



# Asset-Liability Study Results (Updated)

Omaha School Employees' Retirement System (OSERS)  
July 2022

Investment advice and consulting services provided by Aon Investments USA Inc.

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# Comprehensive Overview

# Asset-Liability Management Overview

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## What?

- A comprehensive toolkit for making decisions on a **fund's asset allocation and investment risk that align with the liabilities** those funds support

## Why?

- Aon believes optimal decisions regarding pension plan management are made when they are based on a **clear understanding of the assets and liabilities** and how they interact

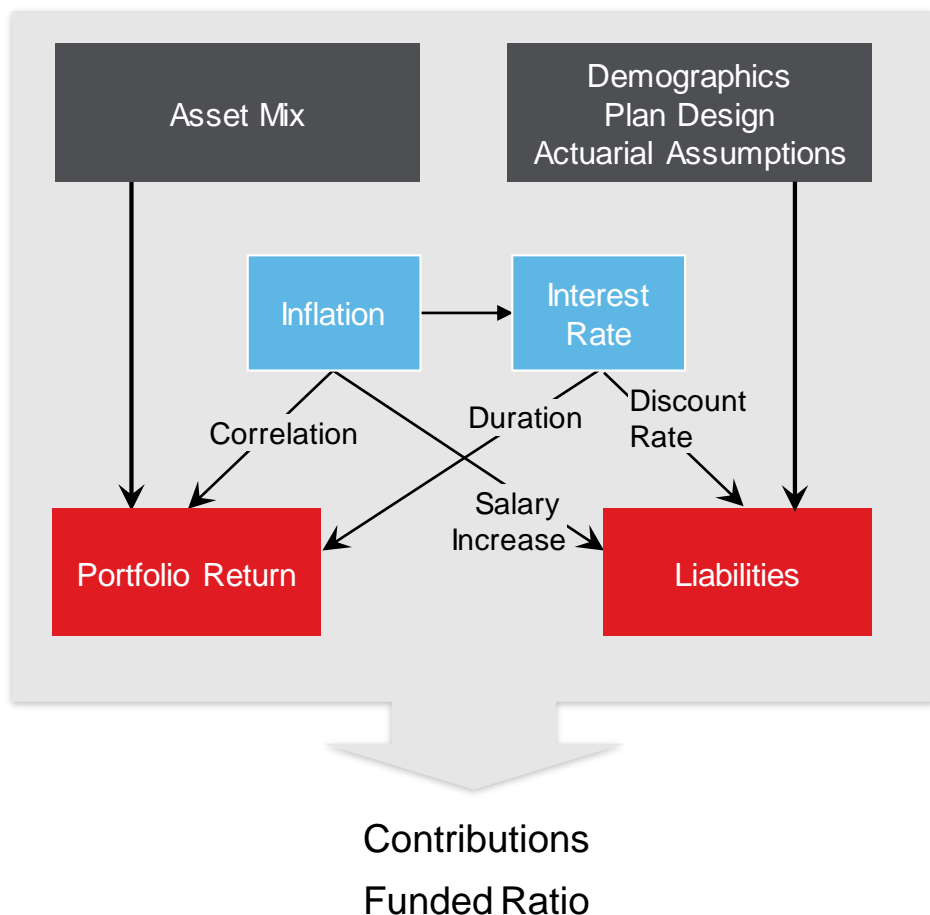
## When?

- Aon suggests conducting asset-liability studies every **3 to 5 years** depending on client specifics, or more frequently should circumstances dictate

## How?

- **Identify future trends** in the financial health of the fund based on economic uncertainties that may not be evident from an actuarial valuation

# Mechanics of Asset-Liability Modeling Process



Asset and liability modeling integrated in single platform

- Integrates impact of key economic variables

Flexibility in modeling parameters and output to client preferences

Stochastic and deterministic modeling performed

# Current State Analysis

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## Funded Ratio

- Funded ratio as of March 31, 2022 estimated to be **62.4%** based on a 7.40% actuarial assumed rate of return

## Asset Allocation

- The Current Policy has 57.5% Public Equity, 5.0% Private Equity, 7.5% Real Estate, and 10% Non-Core Fixed Income
- Our asset-liability analysis terms this as **80%** return-seeking assets with 20% risk-reducing assets (Core Bonds)

