



# ASSET-LIABILITY STUDY

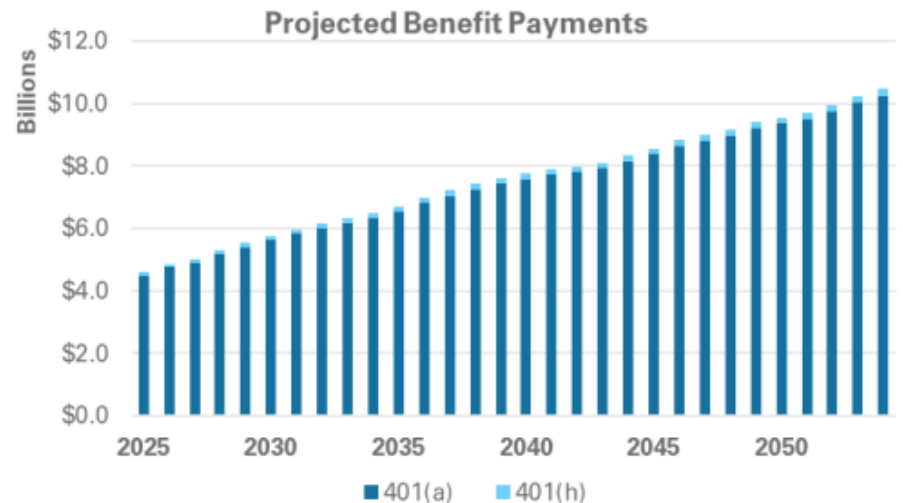
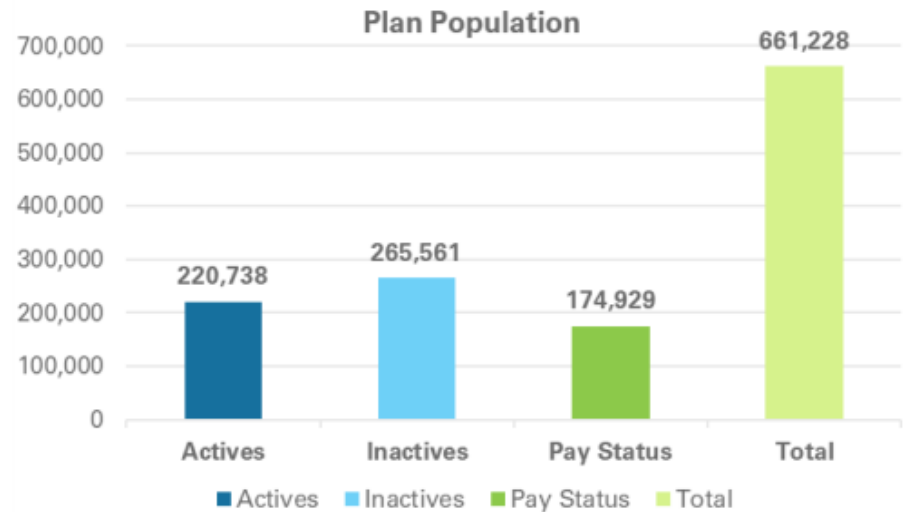
ARIZONA STATE RETIREMENT SYSTEM

MAY 2025



# PLAN CHARACTERISTICS

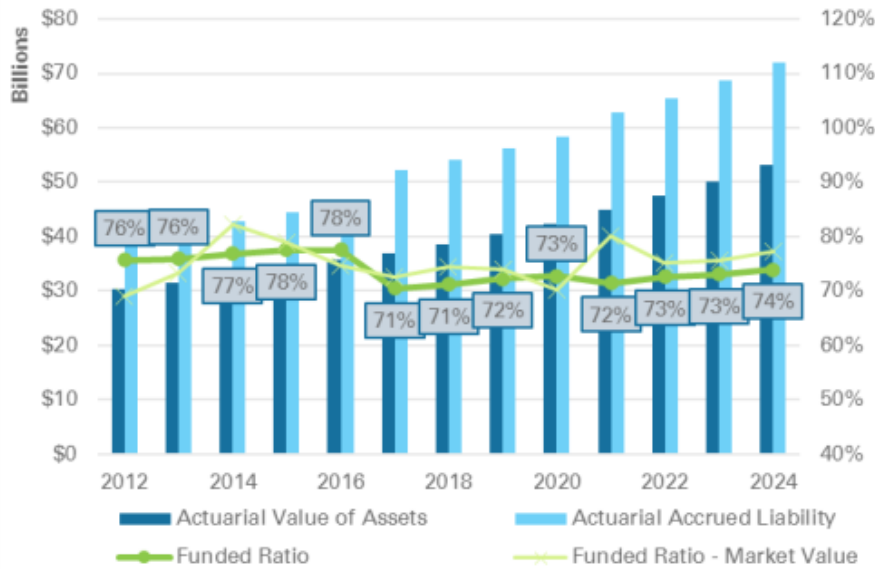
- **The Arizona State Retirement System administers two main defined benefit plans**
  - 401(a) Plan: traditional final average salary pension benefits
  - 401(h) Plan: supplemental health premium benefits
- **401(a) Plan is by far the main cost driver within the system**
  - Consists of 96% of system assets and 98% of system liabilities
- **Investment returns have outperformed the assumed rate of return of 7.00% over the past couple of years**
  - Smoothed assets have a tailwind of investment gains yet to be recognized
- **Recent pay increases/hiring above expectations have been a headwind to funded status**
  - About \$2.7 billion in losses over last years



Source: GRS

# ASSET-LIABILITY PROFILE

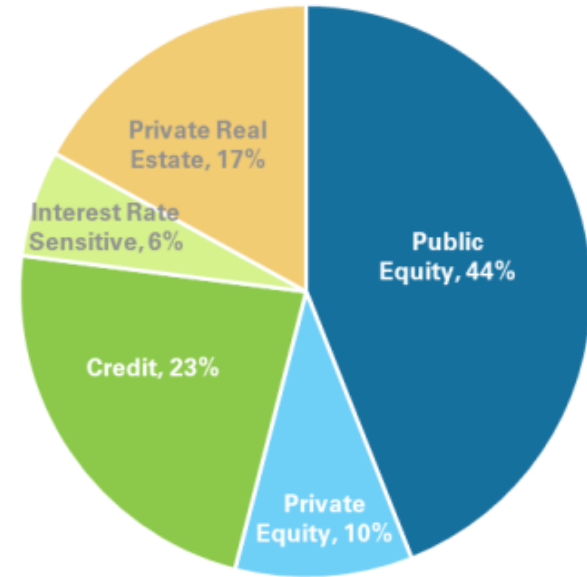
## Funded Status



Source: GRS

<b>Liability Discount Rate</b>	<b>7.00%</b>
<b>Funded Status as June 30, 2024</b>	<b>74.0%</b>
<b>Contribution Rate for FY 2025</b>	<b>24.2%</b>

## Asset Allocation<sup>1</sup>



	<b>NEPC Beta</b>	<b>ASRS Projected</b>
<b>10-Yr Expected Return</b>	7.5%	8.2%
<b>30-Yr Expected Return</b>	8.6%	8.5%
<b>Asset Volatility</b>	10.6%	10.4%



Notes: <sup>1</sup> Current Policy targets

# ASSUMPTIONS AND METHODS

- **NEPC Beta return assumptions reflect NEPC’s baseline return assumptions as of 12/31/2024 except for Private Real Estate, which are provided by RCLCo**
  - They represent the market return expectations over a 10-year and 30-year period
  - NEPC utilizes a “building block” framework to generate assumptions with a consistent approach across asset classes
  - Deterministic and stochastic return projections are based on NEPC beta assumptions
    - FYTD estimated return of 3.4% thru 12/31/2024, thereafter NEPC’s expected returns assumed
- **ASRS Projections incorporate staff assumptions tailored to reflect the ASRS specific portfolio**
- **Volatility assumptions for private asset classes reflect NEPC’s accounting, i.e. smoothed, volatility assumptions that better reflect volatility of reported returns**
  - Includes Private Equity, Credit, Private Real Estate, and Private Infrastructure
- **It’s important to note that the smoothed volatilities are substantially lower than NEPC’s economic volatility assumptions for private asset classes**
  - They are meant to provide a better representation of realized returns and how they impact asset-liability outcomes
  - NEPC’s economic volatilities are provided in the appendix

# ASSUMPTIONS AND METHODS

- **Asset-liability projections follow a roll-forward methodology based on the June 30, 2024 Actuarial Valuation Report**
  - Benefit payment projections provided by GRS
  - Other than those described herein, all assumptions remain unchanged from the valuation
  - No gains or losses are assumed other than those attributed to investment experience and Permanent Benefit Increases (PBI)
- **Assets, liabilities and cash flows were modeled for each individual plan and aggregated in the results noted “System Level”**
  - Individual plan results also provided for select outputs
- **Contributions based on gross normal cost plus layered amortizations of unfunded liability**
  - Employers and Members pay an equal share of the contribution requirement

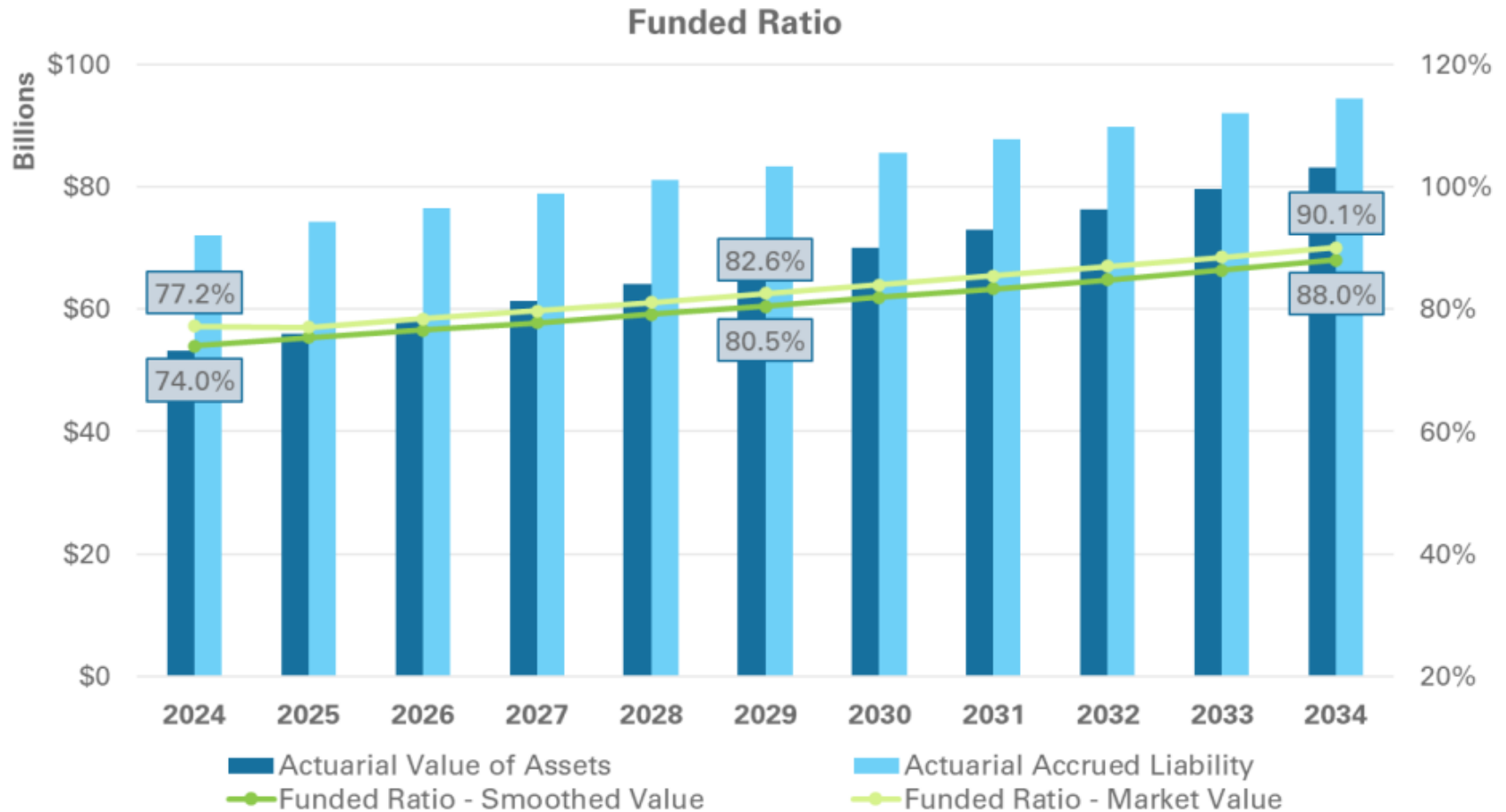
# CURRENT POLICY DETERMINISTIC PROJECTIONS

# NEPC BETA RETURN ASSUMPTIONS



# 10-YR FUNDED RATIO – SYSTEM LEVEL

## NEPC BETA RETURN ASSUMPTIONS

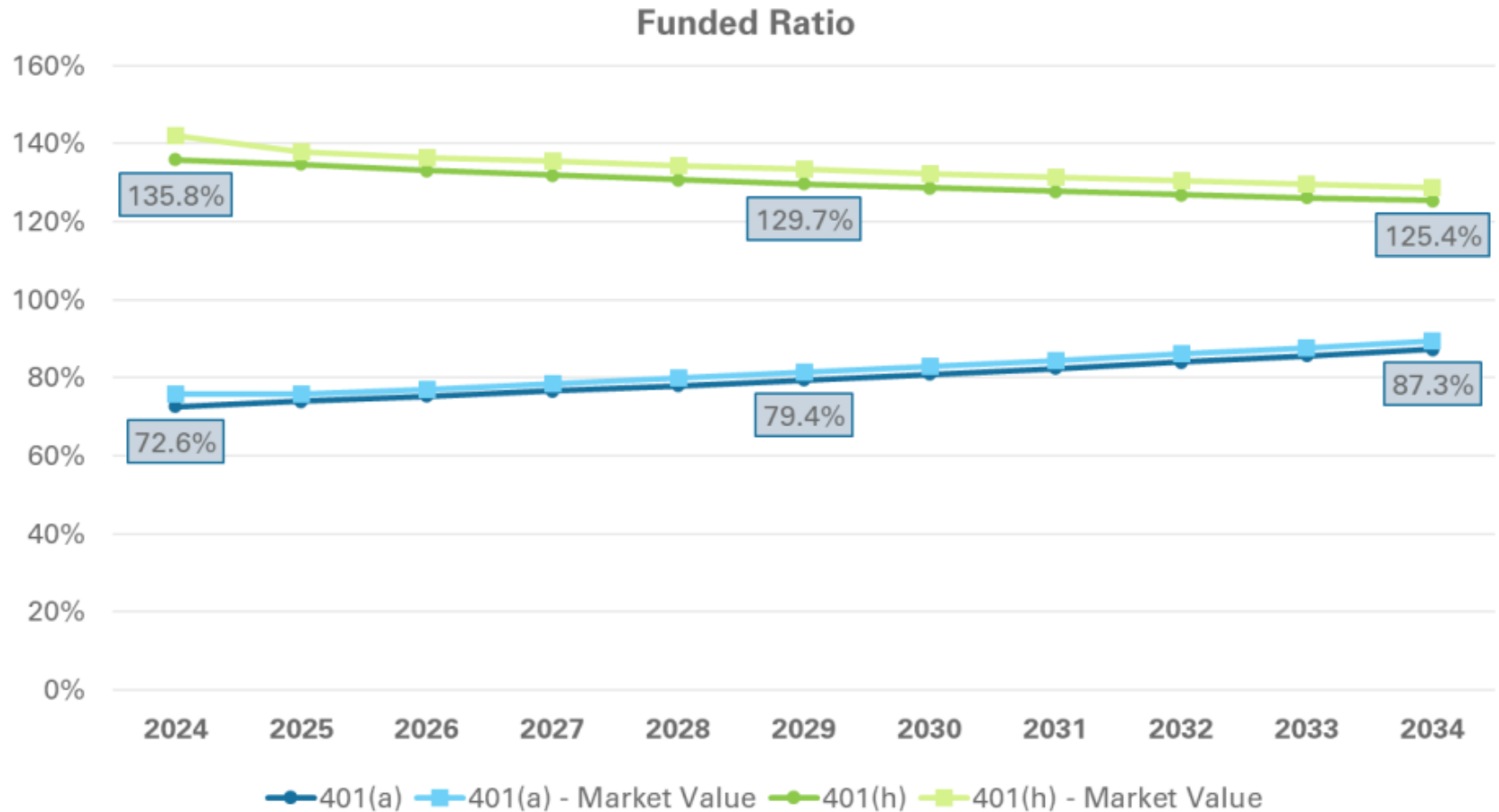


Notes: As of June 30; Assumes Current Policy allocation NEPC Beta 10-yr expected return of 7.5% per annum



