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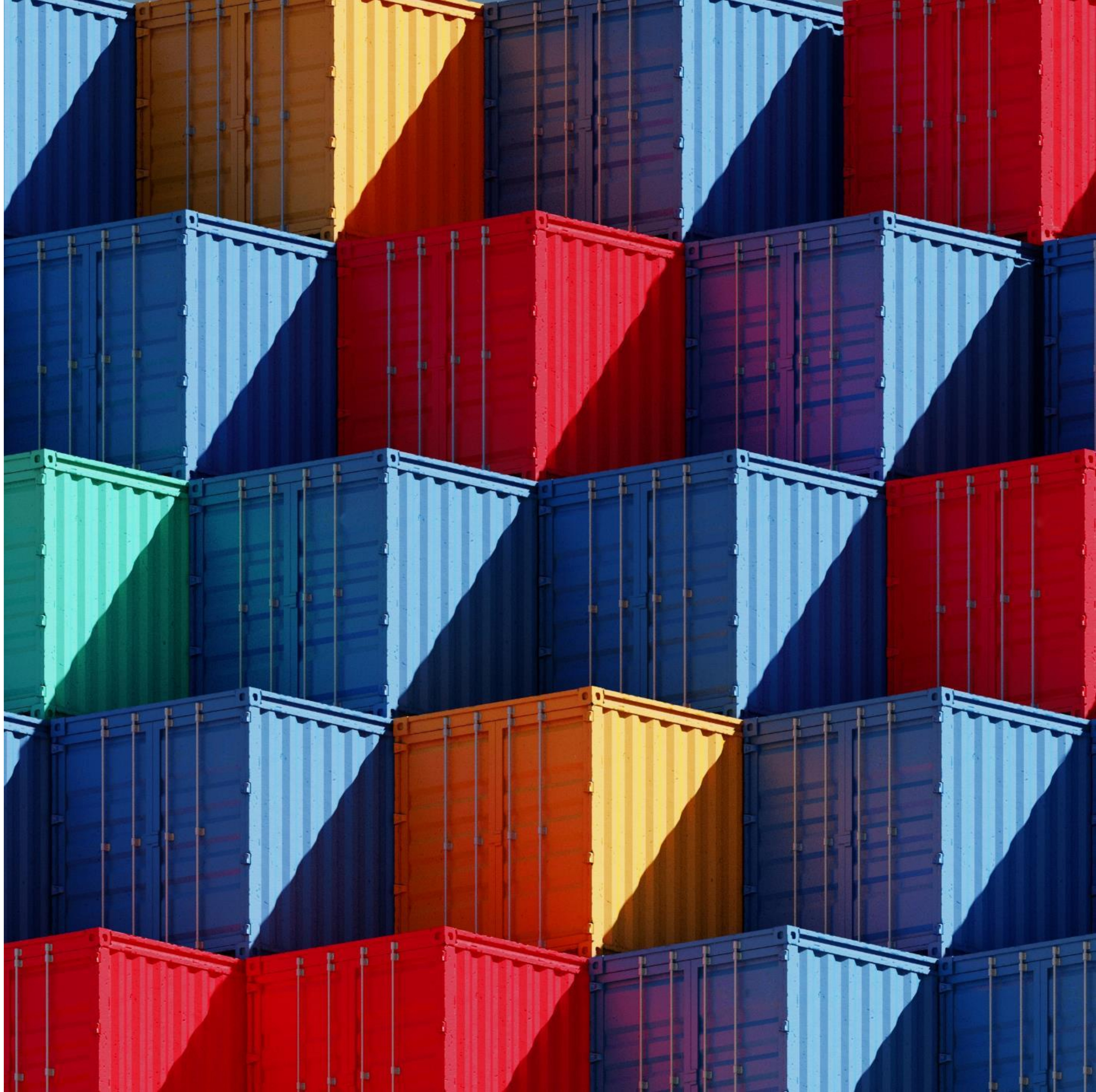
Asset-Liability Study Update

Colorado Public Employees' Retirement Association (PERA)

June 20, 2024



Projected Timeline

Present results to Board in June 2024

Meeting	Key Decision Points	Participants	Target Dates*
Planning Meeting	▪ Set timeline ▪ Define key metrics ▪ Discuss Board objectives ▪ Assess initial portfolio ideas ▪ Discuss assumptions	▪ Aon ▪ PERA Staff ▪ PERA Board	*September 2023*
Portfolio Meetings	▪ Refine constraints ▪ Determine portfolios for further study	▪ Aon ▪ PERA Staff	*October 2023 – January 2024*
Initial Results	▪ Model validation, discussion with plan actuary ▪ Identify "best ideas" ▪ Specify additional analysis	▪ Aon ▪ Segal ▪ PERA Staff ▪ PERA Board	*January 2024 – May 2024*
Board of Trustees Presentation	▪ Strategic asset allocation recommendations and rationale ▪ Select strategy ▪ Implementation considerations	▪ Aon ▪ PERA Staff ▪ PERA Board	*June 2024*
Post-Study Process	▪ Review active risk management and incentive compensation ▪ Implementation details ▪ Transition portfolio	▪ Aon ▪ PERA Staff	*Post-Study*

*Subject to change

Executive Summary

Recap of Last Meeting

- Analyzed three alternative asset allocation scenarios (3B-3D) to current policy
- Each scenario gradually offered a more diversified portfolio, with higher expected returns and lower volatility
- Discussion honed in on portfolio 3D - which studied diversification away from global equity and into private equity, real estate, private debt and real assets

Today's Goals

- Obtain guidance from Board on preferred policy (Current, 3B, 3C, 3D, other)
- Understand any additional information needed to make decision

Today's materials cover:

1. Recap Asset-Liability Results
2. Liquidity Analysis
3. Implementation Considerations

Next Steps

- Assuming consensus on desired policy, September meeting will seek approval for:
  - Specific Policy Recommendation
  - Benchmark Recommendations
- Following Policy approval, implementation plans will be initiated

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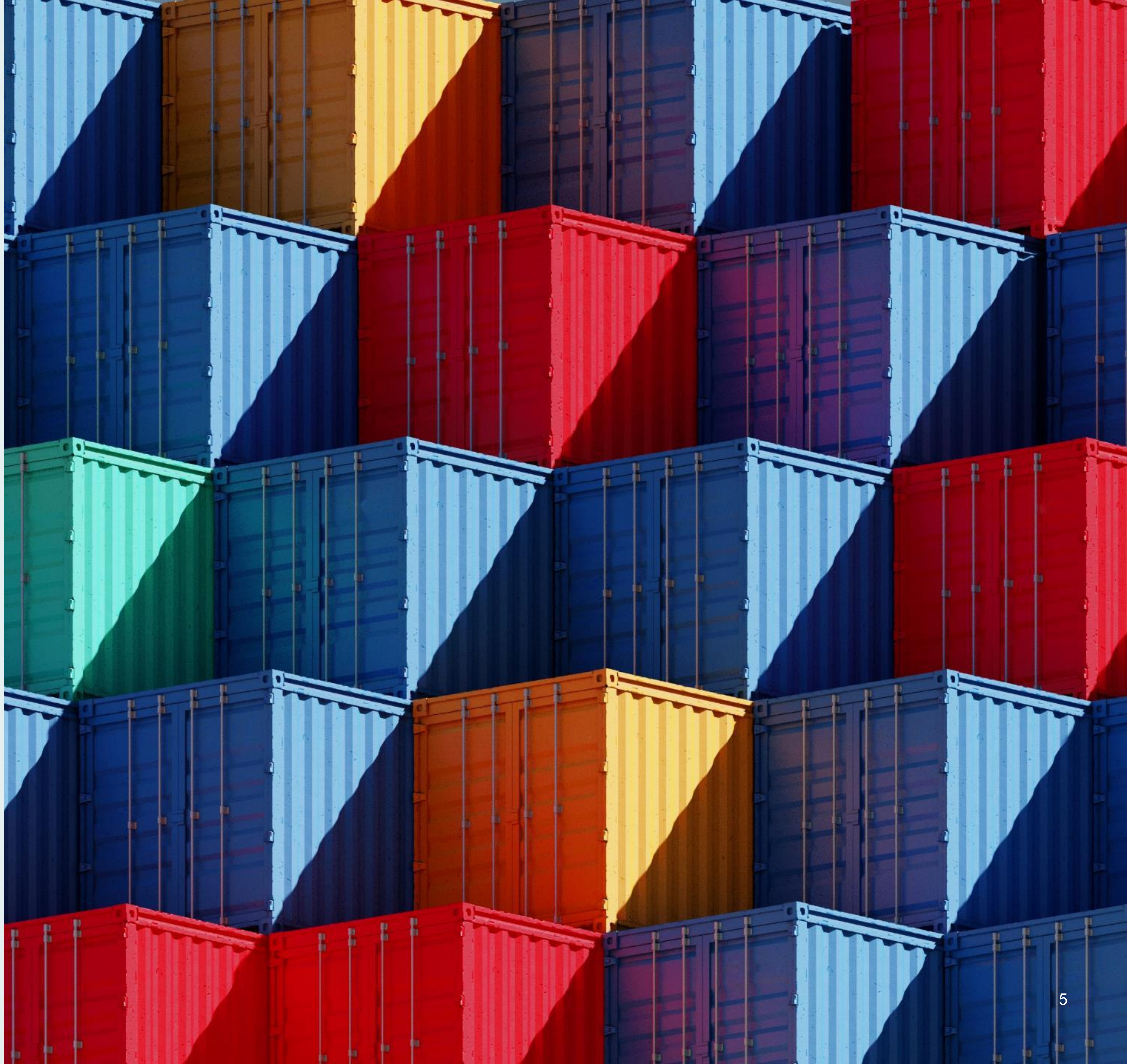
Recap of Asset-Liability Study Results



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Executive Summary

Initial findings from Asset-Liability Study

Current asset allocation is in the reasonable range given the actuarial return target and funding goal

- Aon capital market assumptions show expected return near 7.25% at most points over recent market cycle[1]
- Lower return-seeking allocation may not reach 100% funding within 30 years
- Higher return-seeking allocation may accelerate funded ratio growth, but with more severe downside tail outcomes
- Different asset allocations have modest impact on projected contribution rates and probabilities of triggering Automatic Adjustment Provision[2]

Portfolios with additional diversification can slightly improve expected funded ratio growth

- While the current portfolio is well diversified, additional allocations to private equity, real assets, and private debt can enhance expected return, reduce volatility, and improve probability of reaching 100% funding
- Benefits of diversification should be considered relative to cost of implementation and desired liquidity

Current and alternative portfolios have sufficient liquidity over 10 years in the scenarios studied

- Liquidity becomes more stressed in severe economic scenarios due to declining asset values
- A more diversified, less liquid portfolio is projected to have 3-6% higher allocation to illiquid and quasi-liquid assets than the current portfolio in the modeled stress tests

Expected returns are using AIUSA 30-Year Capital Market Assumptions (CMAs). CMAs contain projections about future returns on asset classes. Our CMA projections are designed to reflect the typical cost of implementing an investment program. Expected returns are calculated using weighted allocations of the underlying CMAs. Expected Returns are geometric (long-term compounded; rounded to the nearest decimal) assuming portfolio weights are rebalanced annually. Expected returns presented are models and do not represent the returns of an actual client account. Your actual returns may differ from model returns presented based on your plan's individual fees/expenses. Aon's advisory fees are described in Part 2A of Aon's Form ADV. Not a guarantee of future results. See appendix for capital market assumptions disclosure pages.
Projections assume a constant 7.25% discount rate for pension liabilities for all investment policies studied and reflect actual investment returns through September 30, 2023. Projections in this material include estimated expenses paid from plan assets, estimated to be $44.1 million for fiscal year ending 12/31/2023, which is assumed to be inclusive of investment management fees. These are increased with inflation for projection purposes. Actual fees and expenses may differ from those presented. See Appendix for details on assumptions and methods used.
Diversification does not ensure a profit, nor does it protect against loss of principal. Diversification among investment options and asset classes may help to reduce overall volatility.

Investment Strategies Studied

Studied a range of asset allocations and portfolio diversification opportunities

Asset Allocation Analysis of higher and lower risk/return strategies

1
60% Return-Seeking

2
70% Return-Seeking

3 / 3A
Current 77% Return-Seeking

3B
Increase Private Equity to 10%

3C
Diversify w/ Current Asset Classes

3D
Include Private Debt in Alternatives

4
80% Return-Seeking

5
90% Return-Seeking

Portfolio Efficiency Analysis of potential diversification opportunities

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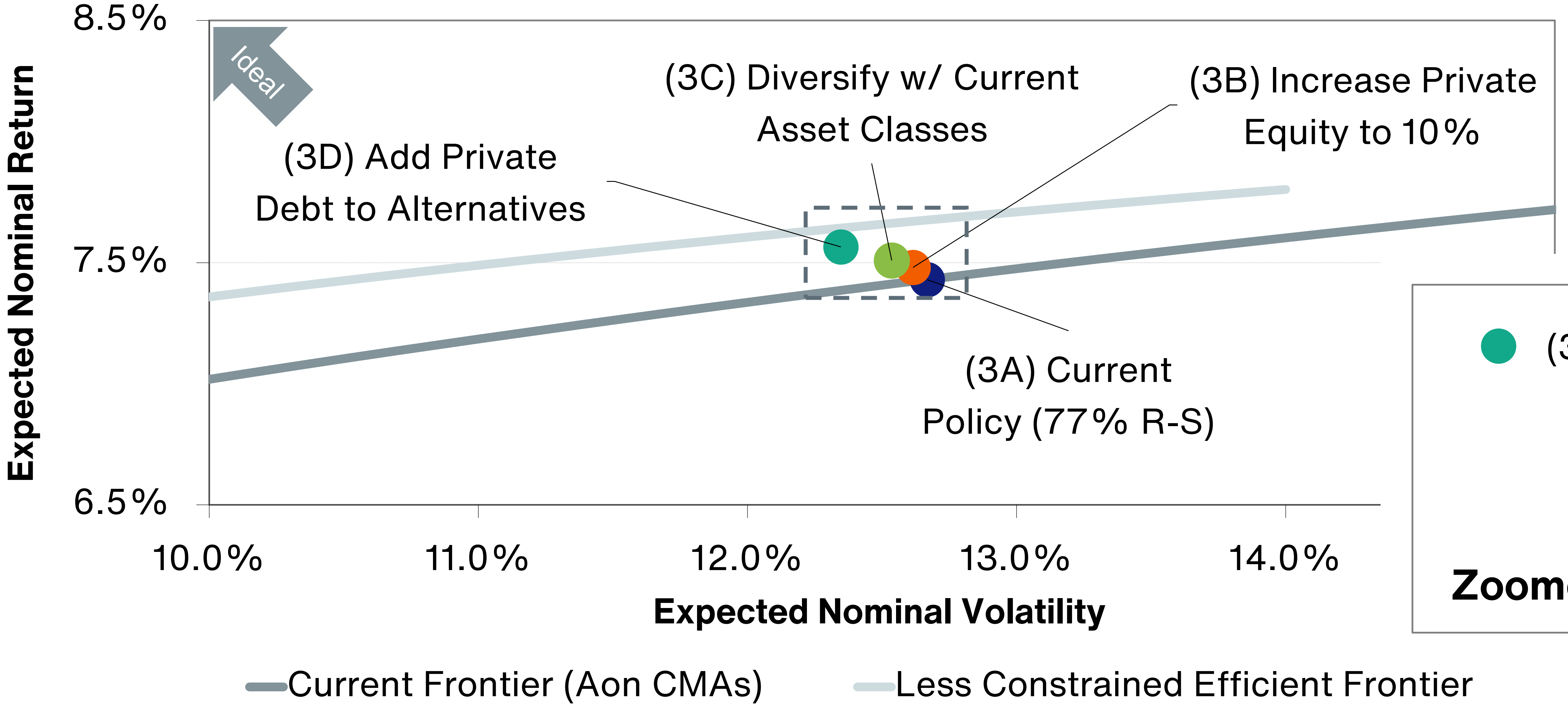
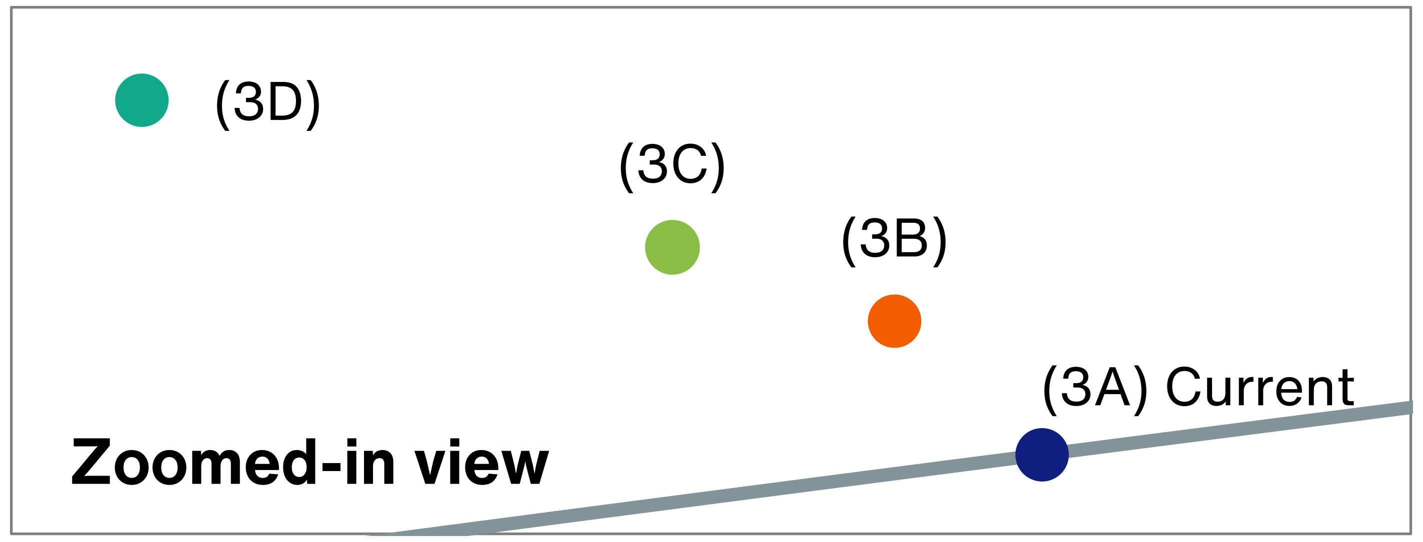
Portfolio Efficiency Analysis – Portfolios Studied

Portfolio “3D” improves expected risk-adjusted return



Key Observations:

- Current portfolio is well diversified
- Portfolios A-D reflect gradually more diversified options with higher expected returns and lower volatility



	Portfolio Metrics			Return-Seeking (R-S) Assets								Risk-Reducing Assets
				Equity		Real Estate		Alternatives				Inv. Grade Bonds
	Expected Nominal Return[1]	Expected Nominal Volatility	Sharpe Ratio	Public Equity	Private Equity	Core Real Estate	Non-Core Real Estate	Liquid Alts	Illiquid R-S Fixed Income	Other Real Assets[2]	Oppor-tunity[3]	Core Bonds
(3A) Current Policy (77% R-S)	7.43%	12.67%	0.26	54.0%	8.5%	4.3%	4.3%	1.7%	-	1.7%	2.7%	23.0%
(3B) Increase Private Equity to 10%	7.48%	12.62%	0.26	**52.5%**	**10.0%**	4.3%	4.3%	1.7%	-	1.7%	2.7%	23.0%
(3C) Diversify w/ Current Asset Classes	7.51%	12.54%	0.26	**51.0%**	10.0%	**5.0%**	**5.0%**	**-**	-	**3.3%**	2.7%	23.0%
(3D) Add Private Debt to Alternatives	7.56%	12.35%	0.27	**51.0%**	10.0%	5.0%	5.0%	-	**3.0%**	**3.0%**	**-**	23.0%

Alternatives are constrained to 6% (same as current)

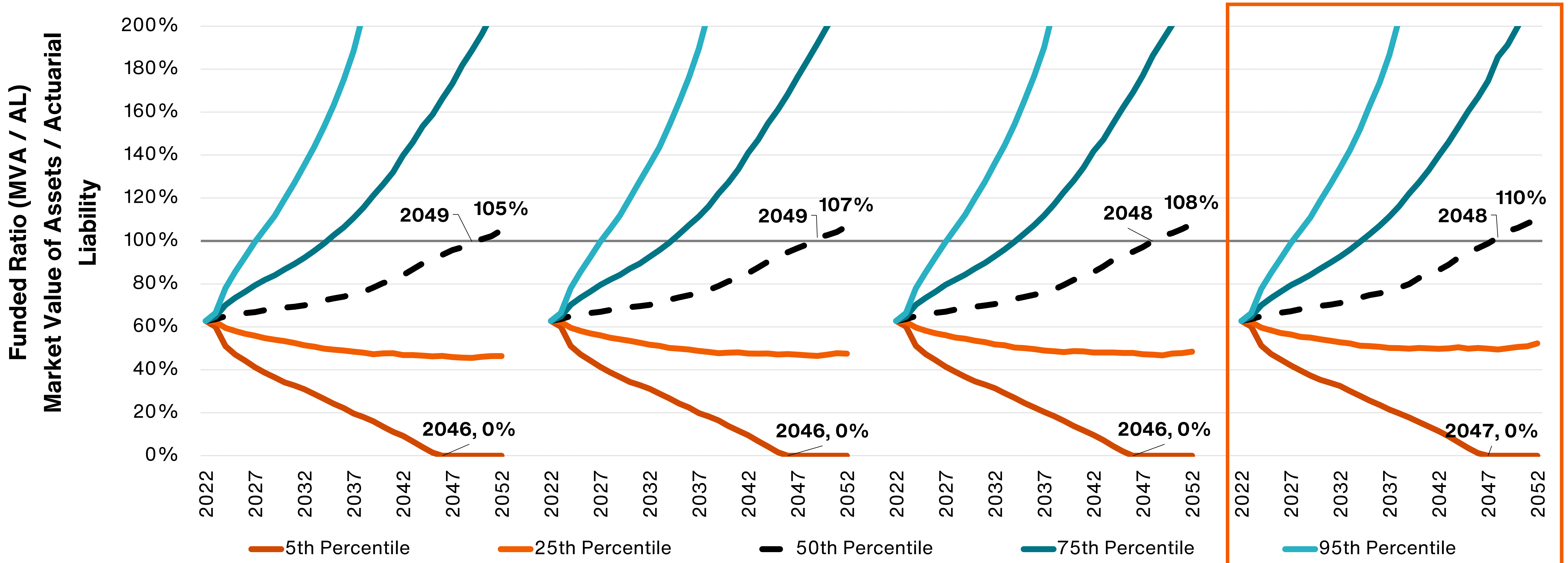
[1] Expected returns are using AIUSA Q4 2023 30-Year Capital Market Assumptions (CMAs) as of 9/30/2023. CMAs contain projections about future returns on asset classes. Our CMA projections are designed to reflect the typical cost of implementing an investment program. Expected returns are calculated using weighted allocations of the underlying CMAs. Expected Returns are geometric (long-term compounded; rounded to the nearest decimal) assuming portfolio weights are rebalanced annually. Expected returns presented are models and do not represent the returns of an actual client account. Your actual returns may differ from model returns presented based on your plan’s individual fees/expenses. Aon's advisory fees are described in Part 2A of Aon's Form ADV. Not a guarantee of future results. See appendix for capital market assumptions disclosure pages.