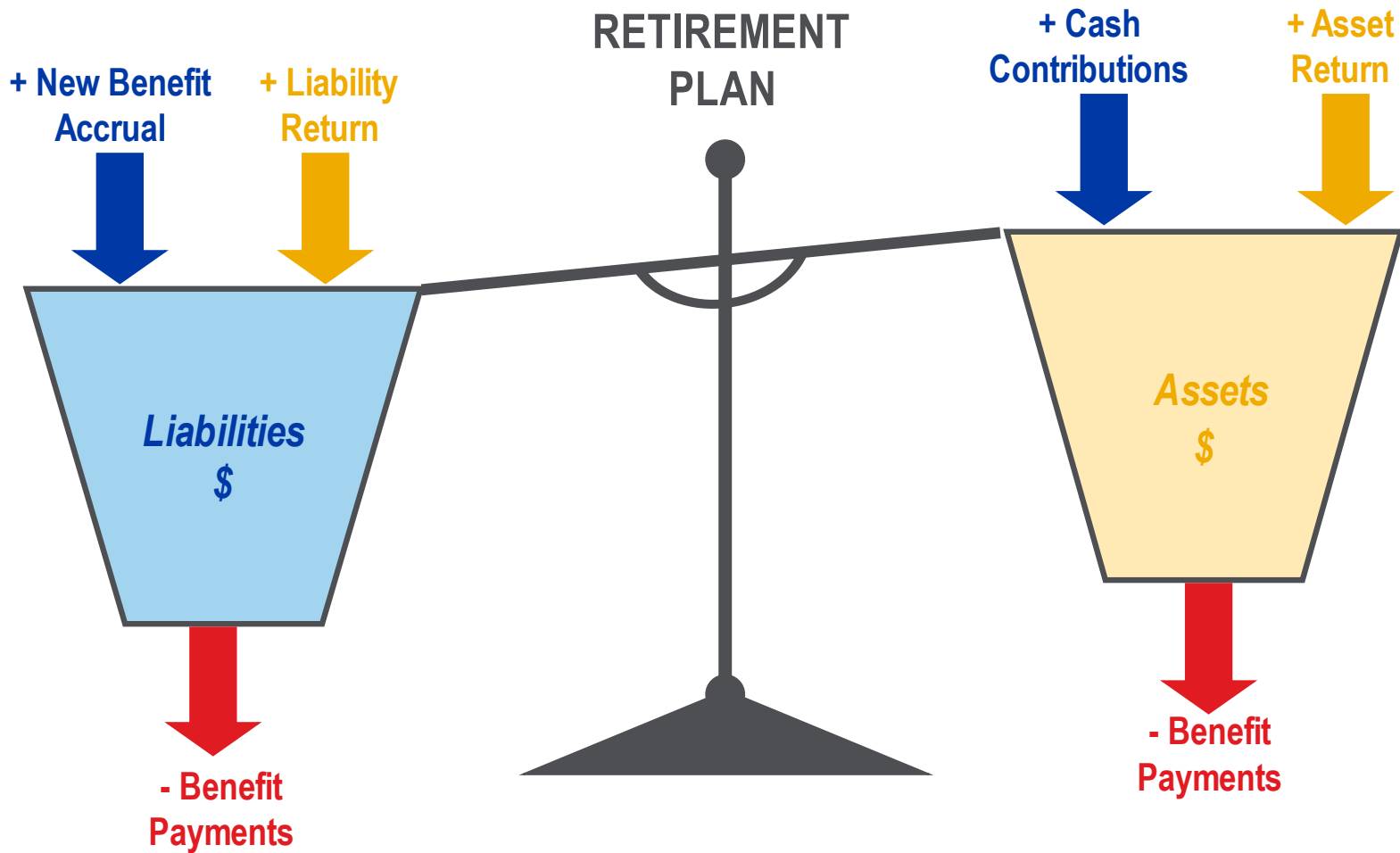
## Expected Return

- Using Aon's 30-year capital market assumptions as of March 31, 2022, the Current Policy has an expected return of **6.47%**

