ASSET-LIABILITY STUDY

MODOT & PATROL EMPLOYEES' RETIREMENT SYSTEM

February 28, 2020

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MPERS
Serving those who keep us safe.

EXECUTIVE SUMMARY

EXECUTIVE SUMMARY – BACKGROUND

- **This report presents the results of the asset-liability study conducted on the MoDOT & Patrol Employees' Retirement System (MPERS)**
- **The goals of the study are to:**
  - Review the current and projected financial status of the Plan
    - Project Pension liabilities and benefit payments
    - Project asset growth and contribution levels
  - Assess the appropriateness of the current asset allocation relative to the expected progress of liabilities and cash flows
    - Analyze the tradeoffs of asset class changes
  - Use multiple models to develop comprehensive understanding of plan dynamics
    - Risk and return of asset allocation
    - Relationship between assets and liabilities

- **MPERS investment objectives:**
  - Efficiently allocate and manage the assets of the Fund so that beneficiaries will receive promised benefits.
  - Manage the portfolio on a total return basis, which recognizes the importance of the preservation of capital, as well as the fact that reasonable and varying degrees of investment risk are generally rewarded over the long-term.
  - Work towards achieving and then maintaining a fully funded pension status.
  - Exceed the Policy benchmark on a net of fees basis over a full market cycle.

- **Important Risks to the Plan:**
  - Volatility of market returns/drawdown risk
  - Volatility of funded ratio
  - Volatility of contributions

EXECUTIVE SUMMARY – KEY FINDINGS

- **The Plan is 59.8% funded on an actuarial value basis as of June 30, 2019**
- **Current Policy allocation is expected to produce an average return of 6.29% over the next 10 years using NEPC's 2020 assumptions**
  - The expected return on assets (EROA) of 7.00%
- **Meaningful relief to employer contribution rates is expected over the next 6 years as the retiree unfunded liability is fully funded**
  - Expected to occur early in 2024
- **Starting in 2024, based on the NEPC 10-year expected return assumptions, the employer contribution rate is expected to drop below 45% and then gradually increase over time due to expected returns falling below the assumed rate of return**
  - However, based on the NEPC 10 year expected return, the employer contribution rate is expected to increase over the next ten years
- **Capital markets backdrop continues to support a well diversified, globally balanced approach**
  - Current long-term asset allocation policy target is a well diversified portfolio that strives for return without taking undue risk
- **This allocation and liability analysis investigates important decisions for improving financial outcomes**

NEPC CONCLUSIONS

1. **NEPC continues to support the existing policy asset allocation based on several factors:**
   - Low return environment for traditional asset classes
   - Attractive and enhanced return environment for alternatives

2. **Furthermore, NEPC continues to support the proposed use of leverage on the existing policy asset allocation**
   - Due to limited opportunities in the market, NEPC has focused increasingly more on implementation tools that can help add marginal return in a risk aware fashion
   - Leverage is a tool that we believe can help bridge the return gap between expected returns and investment objectives
     - MPERS Assumed rate of return = 7.00%
     - Expected Policy 10 year return = 6.29%
     - Expected Policy (20% Leverage) 10 Year return = 6.99%
   - The "20% Leverage" Mix is modeled to produce the highest positive impact on funded status over the next 10 years
   - In addition, the "20% Leverage" Mix is projected to result in a lower employer contribution over the next 10 years

ASSET-LIABILITY STUDY OVERVIEW

ASSET LIABILITY FRAMEWORK

Identify Key Issues

- Investment-related themes
- Demographic trends/changes
- Regulatory environment

Projection of Assets & Liabilities

- Funded status
- Contribution requirements

Multi-Faceted Risk Assessment

- Mean-variance optimization
- Risk budgeting
- Economic scenario analysis
- Sensitivity to market shocks
- Deterministic projections
- Stochastic projections

Asset Allocation Recommendation

- Better risk-adjusted returns
- Better performance in specific economic regimes

ASSET ALLOCATION APPROACH

Be Dynamic

Build a **long-term** strategic allocation that can meet long-term objectives

Look for **medium-term** "opportunistic ideas" to tilt away from the strategic allocation to add value, protect against drawdowns, and take advantage of **short-term** market dislocations

Build a Mosaic

No single asset allocation approach or model has all the answers

Minimize exposure to the shortcomings of any individual approach by using multiple perspectives and approaches

All analytical tools have the potential to provide useful insights

ANALYTICAL MODELING TOOLS

- **NEPC uses a variety of proprietary tools developed to assess strategic asset allocation changes and the impact of tactical adjustments**

Approach	Advantages	Shortcomings
Mean-Variance	• Calculates most efficient portfolio for given volatility • Produces range of portfolios	• Relies on static assumptions and assumes normal distribution • Chosen constraints can drive results • Limits risk definition to volatility of returns
Risk Budgeting	• Provides risk allocations • Recognizes that less efficient portfolios may have better risk balance	• Relies on Mean-Variance optimization assumptions • Defines risk as standard deviation • Ignores tail risks
Scenario Analysis	• Focuses on low-probability, high magnitude economic environments (tail risks) • Recognizes environmental biases of each asset class	• Offers opportunity to test risk tolerance to various outcomes but should not be used to construct best portfolio for each environment
Stochastic Forecasting	• Shows range of results based on Monte Carlo simulation • Includes random return samples	• Percentiled results show ranges but not reasons • Each simulated trial represents a possible but highly unlikely path

THE CORE FUNDING EQUATION IS A CHALLENGE

All investors face the same fundamental challenge

- Contributions + Investment Earnings must equal or exceed total Obligations (Benefits and Operating Expenses)
- For pension plans, this is the classic equation:

$$C + I = B + E$$

If investment return is lower than expected, adjustments are required to balance the equation

- Contributions must be higher, or
- Benefits + operating expenses must be lower, or
- More risk must be taken to earn a similar return, or risk must be taken more efficiently

Adjusting investment return and risk is the most fluid of these factors

- Requires an understanding of both assets and liabilities to determine the "right" amount of risk in a portfolio
- A key input is assessing the efficiency of a portfolio's implementation of the risk target
- Requires any potential structural challenges from future cash flow dynamics be addressed and understood
- The portfolio's macro economic bias must be evaluated and recognized

ASSET-LIABILITY RESULTS: CURRENT POLICY

ACTUARIAL VALUATION RESULTS

	June 30, 2018 Valuation Results	June 30, 2019 Valuation Results
Market Value of Assets (MVA)	$2,315	$2,423
Actuarial Value of Assets (AVA)	$2,274	$2,415
Actuarial Accrued Liability (AAL)	$3,982	$4,037
Unfunded Actuarial Accrued Liability (UAAL)	$1,708	$1,622
Funded Ratio	57.1%	59.8%
Employer Contribution Rate	58.0%[1]	58.0%[2]
Employer Contribution Dollars	$216[1]	$221[2]

[1] Fiscal year 2020 contribution
[2] Fiscal year 2021 contribution
$ in millions

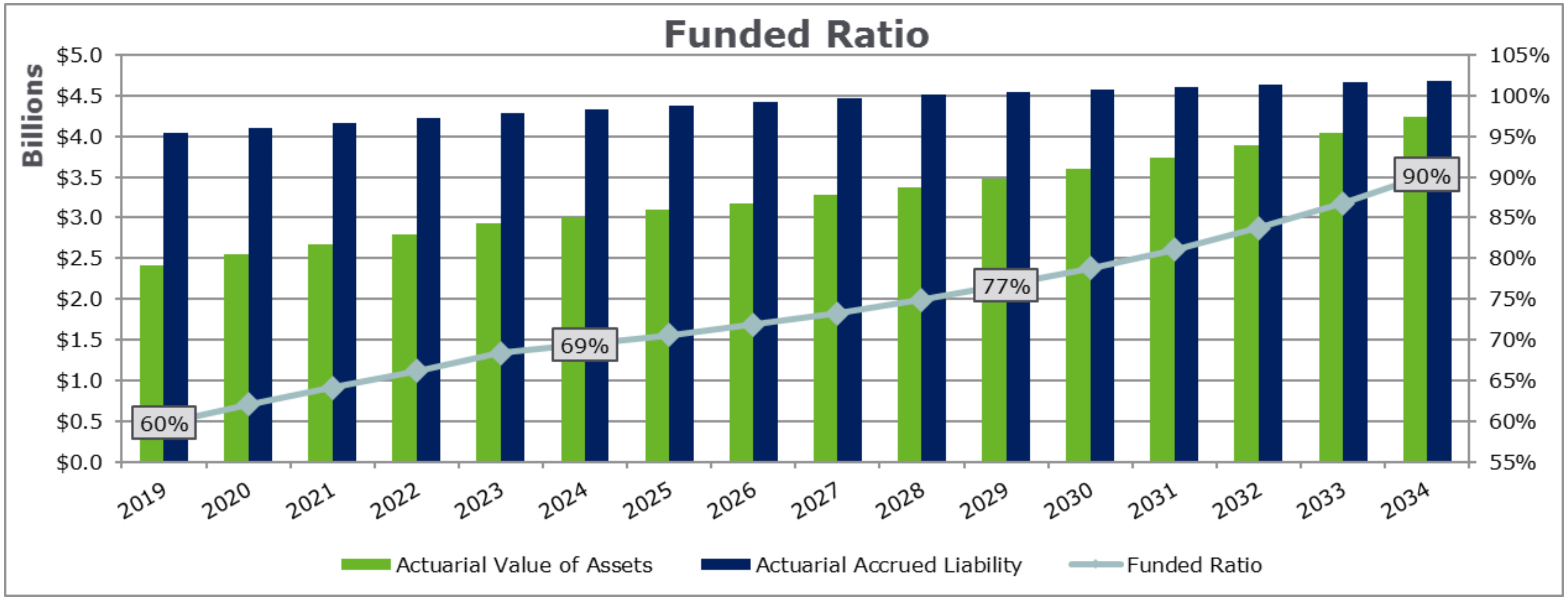
The plan's funding policy has a short-term goal of fully funding the retiree liability within 6 years

The long-term goal of the funding policy is to be fully funded on a total plan level within 16 years

Contributions are expected to remain at 58% until the retiree liability is fully funded and then revert back to the long-term funding mechanism thereafter

- Expected to occur in 2024 though timing will depend on actual asset and liability performance
- Will likely mean lower contributions once the long-term policy takes effect

FUNDED RATIO – CURRENT POLICY



[1] Assumes NEPC's 10-year return assumption for the Current Policy allocation of 6.3% per annum

The funded ratio of the plan is expected to reach above 75% over the next 10 years and progress to 90% over 15 years

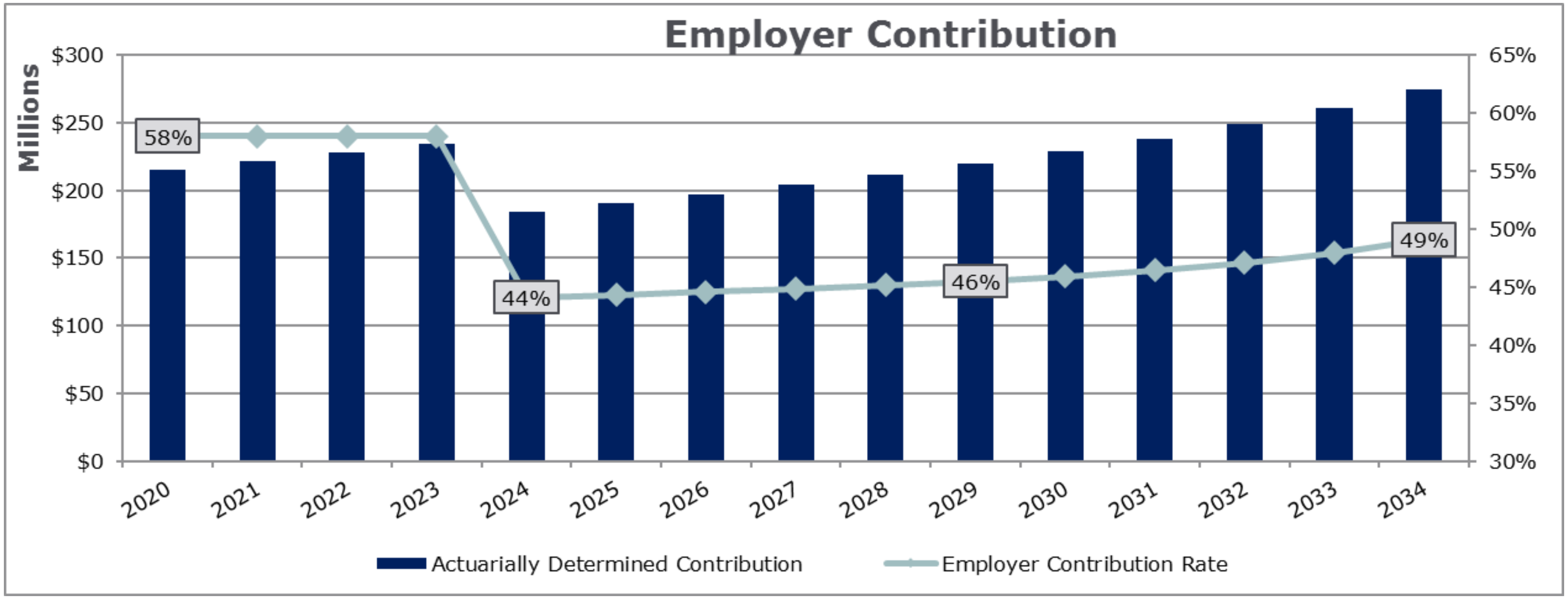
Assets are expected to grow at about 3.8% per year, on average, over the next 15 years