# 10-YR FUNDED RATIO – PLAN LEVEL

## NEPC BETA RETURN ASSUMPTIONS

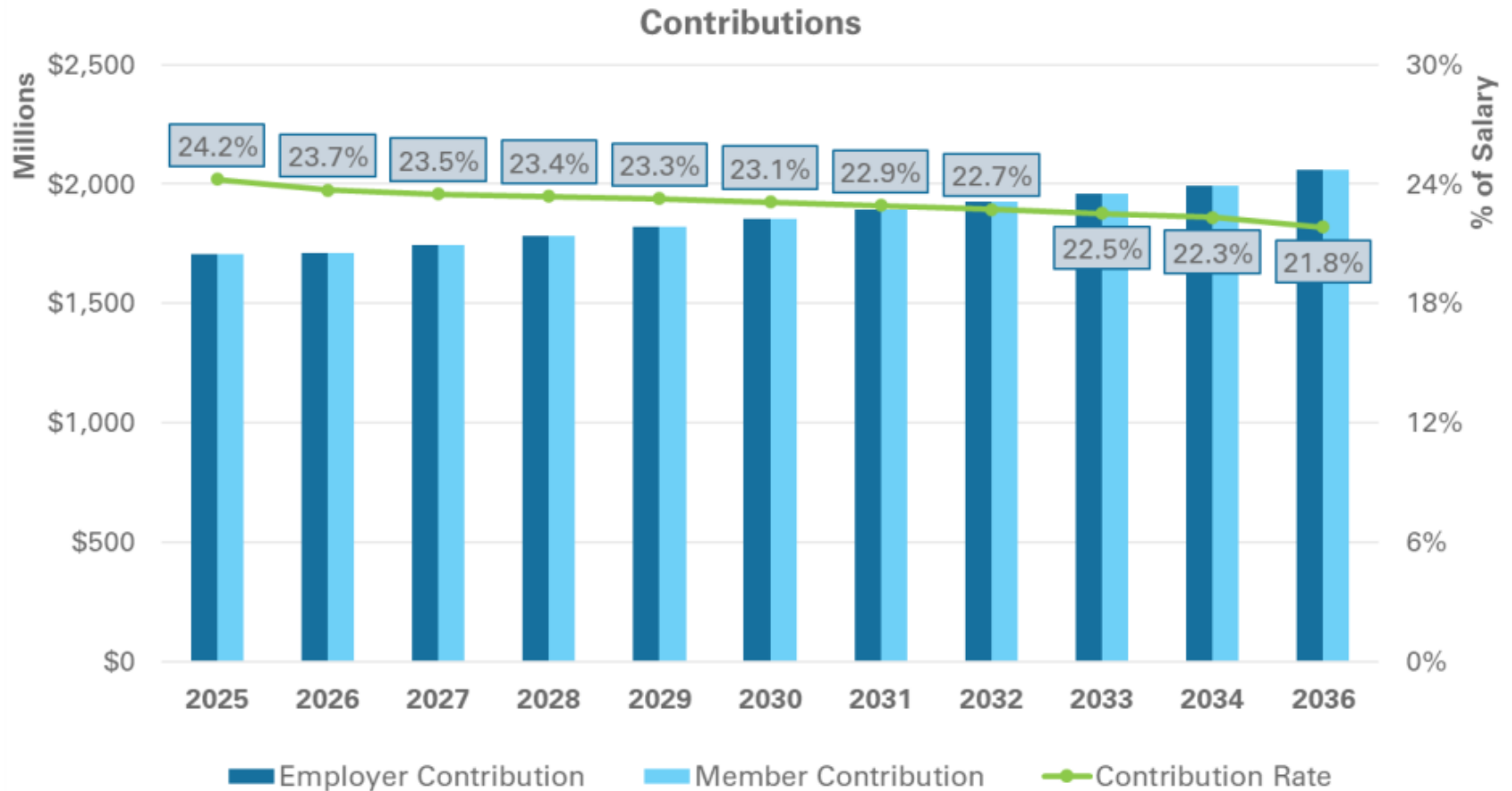


Notes: As of June 30; Assumes Current Policy allocation NEPC Beta 10-yr expected return of 7.5% per annum



# 10-YR CONTRIBUTIONS – SYSTEM LEVEL

## NEPC BETA RETURN ASSUMPTIONS

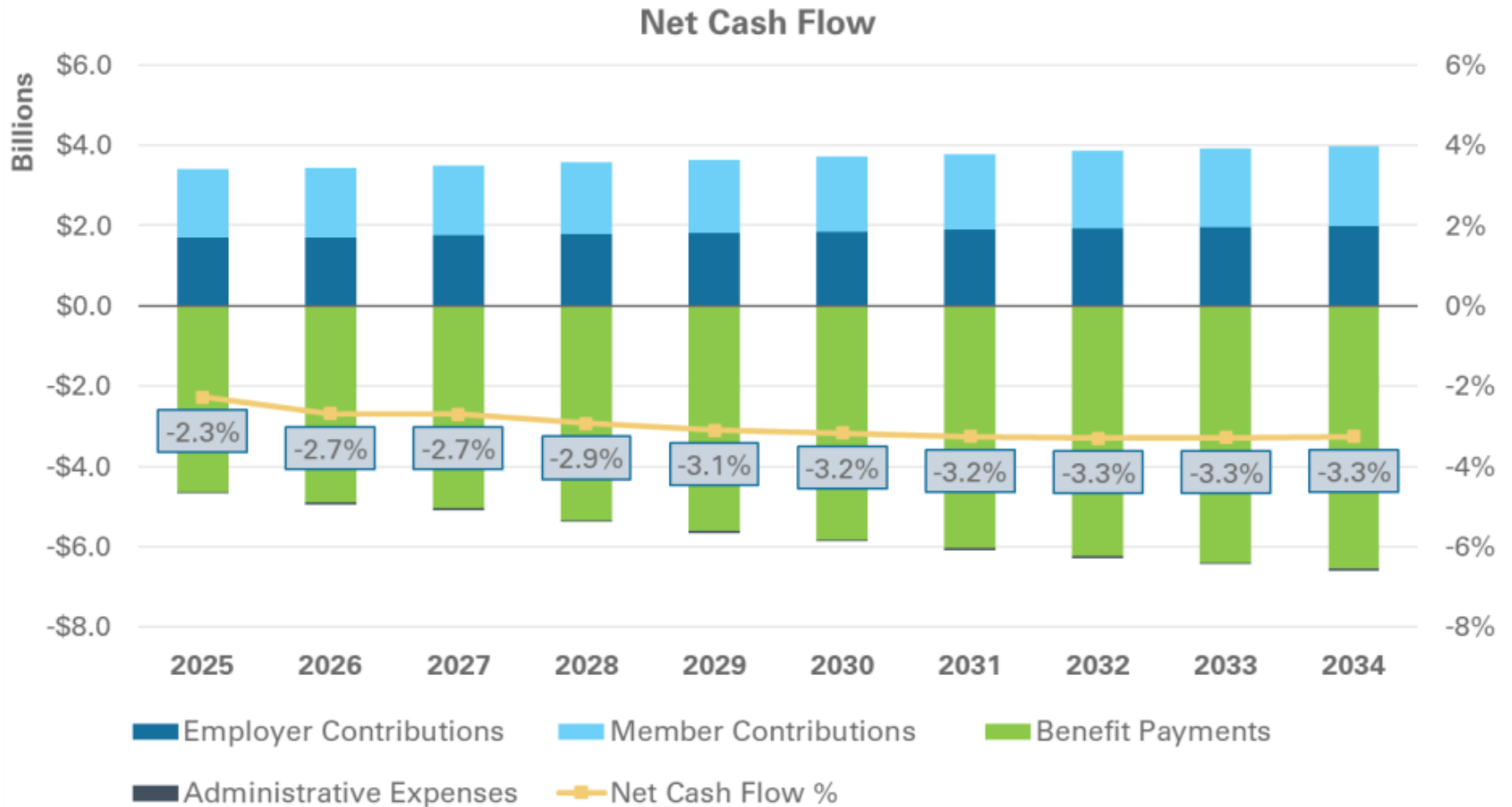


Notes: For the fiscal year ending June 30; Assumes Current Policy allocation NEPC Beta 10-yr expected return of 7.5% per annum



# 10-YR NET CASH FLOW – SYSTEM LEVEL

## NEPC BETA RETURN ASSUMPTIONS

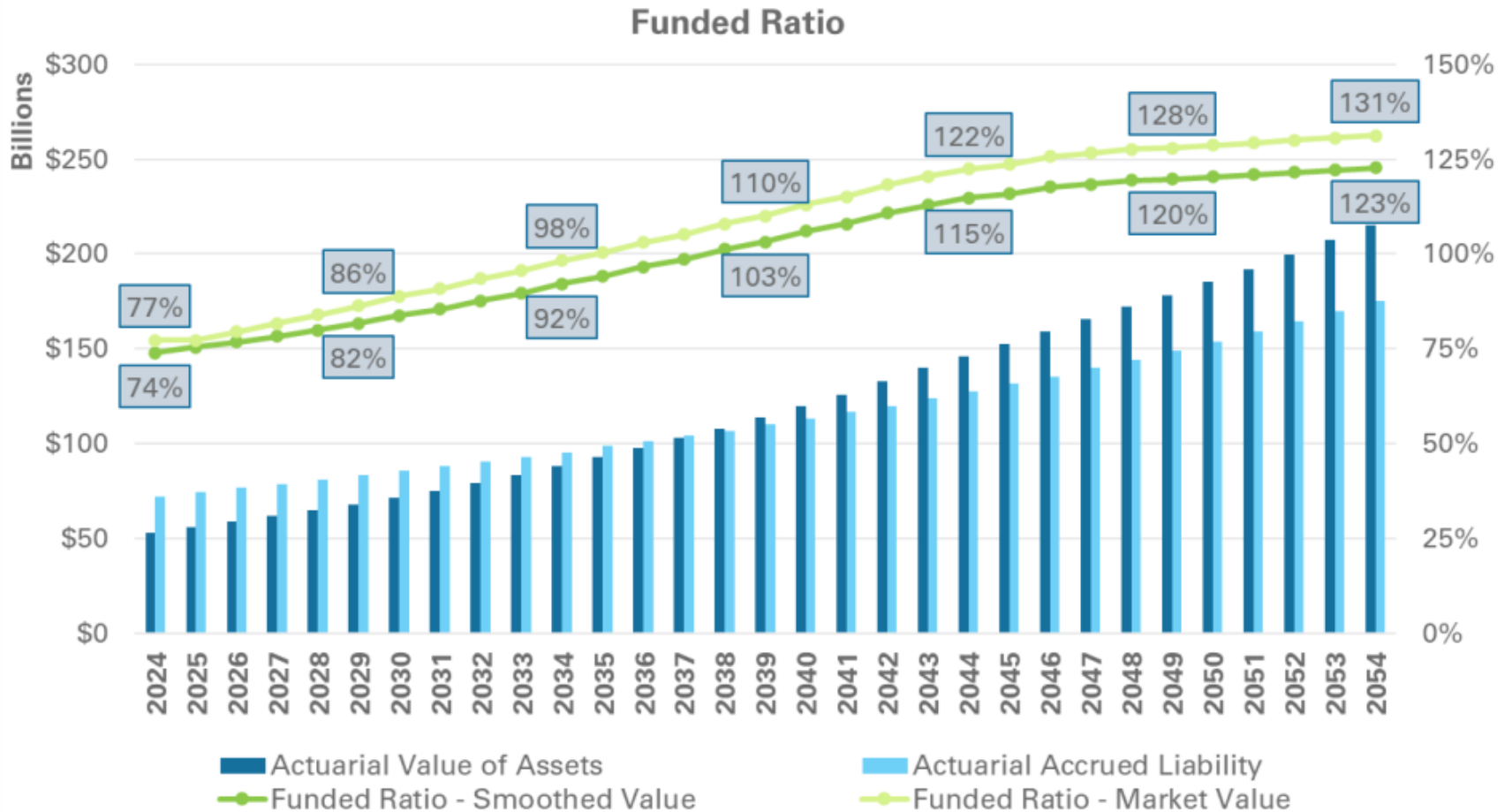


Notes: For the fiscal year ending June 30; Assumes Current Policy allocation NEPC Beta 10-yr expected return of 7.5% per annum



# 30-YR FUNDED RATIO – SYSTEM LEVEL

## NEPC BETA RETURN ASSUMPTIONS

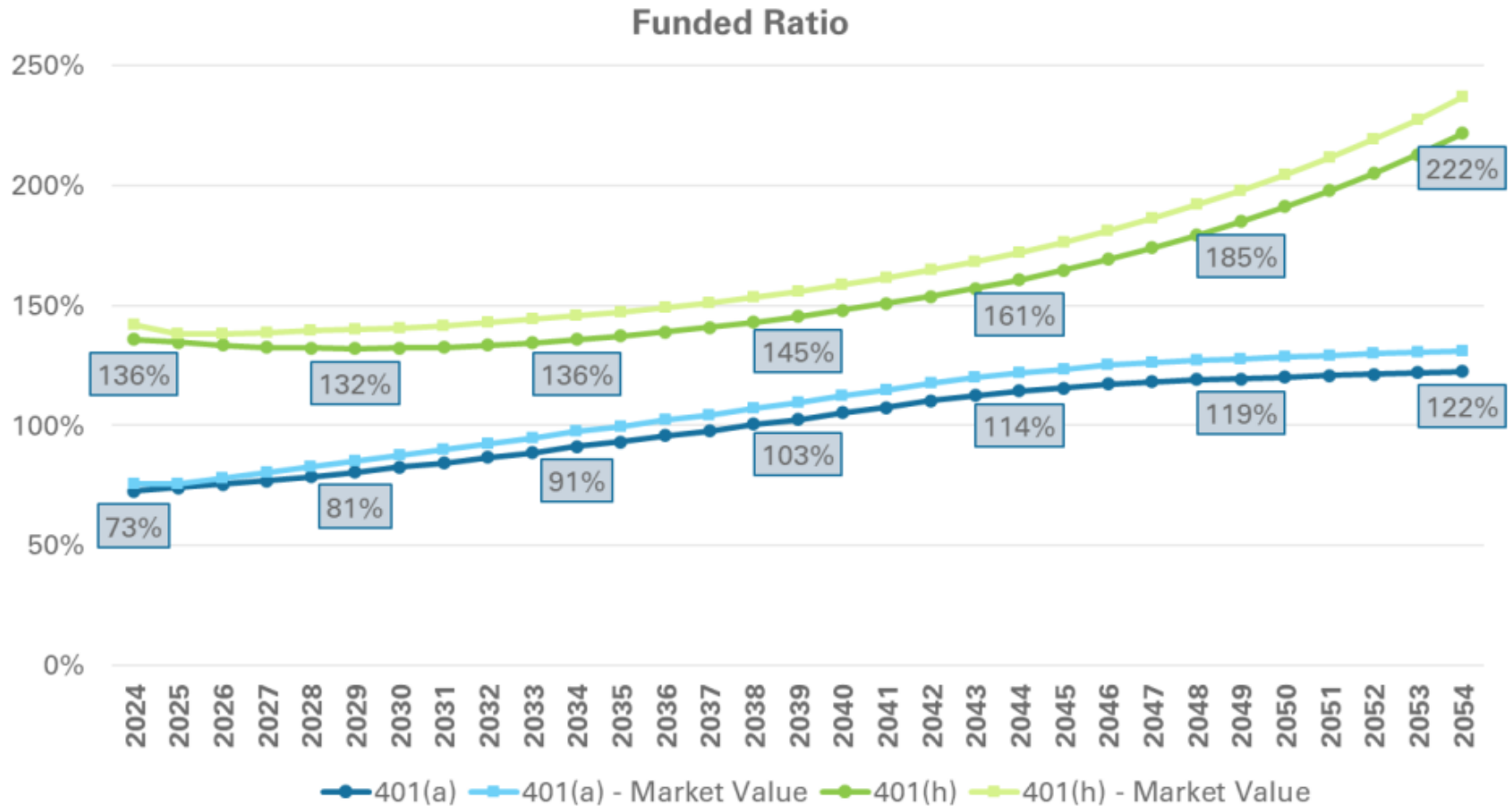


Notes: As of June 30; Assumes Current Policy allocation NEPC Beta 30-yr expected return of 8.6% per annum