## Hurdle Rate Analysis

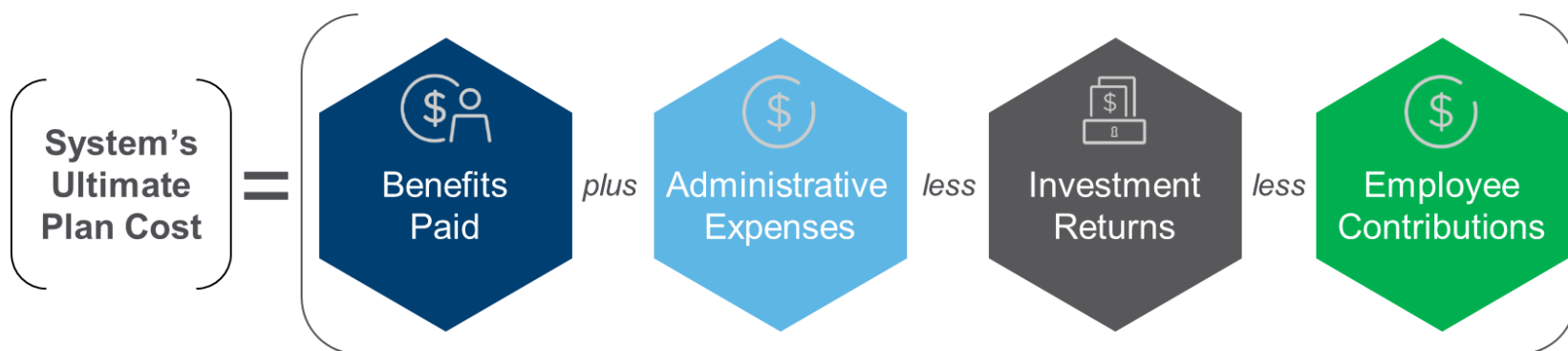
- The hurdle rate is **14.85%**; assets must grow by this rate over the coming year (via contributions and investments) to keep pace with liability growth
- **Asset growth is expected to fall short of the hurdle rate initially**; over time as contributions increase, so will the funded ratio

# Balance of Liabilities and Assets



# Plan Funding

- The ultimate pension financing equation is below:

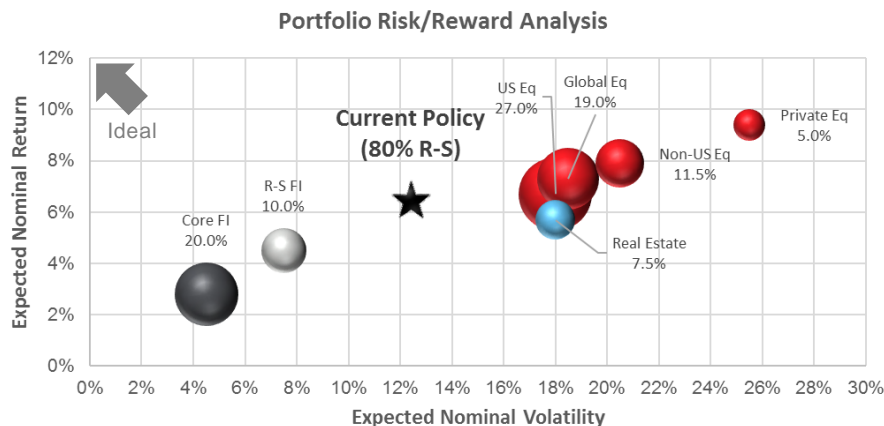


- OSERS' current actuarial contribution policy, which was re-set for the 2019 actuarial valuation, establishes individual, laddered amortization bases that are assumed to expire in 30 years
  - Legacy bases used a 30 year amortization period; starting in 2022, future bases will be 25 years
  - This approach, along with the recent re-setting, will backload contributions over the projection period, placing more stress on investment risk in the near-term



# Portfolio Analysis

## Current Policy (80% Return-Seeking Assets)



### Legend:

- Bubble size proportional to current asset allocation (i.e., larger bubbles = larger allocations)
- Asset classes are color coded:
  - **Equities (red)**
  - **Real Assets (blue)**
  - **Return-Seeking Fixed Income (light gray)**
  - **Safety (dark gray)**

### Key Observation:

- Portfolio is diversified across the risk/return spectrum

<sup>1</sup> Expected returns are using Aon Investments' 30-Year Q2 2022 Capital Market Assumptions. Assumptions do not include fees/expenses. All expected returns are geometric (long-term compounded; rounded to the nearest decimal) and net of investment fees. Expected returns presented are models and do not represent the returns of an actual client account. Not a guarantee of future results. See capital market assumptions disclosure pages in the Appendix.