- 6.3% return on assets + (–2.5% average net cash flow) = 3.8% net asset growth

On the other hand, liabilities are expected to grow at about 1.0% per year

- Hurdle rate for funded status improvement is equal to: 1.0% – (–2.5%) = 3.5%

EMPLOYER CONTRIBUTION – CURRENT POLICY



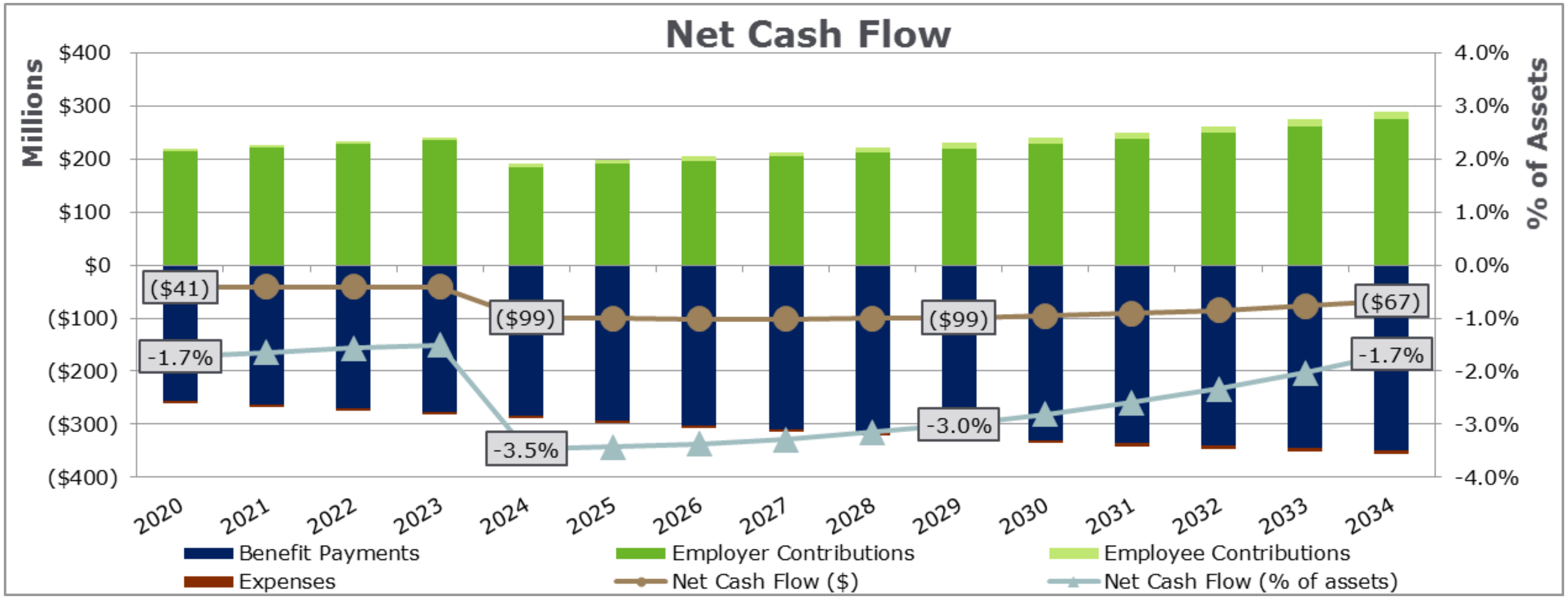
[1] Assumes NEPC's 10-year return assumption for the Current Policy allocation of 6.3% per annum
[2] Contribution rates reflect a percent of payroll

MPERS' current funding policy maintains a 58% contribution rate until the retiree liability is fully funded over the next 6 years

The permanent funding policy takes over once the retiree liability is fully funded or if it produces a higher contribution rate than the temporary policy

The permanent funding policy aims to fully fund the entire plan over the next 16 years

NET CASH FLOW – CURRENT POLICY



[1] Assumes NEPC's 10-year return assumption for the Current Policy allocation of 6.3% per annum

Negative net cash flow can be considered the minimum required return to maintain current asset levels

- % return has to exceed the net % of assets going out in order for asset pool to grow

The more negative net cash flow becomes, the more reliant the plan becomes on investment returns, rather than contributions, to maintain funding levels

Net cash flow is expected to decline sharply in 2024 once the retiree liability is fully funded and the funding policy reverts back to the permanent policy

ASSET ALLOCATION PROFILES

2020 MPERS' MIXES (RISK & RETURN)

	Policy	20% Leverage	60/35/5	Enhanced Real Assets
Global Equity	40.0%*	48.0%*	57.5%	35.0%
Private Equity	10.0%	12.0%	2.5%	12.5%
Total Equity	**50%**	**60%**	**60%**	**47.50%**
TIPS	5.0%	6.0%	7.2%	5.0%
Core Bonds	10.0%	12.0%	14.4%	10.0%
Long Govt/Credit	7.5%	9.0%	10.9%	7.5%
Private Debt	7.5%	9.0%	2.5%	7.5%
Total Fixed Income	**30%**	**36%**	**35%**	**30%**
Private Real Assets	10.0%	12.0%	2.5%	12.5%
Core Real Estate	10.0%	12.0%	2.5%	10.0%
Total Real Assets	**20%**	**24%**	**5%**	**22.5%**
US Leverage Cost	0%	-20%	0%	0%
Total Cash	**0%**	**-20%**	**0%**	**0%**

Expected Return 10 yrs	**6.29%**	**6.99%**	**5.52%**	**6.36%**
Expected Return 30 yrs	**7.31%**	**8.11%**	**6.67%**	**7.41%**
Projected Risk	**11.53%**	**13.82%**	**11.73%**	**11.59%**
Sharpe Ratio (10 years)	**0.39**	**0.38**	**0.32**	**0.39**
Sharpe Ratio (30 years)	**0.43**	**0.41**	**0.37**	**0.43**

* Global Equity includes a 5% allocation to hedged equities and a 2.5% allocation to Midstream Energy
** The TIPS, Core, and Long Govt/Credit allocations within the "60/35/5 Mix" is pro-rated based on their policy target allocations

2020 MPERS' MIXES (BY THE DOLLARS)

	Policy	20% Leverage	60/35/5	Enhanced Real Assets
Global Equity	40.0%	48.0%	57.5%	35.0%
Private Equity	10.0%	12.0%	2.5%	12.5%
Total Equity	**50%**	**60%**	**60%**	**47.50%**
TIPS	5.0%	6.0%	7.2%	5.0%
Core Bonds	10.0%	12.0%	14.4%	10.0%
Long Govt/Credit	7.5%	9.0%	10.9%	7.5%
Private Debt	7.5%	9.0%	2.5%	7.5%
Total Fixed Income	**30%**	**36%**	**35%**	**30%**
Private Real Assets	10.0%	12.0%	2.5%	12.5%
Core Real Estate	10.0%	12.0%	2.5%	10.0%
Total Real Assets	**20%**	**24%**	**5%**	**22.5%**
US Leverage Cost	0%	-20%	0%	0%
Total Cash	**0%**	**-20%**	**0%**	**0%**

15 yrs Inv. Return Diff. vs. Assumed Rate of 7% ($M)	**($270.04)**	**($2.33)**	**($561.08)**	**($241.80)**
Additional Nominal Contribution vs. Assumed Rate of 7% ($M)	**$279.00**	**$2.00**	**$563.00**	**$251.00**

* Global Equity includes a 5% allocation to hedged equities and a 2.5% allocation to Midstream Energy
** The TIPS, Core, and Long Govt/Credit allocations within the "60/35/5 Mix" is pro-rated based on their policy target allocations

NEPC

MPERS' MIXES: 2019 vs. 2020 ASSUMPTIONS

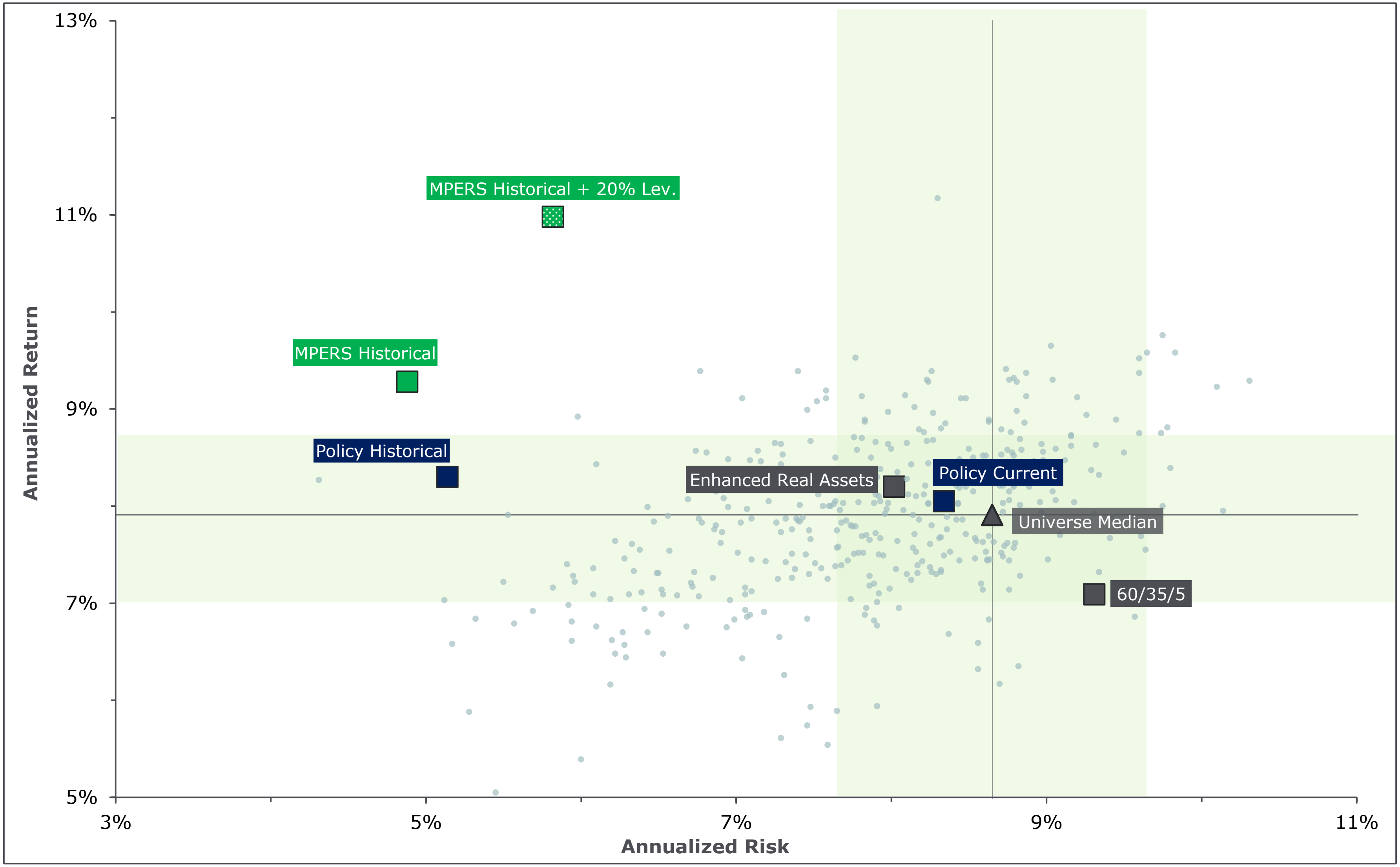
Asset Class	Asset Allocation: Policy	20% Leverage	60/35/5	Enhanced Real Assets
Global Equity	40.0%*	48.0%*	57.5%	35.0%
Private Equity	10.0%	12.0%	2.5%	12.5%
Total Equity	**50%**	**60%**	**60%**	**47.5%**
TIPS	5.0%	6.0%	7.2%	5.0%
Core Bonds	10.0%	12.0%	14.4%	10.0%
Long Govt/Credit	7.5%	9.0%	10.9%	7.5%
Private Debt	7.5%	9.0%	2.5%	7.5%
Total Fixed Income	**30%**	**36%**	**35%**	**30%**
Private Real Assets	10.0%	12.0%	2.5%	12.5%
Core Real Estate	10.0%	12.0%	2.5%	10.0%
Total Real Assets	**20%**	**24%**	**5%**	**22.5%**
US Leverage Cost	0%	-20%	0%	0%
Total Cash	**0%**	**-20%**	**0%**	**0%**

Asset Class	2019 10 Year Return	2020 10 Year Return	|▲|
Global Equity	7.2%	6.1%	-1.1%
Private Equity	10.1%	9.4%	-0.7%
TIPS	3.2%	2.2%	-1.0%
Core Bonds	3.2%	2.5%	-0.7%
Long Govt/Credit	3.2%	2.8%	-0.4%
Private Debt	7.6%	6.7%	-0.9%
Private Real Assets	8.1%	7.5%	-0.6%
Core Real Estate	6.0%	5.2%	-0.8%
US Leverage Cost	2.8%	2.1%	-0.7%

	2019				2020			
	Policy	20% Leverage	60/35/5	Enhanced Real Assets	Policy	20% Leverage	60/35/5	Enhanced Real Assets
Expected Return 10 Yr	7.0%	7.8%	6.4%	7.1%	6.3%	7.0%	5.5%	6.4%
Expected Return 30 Yr	7.9%	8.7%	7.4%	7.9%	7.3%	8.1%	6.1%	7.4%
Projected Risk	11.3%	13.6%	11.6%	11.3%	11.5%	13.9%	11.7%	11.6%
Sharpe Ratio (10 Yr)	0.39	0.38	0.33	0.40	0.39	0.37	0.32	0.39

* Policy Targets: 40% Global Equity = 32.5% Global Equity/5% Hedged Equity(L/S) /2.5% Midstream Energy
** The TIPS, Core, and Long Govt/Credit allocations within the "60/35/5" is pro-rated based on their policy target allocations