# 30-YR FUNDED RATIO – PLAN LEVEL

## NEPC BETA RETURN ASSUMPTIONS

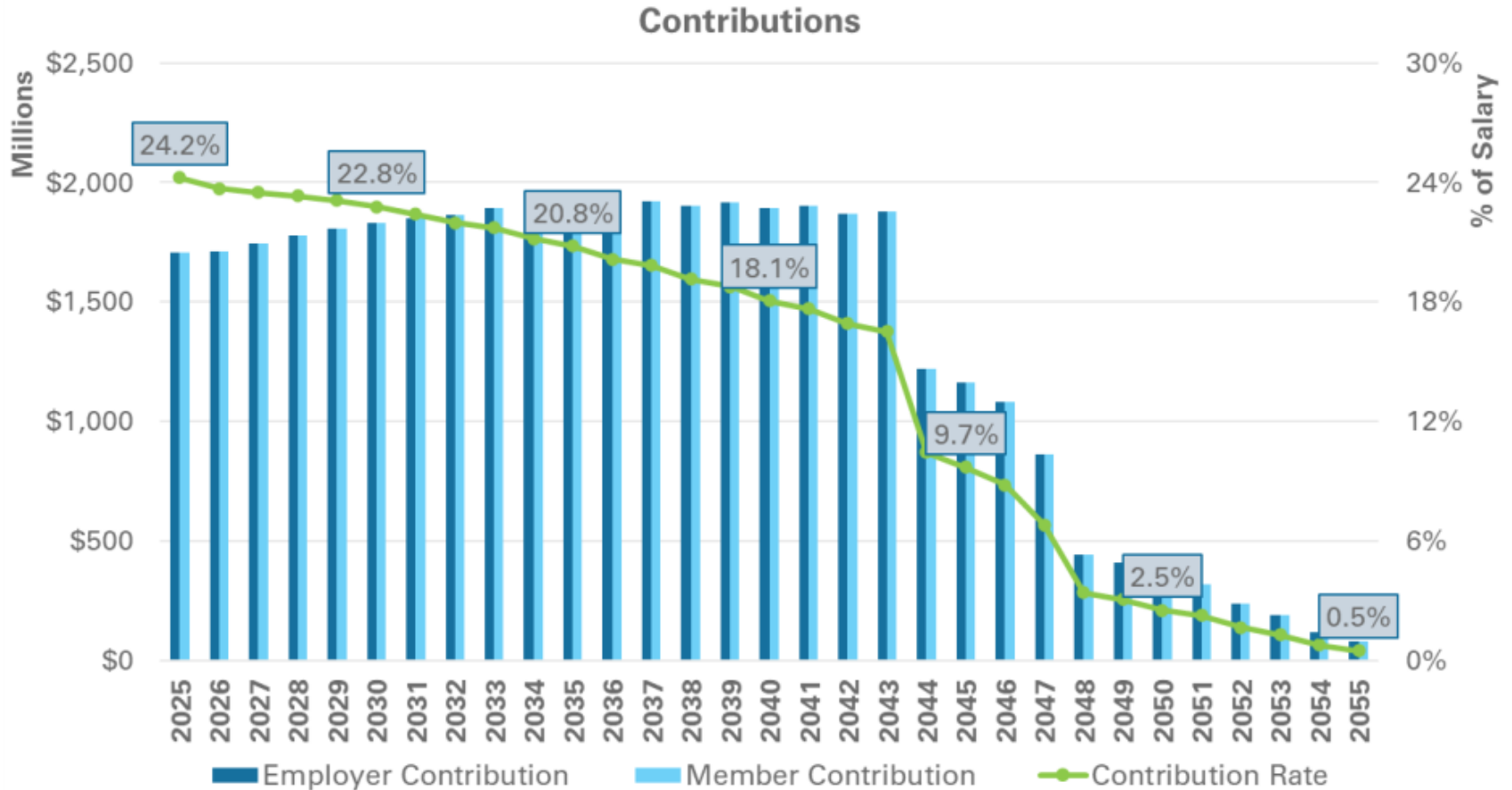


Notes: As of June 30; Assumes Current Policy allocation NEPC Beta 30-yr expected return of 8.6% per annum



# 30-YR CONTRIBUTIONS – SYSTEM LEVEL

## NEPC BETA RETURN ASSUMPTIONS

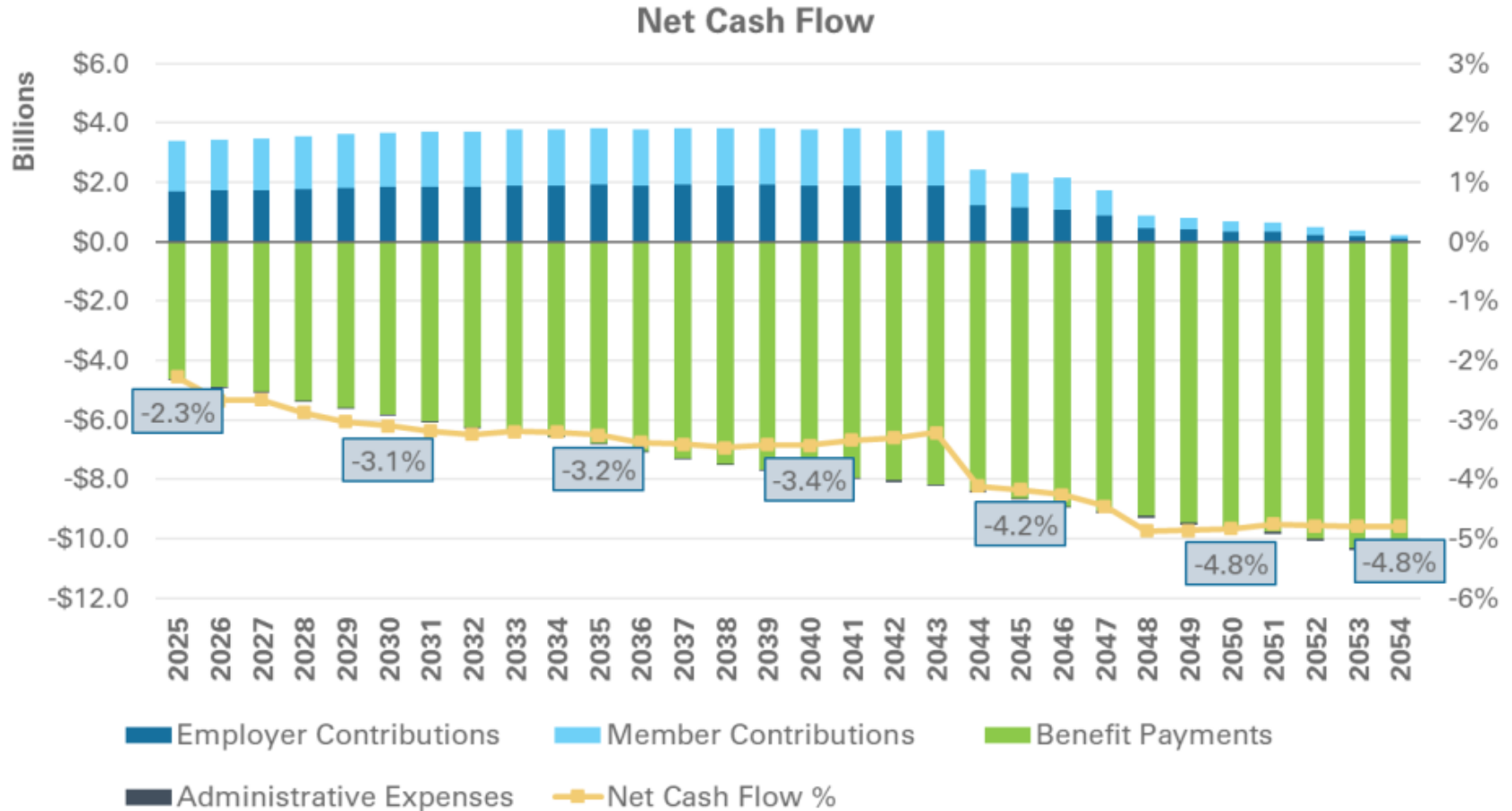


Notes: For the fiscal year ending June 30; Assumes Current Policy allocation NEPC Beta 30-yr expected return of 8.6% per annum



# 30-YR NET CASH FLOW – SYSTEM LEVEL

## NEPC BETA RETURN ASSUMPTIONS



Notes: For the fiscal year ending June 30; Assumes Current Policy allocation NEPC Beta 30-yr expected return of 8.6% per annum



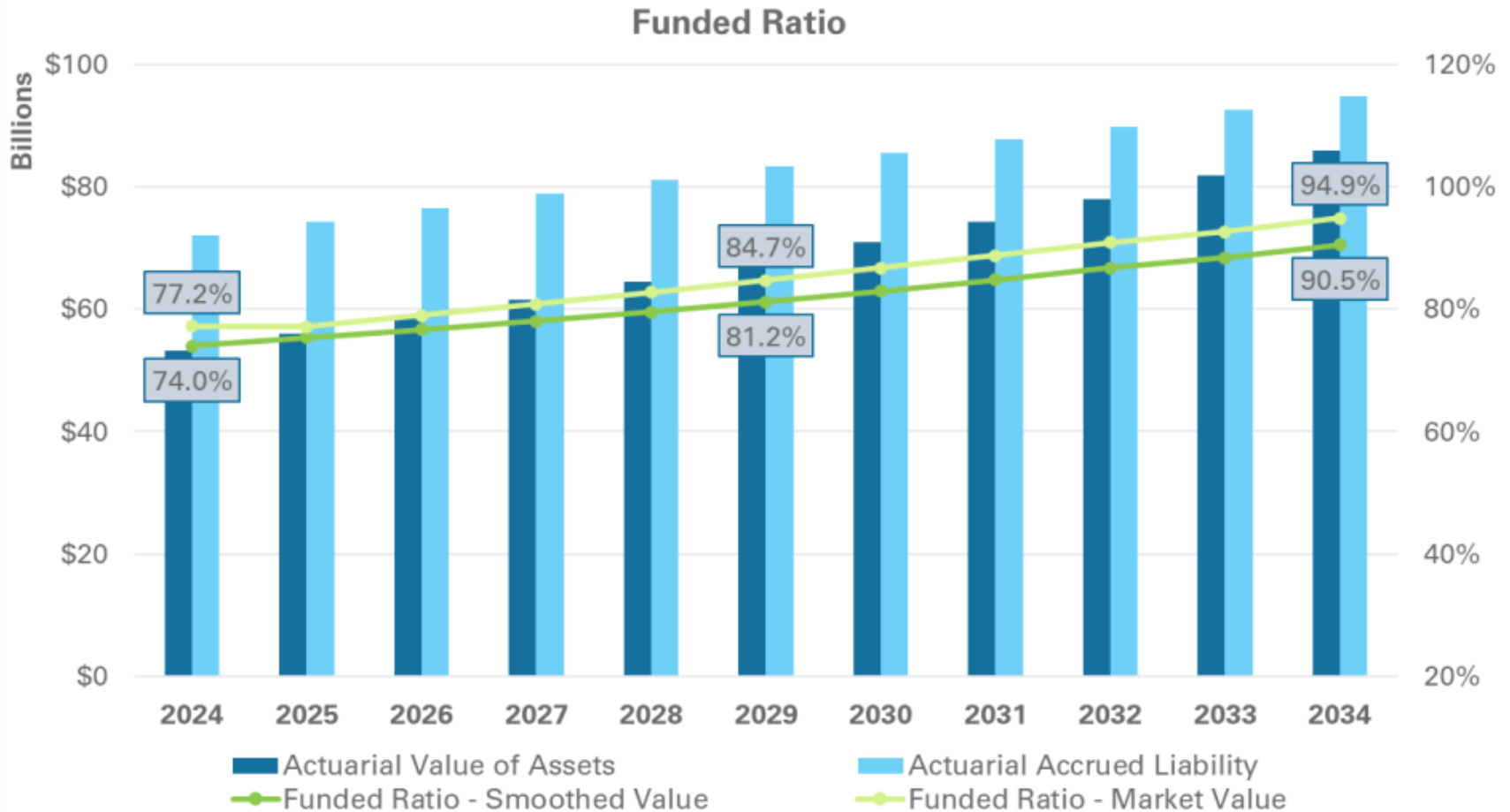
# CURRENT POLICY DETERMINISTIC PROJECTIONS

# ASRS PROJECTED RETURN ASSUMPTIONS



# 10-YR FUNDED RATIO – SYSTEM LEVEL

## ASRS PROJECTED RETURN ASSUMPTIONS

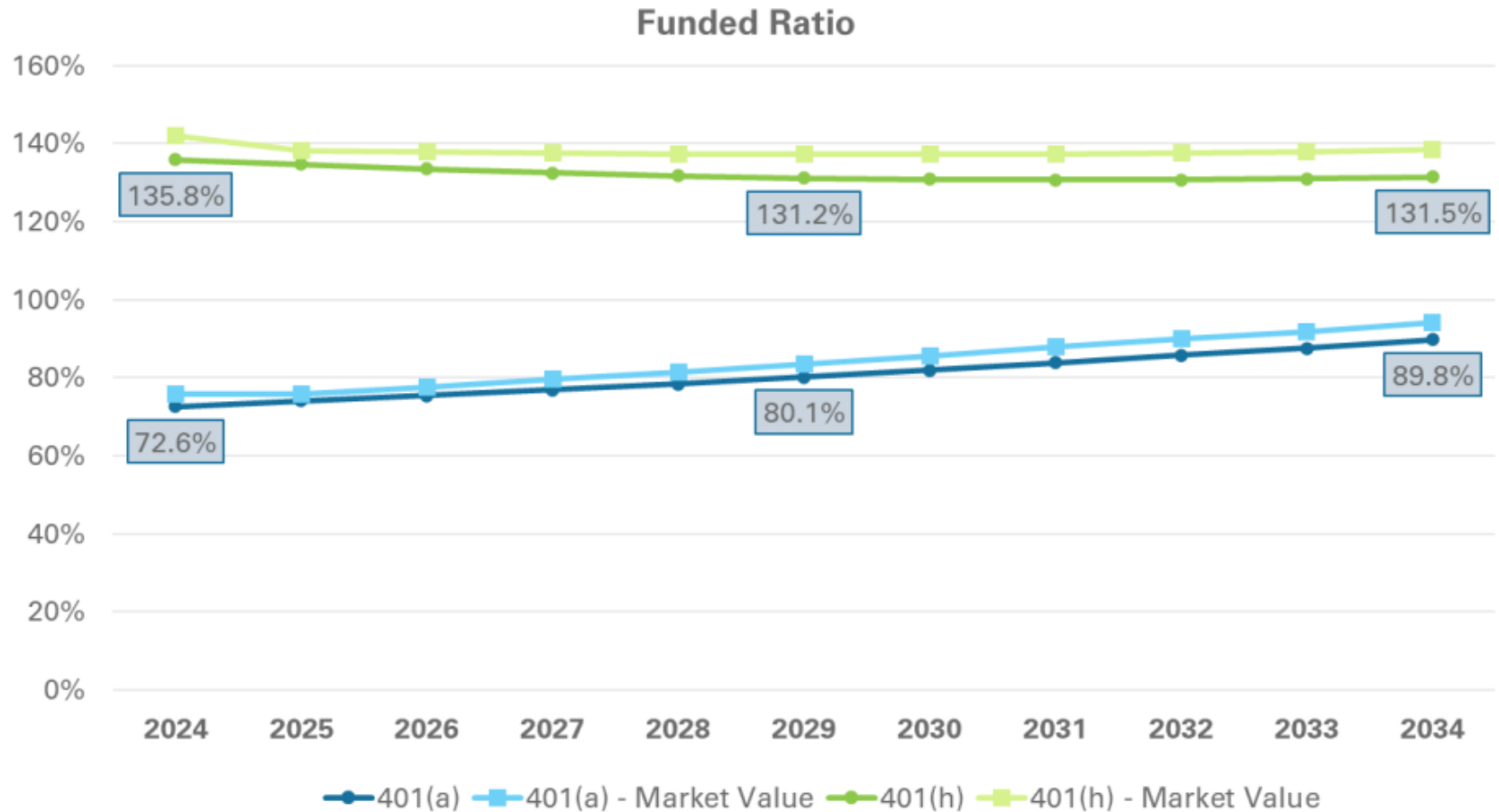


Notes: As of June 30; Assumes Current Policy allocation ASRS Projected 10-yr expected return of 8.2% per annum