[2] Other real assets modeled as 50% infrastructure / 25% timber / 25% farmland

[3] Opportunity modeled as 76% global equity / 24% core fixed income

Portfolio Efficiency Analysis – Projected Funded Ratio

Portfolio "3D" improves expected funded ratio growth



Strategy	(3A) Current Target (77% R-S)			(3B) Increase Private Equity to 10%			(3C) Add'l Diversification (Current Asset Classes)			(3D) Add Private Debt in "Opportunity" Alloc		
Year	**2032**	**2042**	**2052**	**2032**	**2042**	**2052**	**2032**	**2042**	**2052**	**2032**	**2042**	**2052**
5th Percentile	31%	9%	0%	31%	10%	0%	31%	10%	0%	33%	11%	0%
25th Percentile	51%	47%	46%	52%	48%	48%	52%	48%	48%	53%	50%	52%
50th Percentile	70%	84%	105%	70%	85%	107%	71%	86%	108%	71%	86%	110%
75th Percentile	92%	140%	>200%	93%	141%	>200%	93%	142%	>200%	93%	140%	>200%
95th Percentile	135%	>200%	>200%	136%	>200%	>200%	136%	>200%	>200%	134%	>200%	>200%
Probability > 100%	21%	43%	52%	22%	43%	53%	22%	44%	53%	21%	44%	54%

Projections assume a constant 7.25% discount rate for pension liabilities for all investment policies studied and reflect actual investment returns through September 30, 2023. Projections in this material include estimated expenses paid from plan assets, estimated to be $44.1 million for fiscal year ending 12/31/2023, which is assumed to be inclusive of investment management fees. These are increased with inflation for projection purposes. Actual fees and expenses may differ from those presented.

Key Observation

- Portfolios A-D reflect gradually more diversified options which provide incremental improvements in expected funded ratio growth

Asset-Liability Projection Analysis

Summary of results

Portfolios	Portfolio Metrics (30-year CMAs)			Financial Results						
	Expected Nominal Return[1]	Expected Nominal Volatility	Sharpe Ratio	Funded Ratio (MVA / AL)			30-year Ending Contribution Percentage Rate as % of Payroll		Probability of Contribution Rate Increase under AAP	
				30-year Expected[2]	Expected Full Funding Year[3]	Downside Depletion Year[4]	Expected[2]	Downside[5]	By 12/31/2025	By 12/31/2030
(3A) Current Policy (77% R-S)	7.43%	12.67%	0.26	105%	2049	2046	26%	48%	59%	61%
(3B) Increase Private Equity to 10%	7.48%	12.62%	0.26	107%	2049	2046	26%	48%	59%	61%
(3C) Diversify w/ Current Asset Classes	7.51%	12.54%	0.26	108%	2048	2046	26%	48%	59%	60%
(3D) Add Private Debt to Alternatives	7.56%	12.35%	0.27	110%	2048	2046	25%	47%	59%	60%

Key Observations:

- Current portfolio is well diversified
- Portfolios with additional diversification provide incremental improvements in expected funded ratio growth
  - Additional allocations to private equity, real assets, and private debt can enhance expected return, reduce volatility, and improve probability of reaching 100% funding
- Different portfolios have modest impact on projected contribution rates and probabilities of triggering Automatic Adjustment Provision

Projections assume a constant 7.25% discount rate for pension liabilities for all investment policies studied and reflect actual investment returns through September 30, 2023.

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[2] Expected = 50th percentile outcome or central expectation across all 5,000 simulations

[3] Expected Full Funding Year =Year the fund is projected to reach 100% funded in the 50th percentile outcome or central expectation across all 5,000 simulations

[4] Downside Depletion Year = Year the fund is projected to become insolvent in the 5th percentile outcome across all 5,000 simulations

[5] Downside = 95th percentile outcome across all 5,000 simulations

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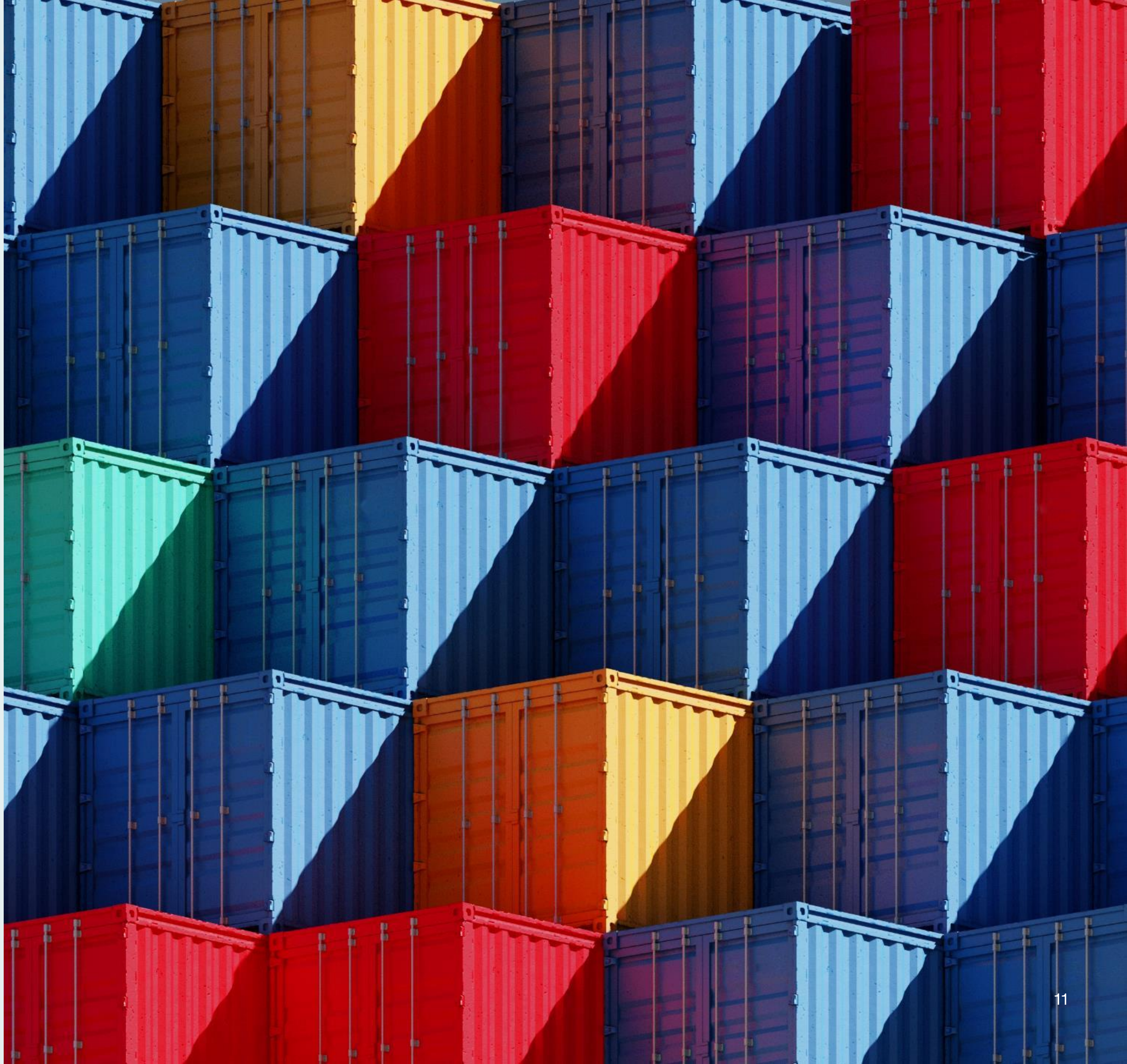
Foreign Currency Risk Discussion



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Foreign Currency Risk
Summary

Aon does not recommend hedging equity currency risk at the total fund level; however, we do believe it can be a useful tool in an active manager's toolkit assuming proper due diligence and monitoring

Aon does not recommend any change to PERA's current practices and policies regarding currency hedging

Why Hedge Currency?	Why Not?
• Currency impacts are difficult to forecast	• Long-term currency hedging returns tend to converge toward zero
• Risk is likely to be unrewarded	• Currency risk is a relatively small proportion of the overall portfolio risk
• Will likely reduce overall equity volatility	• Cash flow volatility is undesirable
• May be a source of alpha	• Implementation is deemed too costly and/or complex

Foreign Currency Risk
Background and Conclusions

PERA Policy indicates foreign currency risk management will be evaluated during the asset-liability study and considered during the determination of asset allocation

- PERA's primary exposure to foreign currency risk resides within the Global Equity asset class via approximately 21%* exposure to non-U.S. equity securities
- Currently, PERA does not employ a currency hedge at the Total Fund level; rather, PERA allows currency hedging to occur via active investment management according to applicable investment guidelines

Aon does not recommend any changes to PERA's approach to equity foreign currency risk management

- Though currency hedging is expected to reduce volatility, we do not believe the benefits outweigh the below considerations
  - Volatility improvement is expected to be minimal at the Total Fund level, as currency risk is a small portion of overall risk, and especially given PERA's diversified portfolio
  - Currency hedging returns tend to converge toward zero over the long-term
  - Currency hedging comes at an explicit cost and requires additional resources
- Aon's capital market assumptions include the expected impact of currency risk, and thus the asset-liability study includes this risk in the presented and evaluated results which are used to inform asset allocation decisions
- Aon supports currency hedging as a potential tool for active managers, given proper due diligence and monitoring

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*Based on 12/31/2023 PERA Global Equity allocation (55%) at non-U.S. market weight (approx. 39% of global equity market)

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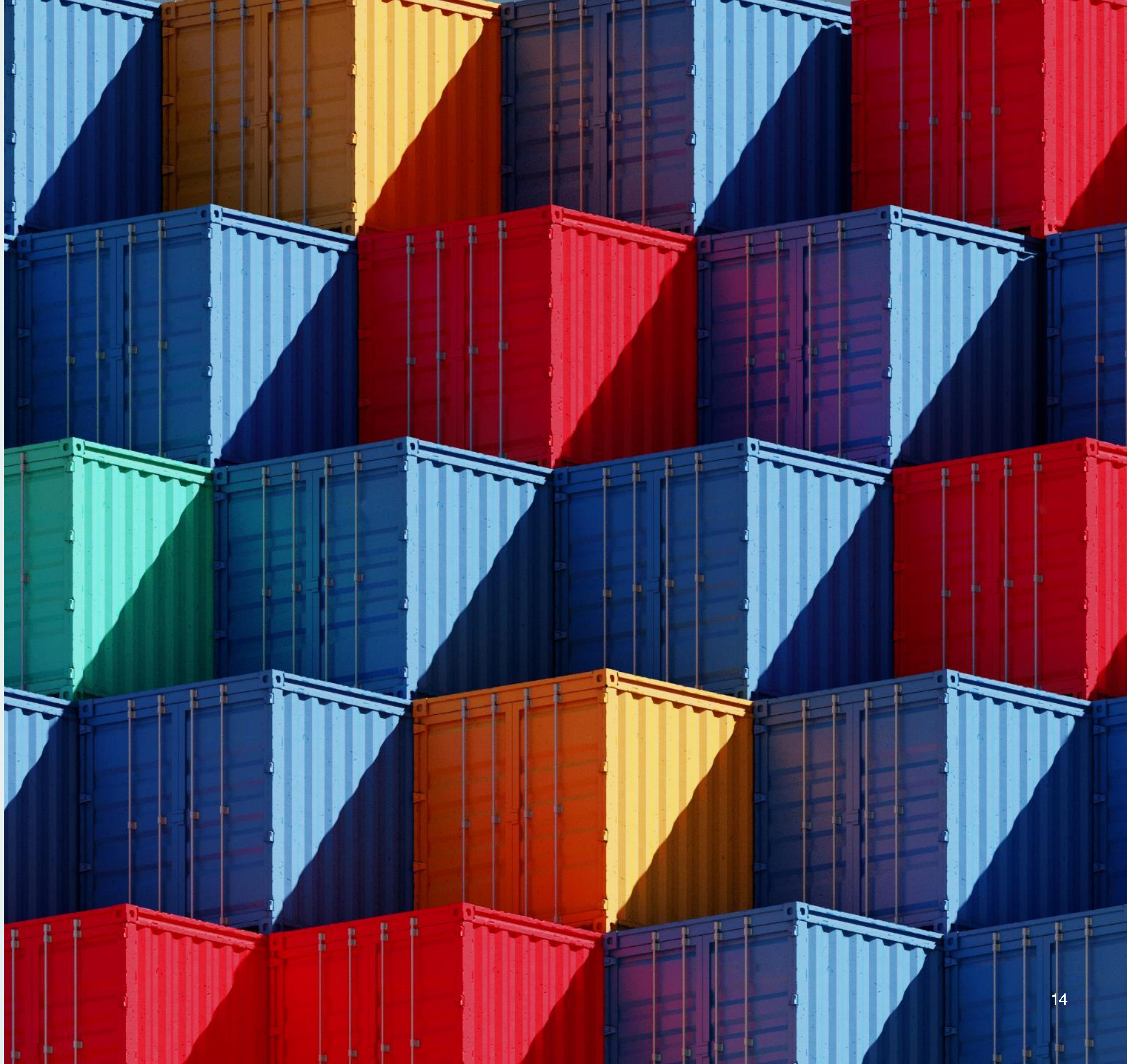
Liquidity Analysis



Liquidity Analysis
Framework for analysis

PERA's liquidity analysis is performed under the modeled portfolios: (3A) Current Policy (77% R-S) and (3D) Add Private Debt to Alternatives

Intended as a stress-testing model, incorporating the profile of the liabilities as well as expected future contributions

Uses different scenarios for economic environments and other relevant events

Shows how the portfolio's liquidity profile could evolve with a given investment strategy

We categorized investments by liquidity into five buckets

Liquid (Risk-Reducing Assets): Less than 3 months needed for return of capital (e.g., publicly traded securities)

Liquid (Return-Seeking Assets): Less than 3 months needed for return of capital (e.g., publicly traded securities)

Quasi-Liquid: Typical lock-up of 3–12 months; Conservatively, we assumed a 1-year lock-up in most economic environments, 2 years in a Recession scenario, and 3 years in a Dark Skies scenario (e.g., many hedge funds, open-end real assets)

Illiquid: Potential lock-up of 5–10 years, depending on economic environment (e.g., closed-end real assets)

Illiquid: Potential lock-up of 10+ years (e.g., typical private equity)

This is intended to be a conservative approximation of the actual liquidity properties of the assets

Liquidity Analysis

Asset allocation, liquidity category, and economic scenarios modeled

Asset allocations and liquidity categories modeled

Liquidity Category	Asset Class	Lower bound (3A) Current Policy (77% R-S)	(3B) Increase Private Equity to 10%	(3C) Diversify w/ Current Asset Classes	Upper bound (3D) Add Private Debt to Alter-natives
Liquid (Risk-Reducing Assets)	Core Fixed Income	23.00%	23.00%	23.00%	23.00%
	Subtotal	**23.00%**	**23.00%**	**23.00%**	**23.00%**
Liquid (Return-Seeking Assets)	Public Equity	54.00%	52.50%	51.00%	51.00%
	Subtotal	**54.00%**	**52.50%**	**51.00%**	**51.00%**
Quasi-Liquid Assets	Core Real Estate	4.25%	4.25%	5.00%	5.00%
	Liquid Alternatives	1.65%	1.65%	--	--
	Opportunity	2.70%	2.70%	2.70%	--
	Subtotal	**8.60%**	**8.60%**	**7.70%**	**5.00%**
Illiquid 5-10 Years	Non-Core Real Estate	4.25%	4.25%	5.00%	5.00%
	Private Debt	--	--	--	3.00%
	Subtotal	**4.25%**	**4.25%**	**5.00%**	**8.00%**
Illiquid 10+ Years	Private Equity	8.50%	10.00%	10.00%	10.00%
	Other Real Assets	1.65%	1.65%	3.30%	3.00%
	Subtotal	**10.15%**	**11.65%**	**13.30%**	**13.00%**
Totals	Asset Allocation	100.00%	100.00%	100.00%	100.00%
	Quasi + Illiquid Assets	**23.00%**	**24.50%**	**26.00%**	**26.00%**

Economic scenarios modeled

Base Case Scenario

- Markets perform consistent with Aon's Capital Market Assumptions (~50th percentile)

Recession Scenario

- Somewhat pessimistic outlook for the markets
- Return-seeking assets decline in the first two years with a modest rebound in later years

Dark Skies Scenario

- Very pessimistic outlook for markets
- Return-seeking assets decline significantly
- The value of public equities declines approximately 50% over three years, without an immediate rebound