Percentages may not sum to 100% due to rounding.

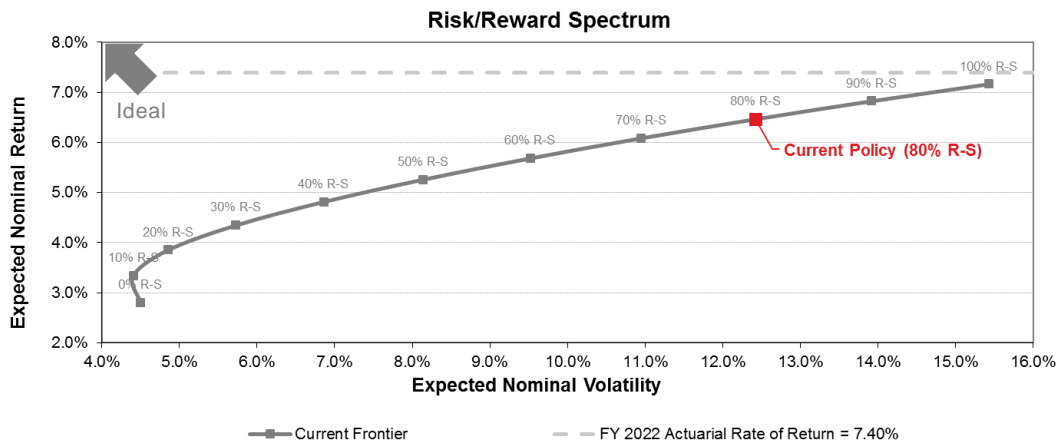
	Expected Real Return <sup>1</sup>	Expected Nominal Return <sup>1</sup>	Expected Nominal Volatility <sup>1</sup>
<b>Equity</b>			
U.S. Equity	4.2%	6.7%	18.0%
Global Equity IMI	4.8%	7.3%	18.5%
Non-U.S. Equity	5.4%	7.9%	20.5%
<b>Fixed Income</b>			
Core Fixed Income	0.4%	2.8%	4.5%
Return-Seeking Fixed Income	2.1%	4.5%	7.5%
<b>Alternatives</b>			
Real Estate	3.2%	5.7%	18.0%
Private Equity	6.8%	9.4%	25.5%
<b>Portfolio Metrics (30-Year Assumptions)</b>			
<b>Total Fund</b>	<b>3.99%</b>	<b>6.47%</b>	<b>12.42%</b>

Notes: Categories above reflect blended Aon capital market assumptions as noted below:

- **U.S. Equity:** 90% U.S. Large Cap / 10% U.S. Small Cap
- **Non-U.S. Equity:** 75% Developed / 25% Emerging Market
- **Return-Seeking Fixed Income:** 25% High Yield Bonds / 25% Bank Loans / 25% Emerging Market Debt (Sov. USD) / 25% Intermediate Credit
- **Real Estate:** 75% Core Real Estate / 25% Non-Core Real Estate

# Portfolio Analysis

## Risk/Reward Spectrum



### Key Takeaways:

- Current portfolio has an expected return of **6.47%**, which falls short of the FY 2022 actuarial assumed rate of return (7.40%)
- Return-Seeking* assets are diversified with public equity, private equity, real estate, and non-core fixed income
- Risk-Reducing / Safety* assets are comprised of core fixed income