# 10-YR FUNDED RATIO – PLAN LEVEL

## ASRS PROJECTED RETURN ASSUMPTIONS

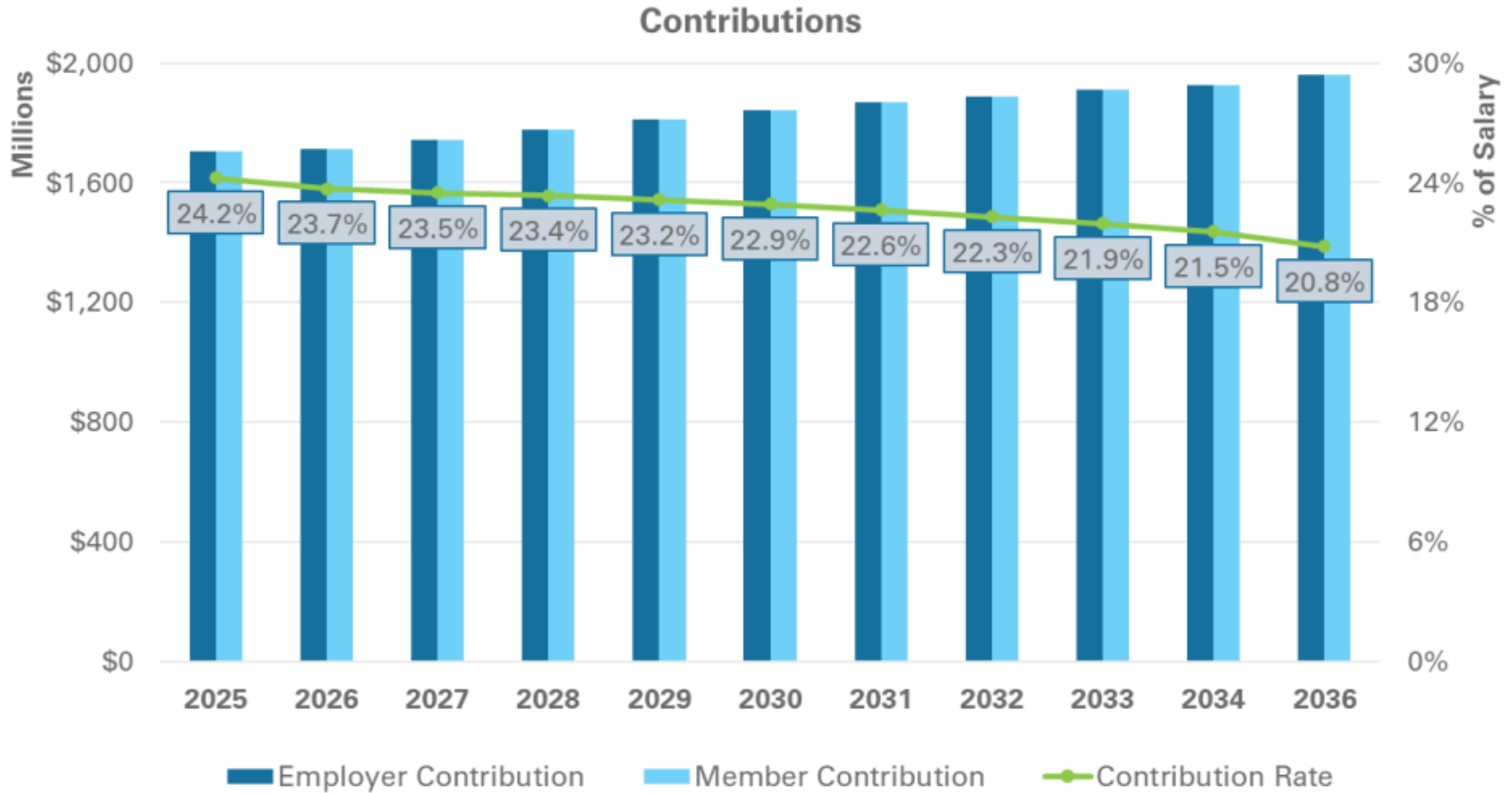


Notes: As of June 30; Assumes Current Policy allocation ASRS Projected 10-yr expected return of 8.2% per annum



# 10-YR CONTRIBUTIONS – SYSTEM LEVEL

## ASRS PROJECTED RETURN ASSUMPTIONS

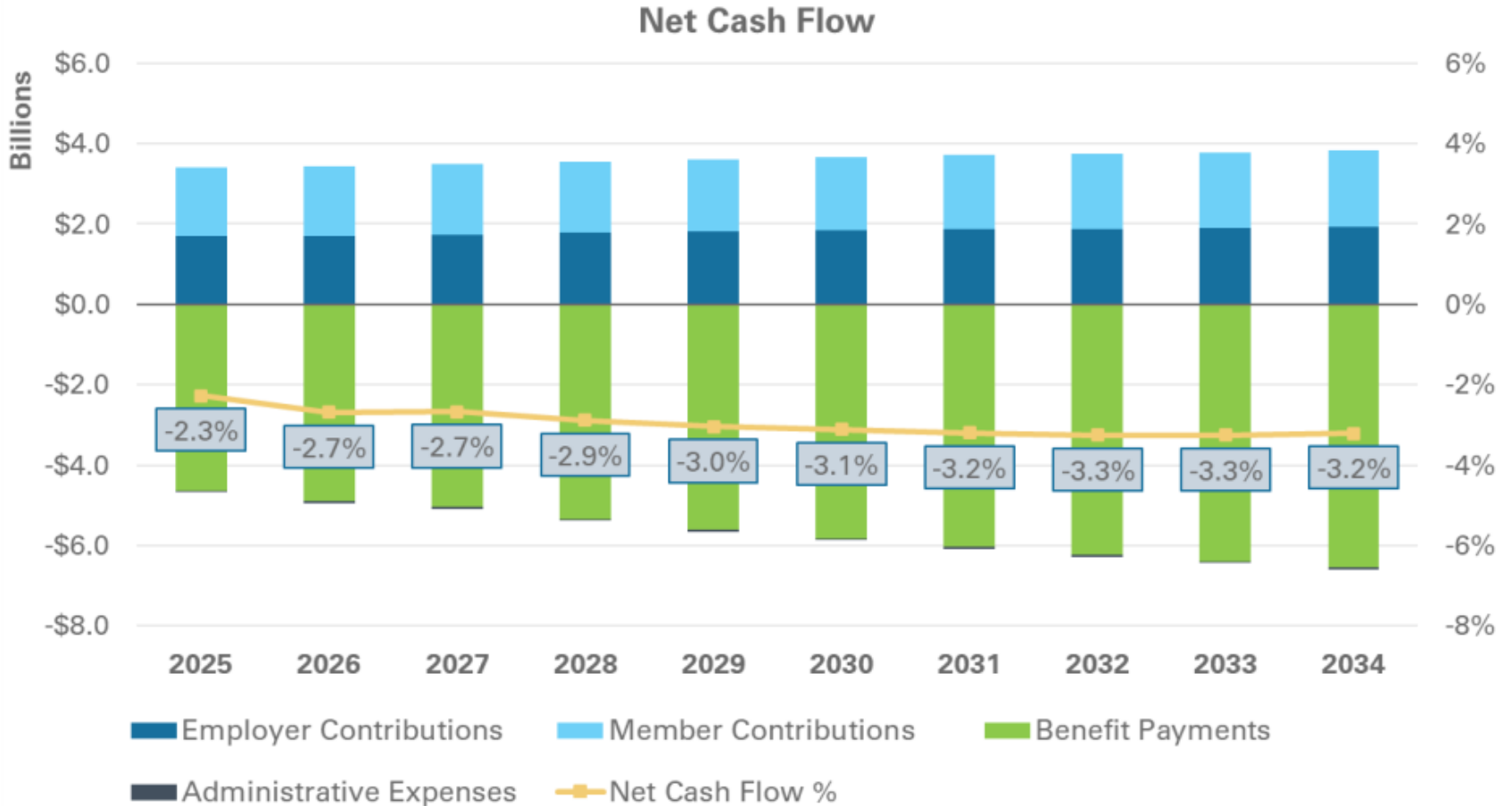


Notes: For the fiscal year ending June 30; Assumes Current Policy allocation ASRS Projected 10-yr expected return of 8.2% per annum



# 10-YR NET CASH FLOW – SYSTEM LEVEL

## ASRS PROJECTED RETURN ASSUMPTIONS

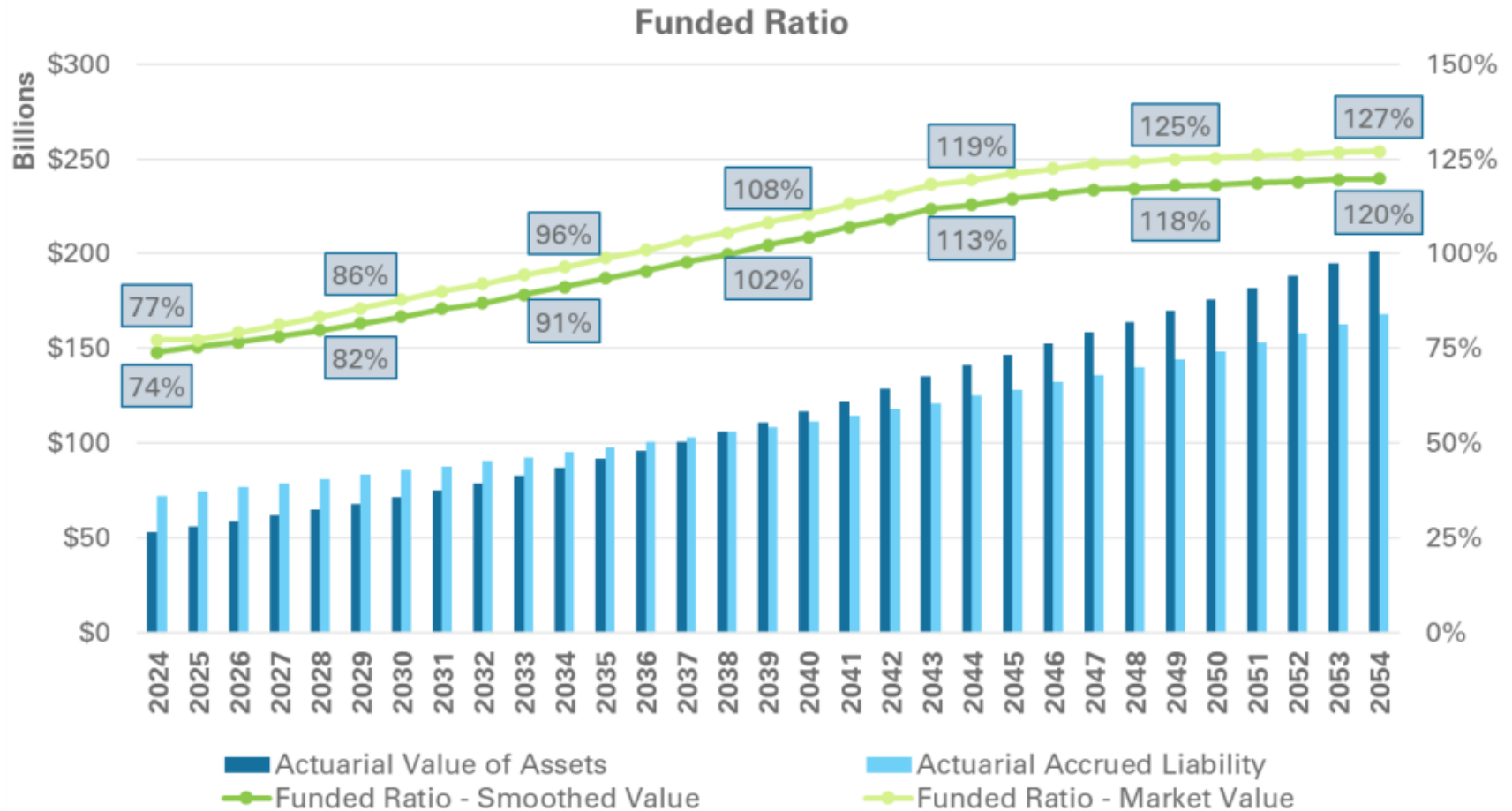


Notes: For the fiscal year ending June 30; Assumes Current Policy allocation ASRS Projected 10-yr expected return of 8.2% per annum



# 30-YR FUNDED RATIO – SYSTEM LEVEL

## ASRS PROJECTED RETURN ASSUMPTIONS

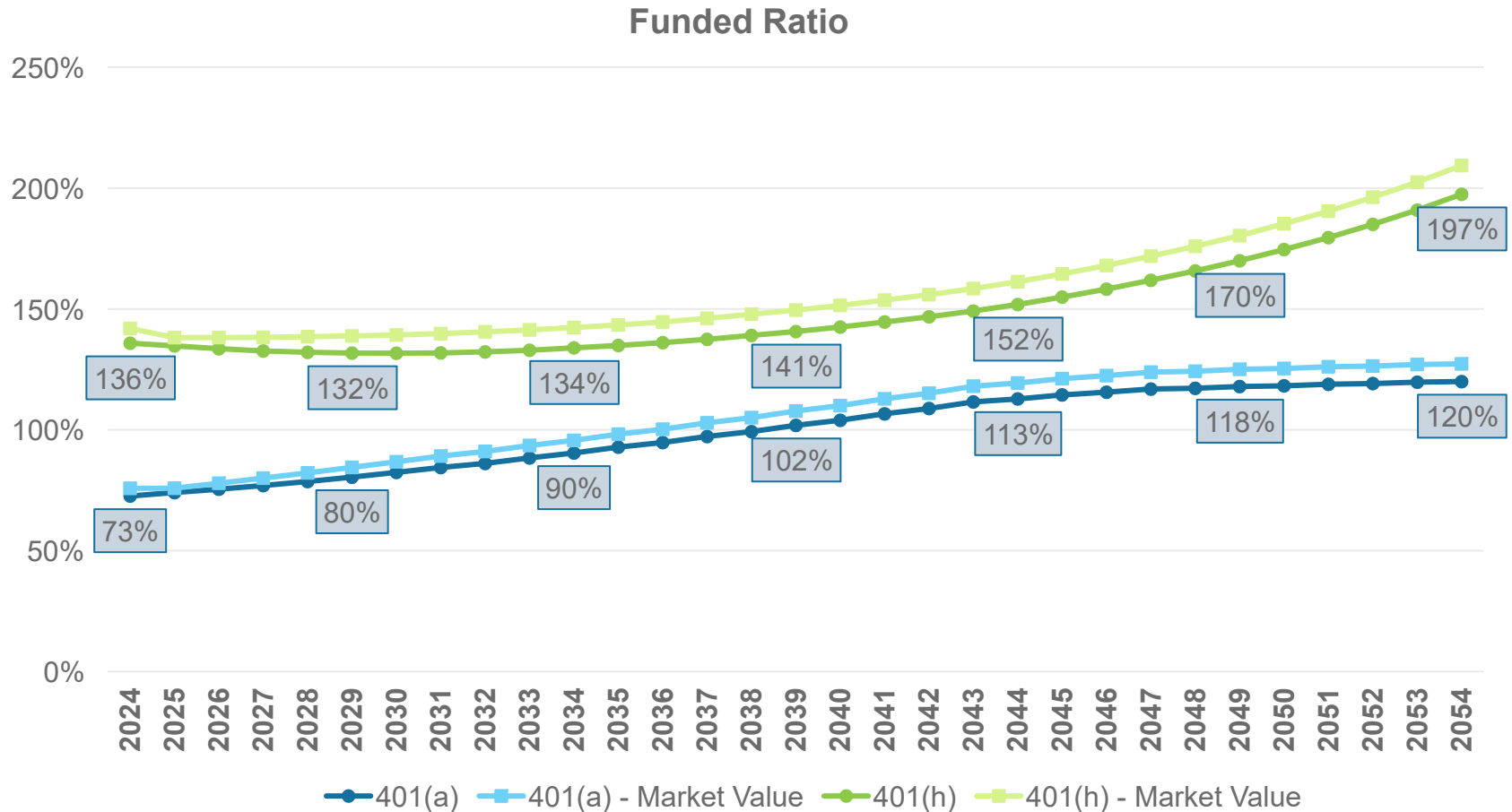


Notes: As of June 30; Assumes Current Policy allocation ASRS Projected 30-yr expected return of 8.5% per annum