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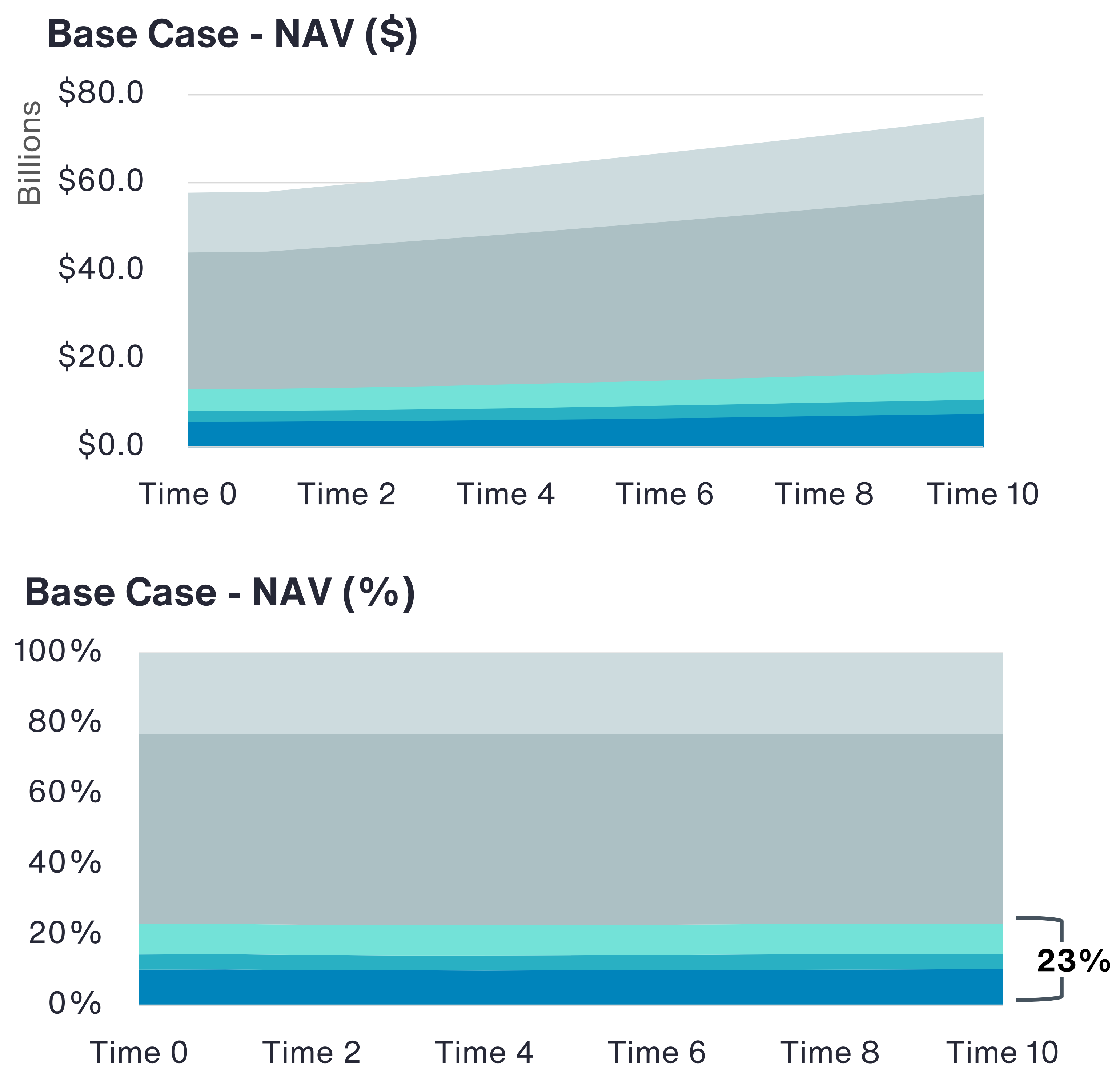
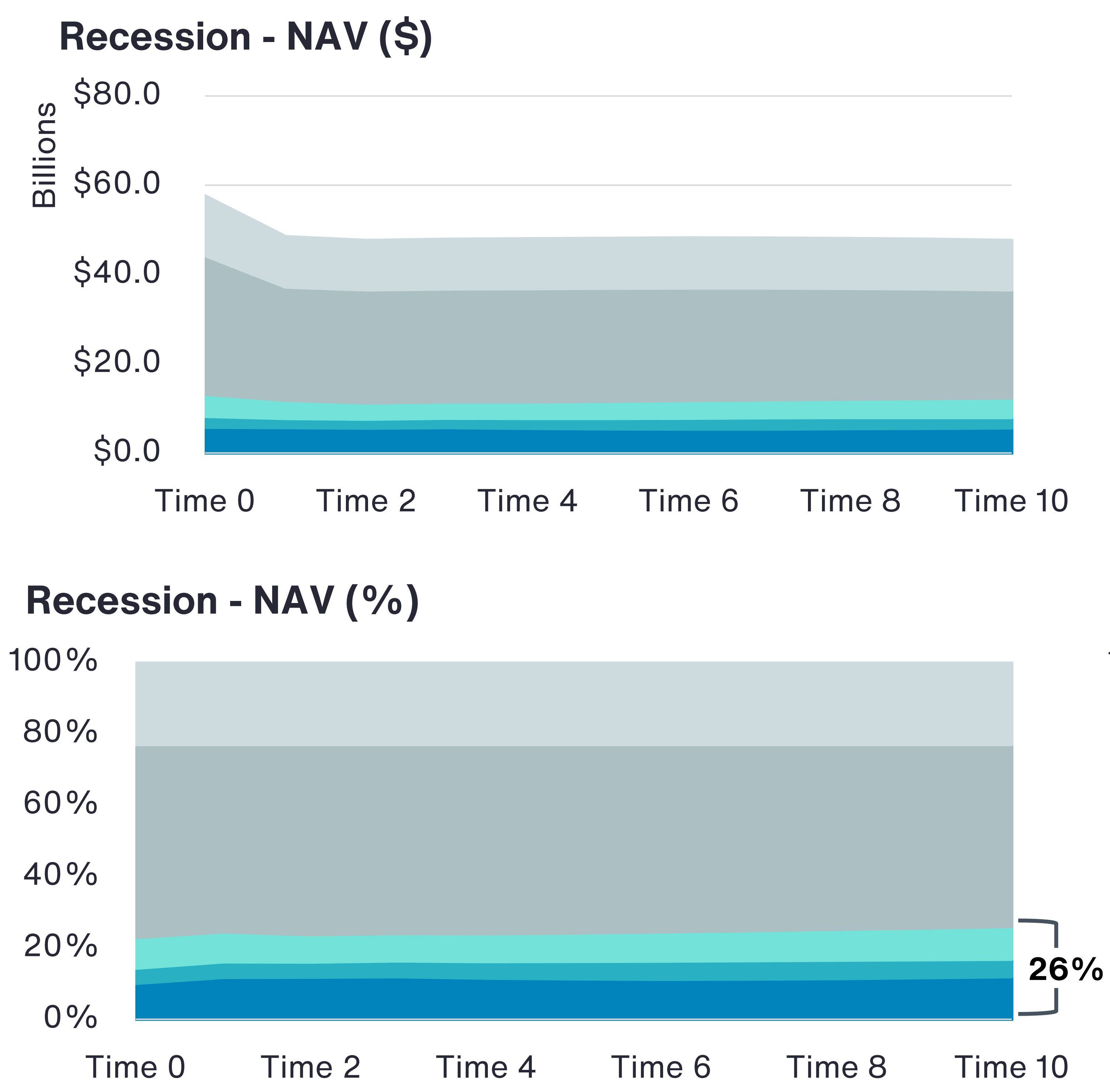
Liquidity Analysis for Portfolio (3A) Current Policy

PERA has sufficient liquidity in the modeled scenarios

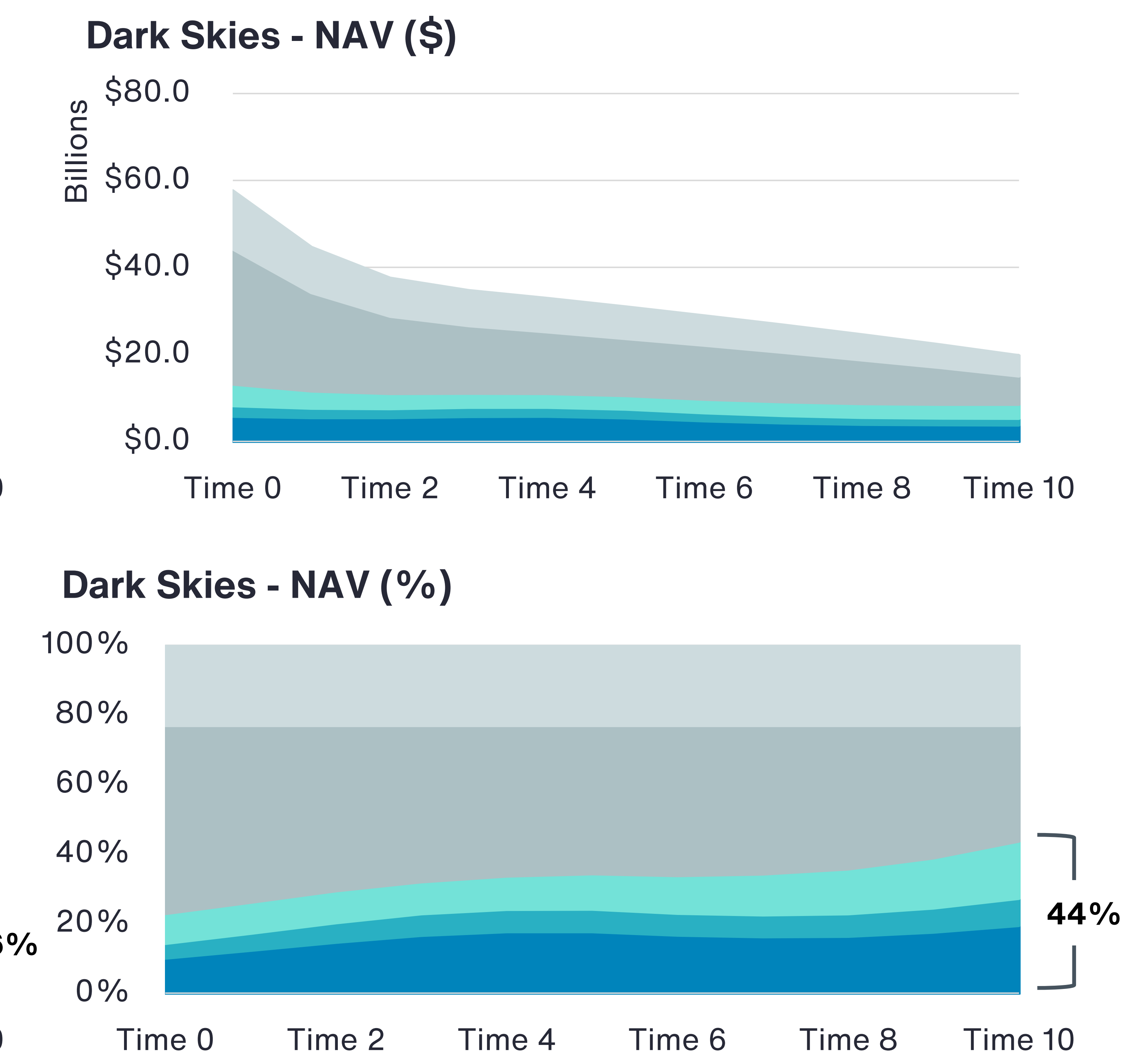
Base Case



Recession



Dark Skies



■ Illiquid: 10+ Years ■ Illiquid: 5-10 Years ■ Quasi-Liquid ■ Liquid (Return-Seeking Assets) ■ Liquid (Risk-Reducing Assets)

Note: Time 0 represents a starting point of September 30, 2023

Projections assume a constant 7.25% discount rate for pension liabilities for all investment policies studied and reflect actual investment returns through September 30, 2023. Projections in this material include estimated expenses paid from plan assets, estimated to be $44.1 million for fiscal year ending 12/31/2023, which is assumed to be inclusive of investment management fees. These are increased with inflation for projection purposes. Actual fees and expenses may differ from those presented.

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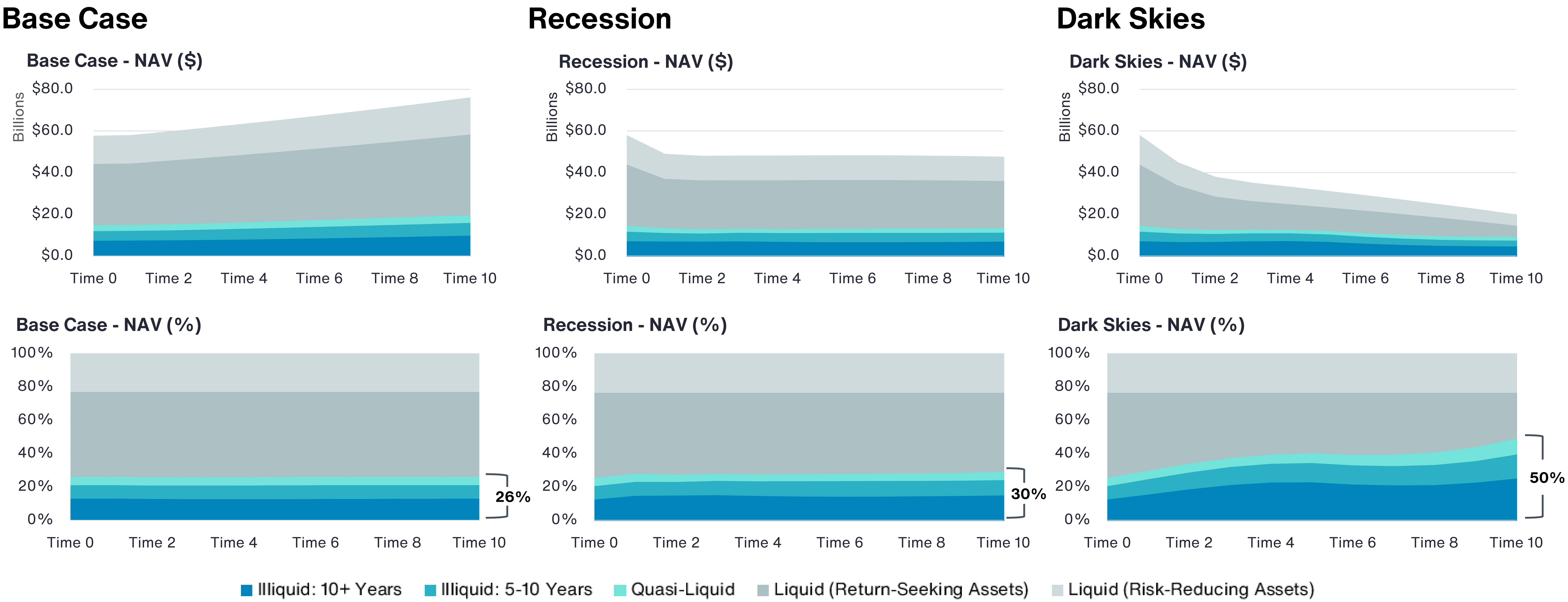
Liquidity Analysis for Portfolio (3D) Add Private Debt to Alternatives

PERA has sufficient liquidity in the modeled scenarios



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Liquidity Analysis – Key Observations

- Current and alternative portfolios have sufficient liquidity over 10 years in the scenarios studied
- Liquidity becomes more stressed in severe economic scenarios due to declining asset values
  - Declining assets and range-bound contribution rates (assuming no change to the contribution policy) can result in roughly half of the portfolio becoming illiquid or quasi-liquid
- Portfolio 3D is projected to have 3-6% higher allocation to illiquid and quasi-liquid assets than the current portfolio in the modeled stress tests

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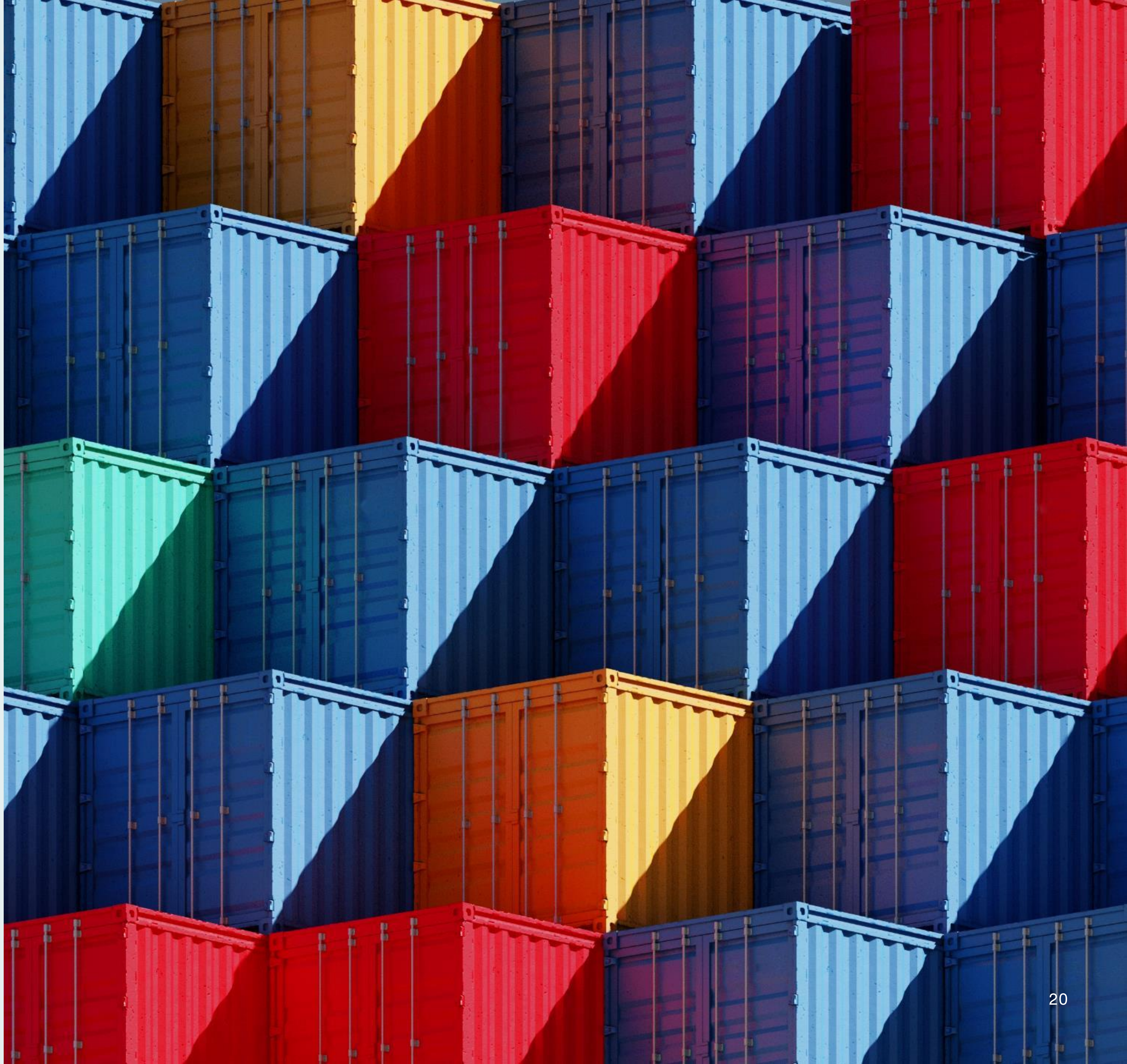
Implementation Considerations



Implementation Considerations

Summary of Potential Changes

Based on prior Board meeting discussion, the implementation section focuses on changes needed to move from Current to Portfolio 3D

Asset Class	Current Policy	Portfolio 3D	Policy Change	Rationale
Global Equity	54.0%	51.0%	-3.0%	• Maintain significant exposure to growth asset class and PERA area of competitive advantage • Modest reduction of largest risk (volatility) contributor
Private Equity	8.5%	10.0%	+1.5%	• Enhance return, diversification
Real Estate	8.5%	10.0%	+1.5%	• Improve diversification and long-term inflation protection
Alternatives	6.0%	6.0%	--	
- Hedge Funds	1.65%	--	-1.65%	• Remove small allocation to more complex exposure
- Real Assets	1.65%	3.0%	+1.35%	• Improve diversification, inflation protection and return stabilization
- Opportunistic	2.70%	--	-2.7%	• 'Graduate' credit exposure to dedicated private debt allocation • Remove small undefined exposure
- Private Debt	--	3.0%	+3.0%	• Improve diversification, provide income-oriented returns and downside protection
Fixed Income	23.0%	23.0%	--	
Total Fund	**100.0%**	**100.0%**	**--**	• **Improve expected risk/reward and funded ratio growth with no liquidity concerns**

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Implementation Considerations
Total Fund Considerations

Impact of Moving from Current to Portfolio 3D	
Investment Impact	
Expected Return	+0.13%
Expected Risk	-0.32%
Expected Sharpe Ratio	+0.01
Liquid Exposure	-3.0%
Asset-Liability Projection Impact	
Expected 30-Year Funded Ratio Improvement	+5%
Impact on Expected Time to Full Funding	-1 Year
Implementation Considerations	
Annual Investment Management Fees ($M/%)*	+$15M / +2.5bps
Annual Carried Interest ($M/%)*	+$16M / +2.6bps
One Time Transition Fees*	$2M / 0.4bps
Estimated time to New Targets	Approx. 3 year**

*Estimates based on asset class expected fees applied to the current long-term policy and the portfolio 3D policy targets. Dollar estimates are based on 12/31/2023 Total Fund market value. Actual costs will vary and depend on current market conditions and portfolio positioning.
**Assuming normal market conditions

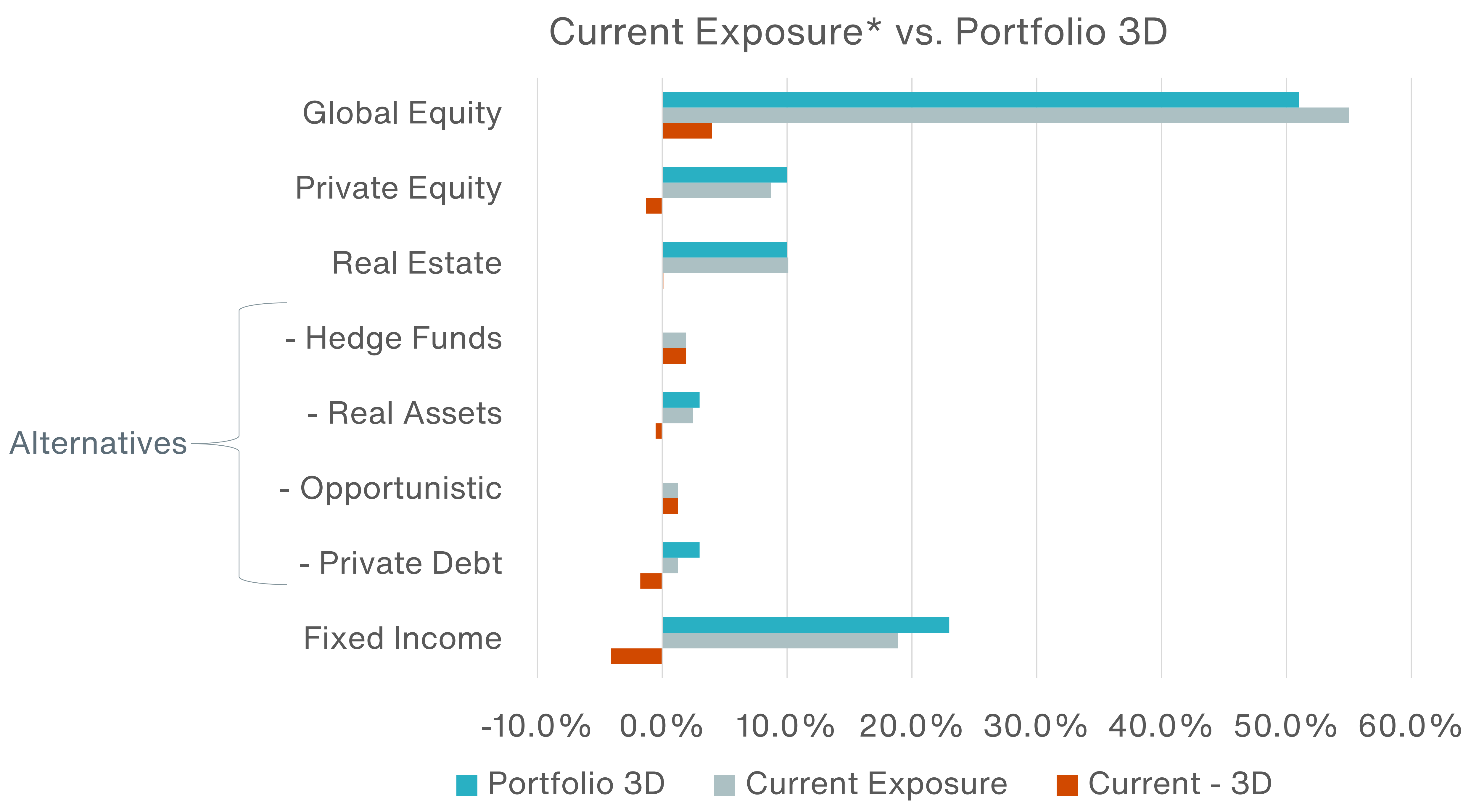
Observations:

- Portfolio 3D expected to improve the risk/reward trade-off and time to full funding, with minimal impact to liquidity
- Modestly higher investment management fees; however, expected returns are net of investment management fees
- Time to long-term target approximated to take 3 years, but will vary based on market environment
- Certain outgoing Alternatives investments may take longer to wind down prudently, but are expected to be a small portion of the Total Fund

Implementation Considerations
Asset Class Comments

Observations:

- New and greater allocations can be built from existing resources, infrastructure and relationships
- Alternative changes most complex and would include a period of portfolio construction and performance evaluation transition
- Overall, anticipate approximately 2-3 years to reach new policy targets, assuming normal market conditions and excluding certain existing opportunistic investments



Increased/Added Categories	
Private Equity	• Anticipate 1-3 years to new target
Real Estate	• Currently at new target
Real Assets	• 1-2 years to new target given existing commitments
Private Debt	• 2-3 years depending on transferability of existing investments

Eliminated Categories	
Hedge Funds	Orderly liquidation may take 2-3 years
Certain Opportunistic Investments	• Many may transfer to Private Debt allocation • Those not determined to fit will be wound down • Several early in investment life; thus, may take several years before completely out of portfolio

*Current exposures reflect values as of 12/31/2023 as reported by Northern Trust

Summary Conclusions

Today's Goal: Identify Board's preferred long-term Policy

- Current asset allocation is in the reasonable range given the actuarial return target and funding goal
- Studied portfolios show modest improvement in expected funded ratio growth and risk/reward characteristics via additional diversification, with Portfolio 3D showing greatest improvements from current
- Current and studied portfolios have sufficient Liquidity over 10-years in scenarios in normal and stressed scenarios
- PERA resources and infrastructure currently in place can accommodate alternative portfolios and expect it would take approximately 1 – 3 years to reach portfolio 3D targets in normal market conditions

Next Steps

- Assuming Board consensus, specific Policy and Benchmark recommendations will be brought to the Board in September

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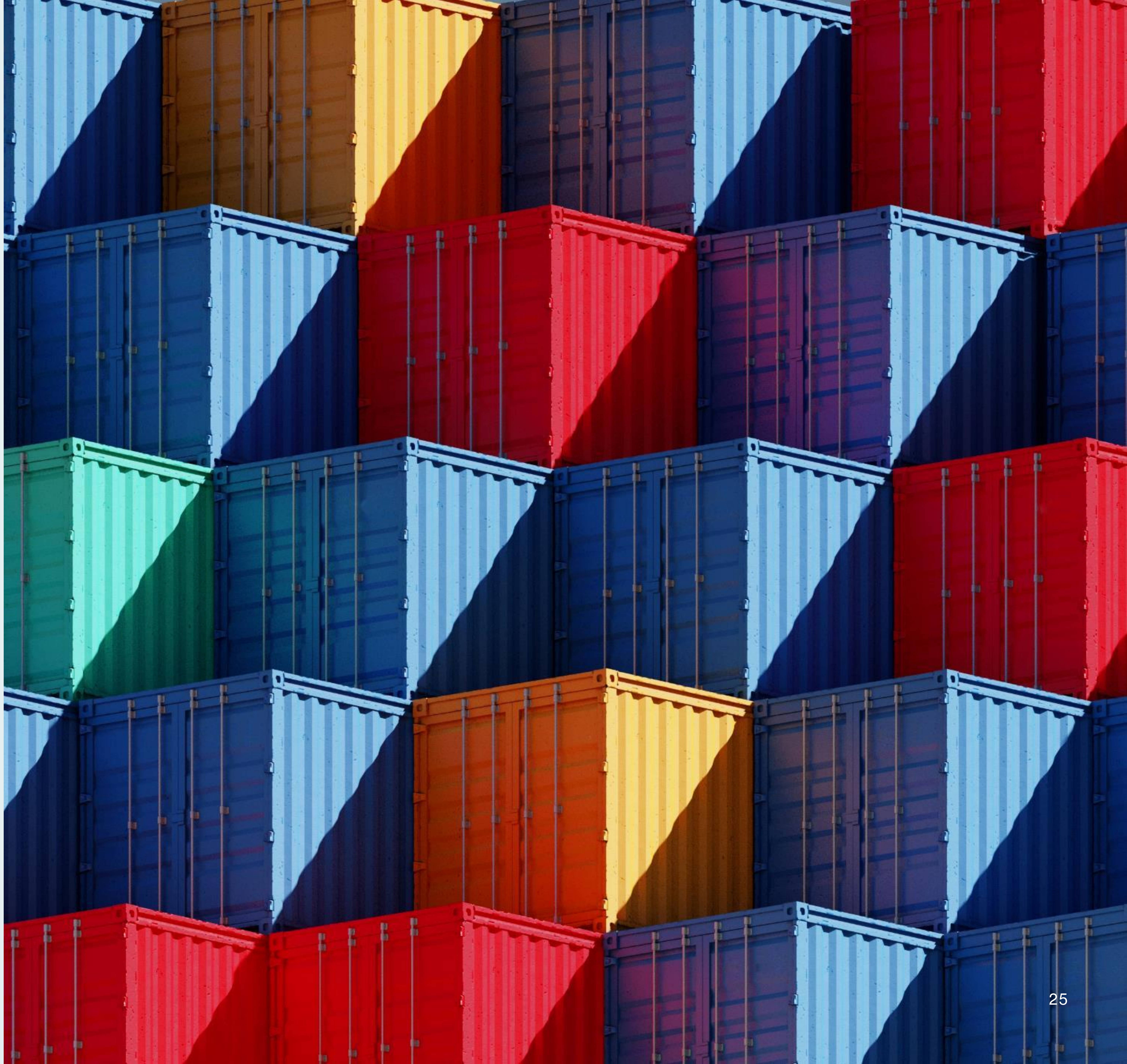
Appendix

- Background
- Additional Analysis
- Actuarial Assumptions and Methods
- Capital Market Assumptions
- Economic Scenario Assumptions
- About this Material



Background

Section 5: Appendix

Colorado PERA Current State

Aggregate of 5 division trusts estimated to be 63% funded as of September 30, 2023

Asset-Liability Snapshot ($, Billions) Aggregate of 5 division trusts	12/31/2022	Estimated 9/30/2023
Actuarial Liabilities[1]	$87.2	$88.7
Estimated Market Value of Assets[2]	$54.7	$56.1
Market Value of Assets Funded Ratio	62.7%	63.2%
Actuarial Value of Assets	$60.9	
Actuarial Value of Assets Funded Ratio	69.9%	

Target Asset Allocation ($, Billions)	Target %	Estimated 9/30/2023
Return-Seeking Assets		
- Public Equity	54%	$30.3
- Private Equity	9%	$4.8
- Liquid Alternatives	2%	$0.9
- Core Real Estate	4%	$2.4
- Non-Core Real Estate	4%	$2.4
- Other Real Assets[3]	2%	$0.9
- Opportunity	3%	$1.5
- **Total Return-Seeking Assets**	**77%**	**$43.2**
Risk-Reducing Assets		
- Core Bonds	23%	$12.9
- **Total Risk-Reducing Assets**	**23%**	**$12.9**
Total	**100%**	**$56.1**

Key Observations:

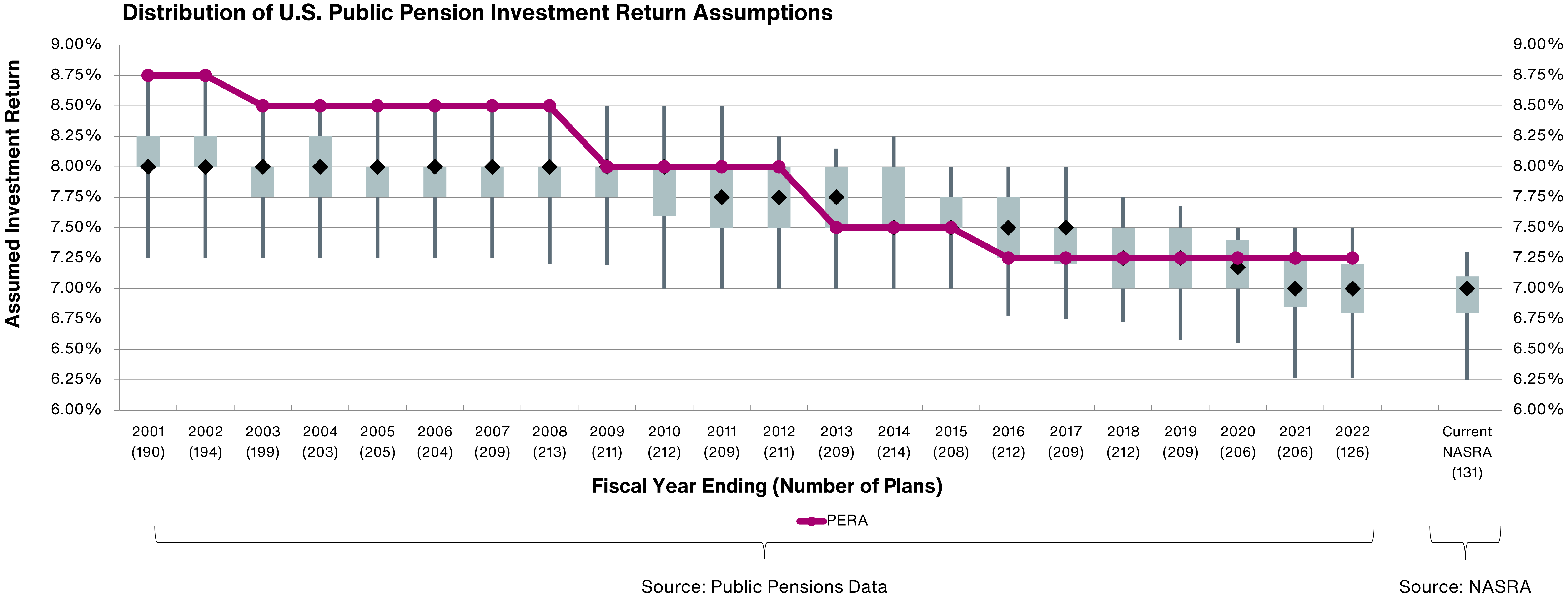
- The starting point of the asset-liability study is the December 31, 2022 actuarial valuation
- Incorporating market experience through September 30, 2023 is expected to increase the funded ratio modestly
- The Actuarial Value of Assets (AVA) smooths investment gains/losses over four years and is a component in setting funding of the division trusts
  - o There are historical investment losses that have not yet been smoothed into the AVA calculation, creating potential headwinds for the AAP

[1] Liability values as of September 30, 2023 based on actuarial projections provided by plan actuary as of 12/31/2022 projected on an open group basis
[2] Total assets as of September 30, 2023 based on the 12/31/2022 market value of assets in the actuarial valuation report projected forward based on a year-to-date asset return of 5.8% and pro-rated expected contributions, benefit payments, and expenses in the actuarial projections provided by the plan actuary.
[3] Other real assets modeled as 50% infrastructure / 25% timber / 25% farmland
Values may not sum due to rounding

AON

Actual Rate of Return

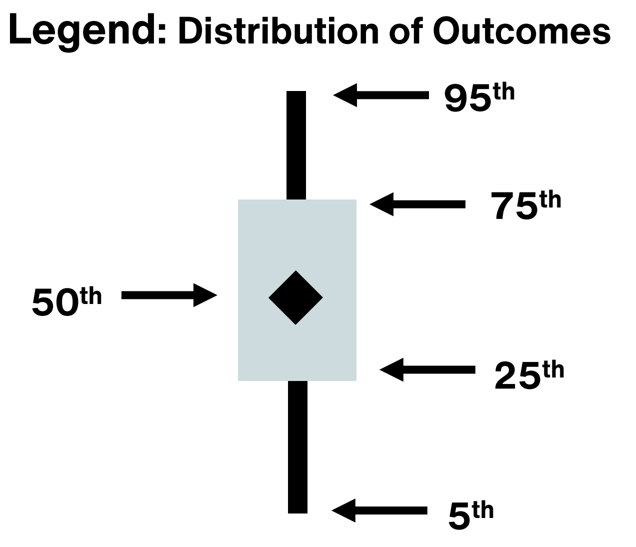
Historical assumptions vs. peers[1]



Key Takeaways:

- The historical actuarial assumption trend for investment returns has declined from an 8.00% median in FYE 2010 to 7.00% as of FYE 2022, per Public Plans Data[1]
- Current actuarial assumptions, as tracked by NASRA as of June 2023, have a median actuarial assumption of 7.00%

The actuarial investment return assumption is set by numerous factors including quarterly investment return assumptions, actuarial experience study recommendations, financial outcomes through asset-liability analysis, how the assumed rate of return is used, consideration to an acceptable return assumptions range to promote contribution stability, industry trends (e.g., Horizon survey), and peer data (e.g., NASRA assumptions)

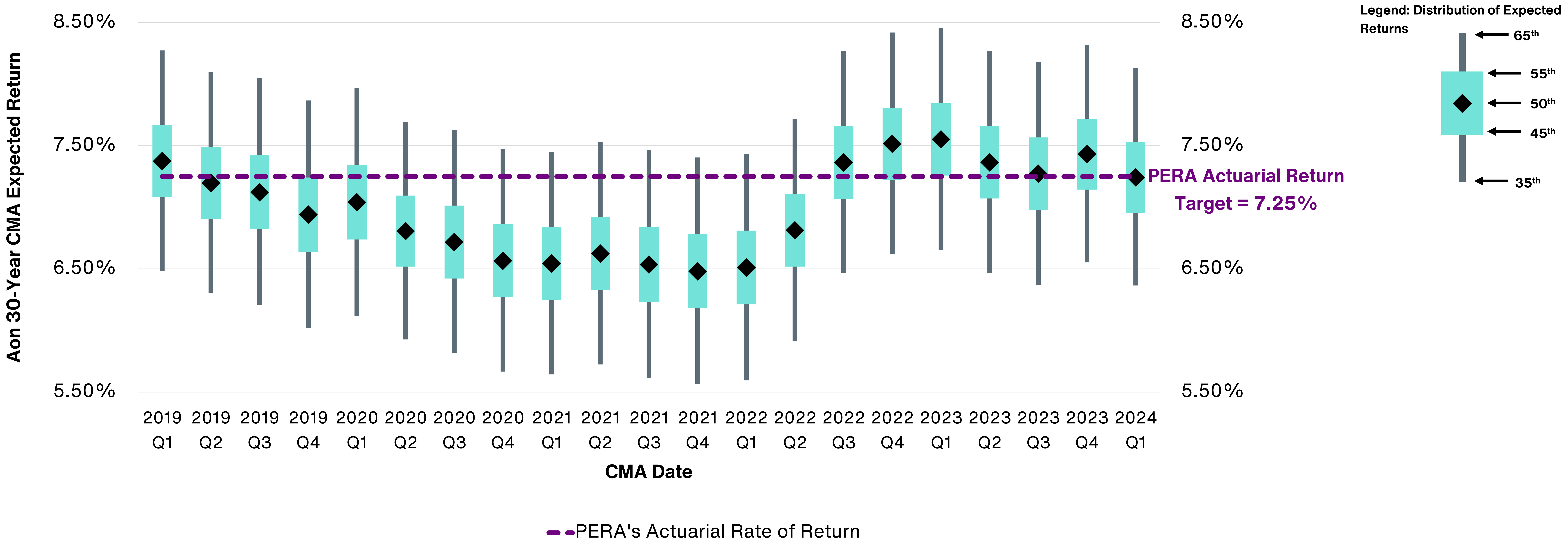


Sources: Public Plans Data (publicplansdata.org) as of June 2023; NASRA downloadable investment return assumptions as of June 2023
[1] Peers defined as public funds published within publicplansdata.org as of June 2023; Number of plans per year are shown in parentheses

Expected Return Analysis

Aon CMAs show expected return near 7.25% at most points over recent market cycle

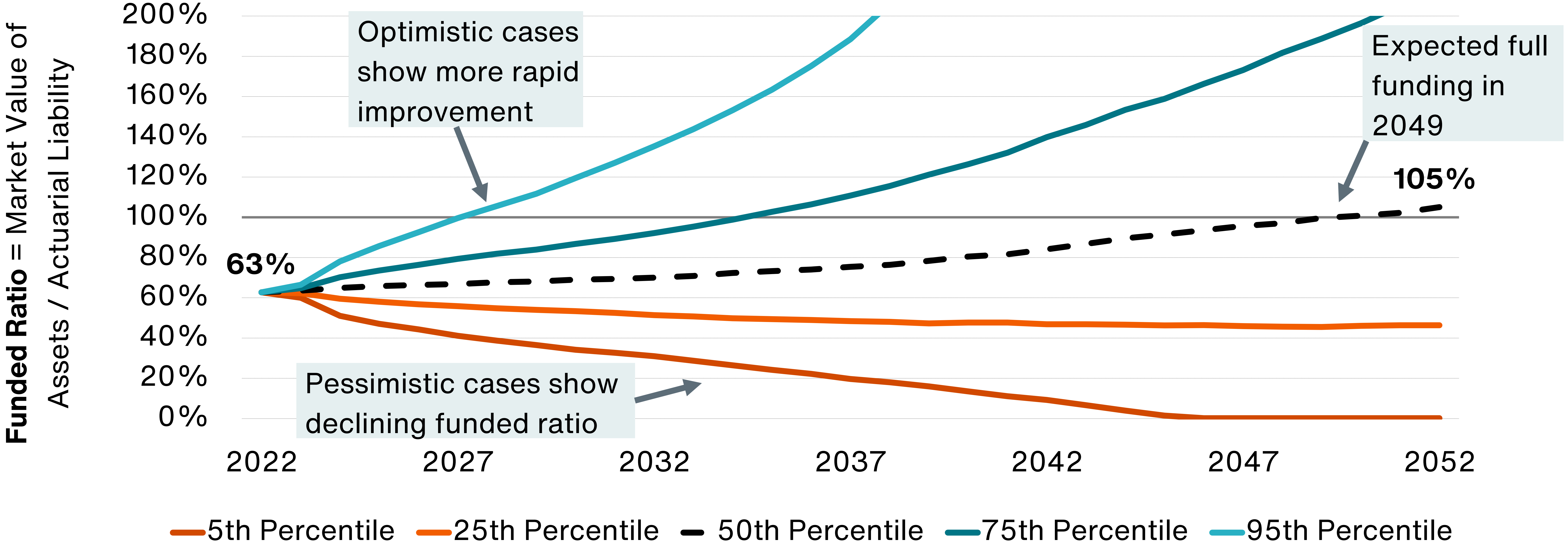
Historical CMA Returns - Aon 30-Year Capital Market Assumption distribution of expected returns using current policy targets



Expected returns are using AIUSA 30-Year Capital Market Assumptions (CMAs). CMAs contain projections about future returns on asset classes. Our CMA projections are designed to reflect the typical cost of implementing an investment program. Expected returns are calculated using weighted allocations of the underlying CMAs. Expected Returns are geometric (long-term compounded; rounded to the nearest decimal) assuming portfolio weights are rebalanced annually. Expected returns presented are models and do not represent the returns of an actual client account. Your actual returns may differ from model returns presented based on your plan's individual fees/expenses. Aon's advisory fees are described in Part 2A of Aon's Form ADV. Not a guarantee of future results. See appendix for capital market assumptions disclosure pages.