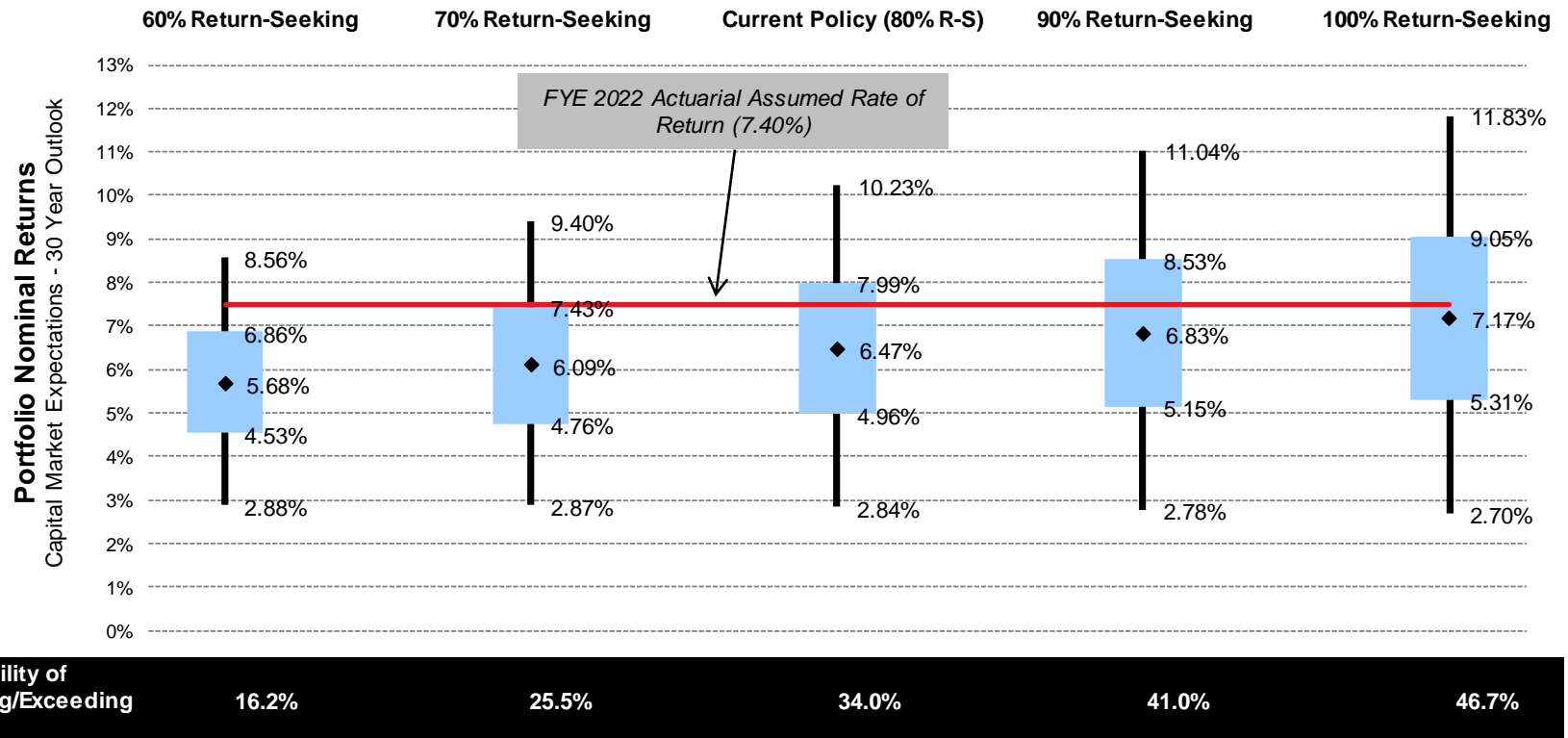
	Exp. Nominal Return <sup>1</sup>	Exp. Nominal Volatility <sup>1</sup>	Sharpe Ratio	Return-Seeking Assets				Risk-Reducing / Safety Assets
				Public Equity	Private Equity	Non-Core Fixed Income <sup>2</sup>	Real Estate	Core Bonds
<b>Current Policy (80% R-S)</b>	<b>6.47%</b>	<b>12.42%</b>	<b>0.344</b>	<b>57.5%</b>	<b>5.0%</b>	<b>10.0%</b>	<b>7.5%</b>	<b>20.0%</b>
<b>Current Frontier</b>								
0% Return-Seeking	2.80%	4.50%	0.133	0.0%	0.0%	0.0%	0.0%	100.0%
10% Return-Seeking	3.34%	4.40%	0.259	7.2%	0.6%	1.3%	0.9%	90.0%
20% Return-Seeking	3.86%	4.86%	0.341	14.4%	1.3%	2.5%	1.9%	80.0%
30% Return-Seeking	4.35%	5.73%	0.375	21.6%	1.9%	3.8%	2.8%	70.0%
40% Return-Seeking	4.82%	6.86%	0.381	28.8%	2.5%	5.0%	3.8%	60.0%
50% Return-Seeking	5.26%	8.14%	0.376	35.9%	3.1%	6.3%	4.7%	50.0%
60% Return-Seeking	5.68%	9.52%	0.366	43.1%	3.8%	7.5%	5.6%	40.0%
70% Return-Seeking	6.09%	10.95%	0.355	50.3%	4.4%	8.8%	6.6%	30.0%
80% Return-Seeking	6.47%	12.42%	0.344	57.5%	5.0%	10.0%	7.5%	20.0%
90% Return-Seeking	6.83%	13.92%	0.332	64.7%	5.6%	11.3%	8.4%	10.0%
100% Return-Seeking	7.17%	15.43%	0.322	71.9%	6.3%	12.5%	9.4%	0.0%