# 30-YR FUNDED RATIO – PLAN LEVEL

## ASRS PROJECTED RETURN ASSUMPTIONS

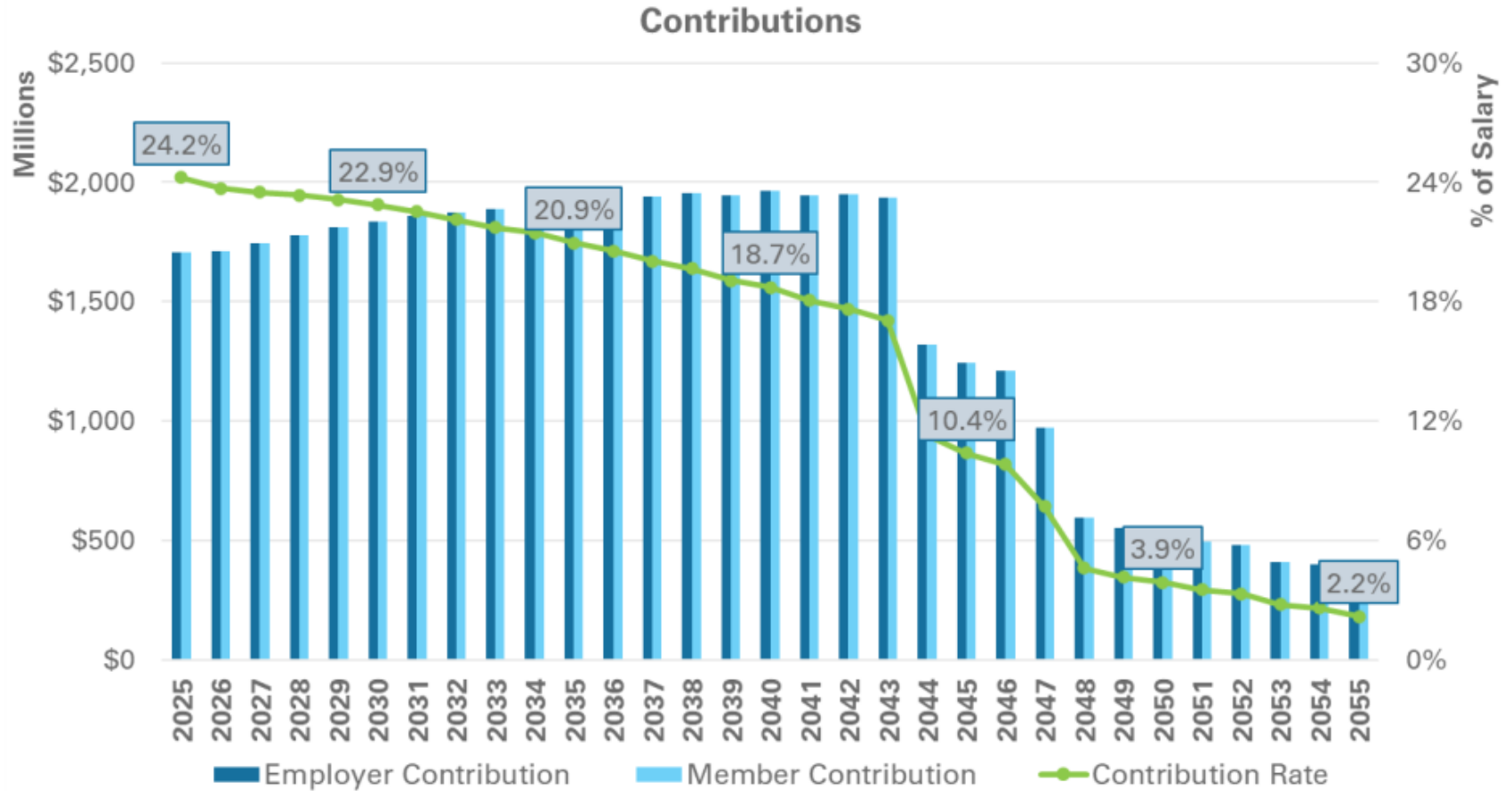


Notes: As of June 30; Assumes Current Policy allocation ASRS Projected 30-yr expected return of 8.5% per annum



# 30-YR CONTRIBUTIONS – SYSTEM LEVEL

## ASRS PROJECTED RETURN ASSUMPTIONS

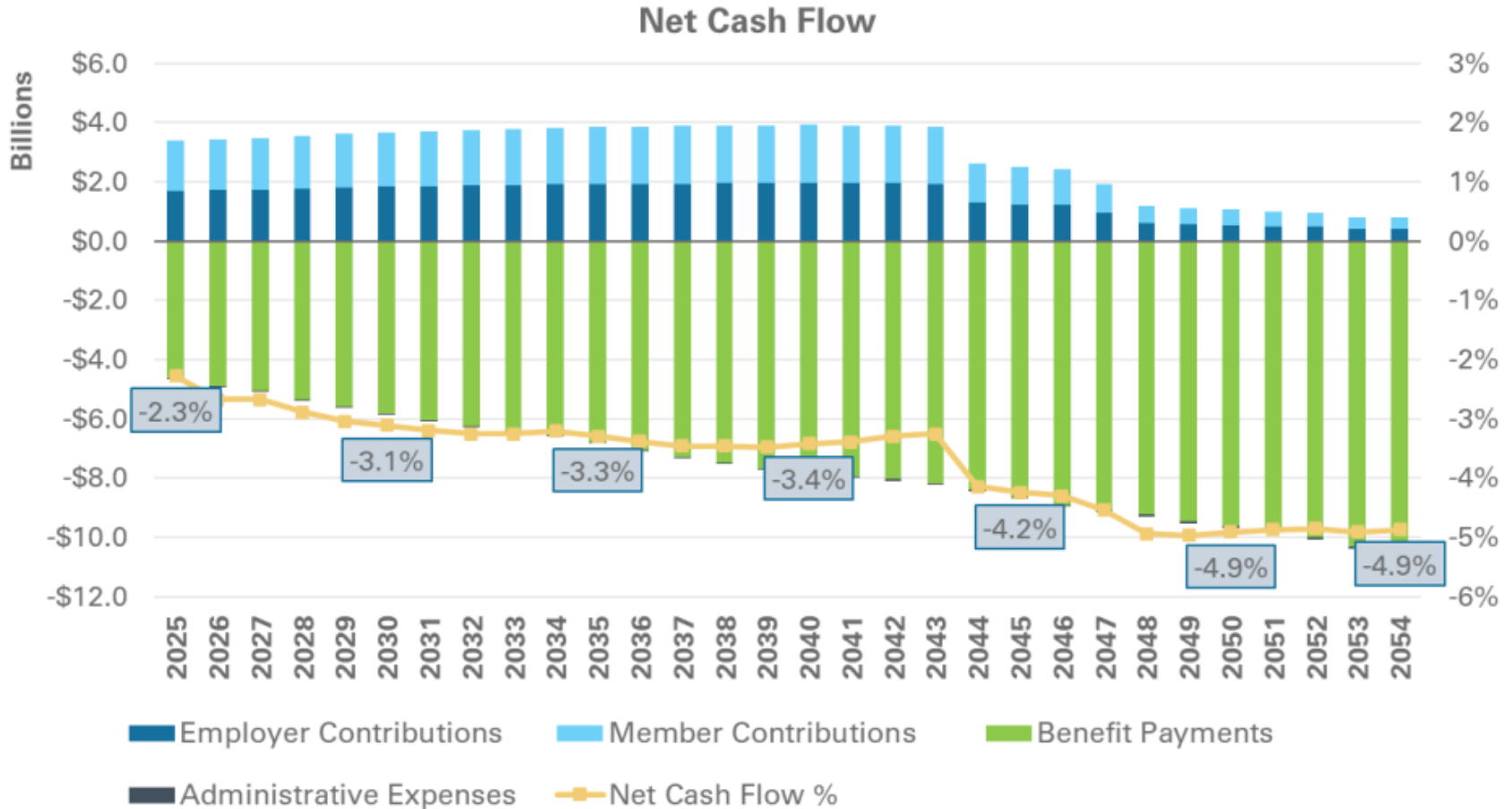


Notes: For the fiscal year ending June 30; Assumes Current Policy allocation ASRS Projected 30-yr expected return of 8.5% per annum



# 30-YR NET CASH FLOW – SYSTEM LEVEL

## ASRS PROJECTED RETURN ASSUMPTIONS



Notes: For the fiscal year ending June 30; Assumes Current Policy allocation ASRS Projected 30-yr expected return of 8.5% per annum



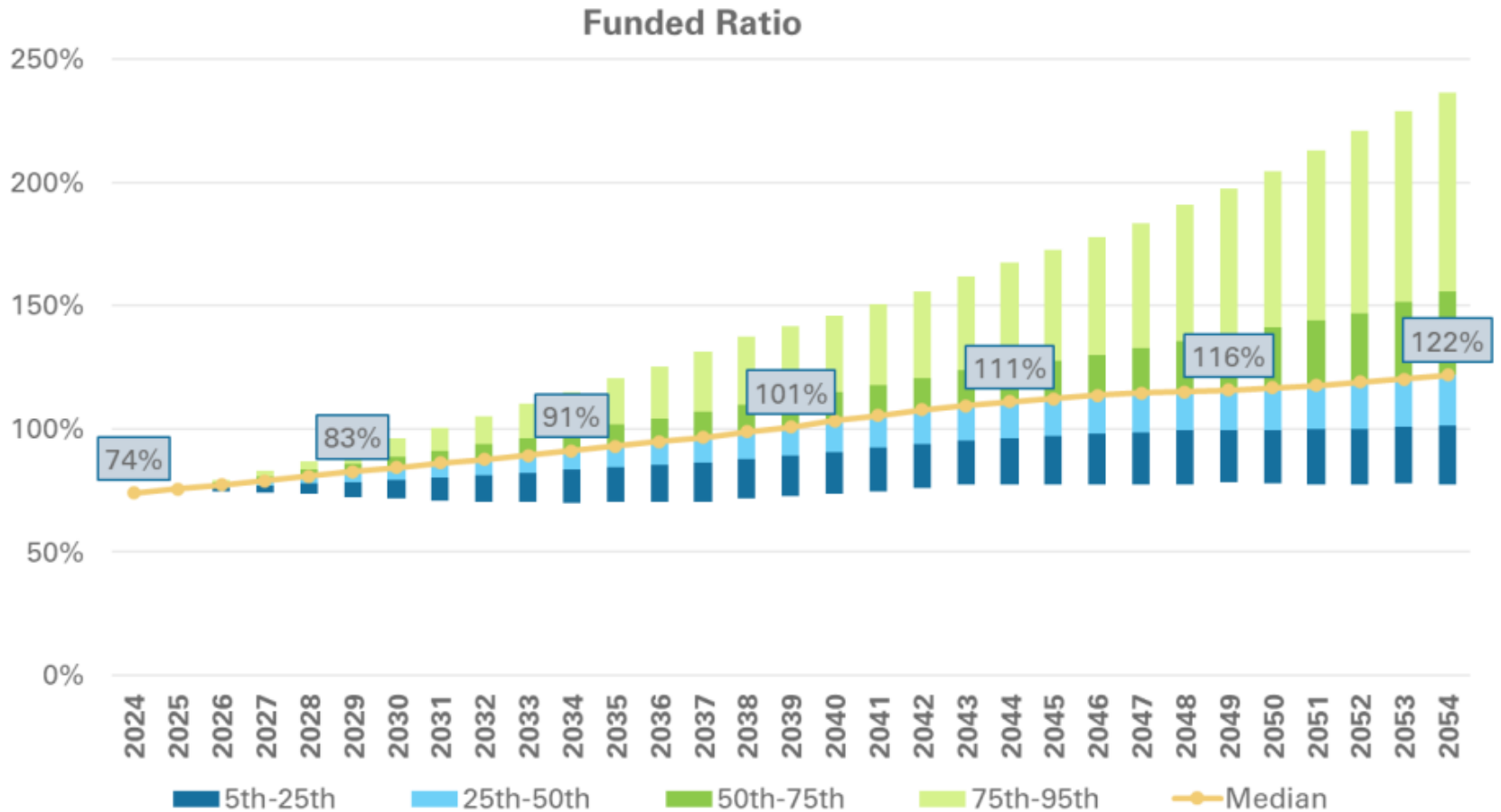
# CURRENT POLICY STOCHASTIC PROJECTIONS

# ASRS PROJECTED RETURN ASSUMPTIONS



# STOCHASTIC FUNDED RATIO – AVA BASIS

## ASRS PROJECTED RETURN ASSUMPTIONS

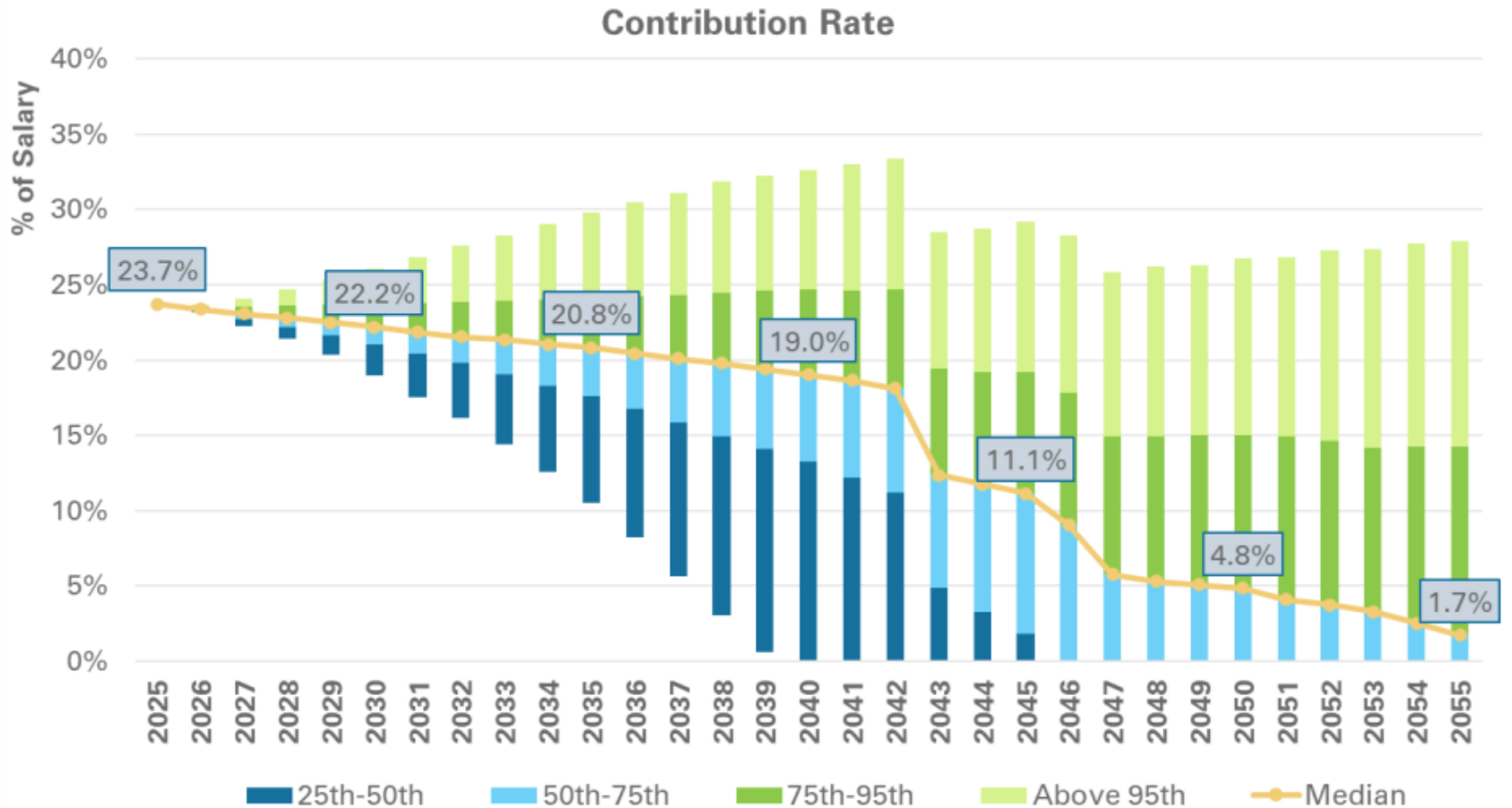


Notes: As of June 30; Assumes mean expected return equal to the ASRS Projected 30-year arithmetic return of 9.3% with 10.4% volatility per annum.



# STOCHASTIC CONTRIBUTIONS

## ASRS PROJECTED RETURN ASSUMPTIONS



Notes: For the fiscal year ending June 30; Assumes mean expected return equal to the ASRS Projected 30-year arithmetic return of 9.3% with 10.4% volatility per annum.