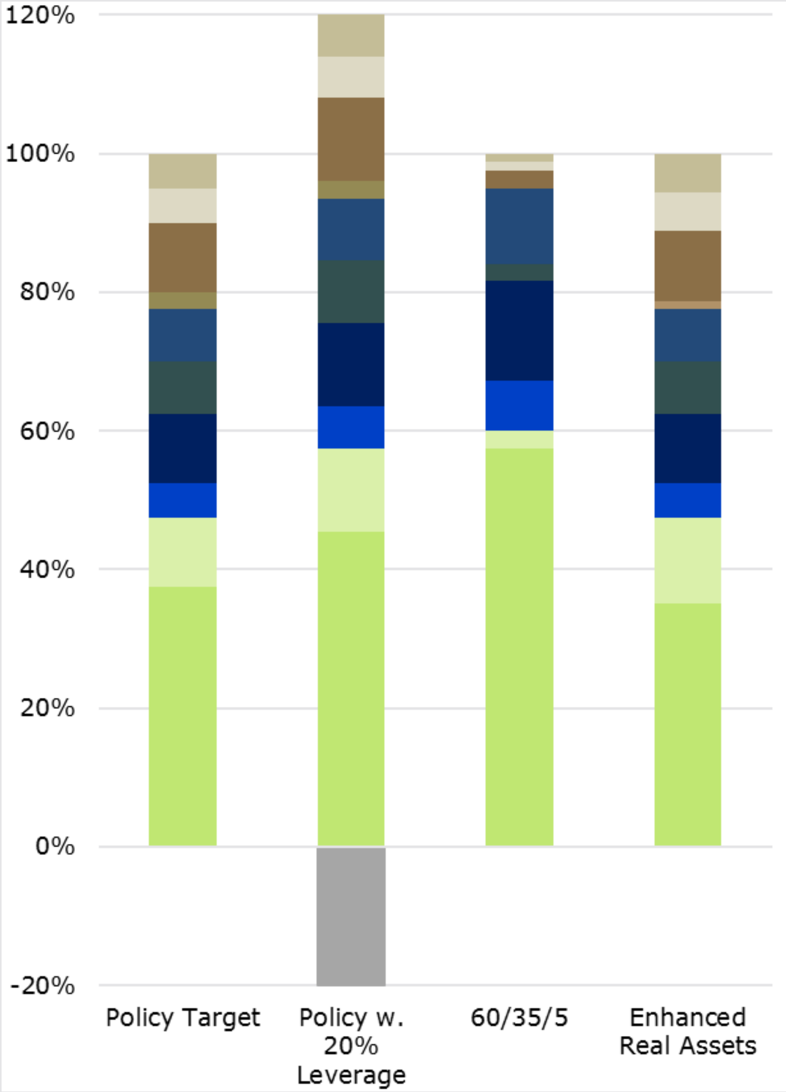
10 YEAR HISTORICAL RISK/RETURN



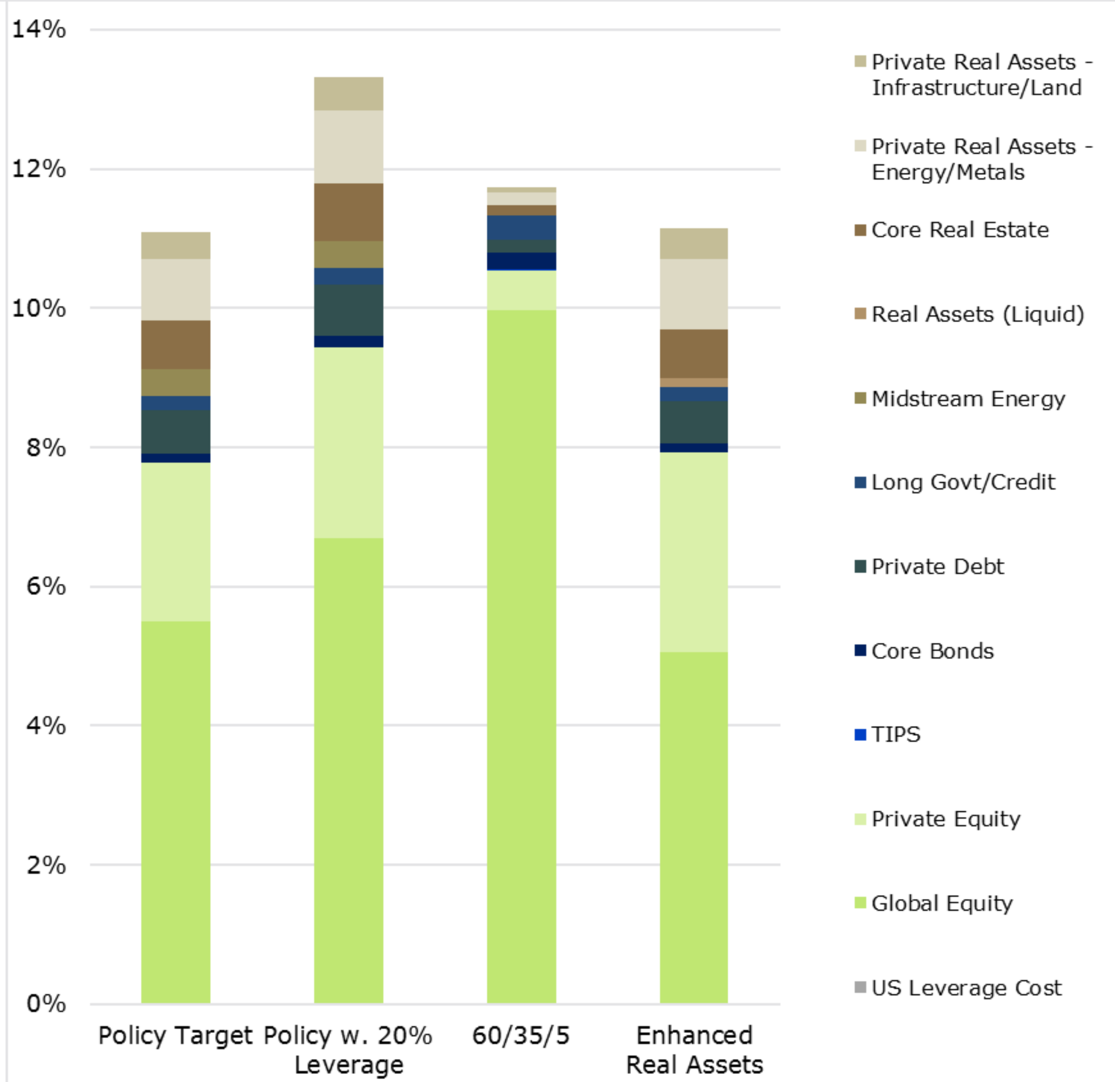
Public DB Universe observations
Returns are net of fees
Quartiles represent the Public DB Universe risk rankings