<sup>1</sup> Expected returns are using Aon Investments' 30-Year Q2 2022 Capital Market Assumptions. Assumptions do not include fees/expenses. All expected returns are geometric (long-term compounded; rounded to the nearest decimal) and net of investment fees. Expected returns presented are models and do not represent the returns of an actual client account. Not a guarantee of future results. See capital market assumptions disclosure pages in the Appendix.

<sup>2</sup> Non-Core Fixed Income modeled as 25% High Yield Bonds/ 25% Bank Loans/ 25% Emerging Market Debt (Sov. USD) / 25% Intermediate Credit Percentages may not sum to 100% due to rounding.

# Portfolio Analysis

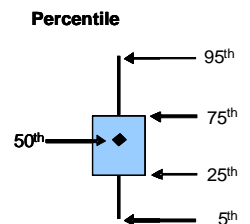
## Range of Nominal Returns



### Key Takeaway:

- Current Policy (80% R-S) has a 34% probability of meeting and/or exceeding the Fiscal Year 2022 actuarial rate of return (7.40%)

Expected returns are using Aon Investments' 30-Year Q2 2022 Capital Market Assumptions. Assumptions do not include fees/expenses. All expected returns are geometric (long-term compounded; rounded to the nearest decimal) and net of investment fees. Expected returns presented are models and do not represent the returns of an actual client account. Not a guarantee of future results. See capital market assumptions disclosure pages in the Appendix.