# ALTERNATIVE ASSET ALLOCATIONS



# NEPC BETA RETURN ASSUMPTIONS

NEPC Beta										
Asset Class	Policy Target	Staff Mix	Alt Mix 1	Alt Mix 2	NEPC Mix	NASIO <sup>1</sup>		10 Yr Return	30 Yr Return	Volatility
Global Equity <sup>2</sup>	44%	44%	30%	44%	43%	39%		5.90%	7.50%	18.25%
Private Equity	10%	13%	5%	15%	11%	12.5%		8.65%	10.53%	12.09%
Credit	23%	22%	22%	22%	22%	8%		8.73%	9.78%	5.26%
Interest Rate Sensitive	6%	6%	3%	6%	10%	14.5%		4.64%	4.79%	5.44%
Private Real Estate <sup>3</sup>	17%	15%	15%	13%	14%	9%		8.52%	8.52%	6.29%
Cash						2%		4.14%	3.57%	0.63%
TIPS			3%					4.89%	4.99%	6.03%
Infrastructure (50/50 Public/Private)			5%			7%		5.81%	6.74%	13.03%
Gold			6%					4.72%	4.78%	16.62%
Long Vol/Tail <sup>4</sup>			1%					4.77%	5.26%	20.99%
Trend Following <sup>5</sup>			10%			8%		5.83%	6.01%	9.25%
Output	Policy Target	Staff Mix	Alt Mix 1	Alt Mix 2	NEPC Mix	NASIO				
10 Yr Expected Return	7.5%	7.5%	7.4%	7.5%	7.4%	6.9%				
30 Yr Expected Return	8.6%	8.7%	8.2%	8.7%	8.5%	7.9%				
Standard Deviation	10.6%	10.9%	8.4%	11.0%	10.4%	9.9%				
10 Yr Sharpe Ratio	0.32	0.31	0.38	0.31	0.32	0.28				
30 Yr Sharpe Ratio	0.48	0.47	0.56	0.47	0.48	0.44				
Probability of 1-Year Return Under 0%	23.9%	24.4%	19.0%	24.7%	23.7%	24.3%				
Probability of 10-Year Return Under 0%	1.3%	1.4%	0.3%	1.5%	1.2%	1.4%				
Probability of 10-Year Return Under 7%	43.6%	43.8%	44.5%	43.8%	44.8%	51.1%				
Probability of 30-Year Return Under 7%	19.9%	19.8%	20.9%	19.6%	20.9%	30.7%				

Notes: <sup>1</sup> National Association of Senior Investment Officers (NASIO) allocation was fit to similar asset classes as ASRS Policy Target and may not represent actual allocation targets of the NASIO survey; <sup>2</sup> Global Equity is ex-China; <sup>3</sup> Private Real Estate return assumptions prescribed by RCLCo; <sup>4</sup> Long Vol/Tail modeled as 20+ Year US Treasury STRIPS; <sup>5</sup> Trend Following modeled as Hedge Fund – Macro

# ASRS PROJECTED RETURN ASSUMPTIONS

ASRS Projections										
Asset Class	Policy Target	Staff Mix	Alt Mix 1	Alt Mix 2	NEPC Mix	NASIO <sup>1</sup>		10 Yr Return	30 Yr Return	Volatility
Global Equity <sup>2</sup>	44%	44%	30%	44%	43%	39%		7.11%	7.50%	18.25%
Private Equity <sup>3</sup>	10%	13%	5%	15%	11%	12.5%		10.00%	10.53%	12.09%
Credit <sup>4</sup>	23%	22%	22%	22%	22%	8%		8.75%	8.75%	4.75%
Interest Rate Sensitive	6%	6%	3%	6%	10%	14.5%		4.64%	4.79%	5.44%
Private Real Estate <sup>5</sup>	17%	15%	15%	13%	14%	9%		8.52%	8.52%	6.29%
Cash						2%		4.14%	3.57%	0.63%
TIPS			3%					4.89%	4.99%	6.03%
Infrastructure (50/50 Public/Private)			5%			7%		5.81%	6.74%	13.03%
Gold			6%					4.72%	4.78%	16.62%
Long Vol/Tail <sup>6</sup>			1%					4.77%	5.26%	20.99%
Trend Following <sup>7</sup>			10%			8%		5.83%	6.01%	9.25%
Output	Policy Target	Staff Mix	Alt Mix 1	Alt Mix 2	NEPC Mix	NASIO				
10 Yr Expected Return	8.2%	8.3%	7.8%	8.3%	8.1%	7.6%				
30 Yr Expected Return	8.5%	8.5%	8.1%	8.6%	8.4%	7.9%				
Standard Deviation	10.4%	10.6%	8.2%	10.8%	10.2%	9.8%				
10 Yr Sharpe Ratio	0.39	0.39	0.45	0.39	0.39	0.35				
30 Yr Sharpe Ratio	0.47	0.47	0.55	0.47	0.47	0.44				
Probability of 1-Year Return Under 0%	21.4%	21.8%	16.9%	22.0%	21.2%	22.0%				
Probability of 10-Year Return Under 0%	0.6%	0.7%	0.1%	0.7%	0.6%	0.7%				
Probability of 10-Year Return Under 7%	35.4%	35.2%	37.7%	35.1%	36.3%	42.8%				
Probability of 30-Year Return Under 7%	21.8%	21.3%	23.9%	21.1%	22.8%	30.8%				

Notes: <sup>1</sup> National Association of Senior Investment Officers (NASIO) allocation was fit to similar asset classes as ASRS Policy Target and may not represent actual allocation targets of the NASIO survey; <sup>2</sup> Global Equity is ex-China and the return assumption is prescribed by ASRS staff; <sup>3</sup> Private Equity return assumptions prescribed by ASRS staff; <sup>4</sup> Credit return assumptions prescribed by ASRS staff; <sup>5</sup> Private Real Estate return assumptions prescribed by RCLCo; <sup>6</sup> Long Vol/Tail modeled as 20+ Year US Treasury STRIPS; <sup>7</sup> Trend Following modeled as Hedge Fund – Macro

# ASSUMPTIONS COMPARISON

Asset Class	NEPC Beta			ASRS Projections			ASRS Projection Based	
	10 Yr Return	30 Yr Return	Volatility	10 Yr Return	30 Yr Return	Volatility	Policy Target	Staff Mix
Global Equity	5.90%	7.50%	18.25%	7.11%	7.50%	18.25%	44%	44%
Private Equity	8.65%	10.53%	12.09%	10.00%	10.53%	12.09%	10%	13%
Credit	8.73%	9.78%	5.26%	8.75%	8.75%	4.75%	23%	22%
Interest Rate Sensitive	4.64%	4.79%	5.44%	4.64%	4.79%	5.44%	6%	6%
Private Real Estate	8.52%	8.52%	6.29%	8.52%	8.52%	6.29%	17%	15%
Cash	4.14%	3.57%	0.63%	4.14%	3.57%	0.63%		
TIPS	4.89%	4.99%	6.03%	4.89%	4.99%	6.03%		
Infrastructure (50/50 Public/Private)	5.81%	6.74%	13.03%	5.81%	6.74%	13.03%		
Gold	4.72%	4.78%	16.62%	4.72%	4.78%	16.62%		
Long Vol/Tail	4.77%	5.26%	20.99%	4.77%	5.26%	20.99%		
Trend Following	5.83%	6.01%	9.25%	5.83%	6.01%	9.25%		
<b>Output</b>								
10 Yr Expected Return							8.20%	8.30%
30 Yr Expected Return							8.50%	8.50%
Standard Deviation							10.40%	10.60%
10 Yr Sharpe Ratio							0.39	0.39
30 Yr Sharpe Ratio							0.47	0.47
Probability of 1-Year Ret <0%							21.40%	21.80%
Probability of 10-Year Ret < 0%							0.60%	0.70%
Probability of 10-Year Ret < 7%							35.40%	35.20%
Probability of 30-Year Ret < 7%							21.80%	21.30%

# ASRS PROJECTED RETURN ASSUMPTIONS

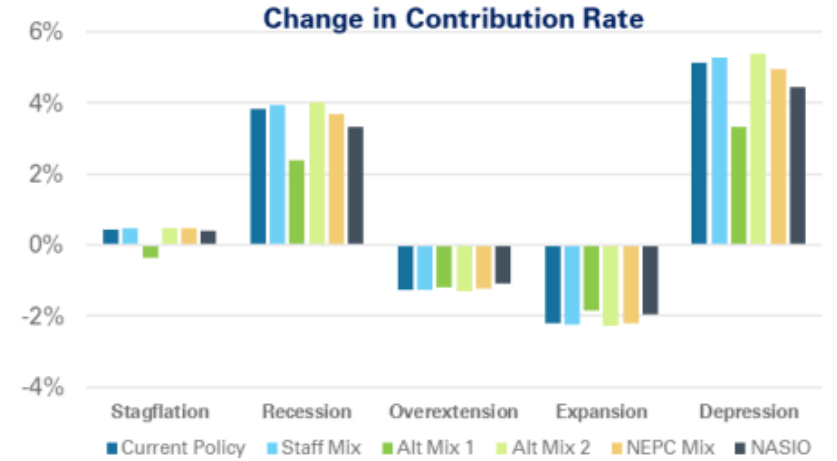
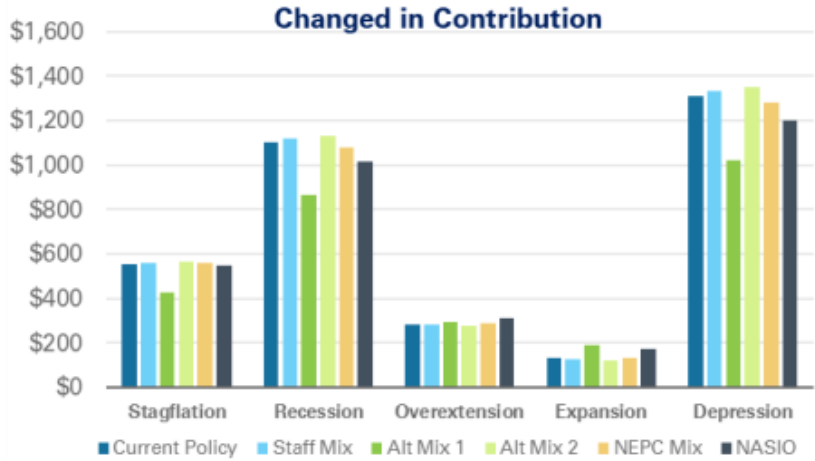
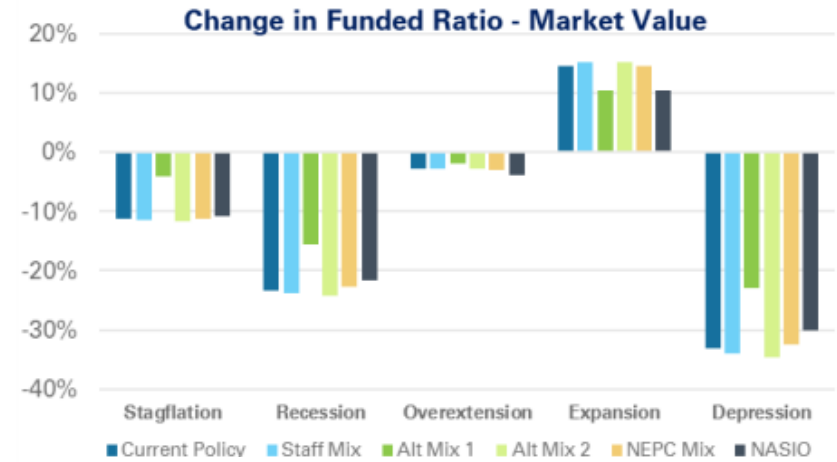
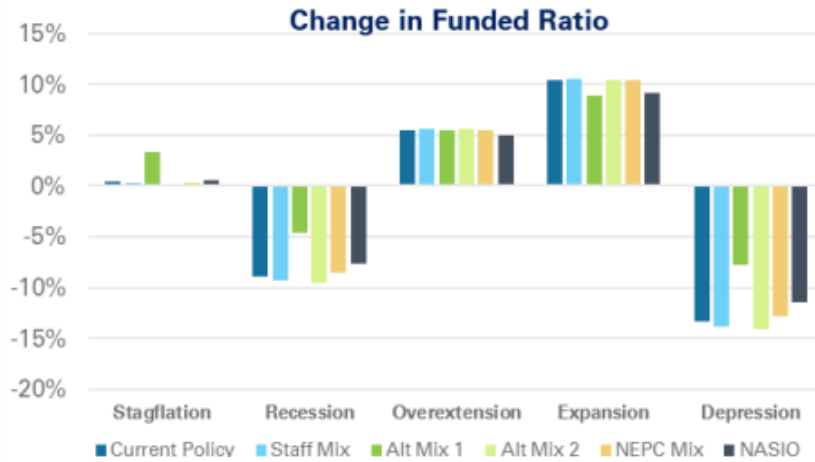
## STOCHASTIC ANALYSIS RESULTS

ASRS Projections						
	Policy Target	Staff Mix	Alt Mix 1	Alt Mix 2	NEPC Mix	NASIO
<b>2054 Funded Ratio</b>	122.4%	123.8%	114.7%	124.8%	120.6%	112.2%
<b>30-Yr Volatility of Funded Ratio</b>	2.3%	2.4%	1.7%	2.5%	2.2%	2.1%
<b>30-Yr Average Contribution Rate</b>	15.1%	14.9%	16.2%	14.7%	15.4%	17.0%
<b>30-Yr Volatility of Contribution Rate</b>	1.4%	1.4%	1.3%	1.4%	1.4%	1.4%

Notes: Data represents median outcomes of 2000 simulated trials using the 30-year ASRS Projected return assumptions



# SCENARIO ANALYSIS



Notes: Scenarios reflect a 5-year market cycle. Change in Funded Ratio is relative to 74.0% and Change in Funded Ratio – Market Value is relative to 77.2 % as of June 30, 2024. Change in Contribution is relative to \$3.4 billion and Change in Contribution Rate is relative to 24.2% for the fiscal year ending June 30, 2025.



# BENCHMARK RECOMMENDATIONS



# BENCHMARK RECOMMENDATIONS

## PRIVATE EQUITY AND CREDIT

	<b>Current Benchmark</b>	<b>Recommended Benchmark</b>
<b>Global Public Equity</b>	MSCI ACWI IMI Custom	MSCI ACWI IMI Custom
<b>Private Equity</b>	MSCI ACWI IMI (1 Quarter Lag)	MSCI PE North America & Europe (1 Quarter Lag)
<b>Credit</b>	Morningstar LSTA Leveraged Loan Index + 250 bps	MSCI Private Debt U.S. and Europe (1 Quarter Lag)
<b>Interest Rate Sensitive</b>	Bloomberg U.S. Treasury Index	Bloomberg U.S. Treasury Index
<b>Private Real Estate</b>	NCRIEF ODCE (1 Quarter Lag)	NCRIEF ODCE (1 Quarter Lag)

Highlighted benchmarks represent change from current benchmarks

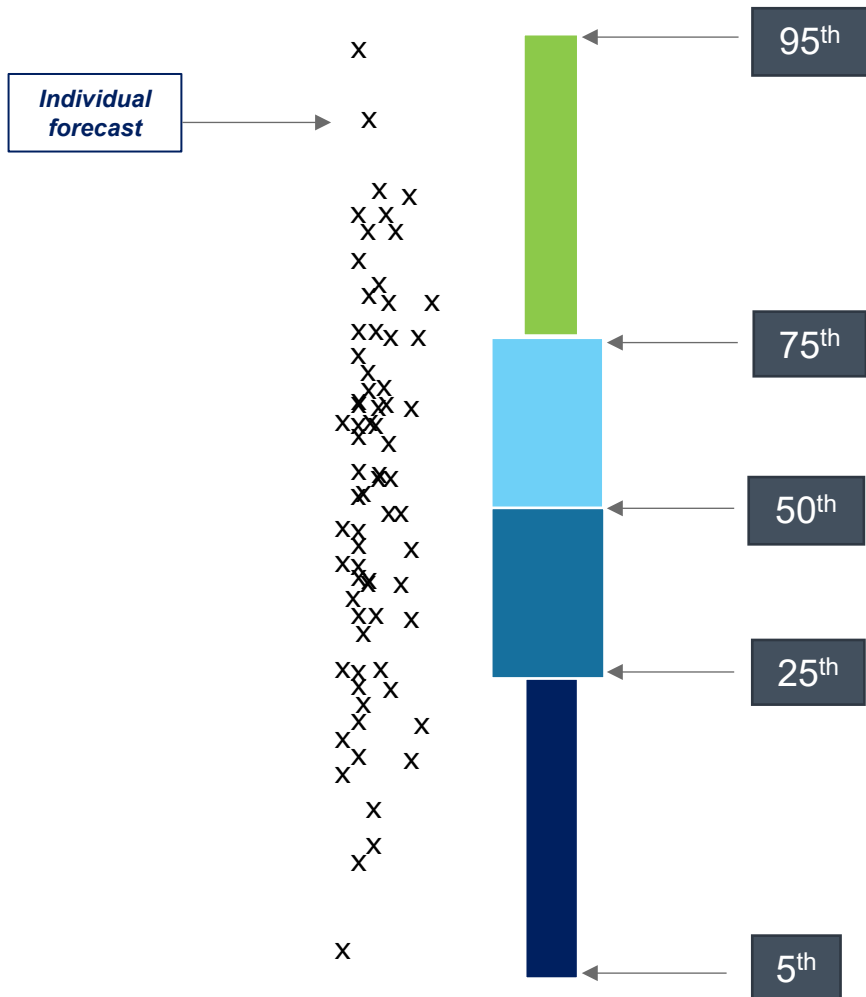


# APPENDIX



# INTERPRETING STOCHASTIC RESULTS

Model ranks 10,000 forecasts each year



- **95<sup>th</sup> percentile**
  - Exceeds 95% of all forecasts
  - Overly optimistic outcome
  
- **75<sup>th</sup> percentile**
  - Exceeds 75% of all forecasts
  - Optimistic outcome
  
- **50<sup>th</sup> percentile**
  - Exceeds 50% of all forecasts
  - Median outcome
  
- **25<sup>th</sup> percentile**
  - Exceeds 25% of all forecasts
  - Pessimistic outcome
  
- **5<sup>th</sup> percentile**
  - Exceeds 5% of all forecasts
  - Overly pessimistic outcome

# NCPERS 2025 PUBLIC RETIREMENT SYSTEMS STUDY

Asset Class	ASRS	NCPERS	ASRS vs NCPERS
Public Equity	44%	41.50%	2.50%
Credit	23%	11.20%	11.80%
Core Bonds/IRS	6%	19.10%	-13.10%
Private Equity	10%	10.40%	-0.40%
Real Estate	17%	8%	9.00%
Real Assets/Infrastructure	0%	4.10%	-4.10%
Absolute Return/Diversifying	0%	3.00%	-3.00%
Cash Equivalents		2.70%	-2.70%
Total	100%	100%	

Survey results based on 201 NCPERS members responses. Defined benefit plan assets reported range from several plans with less than \$100 million to several with more than \$100 billion.