Projected Funded Ratio (Market Value of Assets Basis)

Expected full funding in 2049 with significant dispersion



Strategy	Current Policy (77% R-S)		
Year	**2032**	**2042**	**2052**
5th Percentile	31%	9%	0%
25th Percentile	51%	47%	46%
50th Percentile	70%	84%	105%
75th Percentile	92%	140%	>200%
95th Percentile	135%	>200%	>200%
Probability > 100%	21%	43%	52%

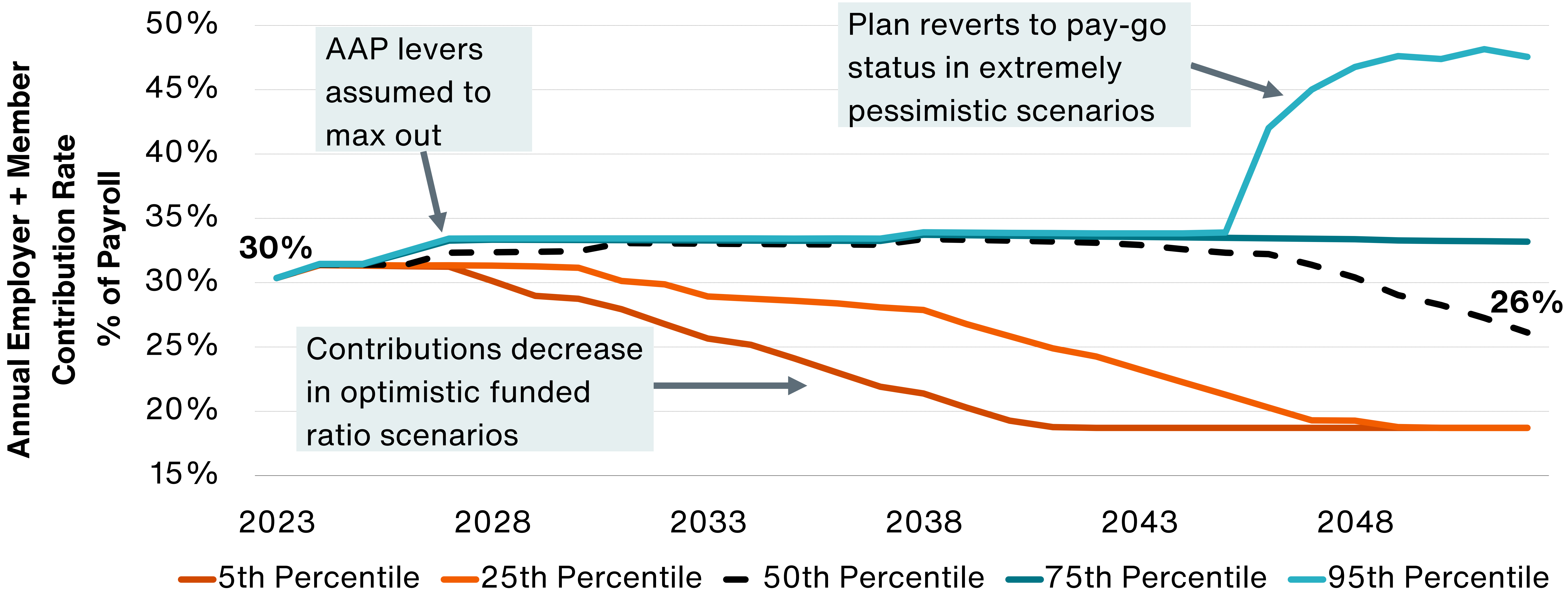
Projections assume a constant 7.25% discount rate for pension liabilities for all investment policies studied and reflect actual investment returns through September 30, 2023. Projections in this material include estimated expenses paid from plan assets, estimated to be $44.1 million for fiscal year ending 12/31/2023, which is assumed to be inclusive of investment management fees. These are increased with inflation for projection purposes. Actual fees and expenses may differ from those presented.

Key Observations

- Median (50th percentile) case demonstrates expected full funding in 2049 with significant dispersion due to economic risks
- Optimistic (75th and 95th percentile) cases demonstrate potential of full funding much sooner
- Pessimistic (25th and 5th percentile) cases demonstrate potential decline in funded ratio

Projected Employer + Member Contribution Rate (Reflecting AAP)

Expected contribution rates gradually increase to maximum statutory amount



Strategy	Current Policy (77% R-S)		
Year	**2032**	**2042**	**2052**
5th Percentile	27%	19%	19%
25th Percentile	30%	24%	19%
50th Percentile	33%	33%	26%
75th Percentile	33%	34%	33%
95th Percentile	33%	34%	48%

Projections assume a constant 7.25% discount rate for pension liabilities for all investment policies studied and reflect actual investment returns through September 30, 2023. Projections in this material include estimated expenses paid from plan assets, estimated to be $44.1 million for fiscal year ending 12/31/2023, which is assumed to be inclusive of investment management fees. These are increased with inflation for projection purposes. Actual fees and expenses may differ from those presented.

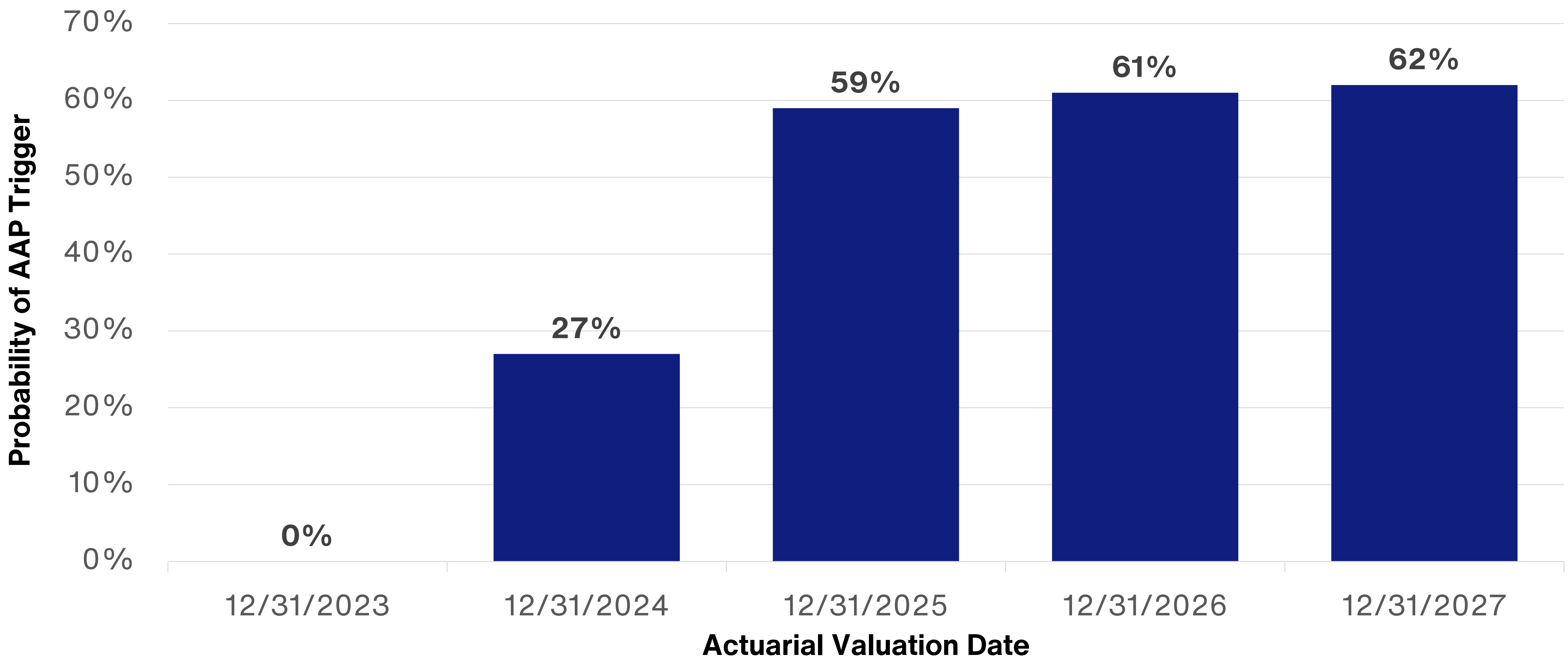
Key Observations

- Median (50th percentile) case contribution rate increases initially due to Automatic Adjustment Provision, then is limited by the maximum statutory rate
- Optimistic (25th and 5th percentile) cases project decreasing contribution rates due to the provisions lowering employer and employee contributions, the direct distribution, and the AED/SAED components

Probability of Automatic Adjustment Provision ("AAP")

59% probability of AAP trigger by the 12/31/2025 valuation

Probability of AAP Contribution Rate Increase (or Reduction in Annual Increase) by Year



Projections assume a constant 7.25% discount rate for pension liabilities for all investment policies studied and reflect actual investment returns through September 30, 2023. Projections in this material include estimated expenses paid from plan assets, estimated to be $44.1 million for fiscal year ending 12/31/2023, which is assumed to be inclusive of investment management fees. These are increased with inflation for projection purposes. Actual fees and expenses may differ from those presented.

Key Observations

- The Automatic Adjustment Provision can be triggered if the actuarially determined contribution rate (based on unfunded actuarial liability) differs from the statutory contribution rate
- Based on current circumstances, the AAP is likely to trigger higher contribution rates and lower annual increase provided to retirees by the 12/31/2025 actuarial valuation

Key Observations

- Current asset allocation is in the reasonable range given the actuarial return target and funding goal

- Expect full funding by 2049 with significant dispersion
  - Expect modest funded ratio improvement over the next ~10 years, followed by more rapid growth thereafter
  - Tail cases demonstrate paths to full funding by 2027 (95th percentile), or potential asset depletion around 2045 (5th percentile)

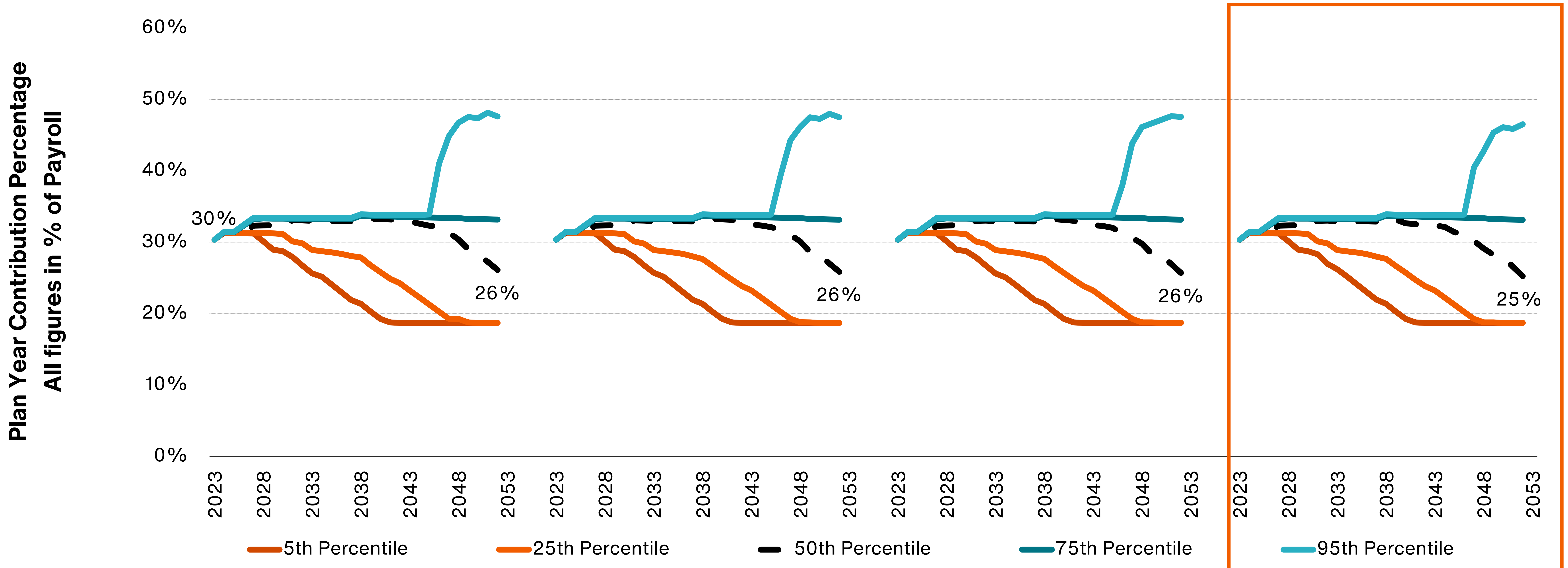
- Contribution rates expected to increase to maximum amount under AAP before ultimately declining
  - Expect at least one AAP contribution increase by the 12/31/2025 actuarial valuation
  - Tail cases demonstrate possibility of additional contribution rate increases or decreases

Additional Analysis

Section 5: Appendix

Portfolio Efficiency Analysis – Projected Contribution Rate

Similar projected contribution rates due to smoothing and AAP



Strategy	(3A) Current Target (77% R-S)			(3B) Increase Private Equity to 10%			(3C) Add'l Diversification (Current Asset Classes)			(3D) Add Private Debt in "Opportunity" Alloc		
Year	2032	2042	2052	2032	2042	2052	2032	2042	2052	2032	2042	2052
5th Percentile	27%	19%	19%	27%	19%	19%	27%	19%	19%	27%	19%	19%
25th Percentile	30%	24%	19%	30%	24%	19%	30%	24%	19%	30%	24%	19%
50th Percentile	33%	33%	26%	33%	33%	26%	33%	33%	26%	33%	32%	25%
75th Percentile	33%	34%	33%	33%	34%	33%	33%	34%	33%	33%	34%	33%
95th Percentile	33%	34%	48%	33%	34%	48%	33%	34%	48%	33%	34%	47%
Probability > 30%	74%	59%	36%	74%	58%	36%	73%	57%	36%	74%	57%	35%

Projections assume a constant 7.25% discount rate for pension liabilities for all investment policies studied and reflect actual investment returns through September 30, 2023. Projections in this material include estimated expenses paid from plan assets, estimated to be $44.1 million for fiscal year ending 12/31/2023, which is assumed to be inclusive of investment management fees. These are increased with inflation for projection purposes. Actual fees and expenses may differ from those presented.

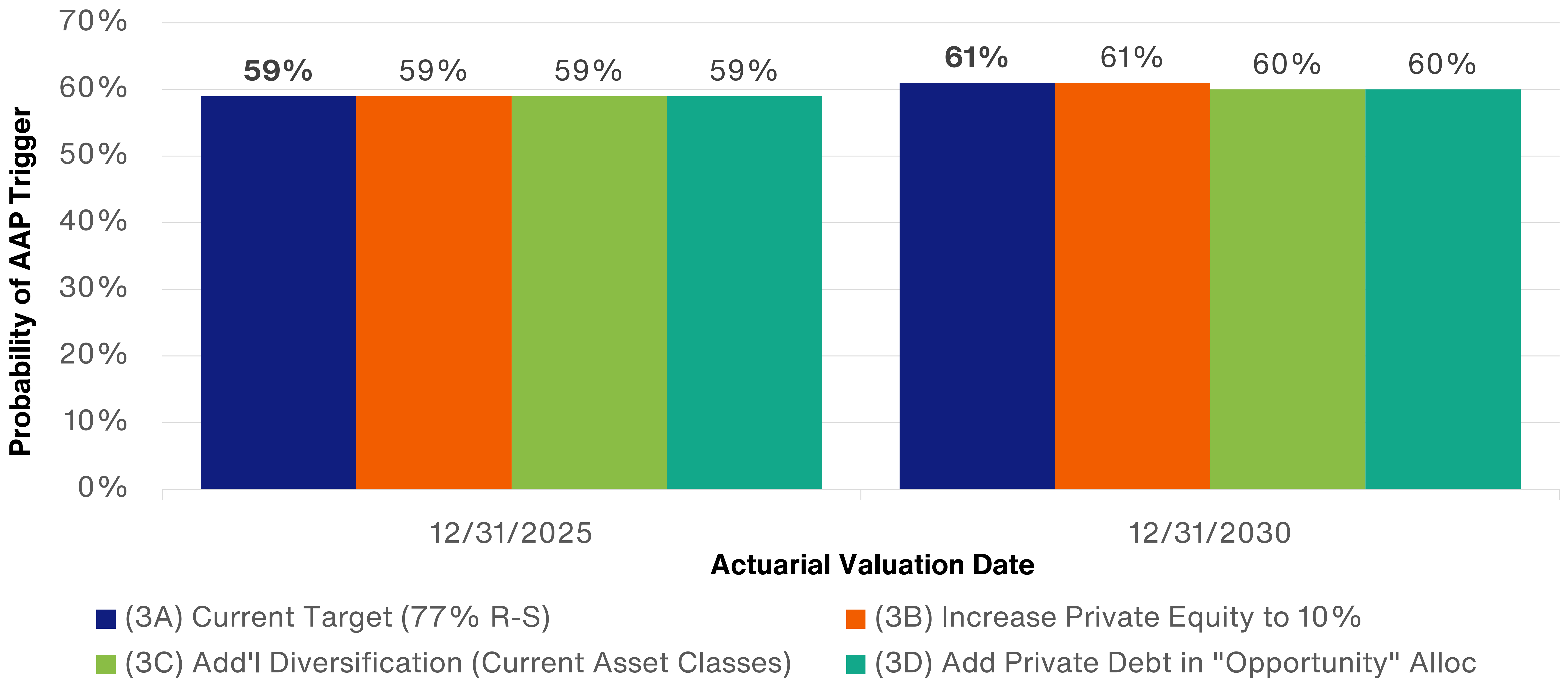
Key Observation

- Contribution rates are similar for the strategies modeled due to smoothing in actuarial valuations and Automatic Adjustment Provision

Portfolio Efficiency Analysis – Automatic Adjustment Provision (AAP)

Portfolio efficiency has modest impact on probability of triggering AAP

Probability of Contribution Rate Increase (or Reduction in Annual Increase) by 12/31/2025 & 12/31/2030 Actuarial Valuations



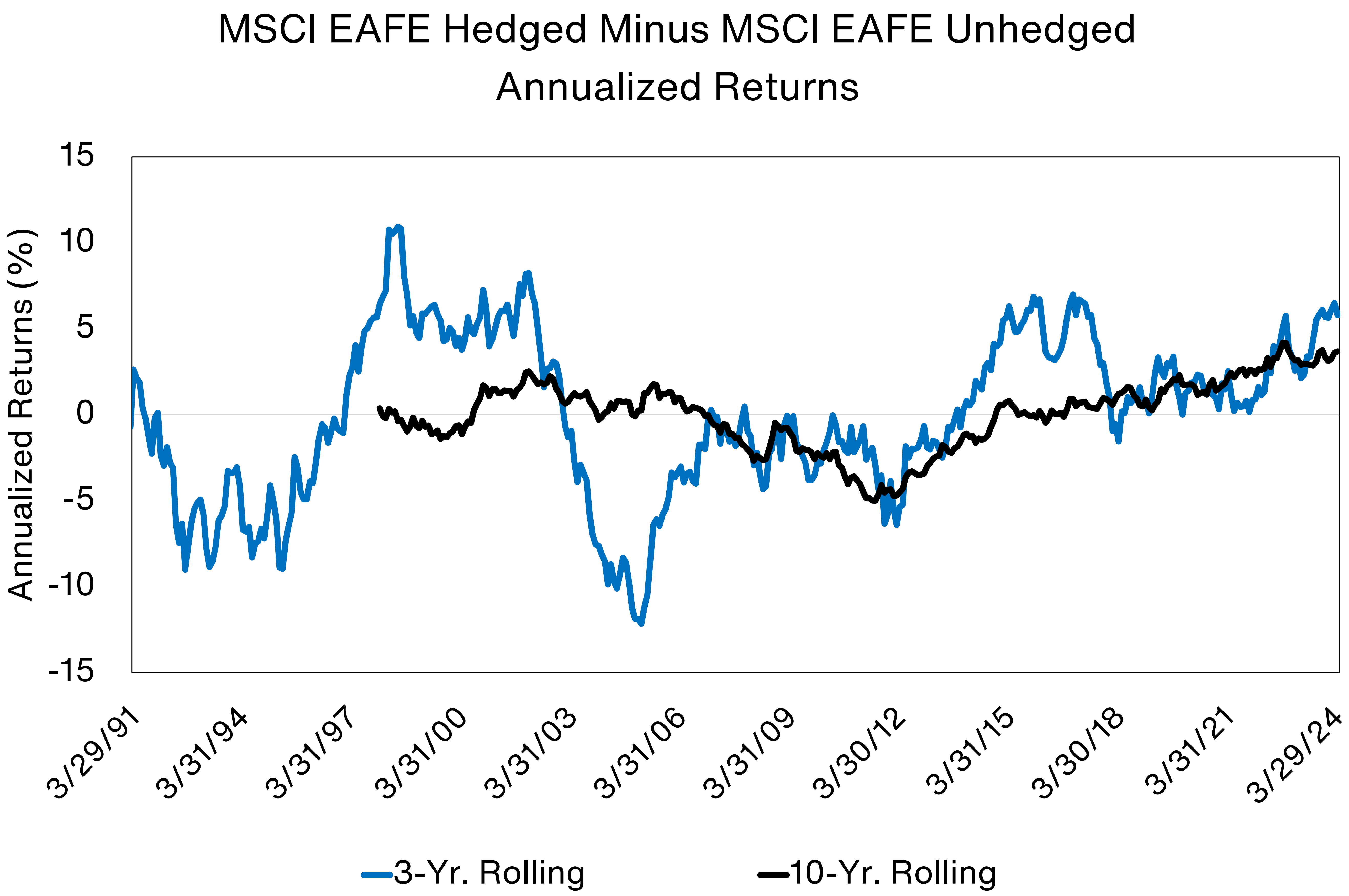
Key Observation

- Probabilities of AAP trigger under more diversified portfolio potions are modestly lower

Projections assume a constant 7.25% discount rate for pension liabilities for all investment policies studied and reflect actual investment returns through September 30, 2023. Projections in this material include estimated expenses paid from plan assets, estimated to be $44.1 million for fiscal year ending 12/31/2023, which is assumed to be inclusive of investment management fees. These are increased with inflation for projection purposes. Actual fees and expenses may differ from those presented.