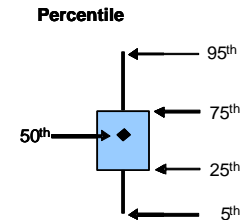


# Peer Analysis

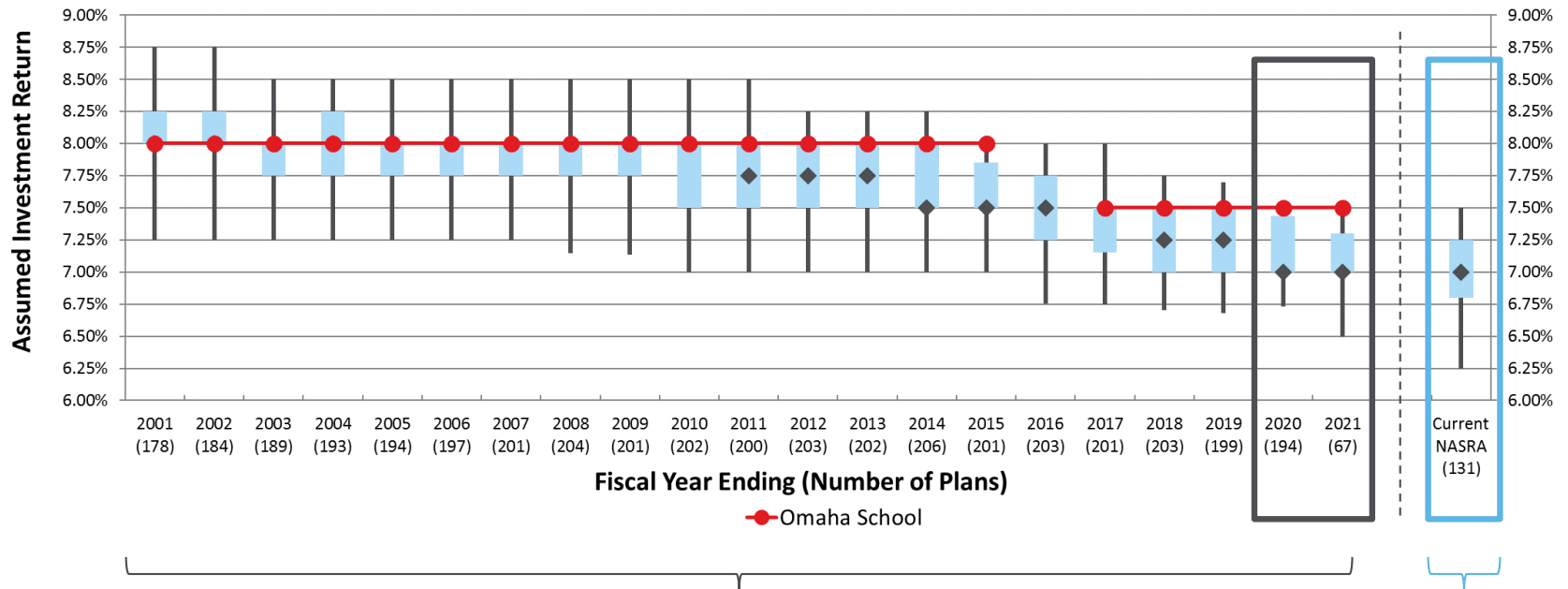
## Distribution of Investment Return Assumptions for U.S. Public Pension Plans

### Key Takeaways:

- The historical actuarial assumption trend for investment returns has declined from an 8.00% median in FYE 2001-2010 to **7.00%** as of FYE 2020-2021, per Public Plans Data<sup>1</sup>
- Current actuarial assumptions, as tracked by NASRA as of June 2022, have a median actuarial assumption of **7.00%**



Distribution of U.S. Public Pension Investment Return Assumptions



Source: Public Pensions Data

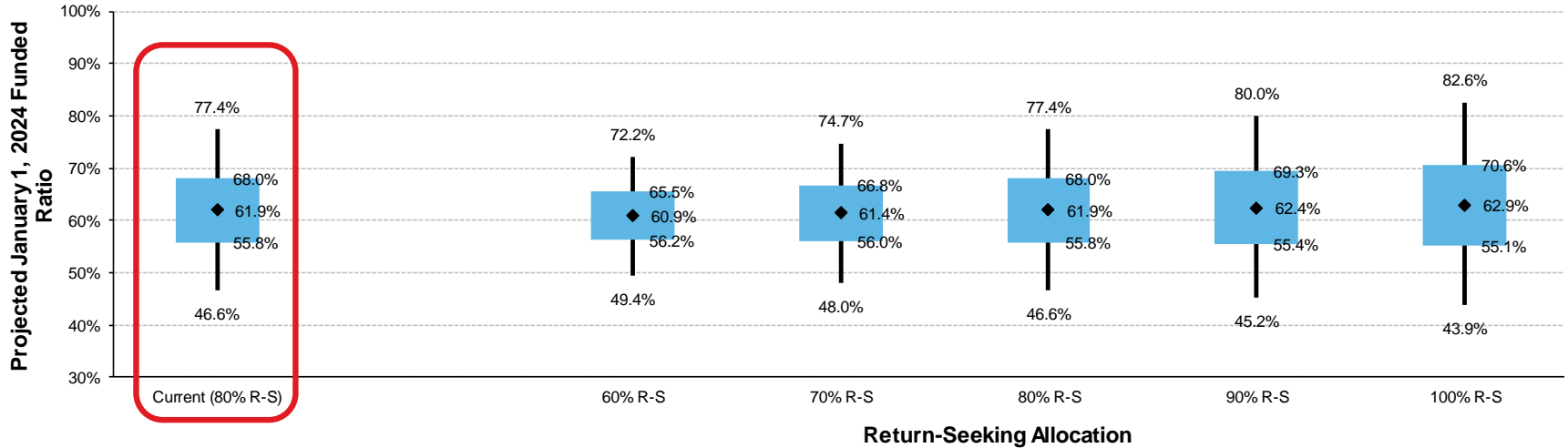
Source: NASRA

Sources: Public PlansData (publicplansdata.org) as of March 2022; NASRA downloadable investment return assumptions as of June 2022