ASSET & RISK ALLOCATIONS

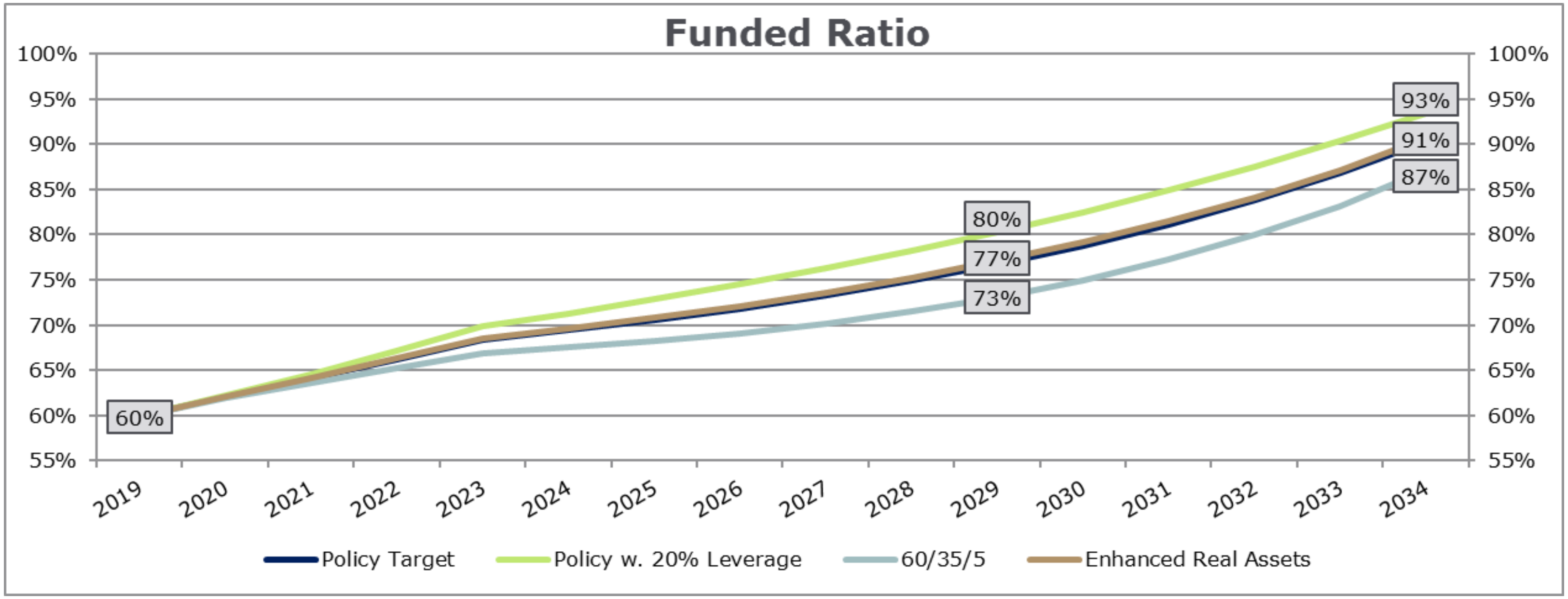
Asset Allocation



Risk Allocation

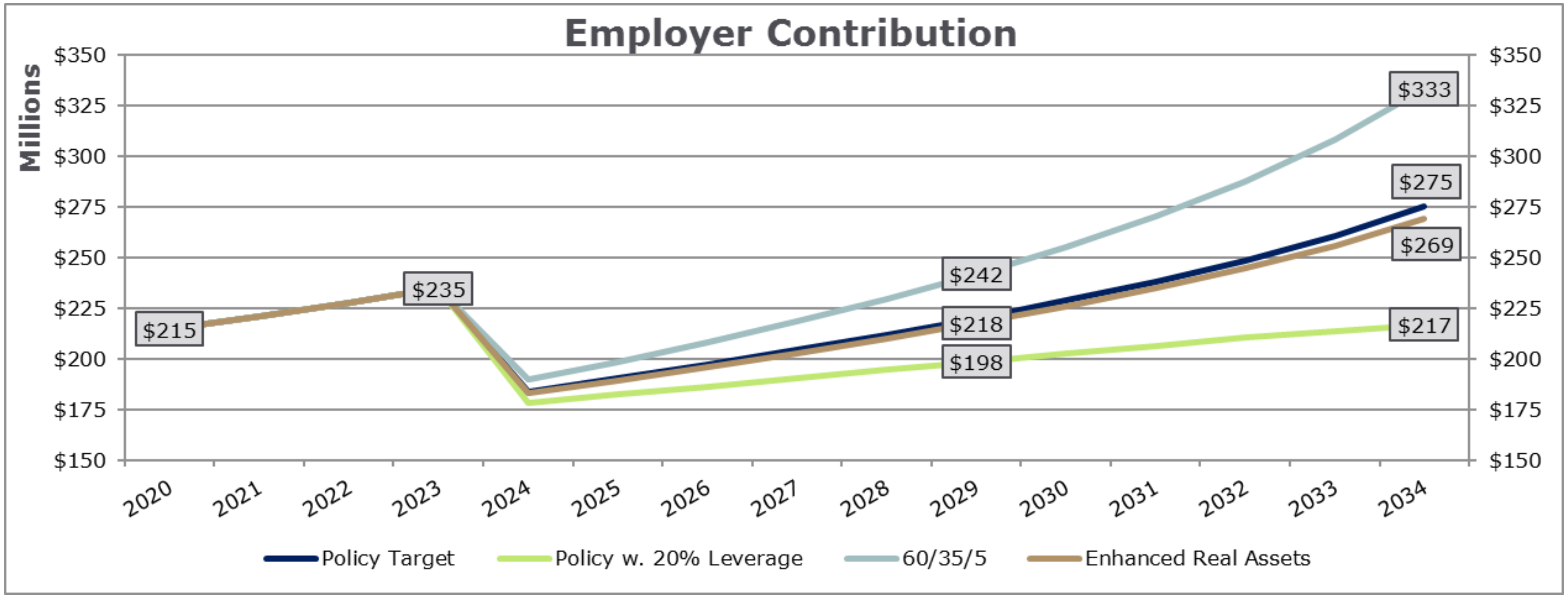


BASELINE FUNDED RATIO: 15 YEAR COMPARISON



[1] Assumes NEPC's 10-year return assumption for each allocation per annum

BASELINE CONTRIBUTION: 15 YEAR COMPARISON

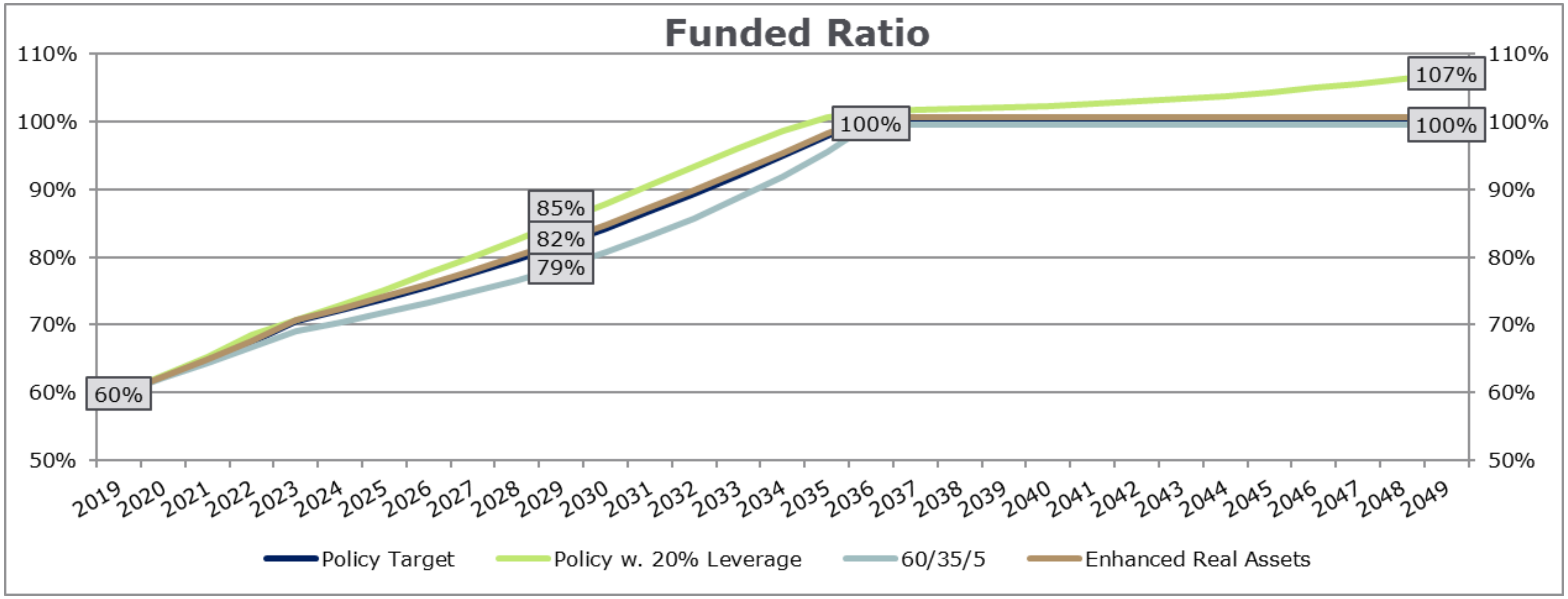


[1] Assumes NEPC's 10-year return assumption for each allocation per annum

Allocation	15-year Nominal Contributions
Policy Target	$3,354 million
Policy w. 20% Leverage	$3,077 million
60/35/5	$3,638 million
Enhanced Real Assets	$3,326 million

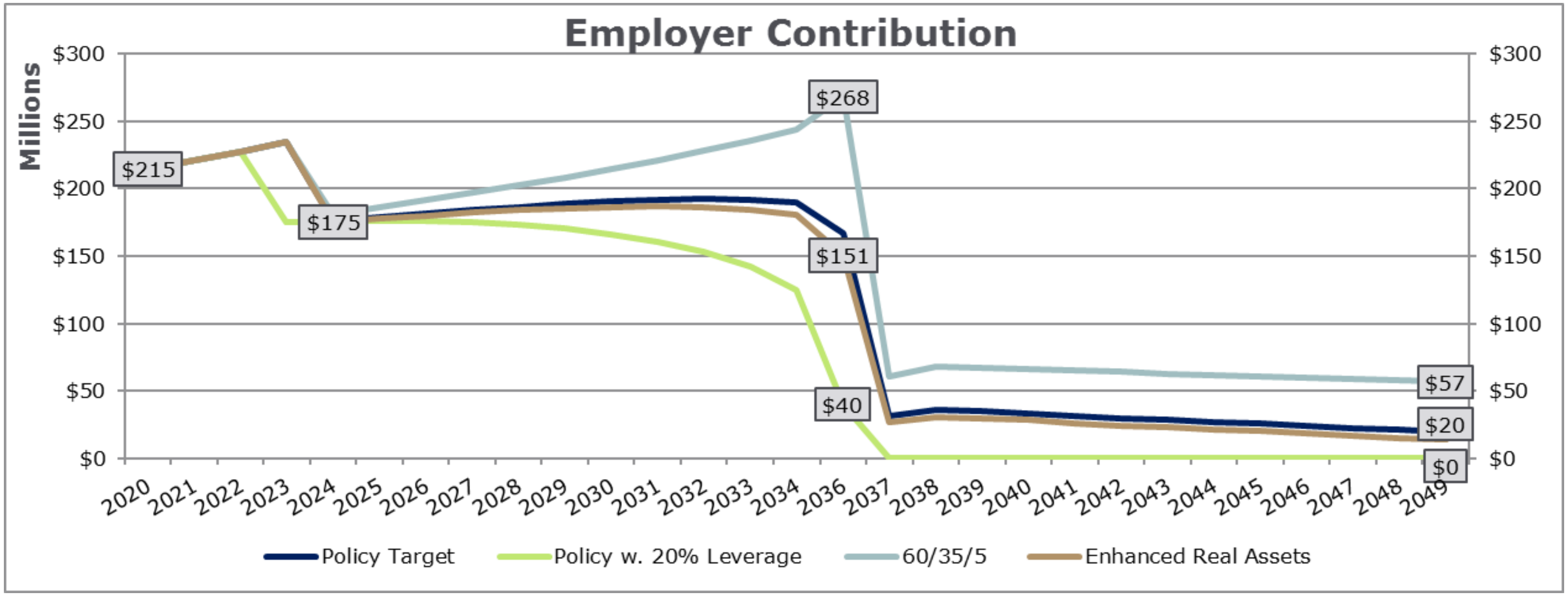
*Present value determined using 7% interest rate and assuming BOY contributions

BASELINE FUNDED RATIO: 30 YEAR COMPARISON



[1] Assumes NEPC's 30-year return assumption for each allocation per annum

BASELINE CONTRIBUTION: 30 YEAR COMPARISON



[1] Assumes NEPC's 30-year return assumption for each allocation per annum

Allocation	30-year Nominal Contributions
Policy Target	$3,665 million
Policy w. 20% Leverage	$2,770 million
60/35/5	$4,539 million
Enhanced Real Assets	$3,526 million

*Present value determined using 7% interest rate and assuming BOY contributions

SCENARIO ANALYSIS

SCENARIO ANALYSIS: REGIME CHANGES

NEPC scenario analysis highlights the impact of shifting economic and market regimes on the portfolio and potential asset allocation mixes

- Risk asset returns are informed by credit returns which are based on changes in real rate, inflation, and credit spreads experienced across market regimes

Expansion

Informed by rising interest rates, moderately rising inflation, elevated positive real rates, and constant tightening of spreads

Overextension

Informed by moderately rising interest rates, rising inflation, depressed negative real rates, and constant tightening spreads followed by spreads widening above current levels

Goldilocks

Informed by level interest rates, level inflation, positive real rates, and constant tightening of spreads

Recession

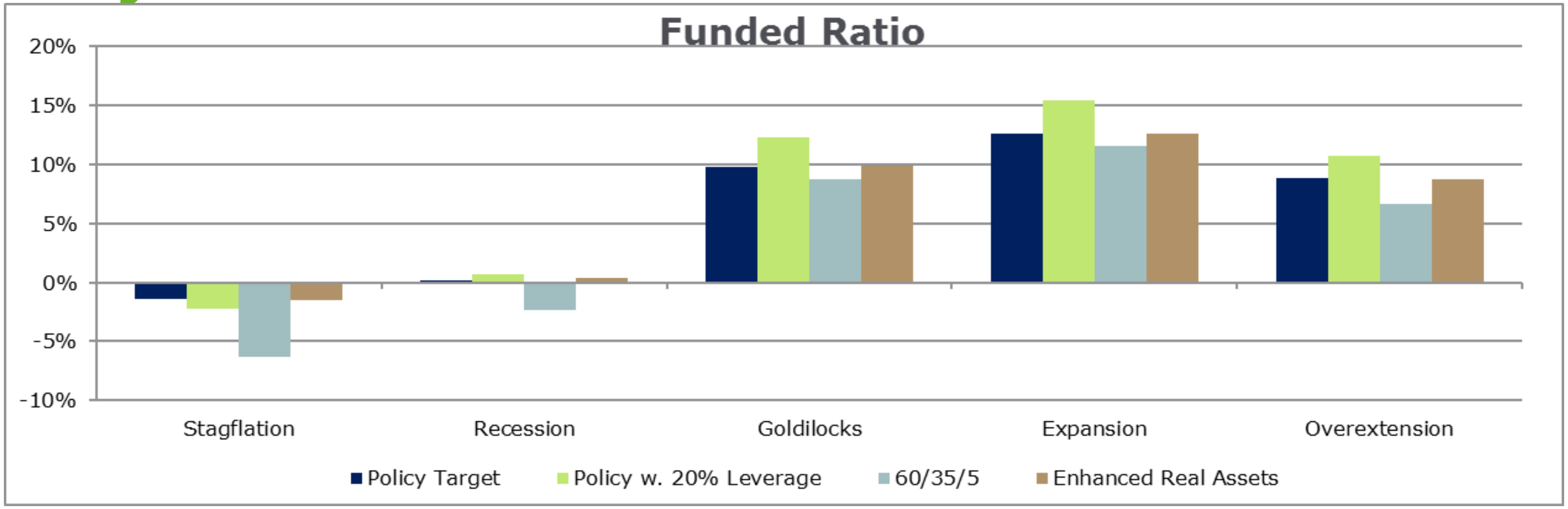
Informed by depressed interest rate levels, falling inflation, depressed positive real rates, and constant spread widening followed by tightening back to current levels

Stagflation

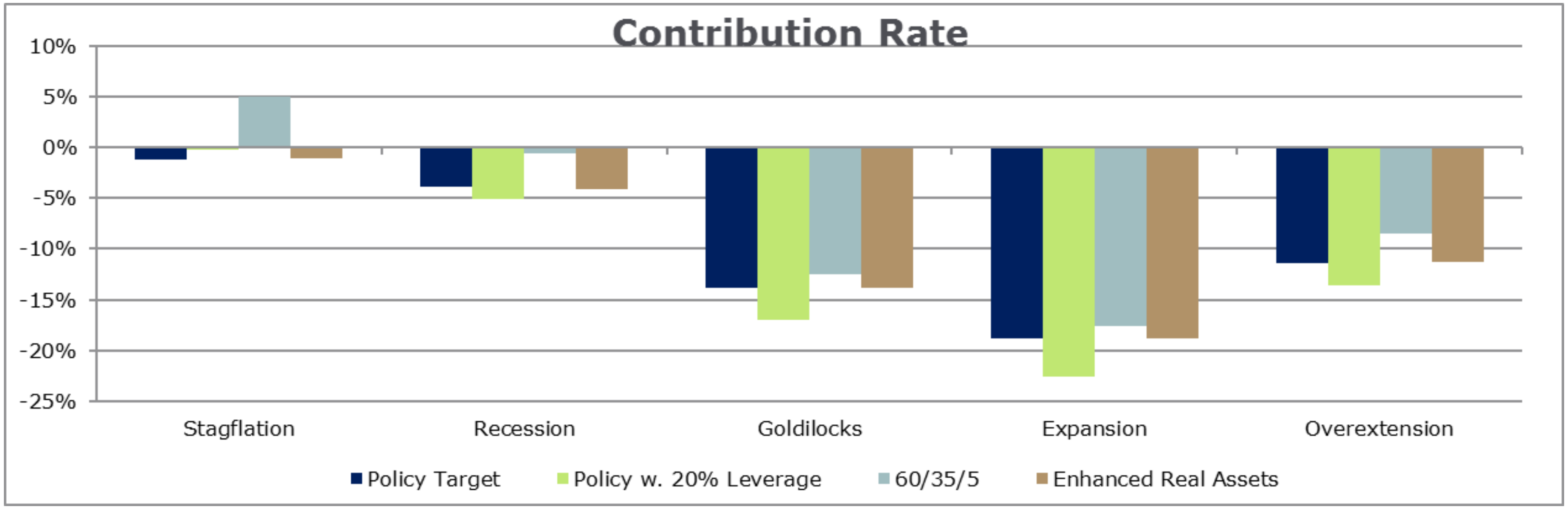
Informed by rising interest rates, rising inflation, depressed negative real rates, and constant spread widening

SCENARIO ANALYSIS COMPARISON

Change in Funded Ratio



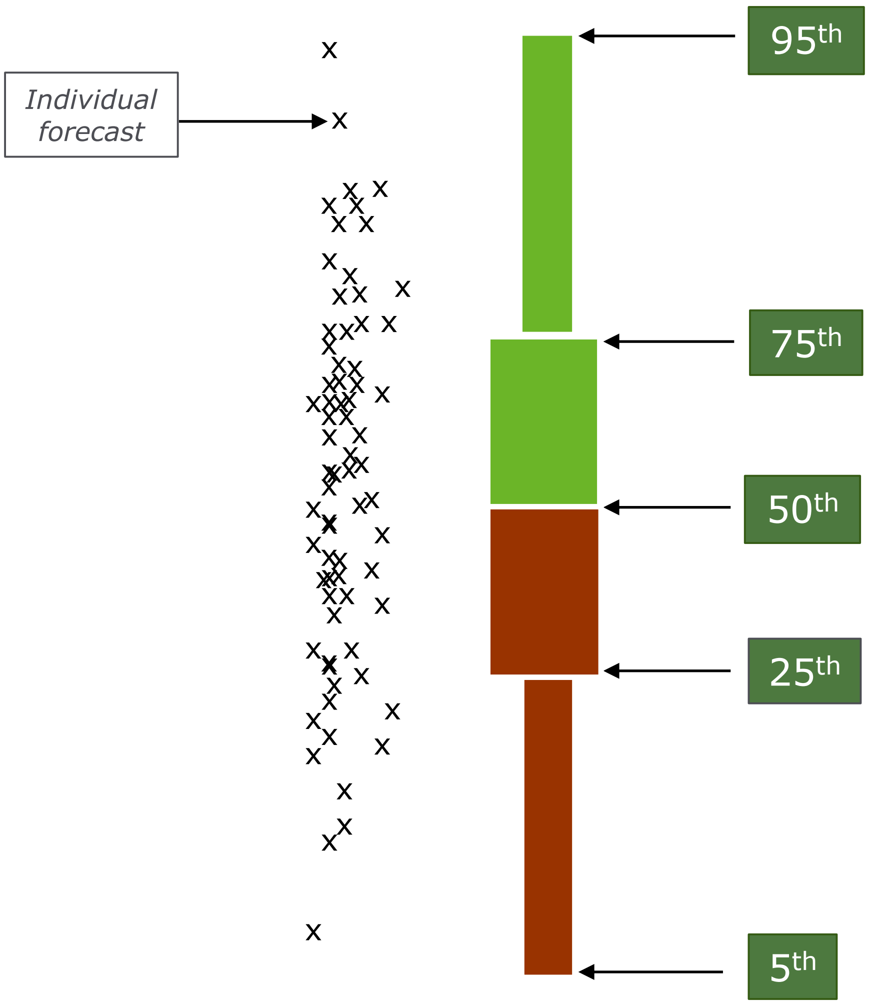
Change in Contribution Rate



STOCHASTIC ANALYSIS

INTERPRETING STOCHASTIC RESULTS

Model ranks 10,000 forecasts each year



95th percentile
- Exceeded by only 5% of forecasts
- Higher than 95% of forecasts
- Overly optimistic outcome