Foreign Currency Risk - Annualized Excess Return From Hedging

MSCI EAFE Hedged Index Excess Returns Over MSCI EAFE Index



Key Observations

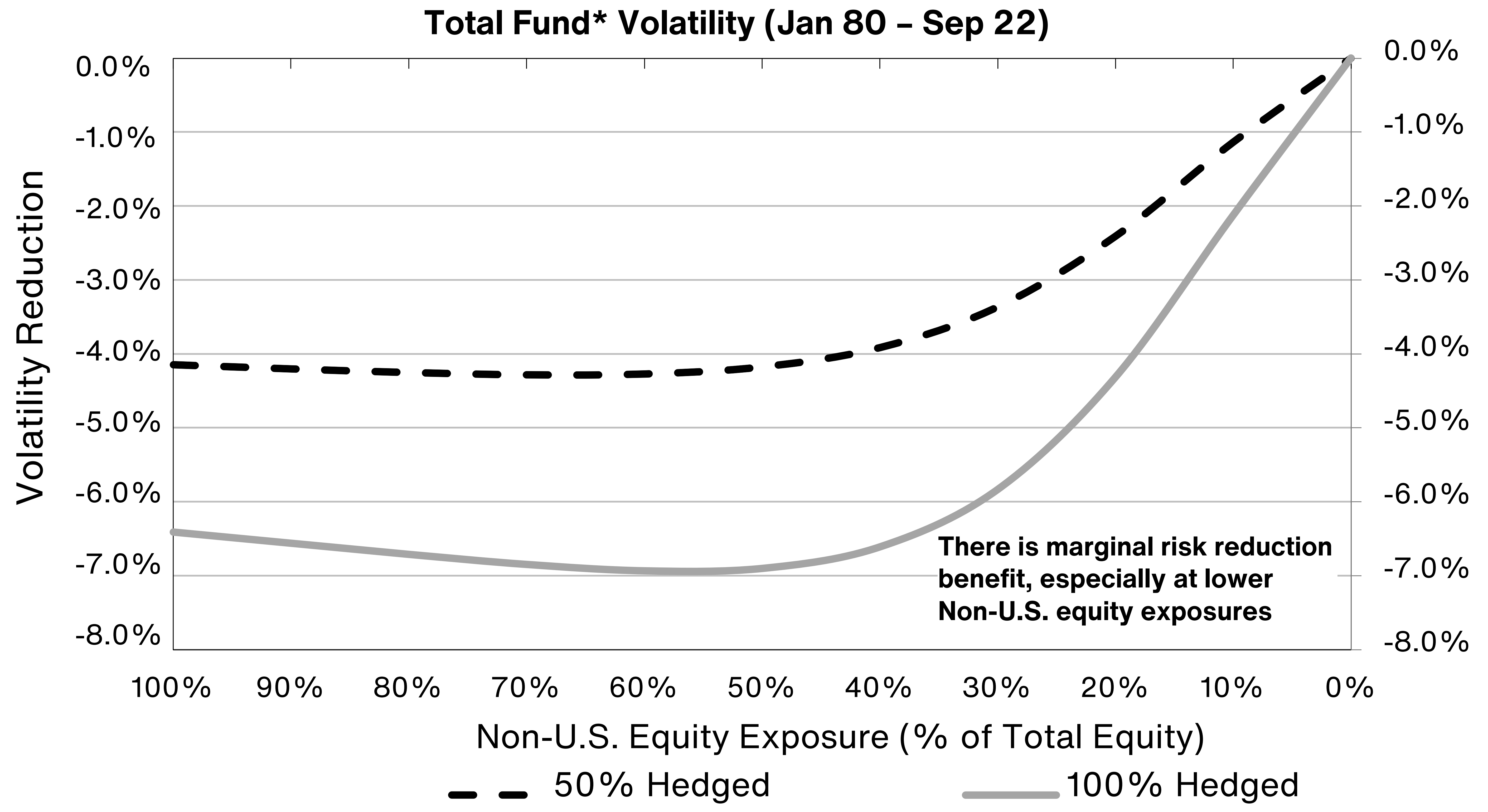
- Rolling excess returns from hedging tend to oscillate between negative and positive over shorter time periods (3 years)
- However, over very long time periods (>10 years) excess returns have hovered closer to zero.
- Hedging returns has been positive recently due to strong U.S. currency returns; however, over long rolling periods it has been in negative territory approximately half of the time

Past Performance is no guarantee of future results. Indices cannot be invested in directly. Unmanaged index returns assume reinvestment of any and all distributions and do not reflect our fees and expenses.

Foreign Currency Risk - Total Fund Volatility

Total fund risk reduction benefits are marginal and vary based Non-U.S. Equity exposure

Illustrative Example of Total Fund* Volatility Benefits:



Source: Aon, MSCI, Russell, Bloomberg Barclays

Key Observations

- Risk reduction benefits are marginal at the total fund level
  - Ex. A 4% volatility reduction to a Fund with a 12.5% volatility level is 50bps
- Risk reduction benefits narrow as allocations to non-U.S. equities decrease
- Chart to the left illustrates expected improvement based on a 70/30 equity/bond portfolio
- PERA's Current Policy is 54% to Global Equity, of which approximately 40% is to non-U.S. equities
- Thus, for PERA, we believe Total Fund volatility improvement from currency hedging would be minimal

**Total Fund is defined as dynamic allocations between US bonds and equity. The equity allocation remains constant at 50% US equity and 50% Non-U.S. equity. US equity. For example, 70% equity exposure (as plotted in the chart above) equates to a 30% US bond / 35% US equity / 35% non-U.S. equity allocation*

Actuarial Assumptions and Methods

Section 5: Appendix

Actuarial Assumptions and Methods

Data used & actuarial assumptions

Data

Actuarial projections for the full asset-liability study reflected open group projections from the plan actuary (Segal) as of December 31, 2022. The information was supplied for all five (5) plans with sensitivity for realized inflation (intended to proxy the annual increase impact). These plan figures were combined to study the aggregate division trust funds for purposes of this study.

Actuarial assumptions:

- Valuation Rate of Interest = 7.25%
- Inflation = 2.30%
- Payroll Growth = 3.00%
- Actuarial Value of Assets: determined by recognizing differences between actual and expected investment income over a closed four-year period with no corridor
- Administrative Expenses: Assumed $44.1 million payable from the trust for 2023 consistent with the provided actuarial projections
    - Assumed annual growth consistent with inflation
- Annual Increase rate = 1.00%
- All other assumptions as documented in the Actuarial Valuation Report as of December 31, 2022 unless noted otherwise

Source: 12/31/2022 Actuarial Valuation

Actuarial Assumptions and Methods

Employer/state contributions

Employer Contributions:

Initial employer contributions were assumed to be 18.53% of payroll. This is based on the following components detailed in the Actuarial Valuation Report as of 12/31/2022, weighted by expected payroll as provided by the plan actuary. Rates are projected to remain level unless otherwise stated.

Division	Projected Payroll 2023 ($ million)	Basic Rate[1]	Annual Increase Reserve	Amortization Equalization Disbursement (AED)	Supplemental Amortization Equalization Disbursement (SAED)	Pension Certificates of Participation	Defined Contribution Supplement	Total
State	3,340	10.52%[2]	-0.69%	5.00%	5.00%	0.00%	0.21%	20.04%
School	5,973	10.38%	-0.61%	4.50%	5.50%	0.00%	0.00%	19.77%
Local Government	800	9.99%[2]	-0.72%	2.20%	1.50%	0.00%	0.08%	13.05%
Judicial	59	13.89%	-0.63%	5.00%	5.00%	0.00%	0.00%	23.26%
Denver Public Schools	861	10.38%	-0.73%	4.50%	5.50%	-10.77%	0.00%	8.88%
Aggregate	**11,033**						**Weighted Average:**	**18.53%**

[1] Basic rate stated reflects current 1.00% increase for AAP and 1.02% reduction for the Health Care Trust Fund Contribution

[2] State and Local Government basic rates reflect blended rate of 13.08% for State Trooper Members, 10.38% for all other State division members, and 9.98% for all other Local Government division members

Direct Distribution:

Assumed to be $35 million as of 7/1/2023 and reverting to $225 million as of 7/1/2024 and beyond (subject to Automatic Adjustment Provisions)

AON

Source: 12/31/2022 Actuarial Valuation

Actuarial Assumptions and Methods

Member/employee contributions

Member / Employee Contributions:

Initial member contributions were assumed to be 10.89% of payroll. This is based on the following member contribution rates detailed in the Actuarial Valuation Report as of 12/31/2022, weighted by expected payroll as provided by the plan actuary. Rates are projected to remain level unless otherwise stated.

Division	Projected Payroll 2023 ($ million)	Member / Employee Contribution Rate[1]
State	3,340	11.10%[2]
School	5,973	11.00%
Local Government	800	9.01%[3]
Judicial	59	11.00%
Denver Public Schools	861	11.00%
Aggregate / Weighted Average by Payroll	**11,033**	**10.89%**

[1] Member rate stated reflects current 1.00% increase for AAP

[2] State member / employee rate reflects blended rate of 13.00% for State Trooper Members and 11.00% for all others

[3] Local Government member / employee rate reflects blended rate of 13.00% for State Trooper Members and 9.00% for all others

Source: 12/31/2022 Actuarial Valuation

Actuarial Assumptions and Methods

Automatic adjustment provision (AAP)

SB 18-200 includes a mechanism for an automatic adjustment to stay on track for full funding of the pension plans

The Automatic Adjustment Provision (AAP) impacts employer contributions, member contributions, the annual increase (annual cost-of-living adjustment), and the direct distribution received from the state. The AAP of SB 18-200 was designed using the concept of comparing one blended statutory rate or “Blended Total Contribution Amount” to one “Blended Total Required Contribution” across all five division trust funds

Blended Total Contribution Amount ÷ Blended Total Required Contribution = **AAP Resulting Ratio**

Blended Total Contribution Amount:

+ Employer contribution rates
+ Member contribution rate
+ Direct distribution as a rate of pay
= **Blended Total Contribution Amount**

Blended Total Required Contribution:

+ Actuarially determined contribution rate[1]
+ Member contribution rate
= **Blended Total Required Contribution**

AAP Resulting Ratio	Impact
<98%	Equitable adjustments applied (e.g., increase contributions, lower AI)
98% to 119%	No adjustment
≥120%	Equitable adjustments applied (e.g., decrease contributions, increase AI)

The Actuarial Valuation Report as of December 31, 2022 determines member contribution, employer contribution, and actuarial determined contribution rates by division and calculates plan totals based on the weighted average of unfunded liability by each division. For purposes of the stochastic modeling, Aon’s asset-liability study considers the total pension system in aggregate for determining these rates.

[1]Actuarially determined contribution rate determined as the sum of the Employer’s portion of Normal Cost plus the Unfunded Accrued Actuarial Liability amortized over layered, closed 30-year, level percent periods

Source: 12/31/2022 Actuarial Valuation

Actuarial Assumptions and Methods

Automatic adjustment provision (AAP)

When an adjustment is activated under the Automatic Adjustment Provision (AAP), Aon has assumed that each lever will move in its maximum annual amount subject to the restricted minimum and maximum amounts:

- Employer and Member Contribution Rates – Annual adjustments cannot exceed 50 basis points
- Actuarial Increase (Cost of Living Adjustment) – Annual adjustment cannot exceed 25 basis points
- Direct Distribution – Annual adjustments of $20 million

Aon has assumed the levers utilized under the AAP have the following minimum and maximum amounts:

- Employer and Member / Employee Contribution Rates
  - Rates cannot be less than the statutory contribution rates based on SB 18-200
  - Rates cannot exceed the statutory contribution rates plus 2% based on SB 18-200

- Annual Increase (Cost of Living Adjustment)
  - Cannot fall below a 0.50% annual increase cap minimum
  - Cannot exceed a 2.00% annual increase cap maximum

- Direct Distribution
  - Can fall to a minimum of $0
  - Cannot exceed $225 million per year

Actual Assumptions and Methods

Automatic adjustment provision (AAP) – levers available

PERA's current positioning on the four levers is shown below

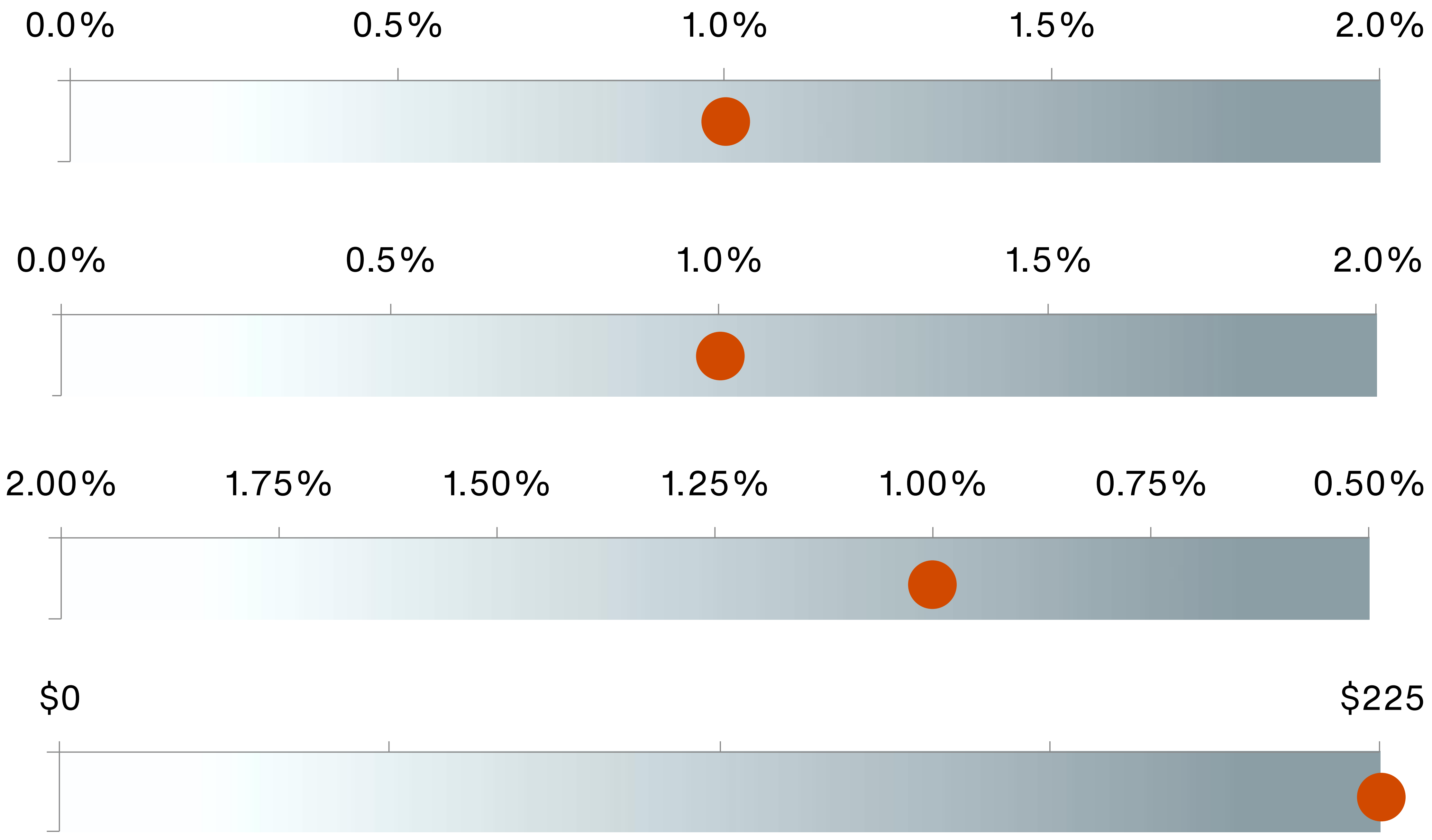
- The right-side of the exhibit represents the limit on each lever to improve the funded ratio

Member Contributions
(cumulative increase since 2018)

Employer Contributions
(cumulative increase since 2018)

Annual Increase to Retirees

Direct Distribution from State
(in $ Millions)



The AAP was triggered for the 2020 and 2022 plan years resulting in:

- Cumulative 1% increase to member and employer contributions
- Cumulative 0.5% reduction in the annual increase to retirees (from 1.5% to 1.0%)
- No change to the direct distribution

Actuarial Assumptions and Methods

Automatic adjustment provision (AAP) – minimum and maximum employer rates

Employer Contributions Minimum (Basic Rate):

Assumed to be an aggregate rate of 9.41% of payroll. This is determined based on the statutory rates stated in SB 18-200 weighted by expected payroll as provided by the plan actuary unless otherwise stated:

Division	Projected Payroll 2023 ($ million)	Current Basic Rate[1,2]	Statutory Basic Rate under SB 18-200[2]
State	3,340	10.52%[3]	9.52%[3]
School	5,973	10.38%	9.38%
Local Government	800	9.99%[3]	8.99%[3]
Judicial	59	13.89%	12.89%
Denver Public Schools	861	10.38%	9.38%
Aggregate / Weighted Average by Payroll	**11,033**	**10.41%**	**9.41%**

Employer Contributions Maximum (Basic Rate):

Assumed to be an aggregate rate of 11.41% of payroll. This is determined based on the statutory rates stated in SB 18-200 plus 2% weighted by expected payroll as provided by the plan actuary unless otherwise stated:

Division	Projected Payroll 2023 ($ million)	Current Basic Rate[1,2]	Statutory Basic Rate under SB 18-200 Plus 2%[2]
State	3,340	10.52%[3]	11.52%[3]
School	5,973	10.38%	11.38%
Local Government	800	9.99%[3]	10.99%[3]
Judicial	59	13.89%	14.89%
Denver Public Schools	861	10.38%	11.38%
Aggregate / Weighted Average by Payroll	**11,033**	**10.41%**	**11.41%**

[1] Current basic rate stated reflects 1.00% increase associated with the AAP

[2] Basic rates reflect a 1.02% reduction for the Health Care Trust Fund Contribution

[3] State and Local Government basic rates reflect blended rates of 12.08% (Statutory) / 13.08% (Current) / 14.08% (Statutory +2%) for State Trooper Members, 9.38% / 10.38% / 11.38% for all others in the State division, and 8.98% / 9.98% / 10.98% for all others in the Local Government division

Source: SB 18-200, 12/31/2022 Actuarial Valuation

Actuarial Assumptions and Methods

Automatic adjustment provision (AAP) – minimum and maximum member rates

Member / Employee Contributions Minimum (Basic Rate):

Assumed to be an aggregate rate of 9.89% of payroll. This is determined based on the statutory rates stated in SB 18-200 weighted by expected payroll as provided by the plan actuary unless otherwise stated:

Division	Projected Payroll 2023 ($ million)	Current Basic Rate[1]	Statutory Basic Rate under SB 18-200
State	3,340	11.10%[2]	10.10%[2]
School	5,973	11.00%	10.00%
Local Government	800	9.01%[2,3]	8.01%[2,3]
Judicial	59	11.00%	10.00%
Denver Public Schools	861	11.00%	10.00%
Aggregate / Weighted Average by Payroll	**11,033**	**10.89%**	**9.89%**

Member / Employee Contributions Maximum (Basic Rate):

Assumed to be an aggregate rate of 11.89% of payroll. This is determined based on the statutory rates stated in SB 18-200 plus 2% weighted by expected payroll as provided by the plan actuary unless otherwise stated:

Division	Projected Payroll 2023 ($ million)	Current Basic Rate[1]	Statutory Basic Rate under SB 18-200 Plus 2%
State	3,340	11.10%[2]	12.10%[2]
School	5,973	11.00%	12.00%
Local Government	800	9.01%[2,3]	10.01%[2,3]
Judicial	59	11.00%	12.00%
Denver Public Schools	861	11.00%	12.00%
Aggregate / Weighted Average by Payroll	**11,033**	**10.89%**	**11.89%**

[1] Current basic rate stated reflects 1.00% increase associated with the AAP

[2] State and Local Government basic rates reflect blended rate of 12.00% (Statutory) / 13.00% (Current) / 14.00% (Statutory +2%) for State Trooper Members, 10.00% / 11.00% / 12.00% for all others in the State division, and 8.00% / 9.00% / 10.00% for all others in the Local Government division

[3] Local Government rates based on HB 19-1217

Sources: SB 18-200, HB 19-1217, 12/31/2022 Actuarial Valuation

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Actuarial Assumptions and Methods

Automatic adjustment provision (AAP) – annual increase (cost of living adjustment)

The initial Annual Increase (AI) is assumed to be 1.00% per year based on the Actuarial Valuation Report as of December 31, 2022.

The plan actuary provided projected actuarial accrued liability, normal cost, and annual benefit payments under three scenarios: (1) baseline assumptions consistent with the 12/31/2022 actuarial valuation, (2) +100 basis points realized inflation relative to baseline, and (3) -100 basis points realized inflation relative to baseline.

The projection tracks the AI rate each year and adjusts based on the Automatic Adjustment Provision. The cumulative AI trial is determined and compared to the cumulative rates assumed under the three scenarios of actuarial data. This comparison determines the interpolation point in setting the resulting actuarial accrued liability, normal cost, and annual benefit payments.

An illustrative example of this method is as follows:

Illustrative Example	Projection Trial Example AI	Cumulative Projection Trial Example AI	Actuarial Data Cumulative AI (Baseline Assumptions)	Actuarial Data Cumulative AI (+1% Sensitivity Assumptions)	Illustrative Liability Data (Baseline Assumptions)	Illustrative Liability Data (+1% Sensitivity Assumptions)	Resulting Liability
Year 1	1.0%	1.0%	1.0%	2.0%	$100	$120	$100
Year 2	2.0%	3.0%	2.0%	4.0%	$110	$140	$125

Annual increases of 1.0% and 2.0% total a 3.0% cumulative increase over two years

The 3.0% cumulative increase falls between the 2.0% and 4.0% cumulative increases under the actuarial projection data scenarios

The corresponding point between the liability data scenarios results in $125 under the illustrative example conditions shown here

Actual Assumptions and Methods
AED and SAED

Per C.R.S. Sections 24-51-411(8) and 24-51-411(9), the Amortization Equalization Disbursement (AED) and Supplemental Amortization Equalization Disbursement (SAED) components of employer contributions are adjusted based on the year-end actuarial funded ratio within a particular division.