*Note: The study is reported actual allocations, NOT strategic asset allocation targets.*

# HORIZON ACTUARIAL 2024 SURVEY STRATEGIC ASSET ALLOCATION COMPARISON

Asset Class	Horizon	ASRS	ASRS vs. Horizon
Public Equity	42.5%	44.0%	1.5%
Credit	15.0%	23.0%	8.0%
Core Bonds/IRS	15.0%	6.0%	-9.0%
Private Equity	5.0%	10.0%	5.0%
Real Estate	7.5%	17.0%	9.5%
Real Assets/Infrastructure	10.0%	0.0%	-10.0%
Absolute Return/Diversifying	5.0%	0.0%	-5.0%
Total	100.0%	100.0%	

Survey results based on 201 NCPERS members responses. Defined benefit plan assets reported range from several plans with less than \$100 million to several with more than \$100 billion.



*Note: The study is reported actual allocations, NOT strategic asset allocation targets.*

# PRIVATE MARKETS COMPOSITES

## PUBLIC MARKET BETA INPUTS FOR PRIVATE MARKETS

### PRIVATE EQUITY

**Buyout:** 25% U.S. Large Cap, 75% U.S. Small/Mid Cap

**Secondary:** 25% U.S. Large Cap, 75% U.S. Small/Mid Cap

**Growth:** 100% U.S. Small/Mid Cap

**Early-Stage Venture:** 100% U.S. Small/Mid Cap

**Non-U.S.:** 70% International Small Cap, 30% Emerging Small Cap

**Composite:** 34% Buyout, 34% Growth, 15 % Non-U.S., 8.5% Secondary, 8.5% Early Venture

### PRIVATE DEBT

**Direct Lending:** 100% Bank Loans

**Distressed:** 20% U.S. Small/Mid Cap, 60% U.S. High Yield, 20% Bank Loans

**Credit Opportunities:** 34% High Yield Securitized, 33% U.S. High Yield, 33% Bank Loans

**Composite:** 50% Direct Lending, 25% Credit Opportunities, 25% Distressed

### PRIVATE REAL ASSETS

**Energy:** 30% Comm., 35% Midstream, 35% Public Resource Equity

**Infra/Land:** 30% Commodities, 70% Public Infrastructure

**Private Real Estate Debt:** 50% CMBS, 50% Real Estate - Core

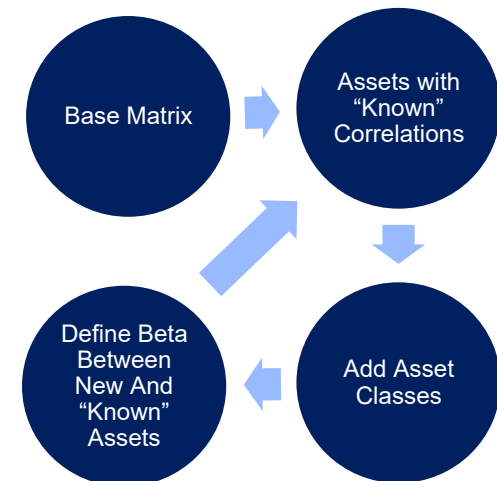
# VOLATILITY ASSUMPTIONS

## OVERVIEW

- **Volatility and correlation assumptions reflect NEPC's view on economic risk, which may differ significantly from realized return volatility**
- **Volatility assumptions serve as inputs when defining correlations for asset classes with limited return history**
- **Adjustments are made to better reflect tail events**
- **Asset class volatilities and diversification will impact portfolio risk and return profiles and should be considered with an investor's risk tolerance in mind**
- **Volatility and correlation assumptions are updated annually with the 12/31 assumption set**

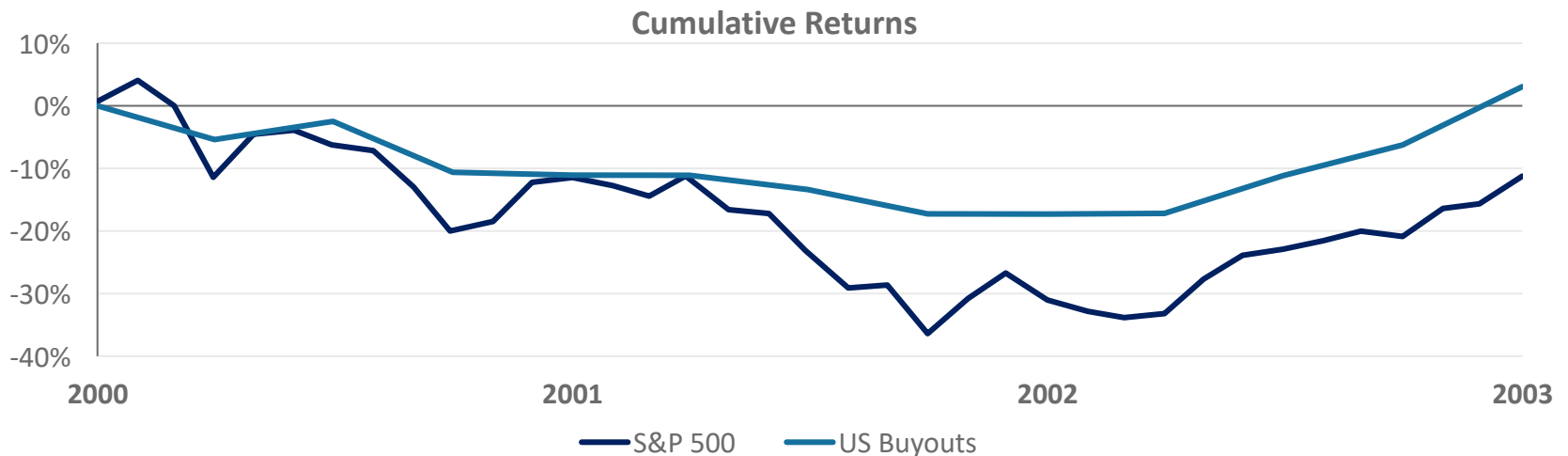
# METHODOLOGY

- **Autocorrelation occurs when past returns are correlated with future returns**
  - Private market investments may exhibit multiple periods of autocorrelation as infrequently traded assets may be difficult to accurately price
- **Risk is elevated when assets exhibit larger or more frequent tail risks**
  - Volatility estimates are adjusted higher when asset classes exhibit negative skewness (frequent smaller gains but larger losses) or positive kurtosis (higher frequency of tail events)
- **Correlations are developed through a multi-layer factor approach**
  1. A base correlation matrix of well-defined beta relationships is defined
  2. Asset class are added (or layered) to the base correlation matrix based on their assumed betas to “known” asset classes
  3. The process is repeated until all asset classes have been included



# VOLATILITY: PRIVATE MARKETS

- **Private market returns are “smoothed” due to reporting standards and the infrequency of assets being traded**
  - Due to appraisal-based valuation methods, economic and business factors that influence private assets may not be immediately reflected in returns
  - Autocorrelation occurs when the impact is spread over multiple periods
- **NEPC’s volatility assumptions are based on “unsmoothed” returns that have been adjusted for up to five periods of autocorrelation**

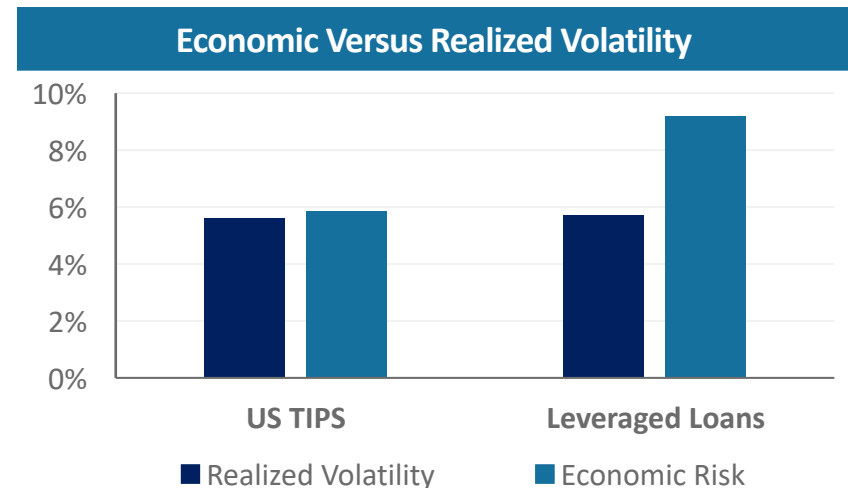
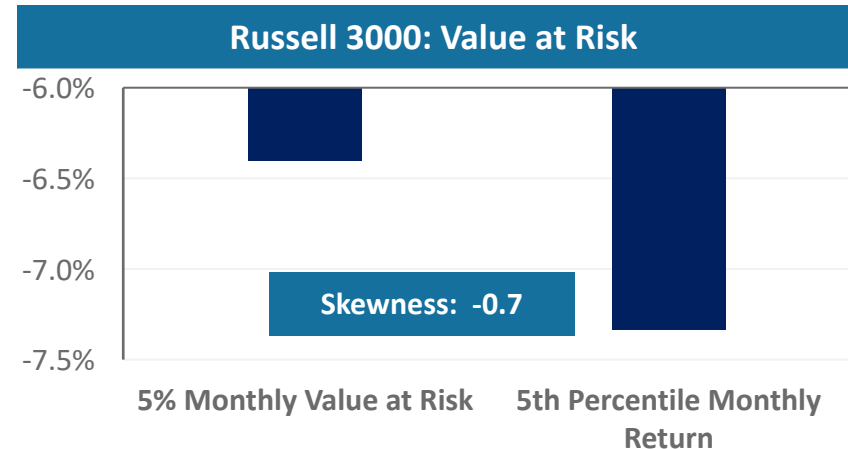


Cumulative returns are calculated as of 12/31/2000 to -12/31/2003  
 Source: Cambridge Associates, S&P, FactSet



# VOLATILITY: TAIL RISKS

- Portfolio and asset risks can be underestimated if negative skewness is exhibited in returns
  - Value at risk estimates can be improved by adjusting volatility assumptions
- While realized volatility may be comparable for certain asset classes, economic risk adjusts for inherent risks
  - For example, leveraged loans and US TIPS have similar realized volatility, while economic risk highlights the additional risk present in leveraged loans



Value at risk and 5<sup>th</sup> percentile return calculated from 12/29/1978 to 12/31/2021  
 TIPS and Bank Loans calculated as of 3/31/1997 and 1/31/1992, respectively  
 Source (Top): Russell, FactSet, NEPC  
 Source (Bottom): Bloomberg, Credit Suisse, FactSet

# NEPC 10-YEAR RETURN FORECASTS

## EQUITY

Geometric Expected Return			
Asset Class	12/31/2024	12/31/2023	Delta
U.S. Large-Cap Equity	5.6%	4.4%	+1.2%
U.S. Small/Mid-Cap Equity	5.8%	6.0%	-0.2%
Non-U.S. Developed Equity	5.3%	4.6%	+0.7%
Non-U.S. Developed Equity (USD Hedge)	5.6%	4.8%	+0.8%
Non-U.S. Developed Small-Cap Equity	6.7%	6.4%	+0.3%
Emerging Market Equity	8.0%	8.6%	-0.6%
Emerging Market Small-Cap Equity	7.1%	7.9%	-0.8%
Hedge Fund - Equity	5.8%	5.5%	+0.3%
Private Equity - Buyout	7.1%	7.4%	-0.3%
Private Equity - Growth	8.2%	8.7%	-0.5%
Private Equity - Early Stage Venture	9.3%	9.8%	-0.5%
Private Equity - Secondary	6.8%	6.9%	-0.1%
Non-U.S. Private Equity	9.4%	10.3%	-0.9%
China Equity	8.3%	9.9%	-1.6%
Global Equity*	6.1%	5.4%	+0.7%
Private Equity*	8.5%	9.0%	-0.5%

Note: \*Calculated as a blend of other asset classes. NEPC's capital market assumptions reflect proprietary forecasts for expected returns, volatility, and correlations. Return expectations may differ from an investor's realized returns after accounting for fees, taxes, or other aspects that can influence actual returns. Return forecasts and methodology are reviewed on an ongoing basis and are subject to change over time.

# NEPC 10-YEAR RETURN FORECASTS

## FIXED INCOME

Geometric Expected Return			
Asset Class	12/31/2024	12/31/2023	Delta
Cash	4.1%	3.9%	+0.2%
US TIPS	4.9%	4.6%	+0.3%
US Treasury Bond	4.7%	4.2%	+0.5%
US Corporate Bond	5.7%	5.3%	+0.4%
US Corporate Bond - AAA	5.0%	4.4%	+0.6%
US Corporate Bond - AA	5.2%	4.6%	+0.6%
US Corporate Bond - A	5.5%	5.1%	+0.4%
US Corporate Bond - BBB	5.9%	5.6%	+0.3%
US Mortgage-Backed Securities	4.9%	4.4%	+0.5%
US Securitized Bond	5.4%	5.2%	+0.2%
US Collateralized Loan Obligation	5.7%	5.5%	+0.2%
US Municipal Bond	3.8%	3.5%	+0.3%
US Municipal Bond (1-10 Year)	3.4%	2.9%	+0.5%
US Taxable Municipal Bond	5.6%	5.3%	+0.3%

Note: NEPC's capital market assumptions reflect proprietary forecasts for expected returns, volatility, and correlations. Return expectations may differ from an investor's realized returns after accounting for fees, taxes, or other aspects that can influence actual returns. Return forecasts and methodology are reviewed on an ongoing basis and are subject to change over time.



# NEPC 10-YEAR RETURN FORECASTS

## FIXED INCOME

Geometric Expected Return			
Asset Class	12/31/2024	12/31/2023	Delta
Non-US Government Bond	2.5%	2.4%	+0.1%
Non-US Government Bond (USD Hedge)	2.8%	2.6%	+0.2%
Non-US Inflation-Linked Bond (USD Hedge)	3.6%	3.2%	+0.4%
US Short-Term TIPS (1-3 Year)	4.8%	4.7%	+0.1%
US Short-Term Treasury Bond (1-3 Year)	4.6%	4.4%	+0.2%
US Short-Term Corporate Bond (1-3 Year)	5.6%	5.4%	+0.2%
US Intermediate-Term TIPS (3-10 Year)	4.9%	4.6%	+0.3%
US Intermediate-Term Treasury Bond (3-10 Year)	4.6%	4.2%	+0.4%
US Intermediate-Term Corporate Bond (3-10 Year)	5.9%	5.6%	+0.3%
US Long-Term TIPS (10-30 Year)	5.3%	4.5%	+0.8%
US Long-Term Treasury Bond (10-30 Year)	4.8%	3.7%	+1.1%
US Long-Term Corporate Bond (10-30 Year)	5.4%	4.7%	+0.7%
20+ Year US Treasury STRIPS	4.8%	3.3%	+1.5%
10 Year US Treasury Bond	4.8%	4.2%	+0.6%
10 Year Non-US Government Bond (USD Hedge)	2.4%	2.1%	+0.3%
US Aggregate Bond*	5.0%	4.6%	+0.4%

Note: \*Calculated as a blend of other asset classes. NEPC's capital market assumptions reflect proprietary forecasts for expected returns, volatility, and correlations. Return expectations may differ from an investor's realized returns after accounting for fees, taxes, or other aspects that can influence actual returns. Return forecasts and methodology are reviewed on an ongoing basis and are subject to change over time.



# NEPC 10-YEAR RETURN FORECASTS

## FIXED INCOME

Geometric Expected Return			
Asset Class	12/31/2024	12/31/2023	Delta
US High Yield Corporate Bond	6.3%	6.1%	+0.2%
US Corporate Bond - BB	6.9%	6.8%	+0.1%
US Corporate Bond - B	6.6%	6.3%	+0.3%
US Corporate Bond - CCC/Below	-0.2%	1.4%	-1.6%
US Short-Term High Yield Corporate Bond (1-3 Year)	5.7%	5.5%	+0.2%
US Leveraged Loan	7.3%	7.2%	+0.1%
Emerging Market Investment Grade External Debt	5.7%	5.0%	+0.7%
Emerging Market High Yield External Debt	7.8%	9.0%	-1.2%
Emerging Market Local Currency Debt	6.7%	6.1%	+0.6%
US High Yield Securitized Bond	9.3%	8.7%	+0.6%
US High Yield Collateralized Loan Obligation	7.8%	7.8%	-
US High Yield Municipal Bond	4.3%	4.5%	-0.2%
Hedge Fund - Credit	6.9%	6.6%	+0.3%
Private Debt - Credit Opportunities	8.1%	7.8%	+0.3%
Private Debt - Distressed	8.3%	8.6%	-0.3%
Private Debt - Direct Lending	8.2%	8.1%	+0.1%
Private Debt*	8.3%	8.3%	-

Note: \*Calculated as a blend of other asset classes. NEPC's capital market assumptions reflect proprietary forecasts for expected returns, volatility, and correlations. Return expectations may differ from an investor's realized returns after accounting for fees, taxes, or other aspects that can influence actual returns. Return forecasts and methodology are reviewed on an ongoing basis and are subject to change over time.