75th percentile
- Exceeded by 25% of forecasts
- Higher than 75% of forecasts
- Optimistic outcome

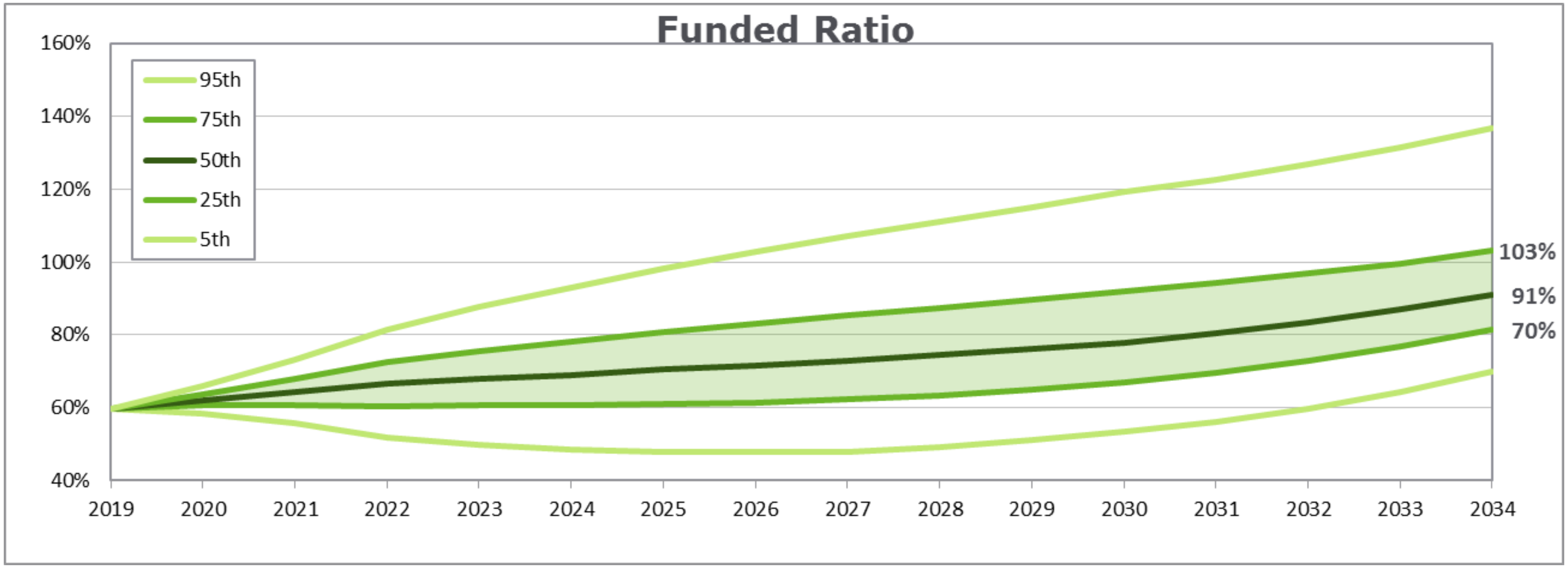
50th percentile
- Exceeded by 50% of forecasts
- Higher than 50% of forecasts
- Generally in line with best estimate

25th percentile
- Exceeded by 75% of forecasts
- Higher than 25% of forecasts
- Pessimistic outcome

5th percentile
- Exceeded by 95% of forecasts
- Higher than only 5% of forecasts
- Overly pessimistic outcome

**The above interpretation is in the context of funded percentage*

STOCHASTIC FUNDED RATIO: CURRENT POLICY



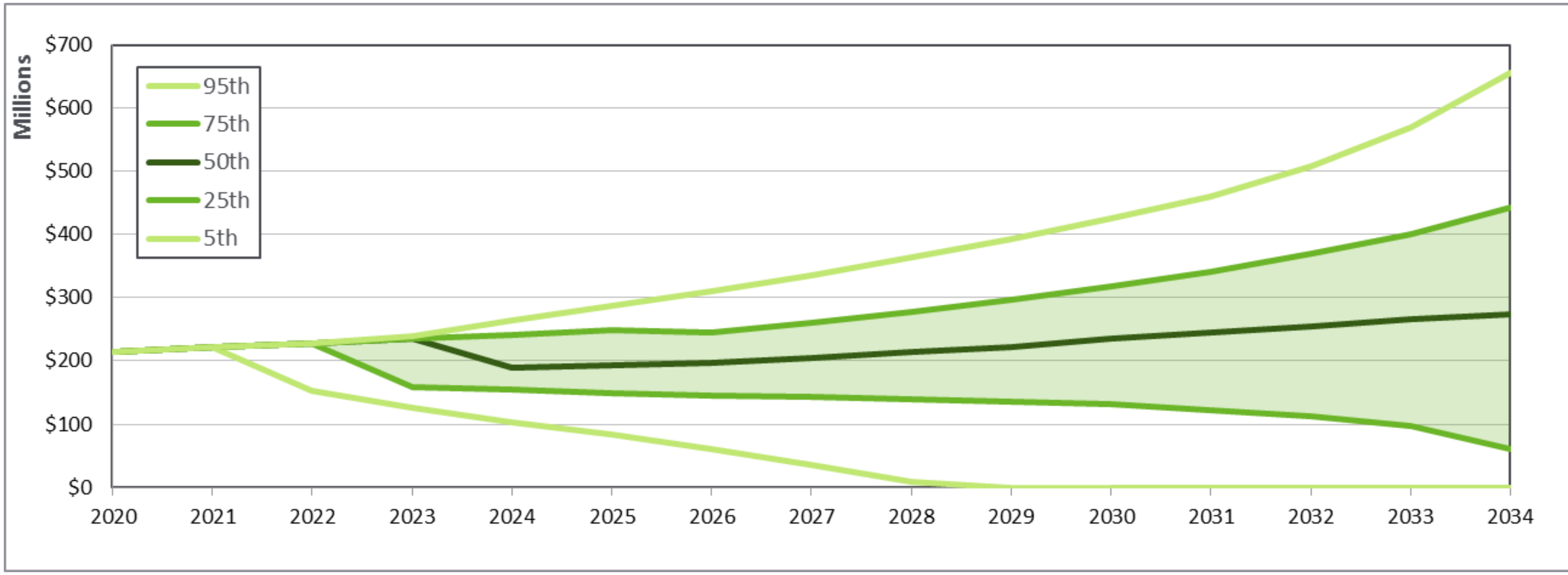
[1] Assumes arithmetic mean and variance corresponding to NEPC's 10-year return assumptions and asset risk

75th and 25th percentiles portray the optimistic and pessimistic range of funded ratio outcomes that could occur over the next 10 years

95th and 5th percentiles show the extreme upside and downside possibilities, but ignore likely plan changes that could occur

- 95th percentile ignores likelihood of increased benefits to prevent stranded assets
- 5th percentile ignores likelihood of increased contributions to prevent underfunding

STOCHASTIC CONTRIBUTION: CURRENT POLICY

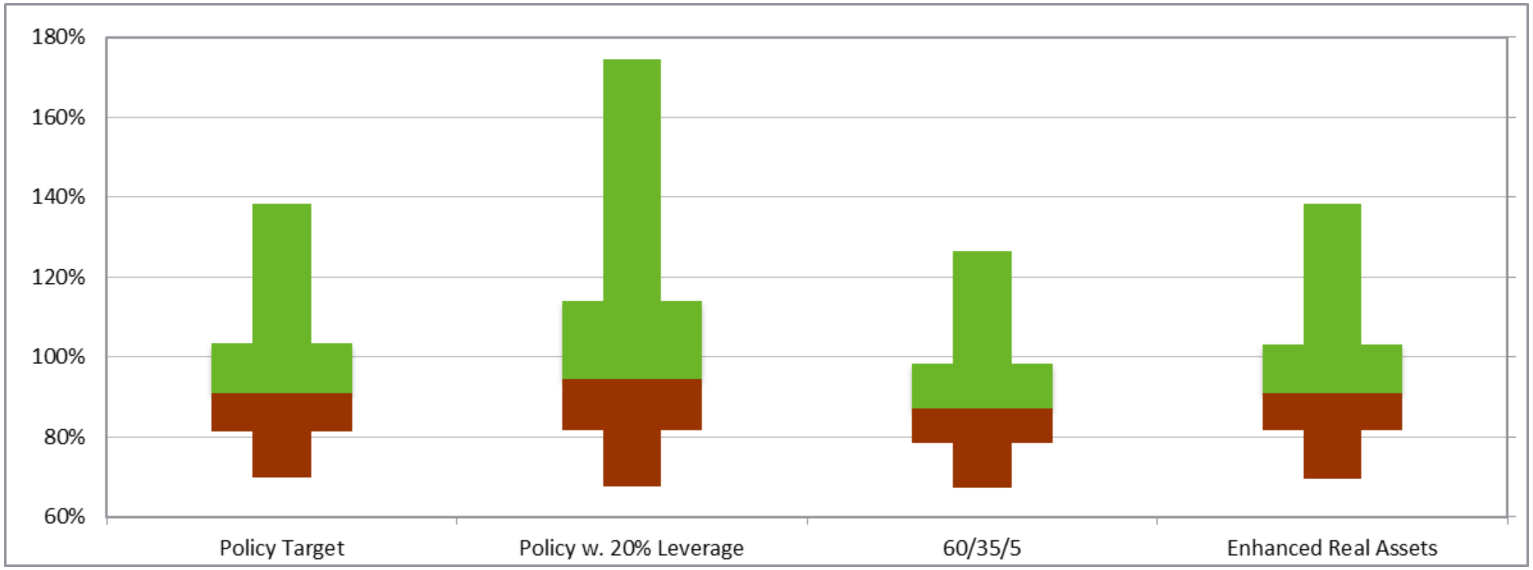


[1] Assumes arithmetic mean and variance corresponding to NEPC's 10-year return assumptions and asset risk

75th and 25th percentiles portray the pessimistic and optimistic range of contribution outcomes that could occur over the next 10 years

STOCHASTIC FUNDED RATIO COMPARISON

15 Year Projected Funded Ratio

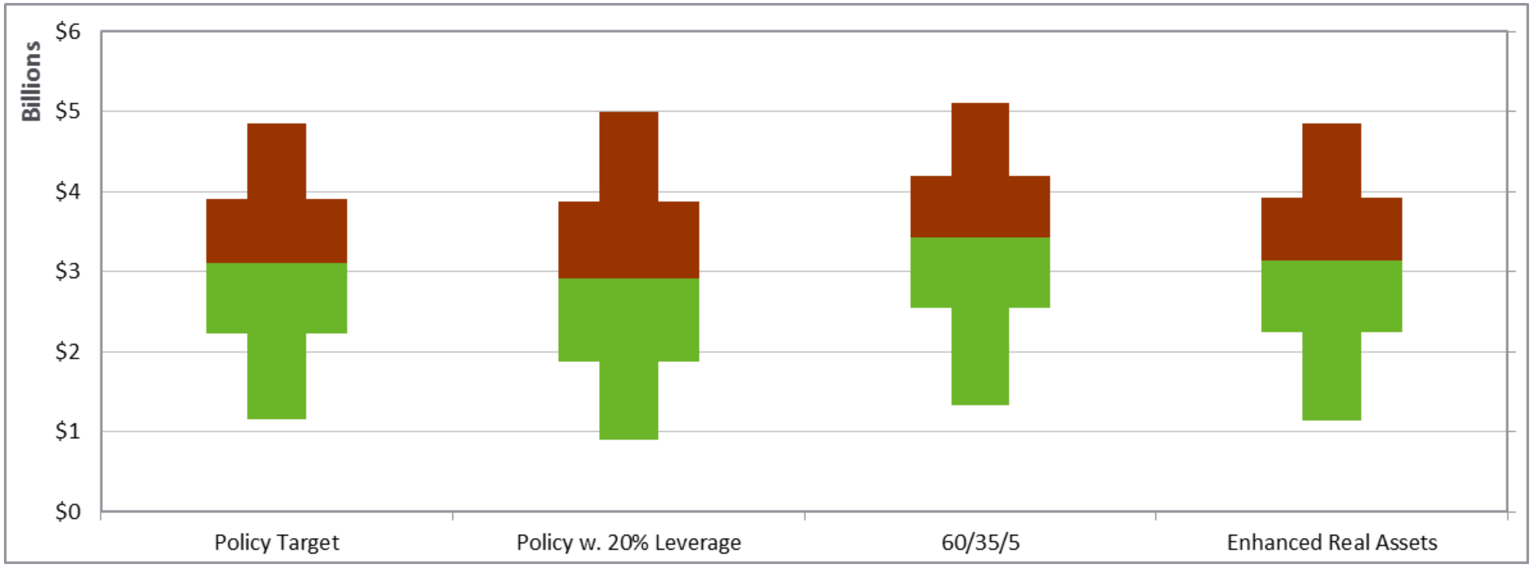


[1] Assumes arithmetic mean and variance corresponding to NEPC's 10-year return assumptions and asset risk
[2] Reflects projected funded ratio on 6/30/2034

