 1.00 | | | | | | | | | | | | | | |
| High Yield | 0.65 | 0.70 | 0.65 | 0.65 | 0.70 | 0.70 | 0.60 | 0.35 | 1.00 | | | | | | | | | | | | | |
| Bank Loans | 0.50 | 0.55 | 0.50 | 0.50 | 0.50 | 0.50 | 0.55 | -0.10 | 0.65 | 1.00 | | | | | | | | | | | | |
| EMD External | 0.55 | 0.55 | 0.60 | 0.60 | 0.70 | 0.70 | 0.35 | 0.43 | 0.70 | 0.25 | 1.00 | | | | | | | | | | | |
| EMD Local Currency | 0.60 | 0.50 | 0.65 | 0.70 | 0.80 | 0.80 | 0.40 | 0.32 | 0.55 | 0.25 | 0.75 | 1.00 | | | | | | | | | | |
| Private Debt | 0.60 | 0.65 | 0.75 | 0.75 | 0.80 | 0.80 | 0.65 | -0.12 | 0.65 | 0.70 | 0.50 | 0.60 | 1.00 | | | | | | | | | |
| TIPS | -0.10 | -0.10 | -0.05 | -0.05 | -0.10 | -0.10 | -0.10 | 0.71 | 0.20 | 0.05 | 0.30 | 0.25 | -0.10 | 1.00 | | | | | | | | |
| Commodities | 0.30 | 0.30 | 0.40 | 0.35 | 0.55 | 0.55 | 0.25 | 0.02 | 0.20 | 0.40 | 0.35 | 0.50 | 0.30 | 0.30 | 1.00 | | | | | | | |
| REITS | 0.70 | 0.75 | 0.60 | 0.60 | 0.60 | 0.60 | 0.50 | 0.15 | 0.55 | 0.55 | 0.35 | 0.40 | 0.60 | 0.30 | 0.35 | 1.00 | | | | | | |
| Core Real Estate | 0.40 | 0.40 | 0.35 | 0.35 | 0.30 | 0.30 | 0.50 | 0.11 | 0.35 | 0.20 | 0.25 | 0.40 | 0.40 | 0.10 | 0.30 | 0.60 | 1.00 | | | | | |
| Non-Core Real Estate | 0.55 | 0.60 | 0.50 | 0.50 | 0.40 | 0.40 | 0.75 | 0.00 | 0.50 | 0.40 | 0.30 | 0.40 | 0.55 | 0.00 | 0.35 | 0.30 | 0.75 | 1.00 | | | | |
| Private Real Assets: Energy/Metals | 0.65 | 0.70 | 0.55 | 0.55 | 0.50 | 0.50 | 0.85 | -0.01 | 0.50 | 0.55 | 0.40 | 0.40 | 0.65 | -0.05 | 0.35 | 0.55 | 0.45 | 0.65 | 1.00 | | | |
| Cash | -0.10 | -0.15 | -0.10 | -0.10 | -0.10 | -0.10 | -0.20 | 0.20 | -0.05 | 0.00 | 0.05 | 0.05 | 0.00 | 0.35 | 0.10 | -0.05 | 0.10 | -0.05 | -0.05 | 1.00 | | |
| Hedge Funds** | 0.68 | 0.70 | 0.68 | 0.71 | 0.72 | 0.71 | 0.73 | 0.25 | 0.70 | 0.57 | 0.62 | 0.66 | 0.78 | 0.20 | 0.51 | 0.49 | 0.23 | 0.46 | 0.69 | 0.00 | 1.00 | |

*Assumption based on market weighted blend of index components

** Hedge Fund is calculated blend of 40% Equity, 40% Credit, 20% Macro-related strategies



DISCLOSURES

- **NEPC, LLC is an investment consulting firm. We provide asset-liability studies for certain clients but we do not provide actuarial services. Any projections of funded ratio or contributions contained in this report should not be used for budgeting purposes. We recommend contacting the plan's actuary to obtain budgeting estimates.**
- **The goal of this report is to provide a basis for substantiating asset allocation recommendations.**
- **The projection of liabilities in this report uses standard actuarial projection methods and does not rely on actual participant data. Asset and liability information was received from the plan's actuary, and other projection assumptions are stated in the report.**
- **Assets are projected using a methodology chosen by the client. Gains and losses are estimated through investment returns generated by applying NEPC's 5-7 year asset class assumptions and scenario assumptions for the current year.**
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