# NEPC 10-YEAR RETURN FORECASTS

## REAL ASSETS

Geometric Expected Return			
Asset Class	12/31/2024	12/31/2023	Delta
Commodity Futures	4.4%	4.6%	-0.2%
Midstream Energy	4.6%	5.5%	-0.9%
REIT	5.3%	6.0%	-0.7%
Global Infrastructure Equity	5.4%	6.6%	-1.2%
Global Natural Resources Equity	7.0%	6.2%	+0.8%
Gold	4.7%	4.9%	-0.2%
Real Estate - Core	5.9%	5.4%	+0.5%
Real Estate – Value-Add	7.1%	6.6%	+0.5%
Real Estate - Opportunistic	8.1%	7.6%	+0.5%
Private Debt - Real Estate	6.5%	6.3%	+0.2%
Private Real Assets - Natural Resources	8.2%	8.2%	-
Private Real Assets - Infrastructure	6.0%	6.8%	-0.8%

Note: NEPC's capital market assumptions reflect proprietary forecasts for expected returns, volatility, and correlations. Return expectations may differ from an investor's realized returns after accounting for fees, taxes, or other aspects that can influence actual returns. Return forecasts and methodology are reviewed on an ongoing basis and are subject to change over time.



# NEPC 30-YEAR RETURN FORECASTS

## EQUITY

Geometric Expected Return			
Asset Class	12/31/2024	12/31/2023	Delta
U.S. Large-Cap Equity	7.1%	6.7%	+0.4%
U.S. Small/Mid-Cap Equity	7.2%	7.4%	-0.2%
Non-U.S. Developed Equity	6.7%	6.4%	+0.3%
Non-U.S. Developed Equity (USD Hedge)	6.9%	6.6%	+0.3%
Non-U.S. Developed Small-Cap Equity	7.8%	7.5%	+0.3%
Emerging Market Equity	9.1%	9.2%	-0.1%
Emerging Market Small-Cap Equity	8.5%	9.1%	-0.6%
Hedge Fund - Equity	6.3%	6.0%	+0.3%
Private Equity - Buyout	9.3%	8.8%	+0.5%
Private Equity - Growth	10.3%	9.7%	+0.6%
Private Equity - Early Stage Venture	11.2%	10.6%	+0.6%
Private Equity - Secondary	8.7%	8.2%	+0.5%
Non-U.S. Private Equity	10.5%	10.8%	-0.3%
China Equity	9.0%	9.5%	-0.5%
Global Equity*	7.5%	7.3%	+0.2%
Private Equity*	10.5%	10.1%	+0.4%

Note: \*Calculated as a blend of other asset classes. NEPC's capital market assumptions reflect proprietary forecasts for expected returns, volatility, and correlations. Return expectations may differ from an investor's realized returns after accounting for fees, taxes, or other aspects that can influence actual returns. Return forecasts and methodology are reviewed on an ongoing basis and are subject to change over time.



# NEPC 30-YEAR RETURN FORECASTS

## FIXED INCOME

Geometric Expected Return			
Asset Class	12/31/2024	12/31/2023	Delta
Cash	3.6%	3.4%	+0.2%
US TIPS	5.0%	4.7%	+0.3%
US Treasury Bond	4.8%	4.3%	+0.5%
US Corporate Bond	6.3%	5.9%	+0.4%
US Corporate Bond - AAA	5.7%	5.1%	+0.6%
US Corporate Bond - AA	5.5%	5.1%	+0.4%
US Corporate Bond - A	6.0%	5.5%	+0.5%
US Corporate Bond - BBB	6.5%	6.1%	+0.4%
US Mortgage-Backed Securities	5.0%	4.6%	+0.4%
US Securitized Bond	5.6%	5.4%	+0.2%
US Collateralized Loan Obligation	5.1%	4.9%	+0.2%
US Municipal Bond	4.1%	3.8%	+0.3%
US Municipal Bond (1-10 Year)	3.8%	3.5%	+0.3%
US Taxable Municipal Bond	6.4%	6.0%	+0.4%

Note: NEPC's capital market assumptions reflect proprietary forecasts for expected returns, volatility, and correlations. Return expectations may differ from an investor's realized returns after accounting for fees, taxes, or other aspects that can influence actual returns. Return forecasts and methodology are reviewed on an ongoing basis and are subject to change over time.



# NEPC 30-YEAR RETURN FORECASTS

## FIXED INCOME

Geometric Expected Return			
Asset Class	12/31/2024	12/31/2023	Delta
Non-US Government Bond	3.1%	2.9%	+0.2%
Non-US Government Bond (USD Hedge)	3.3%	3.2%	+0.1%
Non-US Inflation-Linked Bond (USD Hedge)	3.6%	3.3%	+0.3%
US Short-Term TIPS (1-3 Year)	4.6%	4.4%	+0.2%
US Short-Term Treasury Bond (1-3 Year)	4.4%	4.2%	+0.2%
US Short-Term Corporate Bond (1-3 Year)	5.5%	5.2%	+0.3%
US Intermediate-Term TIPS (3-10 Year)	5.0%	4.7%	+0.3%
US Intermediate-Term Treasury Bond (3-10 Year)	4.8%	4.4%	+0.4%
US Intermediate-Term Corporate Bond (3-10 Year)	6.4%	6.0%	+0.4%
US Long-Term TIPS (10-30 Year)	5.4%	4.8%	+0.6%
US Long-Term Treasury Bond (10-30 Year)	5.1%	4.3%	+0.8%
US Long-Term Corporate Bond (10-30 Year)	6.6%	6.0%	+0.6%
20+ Year US Treasury STRIPS	5.3%	4.2%	+1.1%
10 Year US Treasury Bond	5.3%	4.8%	+0.5%
10 Year Non-US Government Bond (USD Hedge)	3.2%	2.8%	+0.4%
US Aggregate Bond*	5.3%	4.9%	+0.4%

Note: \*Calculated as a blend of other asset classes. NEPC's capital market assumptions reflect proprietary forecasts for expected returns, volatility, and correlations. Return expectations may differ from an investor's realized returns after accounting for fees, taxes, or other aspects that can influence actual returns. Return forecasts and methodology are reviewed on an ongoing basis and are subject to change over time.

# NEPC 30-YEAR RETURN FORECASTS

## FIXED INCOME

Geometric Expected Return			
Asset Class	12/31/2024	12/31/2023	Delta
US High Yield Corporate Bond	7.4%	7.1%	+0.3%
US Corporate Bond - BB	7.8%	7.7%	+0.1%
US Corporate Bond - B	7.3%	7.1%	+0.2%
US Corporate Bond - CCC/Below	1.3%	1.9%	-0.6%
US Short-Term High Yield Corporate Bond (1-3 Year)	5.9%	5.6%	+0.3%
US Leveraged Loan	6.7%	6.6%	+0.1%
Emerging Market Investment Grade External Debt	6.4%	5.0%	+1.4%
Emerging Market High Yield External Debt	8.3%	9.0%	-0.7%
Emerging Market Local Currency Debt	5.8%	5.5%	+0.3%
US High Yield Securitized Bond	8.8%	8.3%	+0.5%
US High Yield Collateralized Loan Obligation	7.5%	7.3%	+0.2%
US High Yield Municipal Bond	5.1%	4.9%	+0.2%
Hedge Fund - Credit	7.2%	7.0%	+0.2%
Private Debt - Credit Opportunities	8.9%	8.4%	+0.5%
Private Debt - Distressed	9.7%	9.3%	+0.4%
Private Debt - Direct Lending	8.9%	8.9%	-
Private Debt*	9.2%	9.0%	+0.2%

Note: \*Calculated as a blend of other asset classes. NEPC's capital market assumptions reflect proprietary forecasts for expected returns, volatility, and correlations. Return expectations may differ from an investor's realized returns after accounting for fees, taxes, or other aspects that can influence actual returns. Return forecasts and methodology are reviewed on an ongoing basis and are subject to change over time.

# NEPC 30-YEAR RETURN FORECASTS

## REAL ASSETS

Geometric Expected Return			
Asset Class	12/31/2024	12/31/2023	Delta
Commodity Futures	3.9%	3.9%	-
Midstream Energy	6.3%	6.6%	-0.3%
REIT	7.1%	7.3%	-0.2%
Global Infrastructure Equity	6.5%	7.0%	-0.5%
Global Natural Resources Equity	7.5%	7.1%	+0.4%
Gold	4.8%	4.8%	-
Real Estate - Core	6.5%	6.1%	+0.4%
Real Estate – Value-Add	7.8%	7.3%	+0.5%
Real Estate - Opportunistic	8.7%	8.2%	+0.5%
Private Debt - Real Estate	6.9%	6.6%	+0.3%
Private Real Assets - Natural Resources	8.9%	8.7%	+0.2%
Private Real Assets - Infrastructure	6.8%	7.1%	-0.3%

Note: NEPC's capital market assumptions reflect proprietary forecasts for expected returns, volatility, and correlations. Return expectations may differ from an investor's realized returns after accounting for fees, taxes, or other aspects that can influence actual returns. Return forecasts and methodology are reviewed on an ongoing basis and are subject to change over time.



# NEPC VOLATILITY FORECASTS

## EQUITY

Volatility			
Asset Class	12/31/2024	12/31/2023	Delta
U.S. Large-Cap Equity	17.4%	17.2%	+0.2%
U.S. Small/Mid-Cap Equity	21.4%	21.0%	+0.4%
Non-U.S. Developed Equity	19.6%	19.7%	-0.1%
Non-U.S. Developed Equity (USD Hedge)	17.4%	17.7%	-0.3%
Non-U.S. Developed Small-Cap Equity	23.3%	24.2%	-0.9%
Emerging Market Equity	27.4%	28.1%	-0.7%
Emerging Market Small-Cap Equity	30.6%	31.4%	-0.8%
Hedge Fund - Equity	10.9%	11.0%	-0.1%
Private Equity - Buyout	20.7%	20.0%	+0.7%
Private Equity - Growth	30.8%	31.5%	-0.7%
Private Equity - Early Stage Venture	48.0%	46.5%	+1.5%
Private Equity - Secondary	20.4%	20.4%	-
Non-U.S. Private Equity	29.0%	32.0%	-3.0%
China Equity	30.4%	30.6%	-0.2%
Global Equity*	18.2%	18.2%	-
Private Equity*	25.8%	25.9%	-0.1%

Note: \*Calculated as a blend of other asset classes. NEPC's capital market assumptions reflect proprietary forecasts for expected returns, volatility, and correlations. Return expectations may differ from an investor's realized returns after accounting for fees, taxes, or other aspects that can influence actual returns. Return forecasts and methodology are reviewed on an ongoing basis and are subject to change over time.

# NEPC VOLATILITY FORECASTS

## FIXED INCOME

Volatility			
Asset Class	12/31/2024	12/31/2023	Delta
Cash	0.6%	0.6%	-
US TIPS	6.0%	6.0%	-
US Treasury Bond	5.5%	5.4%	+0.1%
US Corporate Bond	7.9%	7.7%	+0.2%
US Corporate Bond - AAA	7.0%	6.8%	+0.2%
US Corporate Bond - AA	6.7%	6.6%	+0.1%
US Corporate Bond - A	7.7%	7.6%	+0.1%
US Corporate Bond - BBB	8.6%	8.4%	+0.2%
US Mortgage-Backed Securities	6.5%	6.5%	-
US Securitized Bond	7.9%	8.0%	-0.1%
US Collateralized Loan Obligation	6.5%	7.7%	-1.2%
US Municipal Bond	6.0%	6.0%	-
US Municipal Bond (1-10 Year)	4.5%	4.5%	-
US Taxable Municipal Bond	7.5%	7.5%	-

Note: NEPC's capital market assumptions reflect proprietary forecasts for expected returns, volatility, and correlations. Return expectations may differ from an investor's realized returns after accounting for fees, taxes, or other aspects that can influence actual returns. Return forecasts and methodology are reviewed on an ongoing basis and are subject to change over time.



# NEPC VOLATILITY FORECASTS

## FIXED INCOME

Volatility			
Asset Class	12/31/2024	12/31/2023	Delta
Non-US Government Bond	9.8%	9.5%	+0.3%
Non-US Government Bond (USD Hedge)	4.1%	4.1%	-
Non-US Inflation-Linked Bond (USD Hedge)	6.7%	6.7%	-
US Short-Term TIPS (1-3 Year)	3.3%	3.3%	-
US Short-Term Treasury Bond (1-3 Year)	2.3%	2.3%	-
US Short-Term Corporate Bond (1-3 Year)	2.8%	2.8%	-
US Intermediate-Term TIPS (3-10 Year)	5.8%	6.0%	-0.2%
US Intermediate-Term Treasury Bond (3-10 Year)	5.4%	5.9%	-0.5%
US Intermediate-Term Corporate Bond (3-10 Year)	7.4%	7.1%	+0.3%
US Long-Term TIPS (10-30 Year)	12.6%	12.4%	+0.2%
US Long-Term Treasury Bond (10-30 Year)	12.3%	11.8%	+0.5%
US Long-Term Corporate Bond (10-30 Year)	12.4%	11.9%	+0.5%
20+ Year US Treasury STRIPS	21.0%	20.7%	+0.3%
10 Year US Treasury Bond	7.6%	7.5%	+0.1%
10 Year Non-US Government Bond (USD Hedge)	4.9%	5.0%	-0.1%
US Aggregate Bond*	5.8%	5.8%	-

Note: \*Calculated as a blend of other asset classes. NEPC's capital market assumptions reflect proprietary forecasts for expected returns, volatility, and correlations. Return expectations may differ from an investor's realized returns after accounting for fees, taxes, or other aspects that can influence actual returns. Return forecasts and methodology are reviewed on an ongoing basis and are subject to change over time.

# NEPC VOLATILITY FORECASTS

## FIXED INCOME

Volatility			
Asset Class	12/31/2024	12/31/2023	Delta
US High Yield Corporate Bond	11.3%	11.2%	+0.1%
US Corporate Bond - BB	9.7%	9.7%	-
US Corporate Bond - B	11.7%	11.6%	+0.1%
US Corporate Bond - CCC/Below	20.4%	20.3%	+0.1%
US Short-Term High Yield Corporate Bond (1-3 Year)	8.2%	8.2%	-
US Leveraged Loan	6.1%	9.1%	-3.0%
Emerging Market Investment Grade External Debt	8.7%	8.7%	-
Emerging Market High Yield External Debt	17.5%	17.5%	-
Emerging Market Local Currency Debt	12.6%	12.7%	-0.1%
US High Yield Securitized Bond	13.0%	11.2%	+1.8%
US High Yield Collateralized Loan Obligation	15.9%	10.4%	+5.5%
US High Yield Municipal Bond	12.0%	12.0%	-
Hedge Fund - Credit	9.7%	9.9%	-0.2%
Private Debt - Credit Opportunities	14.3%	14.5%	-0.2%
Private Debt - Distressed	13.9%	14.4%	-0.5%
Private Debt - Direct Lending	11.0%	11.0%	-
Private Debt*	11.8%	11.8%	-

Note: \*Calculated as a blend of other asset classes. NEPC's capital market assumptions reflect proprietary forecasts for expected returns, volatility, and correlations. Return expectations may differ from an investor's realized returns after accounting for fees, taxes, or other aspects that can influence actual returns. Return forecasts and methodology are reviewed on an ongoing basis and are subject to change over time.



# NEPC VOLATILITY FORECASTS

## REAL ASSETS

Volatility			
Asset Class	12/31/2024	12/31/2023	Delta
Commodity Futures	18.5%	18.5%	-
Midstream Energy	27.7%	28.2%	-0.5%
REIT	22.4%	21.8%	+0.6%
Global Infrastructure Equity	19.3%	19.4%	-0.1%
Global Natural Resources Equity	22.9%	23.3%	-0.4%
Gold	16.6%	16.4%	+0.2%
Real Estate - Core	14.7%	15.0%	-0.3%
Real Estate – Value-Add	23.0%	23.4%	-0.4%
Real Estate - Opportunistic	27.3%	25.8%	+1.5%
Private Debt - Real Estate	11.9%	11.9%	-
Private Real Assets - Natural Resources	32.5%	32.3%	+0.2%
Private Real Assets - Infrastructure	10.6%	12.4%	-1.8%

Note: NEPC's capital market assumptions reflect proprietary forecasts for expected returns, volatility, and correlations. Return expectations may differ from an investor's realized returns after accounting for fees, taxes, or other aspects that can influence actual returns. Return forecasts and methodology are reviewed on an ongoing basis and are subject to change over time.



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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.

Information on market indices was provided by sources external to NEPC. While NEPC has exercised reasonable professional care in preparing this report, we cannot guarantee the accuracy of all source information contained within.

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.

All investments carry some level of risk. Diversification and other asset allocation techniques do not ensure profit or protect against losses.

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