Percentile	Policy Target	Policy w. 20% Leverage	60/35/5	Enhanced Real Assets
95th	138%	174%	126%	138%
75th	103%	114%	98%	103%
50th	91%	94%	87%	91%
25th	81%	82%	78%	82%
5th	70%	68%	67%	70%

STOCHASTIC CONTRIBUTION COMPARISON

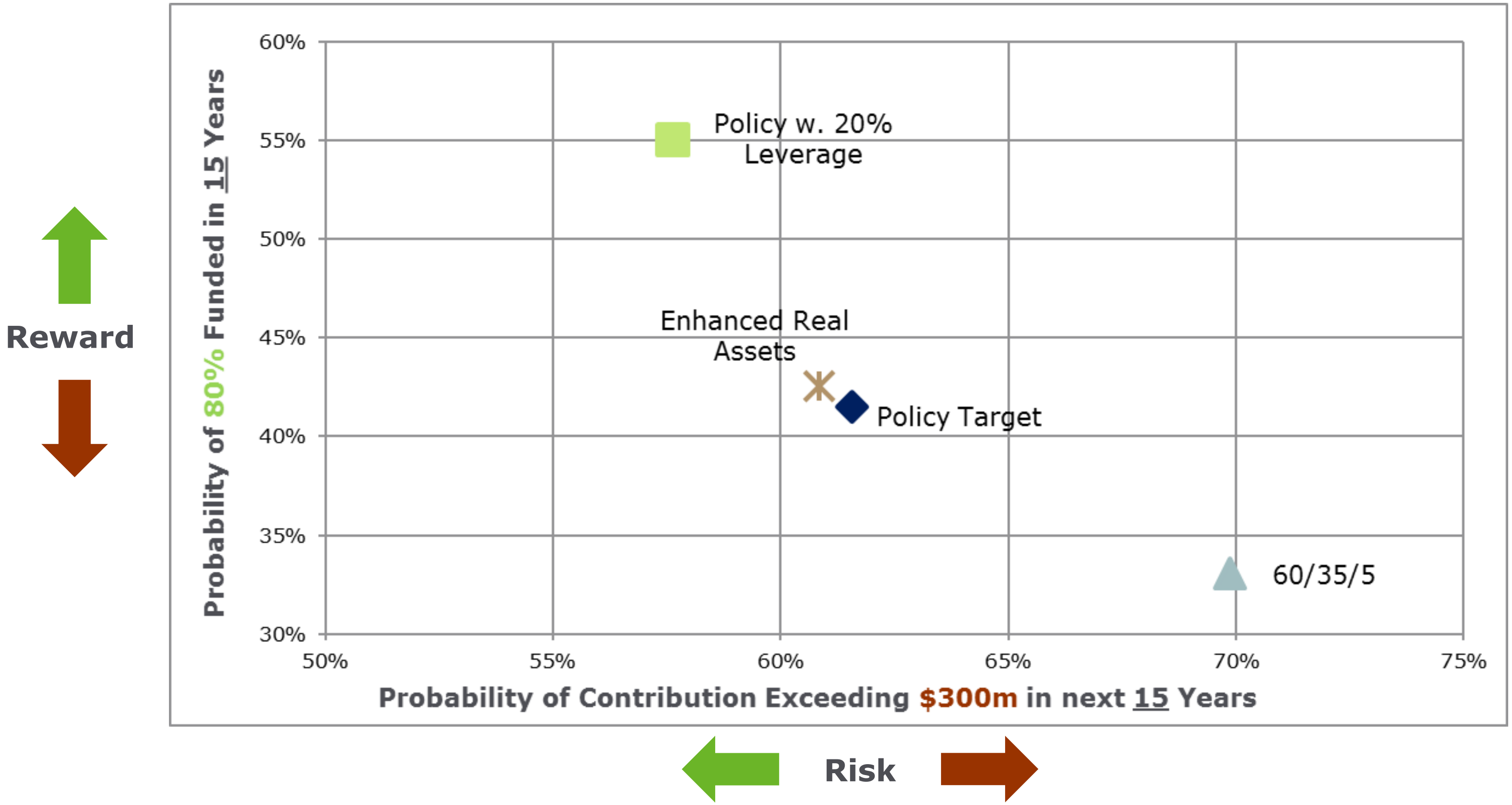
15 Year Projected Total Contributions



[1] Assumes arithmetic mean and variance corresponding to NEPC's 10-year return assumptions and asset risk
[2] Reflects total employer contributions from FY2020 thru FY2034

Percentile	Policy Target	Policy w. 20% Leverage	60/35/5	Enhanced Real Assets
95th	$4,852	$5,002	$5,111	$4,849
75th	$3,915	$3,877	$4,195	$3,918
50th	$3,101	$2,911	$3,435	$3,138
25th	$2,229	$1,884	$2,554	$2,240
5th	$1,163	$906	$1,331	$1,142

STOCHASTIC – RISK VS. REWARD



Allocation	Reward Probability	Risk Probability	Reward/Risk Ratio
Policy	41%	62%	0.67
20% Leverage	55%	58%	0.96
60/35/5	33%	70%	0.47
Enhanced Real Assets	43%	61%	0.70

APPENDIX

ASSUMPTIONS AND METHODS

Deterministic and stochastic projections are based on NEPC's 2020 capital market assumptions

Asset-liability calculations follow roll-forward methodology based on June 30, 2019 actuarial valuation produced by GRS

- Year 2000 Plan active population assumed to reduce linearly over next 30 years
- Normal cost rate assumed to change proportionally to Year 2000 Plan active decline
- Benefit payment projection provided by GRS
- Other than those described herein, all assumptions remain unchanged from the actuarial valuation report
- No gains or losses are assumed other than those attributed to investment experience

Employer contributions based on stated funding policy

- Temporary Funding Policy assumed to remain in place until retiree liability becomes fully funded unless the Permanent Funding Policy produces higher contribution rate
- Thereafter, Permanent Funding Policy assumed

Employee contribution rate assumed to change proportionally to the assumed Year 2000 Plan active population decline

- Results in a 0.09% annual increase in the employee contribution rate (up to max of 4%)

SCENARIO ANALYSIS: REGIME RETURNS

Expansion Scenario Return*

Cash: 2.5%
Treasuries: 1.2%
Long Treasuries: -0.9%
US TIPS: 3.0%
US IG Credit: 2.8%
High Yield Bonds: 4.2%
US Large-Cap Equity: 10.0%
Emerging Market Equity: 17.5%
Commodities: 6.4%

Overextension Scenario Return*

Cash: 2.1%
Treasuries: 2.7%
Long Treasuries: 2.8%
US TIPS: 4.1%
US IG Credit: 3.3%
High Yield Bonds: 2.7%
US Large-Cap Equity: 4.6%
Emerging Market Equity: 8.3%
Commodities: 9.5%

Goldilocks Scenario Return*

Cash: 1.8%
Treasuries: 1.1%
Long Treasuries: -0.3%
US TIPS: 2.1%
US IG Credit: 2.9%
High Yield Bonds: 3.8%
US Large-Cap Equity: 7.3%
Emerging Market Equity: 13.0%
Commodities: 3.7%

Recession Scenario Return*

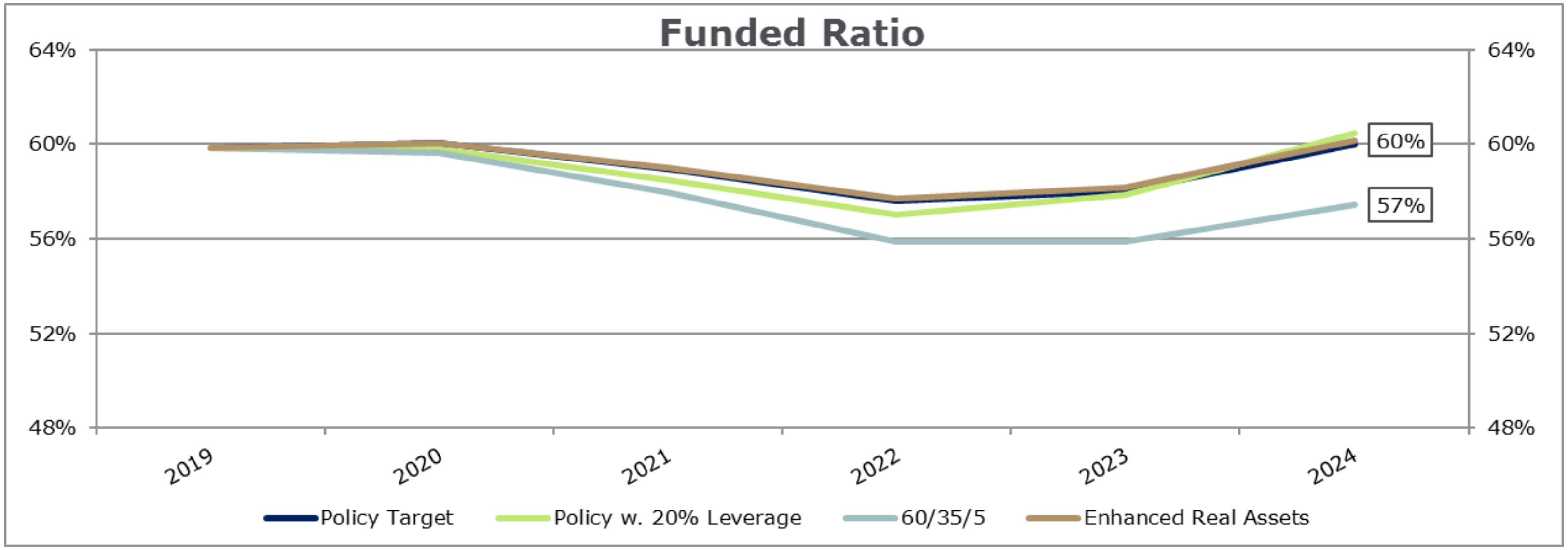
Cash: 0.5%
Treasuries: 1.6%
Long Treasuries: 2.5%
US TIPS: 1.3%
US IG Credit: 3.8%
High Yield Bonds: 3.8%
US Large-Cap Equity: 1.3%
Emerging Market Equity: 2.4%
Commodities: 1.5%

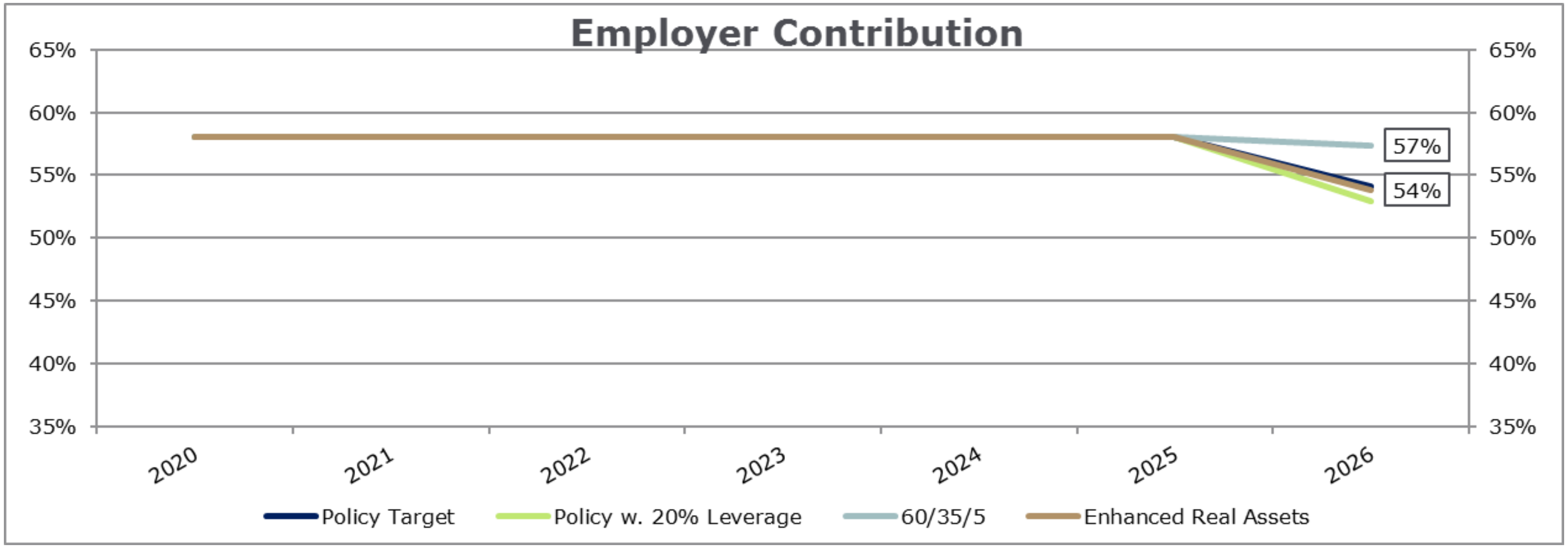
Stagflation Scenario Return*

Cash: 2.7%
Treasuries: -0.3%
Long Treasuries: -4.4%
US TIPS: 4.2%
US IG Credit: 0.1%
High Yield Bonds: 1.4%
US Large-Cap Equity: -0.3%
Emerging Market Equity: -0.1%
Commodities: 8.2%