If a division trust fund's actuarial funded ratio:

- Reaches 103%, a 50 basis point decrease in both the AED and SAED is mandated
- Falls below 90%, a 50 basis point increase in both the AED and SAED is mandated
- For Local Government and Judicial divisions, if the actuarial funded ratio reaches 90% and subsequently falls below 90%, an increase in AED and SAED is mandated for these divisions, subject to a limit of 5.00%

For purposes of the stochastic modeling, Aon's asset-liability study looks at the total aggregate pension system for the year-end actuarial funded ratio for the AED and SAED determination. Aggregate plan rates were assumed weighted by projected payroll as follows:

Division	Projected Payroll 2023 ($ million)		Current 2023 AED Rates	Current 2023 SAED Rates
State	3,340		5.00%	5.00%
School	5,973		4.50%	5.50%
Local Government	800		2.20%	1.50%
Judicial	59		5.00%	5.00%
Denver Public Schools	861		4.50%	5.50%
Aggregate	**11,033**	**Weighted Average:**	**4.49%**	**5.06%**

The AED and SAED were assumed to increase no higher than 2023 levels and no lower than 0% in aggregate.

Source: C.R.S Section 24-51-411, 12/31/2022 Actuarial Valuation

Actuarial Assumptions and Methods

Pension certificates of participation (PCOP)

Employer contribution rates for the Denver Public Schools Division reflect offsets for costs of certain Pension Certificates of Participation (PCOP). This offset was assumed to be 10.77% of Denver Public Schools payroll as of the 12/31/2022 valuation. This was assumed to be a rate of 0.84% of aggregate payroll based on the weighted expected payroll as provided by the plan actuary.

Division	Projected Payroll 2023 ($ million)		Pension Certificates of Participation Credit as Percent of Payroll (12/31/2022)
State	3,340		0.00%
School	5,973		0.00%
Local Government	800		0.00%
Judicial	59		0.00%
Denver Public Schools	861		-10.77%
Aggregate	**11,033**	**Weighted Average:**	**-0.84%**

The PCOP offset to trust contributions is expected to decrease annually and eventually cease. Our projections assume the PCOP offset moves toward zero by 0.025% of aggregate payroll annually and reduces to zero for fiscal year 2038 based on baseline projections as provided by the plan actuary. Actual PCOP experience may vary from these assumed rates.

Source: 12/31/2022 Actuarial Valuation

Actuarial Assumptions and Methods

Other employer contribution rate components

The stochastic modeling assumes aggregate plan rates for the Annual Increase Reserve and Defined Contribution Supplement components of the employer contribution rate. While the annual increase reserve is expected to grow to an offset value of 1.00% over time as defined contribution participation grows, these component rates were assumed to remain level over the projection period for purposes of our asset-liability study projection modeling. The aggregate rates were developed by weighted expected payroll as provided by the plan actuary as follows:

Division	Projected Payroll 2023 ($ million)		Annual Increase Reserve	Defined Contribution Supplement
State	3,340		-0.69%	0.21%
School	5,973		-0.61%	0.00%
Local Government	800		-0.72%	0.08%
Judicial	59		-0.63%	0.00%
Denver Public Schools	861		-0.73%	0.00%
Aggregate	**11,033**	**Weighted Average:**	**-0.65%**	**0.07%**

Source: 12/31/2022 Actuarial Valuation

Actuarial Assumptions and Methods

Liquidity analysis assumptions

We started with the target asset allocation, then see how the actual allocation would change in different economic scenarios, assuming commitments to private assets are continued subject to the conditions below:

- Should actual allocations exceed targets by 10%, future commitments are trimmed 15%
- Should actual allocations exceed targets by 20%, future commitments are trimmed 30%

Actuarial projections leverage the 2023/24 asset-liability study for PERA

Asset experience through September 30, 203 was assumed as part of this analysis

Capital Market Assumptions

Section 5: Appendix

Aon's Capital Market Assumptions
Background

- Long-term (10- and 30-year forecasts) forward-looking assumptions (asset class geometric return, volatility, and correlations)
- Building block approach, primarily based on consensus expectations and market-based inputs
- Best estimates of annualized returns (50/50 better or worse)
- Market returns: no active management value added (except for certain assets classes, such as hedge funds)
- Net of investment fees
- Updated quarterly

AON

Summary of Capital Market Assumptions

As of September 30, 2023

		10-Year CMAs				30-Year CMAs			
		Expected Real Return[1]	Expected Nominal Return[1]	Expected Nominal Volatility	Assumed Global Equity Beta	Expected Real Return[1]	Expected Nominal Return[1]	Expected Nominal Volatility	Assumed Global Equity Beta
	Equity								
1	Large Cap U.S. Equity	4.3%	6.7%	18.0%	0.96	4.6%	7.0%	18.5%	0.97
2	Small Cap U.S. Equity	4.5%	6.9%	24.0%	1.23	5.1%	7.5%	24.8%	1.24
3	Global Equity IMI	4.5%	6.9%	18.2%	1.00	5.0%	7.4%	18.7%	1.00
4	International Equity (Developed)	4.3%	6.7%	19.2%	0.94	4.6%	7.0%	19.7%	0.94
5	Emerging Markets Equity	4.5%	6.9%	22.0%	0.99	4.9%	7.3%	22.5%	0.98
	Fixed Income								
6	Cash (Gov't)	2.2%	4.6%	1.4%	0.01	1.9%	4.2%	2.2%	0.01
7	Core Fixed Income	2.9%	5.3%	5.0%	0.00	2.6%	5.0%	5.2%	0.00
8	Long Duration Bonds – Credit	4.0%	6.4%	9.7%	0.03	3.8%	6.2%	10.1%	0.03
9	Long Duration Bonds – Gov't	3.1%	5.5%	10.2%	-0.08	2.6%	5.0%	9.9%	-0.07
10	Multi-Asset Credit[2]	5.0%	7.4%	8.8%	0.30	4.9%	7.3%	9.0%	0.30
	Alternatives								
11	Hedge Funds – Low Beta[3]	3.2%	5.6%	4.0%	0.09	2.8%	5.2%	4.3%	0.09
12	Core Real Estate	3.2%	5.6%	15.0%	0.30	3.1%	5.5%	15.4%	0.30
13	Non-Core Real Estate	5.1%	7.5%	25.0%	0.65	4.8%	7.2%	25.5%	0.65
14	Private Equity	6.7%	9.2%	20.0%	0.69	7.6%	10.1%	20.5%	0.69
15	Infrastructure	4.8%	7.2%	14.5%	0.28	4.7%	7.1%	15.0%	0.28
16	Closed-End Real Assets	5.6%	8.0%	15.7%	0.47	5.6%	8.0%	16.2%	0.47
17	Farmland	3.1%	5.5%	15.0%	0.01	3.1%	5.5%	15.5%	0.01
18	Timber	2.4%	4.8%	11.9%	0.01	2.4%	4.8%	12.3%	0.01
19	Private Debt	5.8%	8.2%	16.5%	0.33	5.3%	7.7%	17.5%	0.34
	Inflation								
20	Inflation	0.0%	2.3%	1.7%		0.0%	2.3%	1.8%	

1 Expected returns are using Aon's 10/30-Year Capital Market Assumptions as of 9/30/2023. CMAs contain projections about future returns on asset classes. Our CMA projections are designed to reflect the typical cost of implementing an investment program. Expected returns are calculated using weighted allocations of the underlying CMAs. Expected Returns are geometric (long-term compounded; rounded to the nearest decimal) assuming portfolio weights are rebalanced annually. Expected returns presented are models and do not represent the returns of an actual client account. Your actual returns will be reduced by your advisory fees and other expenses you may incur as a client. Aon's advisory fees are described in Part 2A of Aon's Form ADV. Not a guarantee of future results.

2 Alpha incorporated in Expected Nominal Return

3 Represents diversified portfolio of Direct hedge fund investments.

Summary of Capital Market Assumptions

As of September 30, 2023

	Nominal Correlations	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**
1	Large Cap U.S. Equity	**1.00**	0.93	0.98	0.79	0.73	0.09	0.00	0.06	-0.13	0.61	0.40	0.35	0.46	0.62	0.35	0.29	0.52	0.01	0.01	0.34	0.97	0.09
2	Small Cap U.S. Equity	0.93	**1.00**	0.93	0.74	0.69	0.08	0.00	0.05	-0.13	0.56	0.38	0.33	0.44	0.60	0.34	0.28	0.50	0.01	0.01	0.33	0.93	0.08
3	Global Equity IMI	0.98	0.93	**1.00**	0.89	0.82	0.09	-0.01	0.06	-0.14	0.65	0.41	0.36	0.48	0.63	0.35	0.29	0.54	0.01	0.02	0.37	1.00	0.10
4	International Equity (Developed)	0.79	0.74	0.89	**1.00**	0.75	0.05	-0.01	0.05	-0.13	0.61	0.36	0.34	0.44	0.55	0.31	0.26	0.49	0.01	0.03	0.34	0.88	0.11
5	Emerging Markets Equity	0.73	0.69	0.82	0.75	**1.00**	0.07	0.00	0.07	-0.13	0.63	0.34	0.33	0.41	0.53	0.30	0.25	0.46	0.01	0.02	0.37	0.81	0.09
6	Cash (Gov't)	0.09	0.08	0.09	0.05	0.07	**1.00**	0.43	0.23	0.23	0.05	0.20	0.16	0.15	0.10	0.14	0.16	0.18	0.06	0.09	-0.23	0.12	0.41
7	Core Fixed Income	0.00	0.00	-0.01	-0.01	0.00	0.43	**1.00**	0.88	0.80	0.20	0.11	0.05	0.04	0.01	0.04	0.03	0.05	0.00	0.00	-0.03	0.08	-0.01
8	Long Duration Bonds – Credit	0.06	0.05	0.06	0.05	0.07	0.23	0.88	**1.00**	0.81	0.35	0.16	0.05	0.05	0.06	0.05	0.03	0.06	-0.01	-0.02	0.15	0.14	-0.11
9	Long Duration Bonds – Gov't	-0.13	-0.13	-0.14	-0.13	-0.13	0.23	0.80	0.81	**1.00**	-0.15	-0.07	-0.04	-0.06	-0.11	-0.04	-0.05	-0.06	-0.02	-0.04	-0.28	-0.06	-0.16
10	Multi-Asset Credit	0.61	0.56	0.65	0.61	0.63	0.05	0.20	0.35	-0.15	**1.00**	0.45	0.22	0.29	0.40	0.22	0.19	0.33	0.02	0.02	0.70	0.66	0.10
11	Hedge Funds - Low Beta	0.40	0.38	0.41	0.36	0.34	0.20	0.11	0.16	-0.07	0.45	**1.00**	0.19	0.23	0.29	0.18	0.16	0.26	0.01	0.03	0.29	0.42	0.11
12	Core Real Estate	0.35	0.33	0.36	0.34	0.33	0.16	0.05	0.05	-0.04	0.22	0.19	**1.00**	0.96	0.32	0.19	0.16	0.85	0.01	0.01	0.12	0.37	0.09
13	Non-Core Real Estate	0.46	0.44	0.48	0.44	0.41	0.15	0.04	0.05	-0.06	0.29	0.23	0.96	**1.00**	0.38	0.22	0.19	0.89	0.02	0.02	0.16	0.48	0.10
14	Private Equity	0.62	0.60	0.63	0.55	0.53	0.10	0.01	0.06	-0.11	0.40	0.29	0.32	0.38	**1.00**	0.33	0.27	0.45	0.01	0.02	0.27	0.63	0.08
15	Infrastructure	0.35	0.34	0.35	0.31	0.30	0.14	0.04	0.05	-0.04	0.22	0.18	0.19	0.22	0.33	**1.00**	0.81	0.64	0.01	0.02	0.13	0.36	0.08
16	Real Assets (PERA)	0.29	0.28	0.29	0.26	0.25	0.16	0.03	0.03	-0.05	0.19	0.16	0.16	0.19	0.27	0.81	**1.00**	0.52	0.51	0.47	0.11	0.30	0.19
17	Closed-End Real Assets	0.52	0.50	0.54	0.49	0.46	0.18	0.05	0.06	-0.06	0.33	0.26	0.85	0.89	0.45	0.64	0.52	**1.00**	0.01	0.02	0.19	0.54	0.12
18	Farmland	0.01	0.01	0.01	0.01	0.01	0.06	0.00	-0.01	-0.02	0.02	0.01	0.01	0.02	0.01	0.01	0.51	0.01	**1.00**	0.32	0.00	0.01	0.13
19	Timber	0.01	0.01	0.02	0.03	0.02	0.09	0.00	-0.02	-0.04	0.02	0.03	0.01	0.02	0.02	0.02	0.47	0.02	0.32	**1.00**	0.01	0.02	0.21
20	Private Debt	0.34	0.33	0.37	0.34	0.37	-0.23	-0.03	0.15	-0.28	0.70	0.29	0.12	0.16	0.27	0.13	0.11	0.19	0.00	0.01	**1.00**	0.36	-0.01
21	Opportunistic (PERA)	0.97	0.93	1.00	0.88	0.81	0.12	0.08	0.14	-0.06	0.66	0.42	0.37	0.48	0.63	0.36	0.30	0.54	0.01	0.02	0.36	**1.00**	0.10
22	Inflation	0.09	0.08	0.10	0.11	0.09	0.41	-0.01	-0.11	-0.16	0.10	0.11	0.09	0.10	0.08	0.08	0.19	0.12	0.13	0.21	-0.01	0.10	**1.00**

Aon Investments' Capital Market Assumptions

Explanation of Capital Market Assumptions—09/30/2023

The following capital market assumptions were developed by Aon's Global Asset Allocation Team and represent the long-term capital market outlook (i.e., 30 years) based on data at the end of the third quarter of 2023. The assumptions were developed using a building block approach, reflecting observable inflation and interest rate information available in the fixed income markets as well as Consensus Economics forecasts. Our long-term assumptions for other asset classes are based on historical results, current market characteristics, and our professional judgment. Expected returns are using Aon 30 Year Capital Market Assumptions as of 09/30/2023. CMAs contain projections about future returns on asset classes. Our CMA projections are designed to reflect the typical cost of implementing an investment program. Expected returns are calculated using weighted allocations of the underlying CMAs. Expected Returns are geometric (long-term compounded; rounded to the nearest decimal) assuming portfolio weights are rebalanced annually. Expected returns presented are models and do not represent the returns of an actual client account. Your actual returns will be reduced by your advisory fees and other expenses you may incur as a client. Aon's advisory fees are described in Part 2A of Aon's Form ADV. Not a guarantee of future results.

Inflation – Expected Level (2.3%)

Based on Consensus Economics long-term estimates and our near-term economic outlook, we expect U.S. consumer price inflation to be approximately 2.3% during the next 30 years.

Real Returns for Asset Classes

Fixed Income		
Cash	1.9%	Over the long run, we expect the real yield on cash and money market instruments to produce a real return of 1.9% in a moderate to low-inflationary environment.
TIPS	2.2%	We expect intermediate duration Treasury Inflation-Protected Securities to produce a real return of about 2.2%.
Core Fixed Income (i.e., Market Duration)	2.6%	We expect intermediate duration Treasuries to produce a real return of about 1.9%. We estimate the fair value credit spread (credit risk premium - expected losses from defaults and downgrades) to be 0.7%, resulting in a long-term real return of 1.8%.

Aon Investments' Capital Market Assumptions

Explanation of Capital Market Assumptions—09/30/2023

Fixed Income		
Core Plus Bonds	3.0%	Modeled as 20% 5 duration gov't with real return of 1.9% and 80% 5 duration corporate bonds with real return of 3.3%.
Long Duration Bonds – Government and Credit	3.1%	We expect Treasuries with a duration of ~14 years to produce a real return of 2.6%. We estimate the fair value credit spread (credit risk premium - expected losses from defaults and downgrades) to be 0.5%, resulting in an expected real return of 3.1%.
Long Duration Bonds – Credit	3.8%	We expect Treasuries with a duration of ~12 years to produce a real return of 2.6%. We estimate the fair value credit spread (credit risk premium - expected losses from defaults and downgrades) to be 1.2%, resulting in an expected real return of 3.8%.
Long Duration Bonds – Government	2.6%	We expect Treasuries with a duration of ~16 years to produce a real return of 2.6% during the next 30 years.
High Yield Bonds	3.9%	We expect intermediate duration Treasuries to produce a real return of about 1.9%. We estimate the fair value credit spread (credit risk premium - expected losses from defaults and downgrades) to be 2.0%, resulting in an expected real return of 3.9%.
Bank Loans	4.1%	We expect LIBOR to produce a real return of about 2.5%. We estimate the fair value credit spread (credit risk premium - expected losses from defaults) to be 1.6%, resulting in an expected real return of 4.1%.
Non-U.S. Developed Bonds: 50% Hedged	2.1%	We forecast real returns for non-US developed market bonds to be 2.1% over a 30-year period after adjusting for a 50% currency hedge. We assume a blend of one-third investment grade corporate bonds and two-thirds government bonds. We also produce assumptions for 0% hedged and 100% hedged non-US developed bonds.
Emerging Market Bonds (Sovereign; USD)	4.2%	We forecast real returns for emerging market sovereign bonds denominated in US dollars to be 4.2% over a 30-year period.
Emerging Market Bonds (Corporate; USD)	3.9%	We forecast real returns for emerging market corporate bonds denominated in US dollars to be 3.9% over a 30-year period.

Aon Investments' Capital Market Assumptions

Explanation of Capital Market Assumptions—09/30/2023

Emerging Market Bonds (Sovereign; Local)	3.7%	We forecast real returns for emerging market sovereign bonds denominated in local currency to be 3.7% over a 30-year period.
Multi-Asset Credit (MAC)	4.1%	We assume real returns from beta exposure to high yield, bank loans and emerging market debt to add 4.1% over a 30-year period.
Private Debt-Direct Lending	5.3%	The base building block is bank loans 4.1% + spread 1.2% (net of management fees and performance incentives). There is 100% leverage included in the assumption with the nominal cost of financing at LIBOR + 2.5%.
Equities		
Large Cap US. Equity	4.6%	This assumption is based on our 30-year outlook for large cap U.S. company dividends and real earnings growth. Adjustments are made for valuations as needed.
Small Cap U.S. Equity	5.1%	Adding a 0.5% return premium for small cap U.S. equity over large cap U.S. equity results in an expected real return of 5.1%. This return premium is theoretically justified by the higher risk inherent in small cap U.S. equity versus large cap U.S. equity and is also justified by historical data.
Global Equity (Developed & Emerging Markets	5.0%	We employ a building block process similar to the U.S. equity model using the developed and emerging markets that comprise the MSCI All-Country World Index. Our roll-up model produces an expected real return of 5.0% for global equity.
International (Non-U.S.) Equity, Developed Markets	4.6%	We employ a building block process similar to the U.S. equity model using the non-U.S. developed equity markets that comprise the MSCI EAFE Index.
Emerging Market Stocks	4.9%	We employ a building block process similar to the U.S. equity model using the non-U.S. emerging equity markets that comprise the MSCI Emerging Markets Index.
Equity Risk Insurance Premium Strategies-High Beta	3.6%	We expect real returns from 50% equity + 50% cash beta plus insurance risk premium over the next 30 years.

Aon Investments' Capital Market Assumptions

Explanation of Capital Market Assumptions—09/30/2023

Alternative Asset Classes		
Low Beta (Defensive) Hedge Funds	2.8%	Encompasses defensive/low volatility hedge fund strategies with low correlations to risk assets. This assumption represents median manager performance. 1% base fee + 10% performance fee is deducted from the return expectation.
Low Beta (Defensive) Hedge Funds Buy List	3.8%	Represent top-tier defensive/low volatility hedge fund strategies with low correlations to risk assets. 1% base fee + 7% performance fee is deducted from return expectations. To use this category the funds must be buy rated or we advise on manager selection.
High Beta (Return Enhancing) Hedge Funds	3.8%	Encompasses return enhancing/higher volatility hedge fund strategies with higher correlations to risk assets. The assumption represents median manager performance. 1% base fee + 10% performance fee is deducted from the return expectations.
High Beta (Return Enhancing) Hedge Funds Buy List	5.8%	Represents top-tier return enhancing/higher volatility hedge fund strategies with higher correlations to risk assets. 1% base fee + 7% performance fee is deducted from return expectations. To use this category the funds must be buy rated or we advise on manager selection.
Broad Hedge Funds Universe	3.3%	Generic hedge fund investments which represents a portfolio of diversified strategies. We assume 50% defensive/50% return enhancing strategies. 1% base fee + 10% performance fee is deducted from the return expectations.
Broad Hedge Funds Buy List	4.8%	Generic hedge fund investments which represents a portfolio of top-tier diversified strategies. We assume 50% defensive buy list/50% return enhancing buy list strategies. To use this category the funds must be buy rated or we advise on manager selection. 1% base fee + 7% performance fee is deducted from the return expectations.
Core Real Estate	3.1%	Our real return assumption for core real estate is based a gross income of about 3.6%, management fees of roughly 1%, 25% leverage and future capital appreciation near the rate of inflation during the next 30 years. We assume a portfolio of equity real estate holdings that is diversified by property and by geographic region.
Non-Core Real Estate	4.8%	Core real estate is levered approximately 100% as the base building block for this assumption. We subtract financing costs for the leverage and 2% management costs. We also assume nominal alpha of 2% over core real estate. We assume a 50/50 mix of value-add and opportunistic investments.
U.S. REITs	4.2%	Our real return assumption for U.S. REITs is based on income of about 4.4% and future capital appreciation near the rate of inflation during the next 30 years. REITs are a sub-set of U.S. small/mid cap equity universe.

Aon Investments' Capital Market Assumptions

Explanation of Capital Market Assumptions—09/30/2023

Commodities	4.1%	Our assumption is for a diversified portfolio of commodity futures contracts. Commodity futures returns are composed of three parts: spot price appreciation, collateral return, and roll return (positive or negative change implied by the shape of the future curve). We believe that spot prices will converge with CPI over the long run (i.e., 2.3%). Collateral is assumed to be Gov't cash (1.9%). Also, we believe the roll effect will be near zero, resulting in a real return of about 4.1% for commodities.
Private Equity	7.6%	Our private equity assumption reflects a diversified fund of funds with exposure to buyouts, venture capital, distressed debt, and mezzanine debt.
Infrastructure	4.7%	Our infrastructure assumption is formulated using a cash flow-based approach that projects cash flows (on a diversified portfolio of assets) over a 30-year period. Income and capital growth as well as gearing levels, debt costs and terms, relevant tax and management expenses are all taken into consideration. Our approach produces an expected real return of 4.7% for infrastructure.
Equity Risk Insurance Premium Strategies-Low Beta	4.3%	We assume real returns from cash of 1.9% + 2.4% from alpha.
eLDI	4.0%	Combination of various long credit strategies (1/6 real estate debt, 1/3 securitized debt, 1/6 CMOs, 1/3 private placements)
Closed-end Real Assets	6.1%	Modeled as 50% Non-Core Real Estate and 50% Infrastructure

Volatility/Correlation Assumptions

Assumed volatilities are formulated with reference to implied volatilities priced into option contracts of various terms, as well as with regard to historical volatility levels. For asset classes which are not marked to market (for example real estate), we "de-smooth" historical returns before calculating volatilities. Importantly, we consider expected volatility trends in the future – in recent years we assumed the re-emergence of an economic cycle and a loss of confidence in central bankers would lead to an increase in volatility. Correlation assumptions are generally similar to actual historical results; however, we do make adjustments to reflect our forward-looking views as well as current market fundamentals.

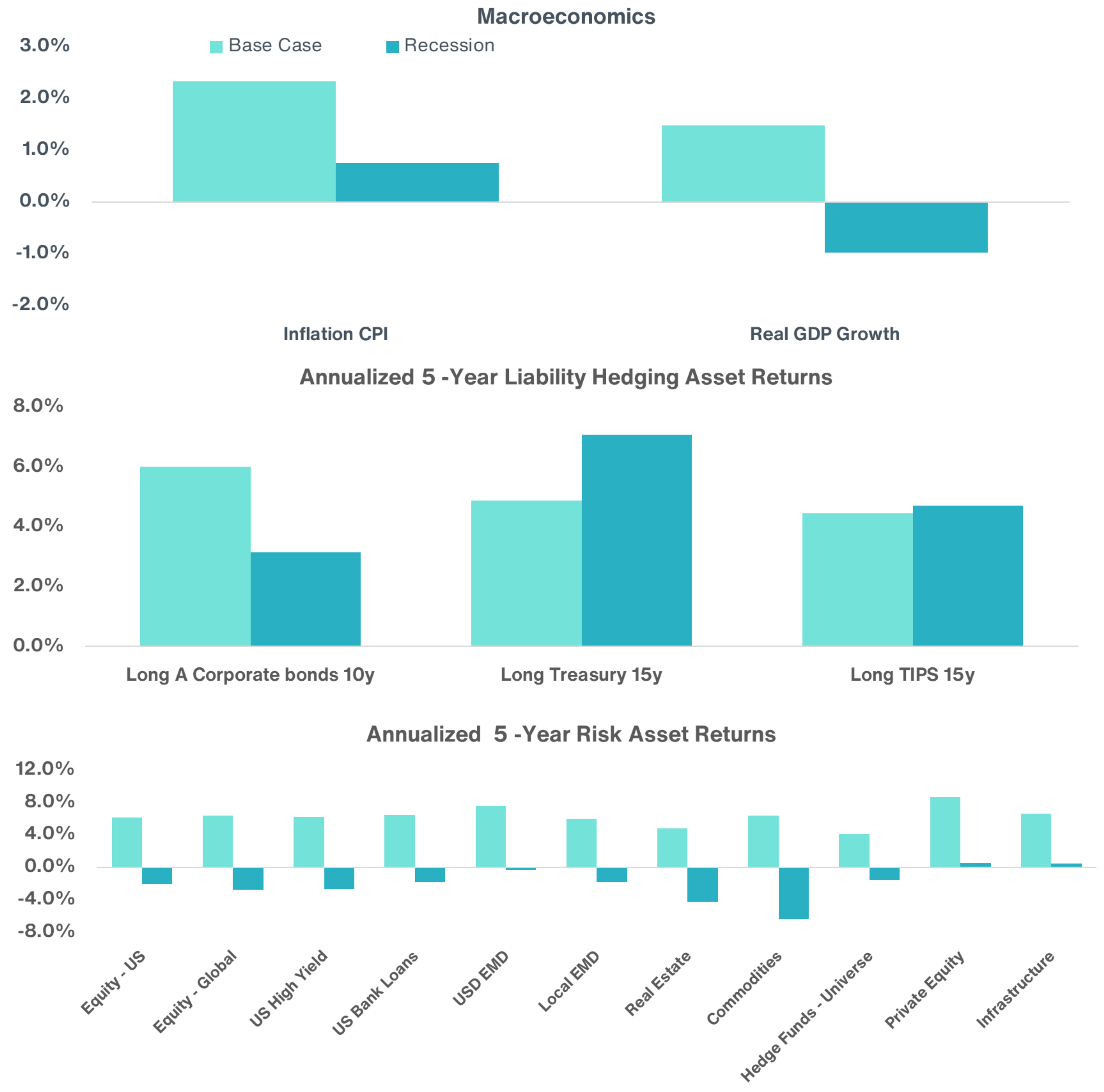
Economic Scenario Assumptions

Section 5: Appendix

Recession Scenario
Description

The U.S. economy slips into a deep recession in 2024

- Global growth is much weaker than the base case. Concerns that inflation will remain high for longer lead to central banks rapidly tightening monetary policies.
- Tightening financial conditions, combined with spill over effects from geopolitical volatility and reduced consumer and business spending, lead to a deep recession in the U.S. in 2024.
- The economic slowdown leads to developed economies implementing modest fiscal stimulus measures and monetary policy becomes more accommodative as central banks are forced to reverse rate hikes within the next 12 months. Policy actions are only partially effective as they are tackling the demand side of the equation.
- Inflation is lower than the base case. However, inflation starts to rise in later years as the post-recession recovery gets underway.
- Treasury yields fall while TIPS yields remain at low levels as the U.S. enters recession. Yields rise in later years as a recovery gets underway. Corporate spreads rise significantly due to the poor economic situation and increased risks of downgrades or defaults.
- Most risk assets make losses in the first two years but rebound in later years as the economy recovers.



Returns from 30 September 2023
Source: Aon

Recession Scenario

Data

Scenario RECESSION SCENARIO

Fixed Income Yields	**9/30/2023**	**9/30/2024**	**9/30/2025**	**9/30/2026**	**9/30/2027**	**9/30/2028**	**9/30/2029**	**9/30/2030**	**9/30/2031**	**9/30/2032**	**9/30/2033**
Treasury yield 5y	4.7%	1.6%	1.2%	2.1%	2.5%	3.0%	3.2%	3.4%	3.7%	3.9%	4.1%
Long Treasury yield 15y	5.0%	1.9%	1.6%	2.8%	3.1%	3.4%	3.6%	3.7%	3.8%	3.8%	3.9%
TIPS yield 5y	2.4%	0.1%	0.0%	0.6%	0.8%	1.1%	1.2%	1.3%	1.4%	1.6%	1.7%
Long TIPS yield 15y	2.4%	0.1%	0.0%	0.8%	1.0%	1.1%	1.3%	1.4%	1.5%	1.7%	1.8%
Breakeven price inflation 15y	2.6%	1.8%	1.6%	2.0%	2.2%	2.3%	2.3%	2.3%	2.3%	2.2%	2.1%
A Corporate bond yield 5y	5.9%	5.6%	6.0%	6.2%	5.9%	6.0%	6.0%	6.0%	6.0%	6.0%	6.0%
A Corporate spread 5y	1.2%	4.1%	4.7%	4.1%	3.4%	3.0%	2.8%	2.6%	2.4%	2.1%	1.9%
Long A Corporate bond yield 10y	5.9%	5.1%	5.4%	6.1%	6.0%	6.1%	6.2%	6.2%	6.2%	6.2%	6.2%
Long A Corporate spread 10y	1.1%	3.4%	3.9%	3.5%	3.0%	2.8%	2.6%	2.5%	2.3%	2.2%	2.0%

Expected nominal return on assets	**Year to 9/30/2024**	**Year to 9/30/2025**	**Year to 9/30/2026**	**Year to 9/30/2027**	**Year to 9/30/2028**	**Year to 9/30/2029**	**Year to 9/30/2030**	**Year to 9/30/2031**	**Year to 9/30/2032**	**Year to 9/30/2033**
Equity – U.S.	-17.8%	-9.7%	11.0%	6.0%	6.0%	6.1%	6.2%	6.2%	6.3%	6.4%
Equity – Global	-20.2%	-11.2%	11.6%	6.2%	6.2%	6.2%	6.3%	6.4%	6.5%	6.5%
EAFE	-22.1%	-12.0%	11.8%	6.0%	6.0%	6.1%	6.2%	6.2%	6.3%	6.4%
EM Equity	-31.9%	-19.1%	13.7%	5.9%	5.9%	6.0%	6.1%	6.2%	6.3%	6.4%
Cash	5.2%	1.2%	1.1%	1.5%	1.8%	2.0%	2.3%	2.6%	2.9%	3.2%
Core Fixed Income	13.2%	3.1%	1.4%	3.9%	3.5%	4.7%	4.9%	5.0%	5.1%	5.3%
U.S. Core Real Estate	-13.6%	-8.2%	-2.8%	0.9%	5.0%	5.0%	5.1%	5.2%	5.2%	5.3%
U.S. Non-Core Real Estate	-18.9%	-11.5%	-4.0%	1.0%	6.6%	6.7%	6.8%	6.9%	7.0%	7.1%
U.S. REITs	-20.3%	-12.8%	-5.1%	0.0%	5.7%	5.8%	5.9%	6.0%	6.1%	6.2%
Private Equity Smoothed	-13.3%	-6.8%	4.5%	6.4%	7.0%	7.7%	8.3%	8.9%	8.7%	8.8%
Private Credit Smoothed	-7.6%	-8.8%	3.1%	1.7%	3.7%	4.1%	4.5%	5.0%	5.4%	5.8%
Infrastructure – U.S.	-5.5%	-1.2%	2.3%	3.1%	6.7%	6.7%	6.8%	6.8%	6.9%	6.9%
Hedge Funds - Broad Universe	-12.8%	-7.3%	9.0%	7.8%	6.0%	6.0%	6.0%	6.0%	6.0%	6.0%
U.S. High Yield	-10.6%	-12.1%	5.7%	4.5%	3.0%	4.8%	5.1%	5.3%	5.7%	6.0%
Bank Loans	-9.6%	-7.9%	5.6%	3.2%	3.1%	3.4%	3.8%	4.1%	4.5%	4.9%
USD Emerging Market Debt	-11.1%	-8.1%	9.4%	6.5%	6.1%	6.8%	7.0%	7.1%	7.2%	7.4%
Local Emerging Market Debt	-12.6%	-9.6%	7.9%	5.0%	4.6%	5.3%	5.5%	5.6%	5.7%	5.9%
Assumed plan return:	-13.40%	-8.07%	7.43%	5.06%	5.71%	6.01%	6.07%	6.11%	6.16%	6.22%

Returns from 30 September 2023

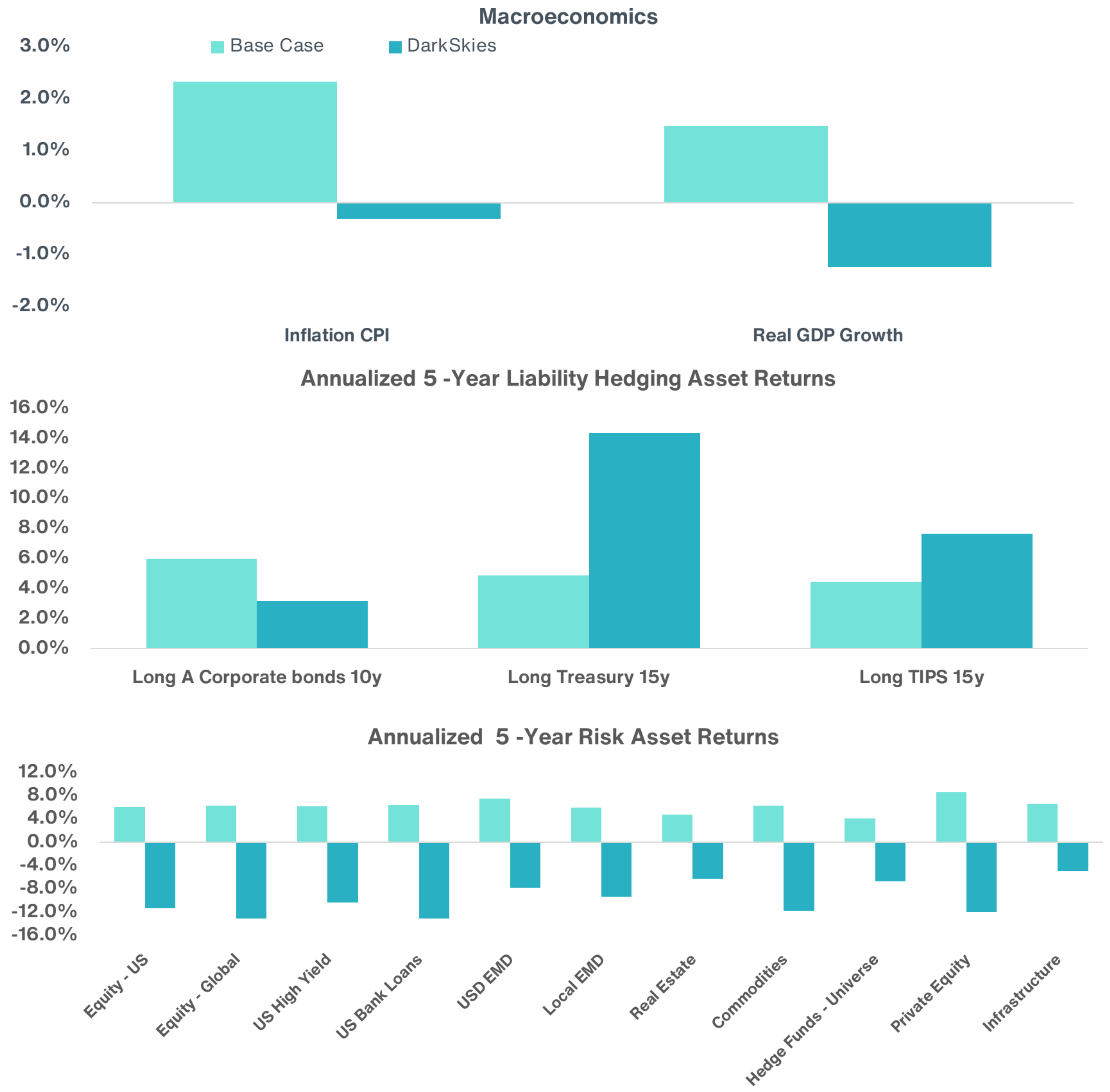
Source: Aon

The opinions referenced are as of the date of publication and are subject to change due to changes in the market or economic conditions and may not necessarily come to pass. Information contained herein is for informational purposes only and should not be considered investment advice.

Dark Skies Scenario
Description

A deep recession followed by a longer period of stagnant growth

- A worsening Russia-Ukraine war, which expands beyond Ukraine's borders, disrupts the global economy. Global supply chains are disrupted on a prolonged basis due to geopolitical events. Worsening geopolitical instability and central banks' aggressive monetary tightening has a severe impact on world economic growth.
- Economic weakness in developed and emerging market economies lead to a global recession followed by stagnation. Failures of smaller banks along with widespread corporate bankruptcies lead to the collapse of some systematically important banks, triggering a new financial crisis, forcing central banks to cut rates to record low levels.
- Inflation falls sharply in 2024 and sluggish growth over the following years means that inflation stays low.
- Treasury yields fall and remain at low levels as the US enters recession. Corporate spreads rise significantly due to the poor economic situation and increased risks of downgrades or defaults.
- Risk assets make losses in the first few years. There is no pronounced bounce in growth and the economic situation remains poor for a long time, which weighs on returns in later years.



Returns from 30 September 2023

Source: Aon

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Dark Skies Scenario

Data

Scenario DARK SKIES SCENARIO

Fixed Income Yields	**9/30/2023**	**9/30/2024**	**9/30/2025**	**9/30/2026**	**9/30/2027**	**9/30/2028**	**9/30/2029**	**9/30/2030**	**9/30/2031**	**9/30/2032**	**9/30/2033**
Treasury yield 5y	4.7%	0.8%	-0.3%	-0.4%	-0.3%	-0.1%	0.3%	0.7%	1.2%	1.6%	2.0%
Long Treasury yield 15y	5.0%	1.1%	0.3%	0.2%	0.2%	0.4%	0.8%	1.2%	1.5%	1.8%	2.1%
TIPS yield 5y	2.4%	0.0%	-0.9%	-1.1%	-1.0%	-0.8%	-0.6%	-0.3%	-0.1%	0.2%	0.5%
Long TIPS yield 15y	2.4%	-0.4%	-1.0%	-1.1%	-1.0%	-0.8%	-0.6%	-0.3%	0.0%	0.2%	0.5%
Breakeven price inflation 15y	2.6%	1.4%	1.3%	1.3%	1.2%	1.3%	1.4%	1.5%	1.5%	1.6%	1.6%
A Corporate bond yield 5y	5.9%	6.3%	5.8%	5.4%	4.8%	4.6%	4.6%	4.7%	4.9%	5.0%	5.1%
A Corporate spread 5y	1.2%	5.5%	6.1%	5.8%	5.1%	4.6%	4.3%	4.0%	3.7%	3.4%	3.0%
Long A Corporate bond yield 10y	5.9%	5.4%	5.1%	4.8%	4.4%	4.3%	4.5%	4.6%	4.8%	5.0%	5.1%
Long A Corporate spread 10y	1.1%	4.4%	4.9%	4.7%	4.2%	3.9%	3.7%	3.5%	3.3%	3.0%	2.8%

Expected nominal return on assets	**Year to 9/30/2024**	**Year to 9/30/2025**	**Year to 9/30/2026**	**Year to 9/30/2027**	**Year to 9/30/2028**	**Year to 9/30/2029**	**Year to 9/30/2030**	**Year to 9/30/2031**	**Year to 9/30/2032**	**Year to 9/30/2033**
Equity – U.S.	-26.8%	-19.2%	-10.3%	3.1%	3.1%	3.4%	3.8%	4.2%	4.5%	4.9%
Equity – Global	-30.0%	-21.6%	-11.7%	2.9%	2.9%	3.3%	3.7%	4.1%	4.5%	4.9%
EAFE	-31.8%	-23.0%	-12.3%	2.7%	2.7%	3.1%	3.5%	3.9%	4.3%	4.7%
EM Equity	-46.3%	-34.2%	-20.1%	1.2%	1.2%	1.8%	2.3%	2.9%	3.5%	4.0%
Cash	5.2%	0.6%	-0.1%	-0.2%	-0.2%	0.0%	0.4%	0.8%	1.2%	1.6%
Core Fixed Income	13.0%	4.7%	1.5%	1.3%	0.3%	-0.4%	0.1%	0.6%	1.1%	1.7%
U.S. Core Real Estate	-15.4%	-10.8%	-4.9%	-0.3%	2.0%	2.3%	2.7%	3.0%	3.4%	3.8%
U.S. Non-Core Real Estate	-21.3%	-15.0%	-6.9%	-0.6%	2.5%	3.0%	3.5%	4.0%	4.5%	5.0%
U.S. REITs	-22.7%	-16.4%	-8.0%	-1.7%	1.5%	2.0%	2.5%	3.0%	3.6%	4.1%
Private Equity Smoothed	-20.3%	-14.4%	-7.4%	-2.4%	-1.5%	-0.3%	0.8%	2.0%	6.6%	7.0%
Private Credit Smoothed	-18.0%	-22.8%	-21.3%	-11.9%	-2.5%	-1.9%	-0.9%	0.0%	0.9%	1.9%
Infrastructure – U.S.	-12.4%	-8.1%	-4.3%	0.7%	3.3%	3.6%	4.0%	4.4%	4.8%	5.2%
Hedge Funds - Broad Universe	-15.8%	-10.3%	-4.4%	2.9%	2.9%	3.2%	3.5%	3.8%	4.2%	4.5%
U.S. High Yield	-14.3%	-14.7%	-12.1%	-2.8%	-4.4%	-4.8%	-3.6%	-2.5%	-1.3%	-0.2%
Bank Loans	-22.7%	-20.8%	-13.5%	-1.7%	-2.0%	-1.4%	-0.7%	0.1%	0.9%	1.6%
USD Emerging Market Debt	-16.9%	-13.6%	-8.2%	2.4%	1.7%	1.7%	2.3%	2.9%	3.5%	4.1%
Local Emerging Market Debt	-18.4%	-15.2%	-9.7%	0.9%	0.2%	0.2%	0.8%	1.4%	2.0%	2.6%
Assumed plan return:	-20.68%	-15.44%	-8.36%	2.18%	2.41%	2.60%	3.02%	3.43%	3.85%	4.26%

Returns from 30 September 2023

Source: Aon

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About This Material

Section 5: Appendix

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