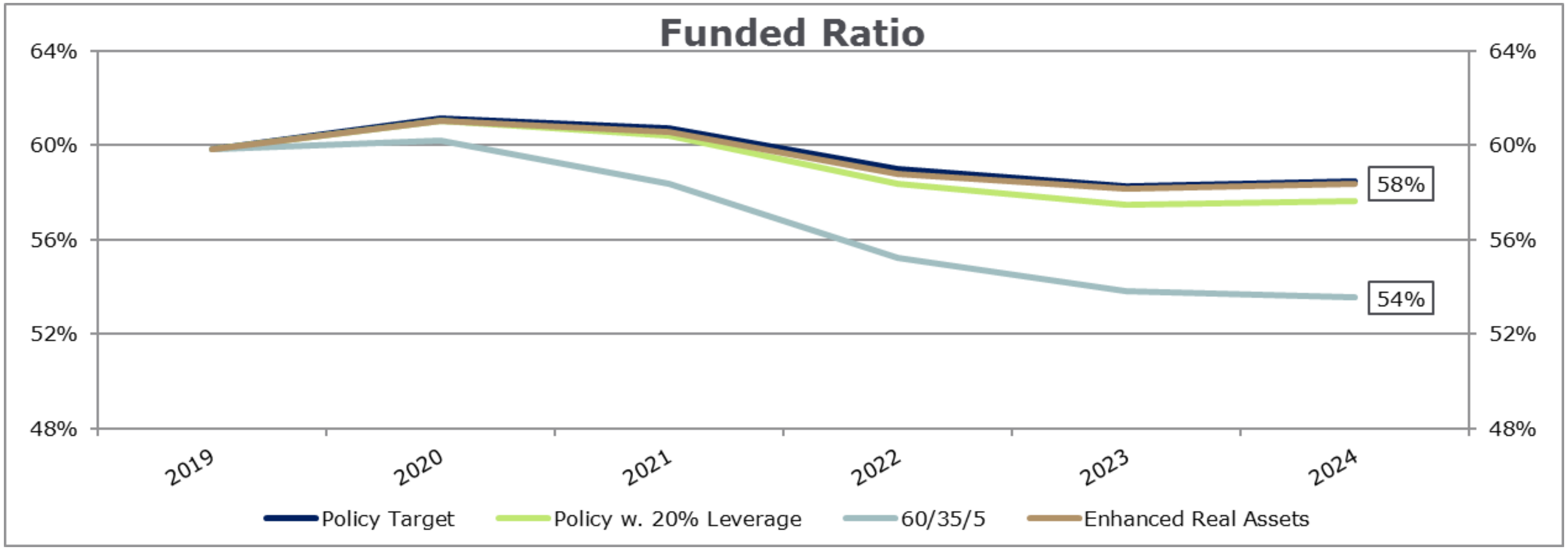
**Scenario returns represent an annualized return over five years*

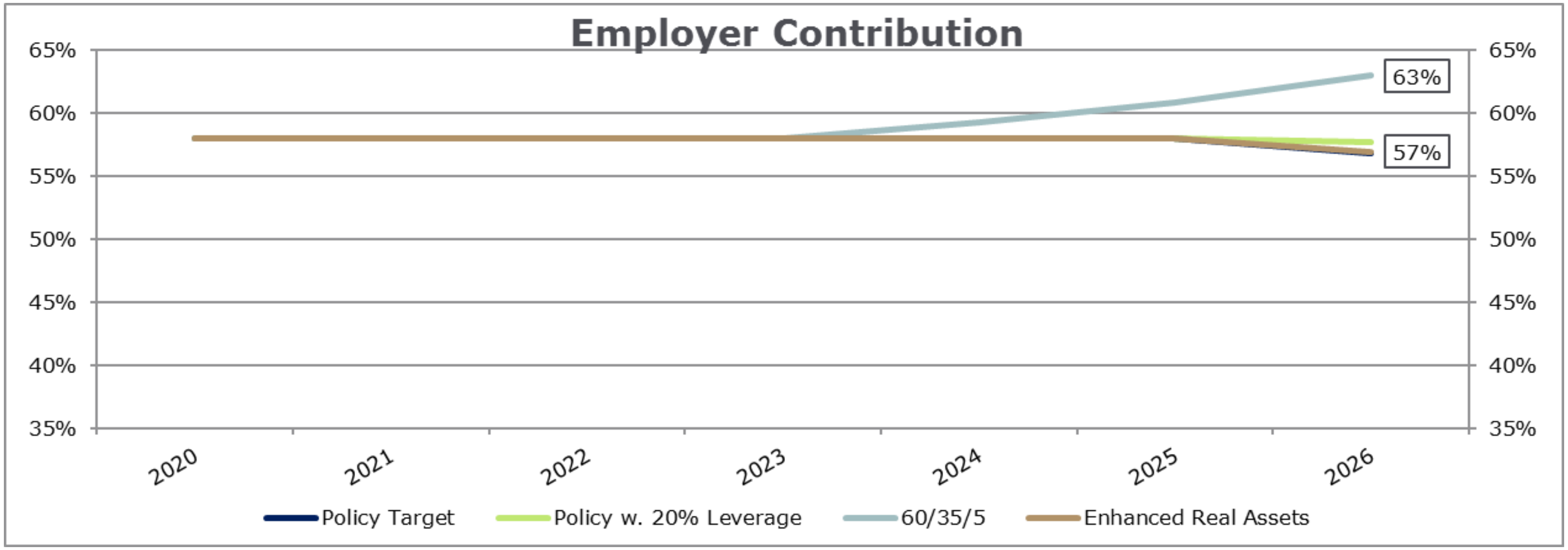
FUNDED RATIO – RECESSION



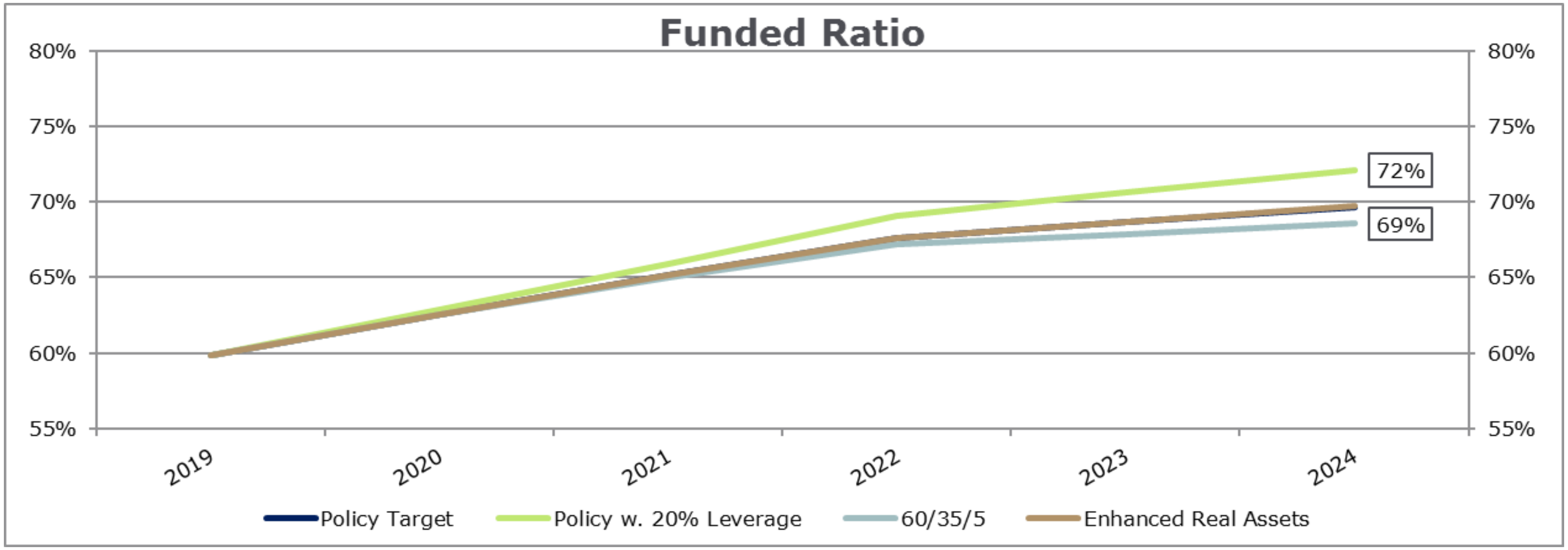


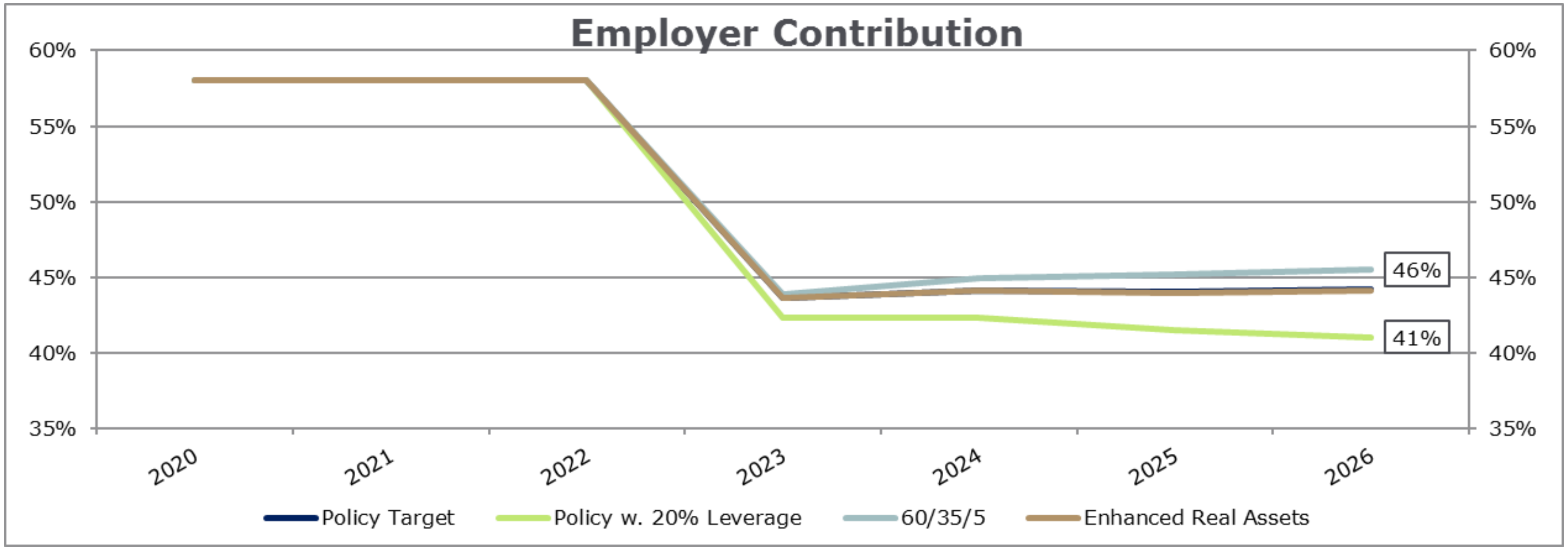
FUNDED RATIO – STAGFLATION



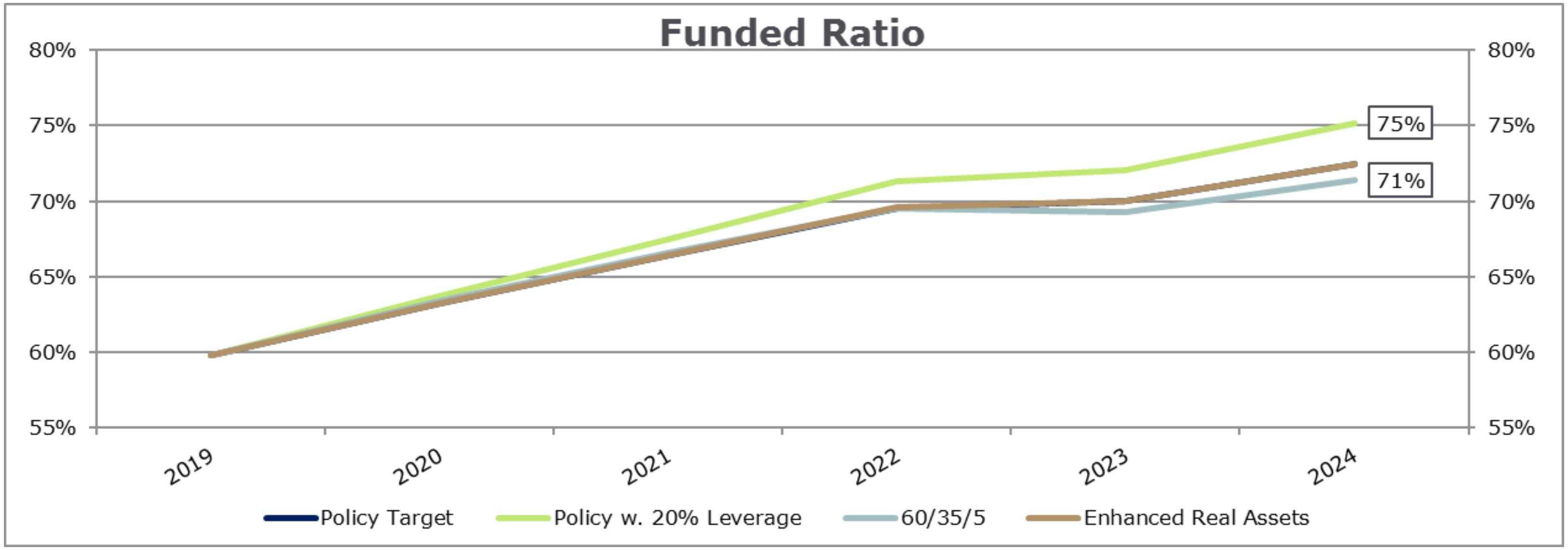


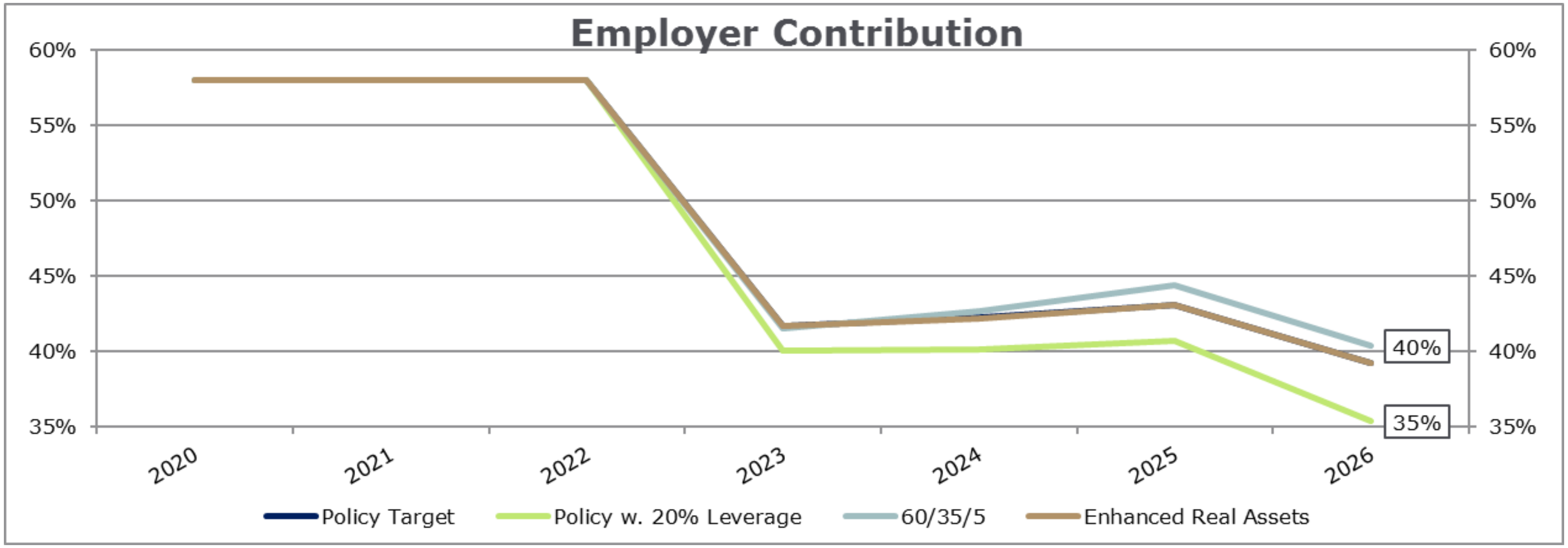
FUNDED RATIO – GOLDILOCKS



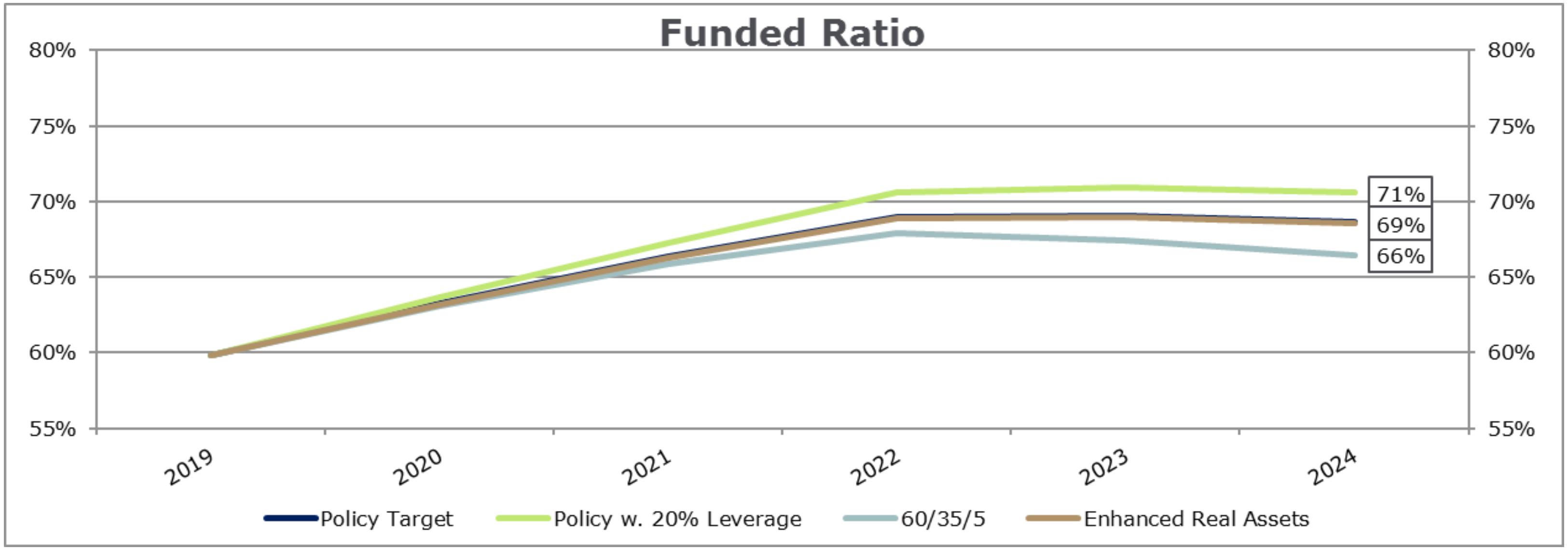


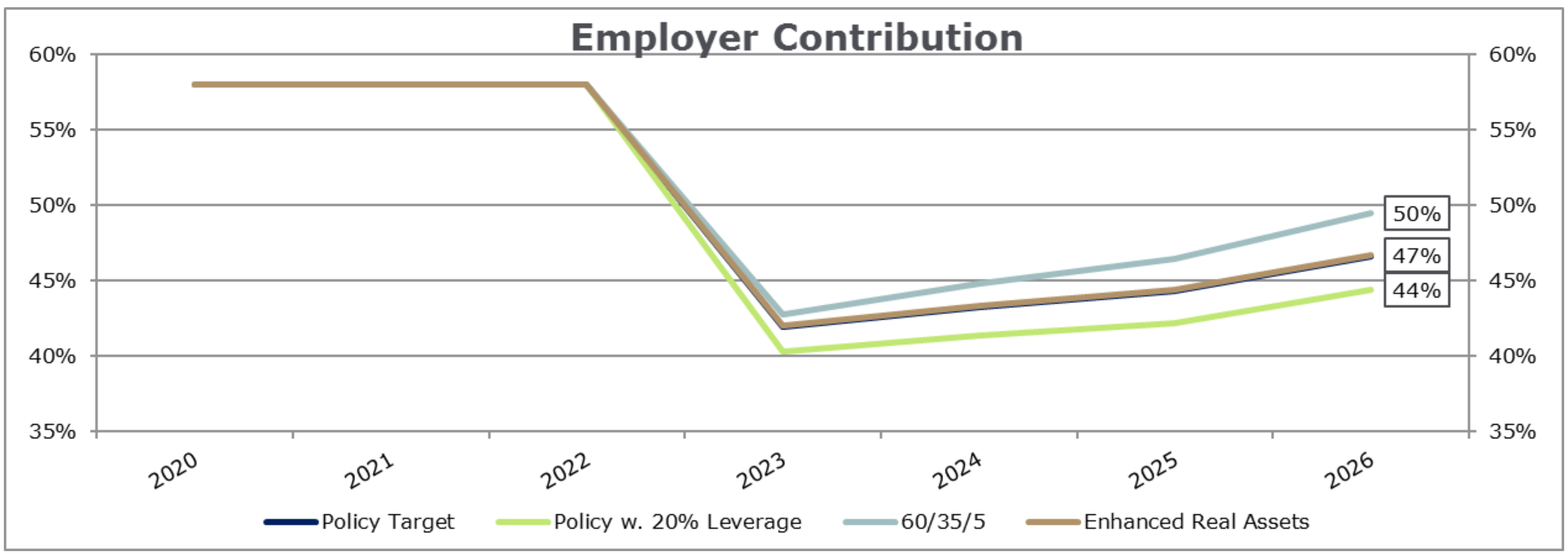
FUNDED RATIO – EXPANSION





FUNDED RATIO – OVEREXTENSION





2020 CAPITAL MARKET FORECASTS

Asset Class	10-Year	30-Year	Volatility
Inflation	2.3%	2.5%	-
Cash	1.8%	2.4%	1.00%
US Leverage Cost	2.1%	2.7%	1.00%
Non-US Cash	0.4%	2.1%	1.00%
Large Cap Equities	5.0%	6.7%	16.50%
Small/Mid Cap Equities	5.5%	7.2%	20.00%
Int'l Equities (Unhedged)	6.0%	7.0%	20.50%
Int'l Equities (Hedged)	6.2%	7.2%	17.50%
Int'l Sm Cap Equities (Unhedged)	6.4%	7.5%	22.00%
Emerging Int'l Equities	9.0%	9.2%	28.00%
Emerging Int'l Sm Cap Equities	9.2%	9.2%	31.00%
Hedge Funds - Long/Short	4.8%	5.7%	11.50%
PE Buyout	7.4%	9.0%	18.50%
PE Growth	9.0%	10.4%	30.50%
PE Venture	10.6%	11.5%	45.00%
PE Secondary	6.9%	8.5%	21.00%
PE Non-US	10.7%	11.1%	33.00%
China Equity	8.8%	9.1%	29.50%
US Microcap Equity	7.0%	8.2%	25.00%

2020 CAPITAL MARKET FORECASTS

Asset Class	10-Year	30-Year	Volatility
TIPS	2.2%	2.7%	6.50%
Treasuries	1.9%	2.7%	5.50%
IG Corp Credit	3.4%	4.4%	7.50%
MBS	2.5%	3.4%	7.00%
High-Yield Bonds	4.1%	5.6%	12.50%
Bank Loans	4.8%	5.2%	9.00%
EMD (External)	4.1%	5.0%	13.00%
EMD (Local Currency)	5.4%	5.3%	13.00%
Non-US Bonds (Unhedged)	0.2%	2.1%	10.00%
Non-US Bonds (Hedged)	0.3%	2.3%	4.50%
Short TIPS (1-5 yr)	2.2%	2.8%	3.50%
Short Treasuries (1-3 yr)	2.1%	2.7%	2.50%
Short Credit (1-3 yr)	2.9%	3.6%	3.50%
Short HY (1-3 yr)	3.4%	4.1%	8.50%
Municipal Bonds	1.9%	2.6%	7.00%
Municipal Bonds (1-10 Year)	1.9%	2.6%	5.50%
High-Yield Municipal Bonds	3.2%	5.0%	12.00%
Hedge Funds - Credit	4.8%	5.9%	9.00%
PD Credit Opportunities	6.3%	7.5%	14.00%

2020 CAPITAL MARKET FORECASTS

Asset Class	10-Year	30-Year	Volatility
PD Distressed	7.6%	8.3%	14.00%
PD Direct Lending	6.3%	7.5%	11.00%
Long Treasuries	1.7%	2.7%	12.00%
Long TIPS	2.2%	2.7%	10.00%
Long Credit	3.4%	4.6%	12.00%
20+ YR STRIPS	1.4%	2.5%	21.00%
Corp - AAA	2.7%	3.6%	7.00%
Corp - AA	2.7%	3.6%	6.50%
Corp - A	3.0%	4.0%	7.50%
Corp - BBB	3.7%	4.6%	8.50%
Corp - BB	4.6%	6.2%	10.50%
Corp - B	4.4%	5.7%	12.50%
Corp - CCC/Below	0.7%	0.8%	20.00%
IG ABS/CMBS	2.8%	3.7%	9.00%
IG CLO	2.9%	3.5%	7.50%
HY Securitized	4.2%	5.6%	11.00%
HY CLO	5.3%	5.8%	11.00%
Taxable Muni Debt	2.8%	4.3%	8.00%
US 10 yr Treasuries	1.9%	2.9%	7.50%

2020 CAPITAL MARKET FORECASTS

Asset Class	10-Year	30-Year	Volatility
Non-US 10-Year Sovereign (Hedged)	0.4%	2.6%	5.50%
Commodities	4.0%	4.8%	19.00%
Midstream Energy	7.4%	7.1%	18.50%
REITs	5.4%	6.5%	20.00%
Public Infrastructure	5.3%	6.1%	18.50%
Public Resource Equity	7.3%	7.4%	22.00%
Core Real Estate	5.2%	6.0%	13.00%
Non-Core Real Estate	6.4%	7.4%	19.50%
Private RE Debt	5.0%	5.7%	11.00%
Private Real Assets - Energy/Metals	9.1%	9.0%	32.00%
Private Real Assets - Infra/Land	5.9%	6.7%	12.00%
Hedge Funds - Macro	5.0%	5.4%	9.50%
*Global Equity**	6.2%	7.5%	17.79%
*Private Equity**	*9.4%*	*10.7%*	*24.58%*
*Core Bonds**	*2.5%*	*3.4%*	*6.01%*
*Private Debt**	*6.7%*	*7.8%*	*11.54%*
*Long Govt/Credit**	*2.8%*	*3.9%*	*11.25%*
*Hedge Funds**	*5.0%*	*5.9%*	*8.18%*

*Assumptions are derived from the underlying equity, credit, and real assets building blocks

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Past performance is no guarantee of future results.

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The goal of this report is to provide a basis for substantiating asset allocation recommendations. The opinions presented herein represent the good faith views of NEPC as of the date of this report and are subject to change at any time.

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.

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