<sup>1</sup> Peers defined as public funds published within publicplansdata.org as of March 2022; Number of plans per year are shown in parentheses

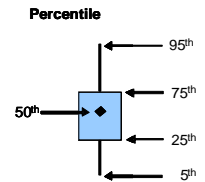
# Asset-Liability Projection Results

## Market Value of Assets / Actuarial Liability Funded Ratio | Short-Term Risk



### Key Takeaway:

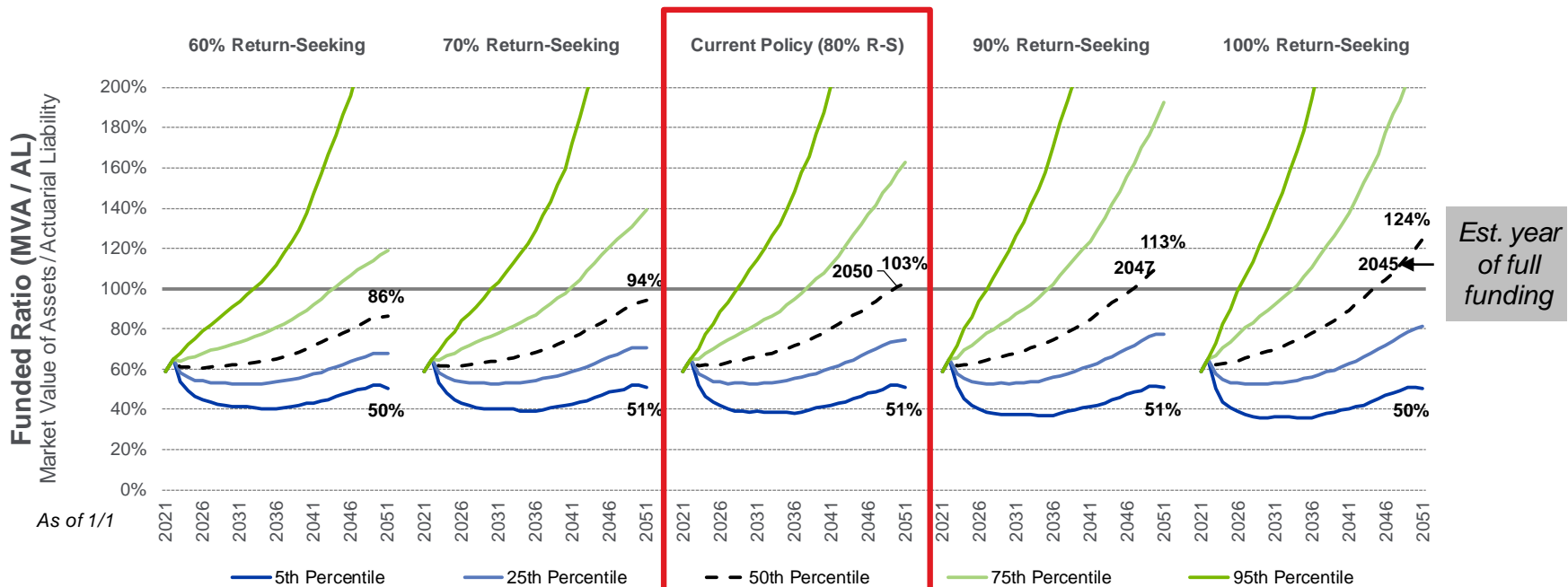
- Higher risk portfolios are projected to have both more upside and downside potential over a short time horizon



\* Liability projections assume discount rates of 7.50% (for 2021), 7.40% (2022), 7.30% (2023), 7.20% (2024), and 7.00% (2025+) for all investment policies studied

# Asset-Liability Projection Results

## Market Value of Assets / Actuarial Liability Funded Ratio



Strategy	60% Return-Seeking			70% Return-Seeking			Current Policy (80% R-S)			90% Return-Seeking			100% Return-Seeking		
Year	2031	2041	2051	2031	2041	2051	2031	2041	2051	2031	2041	2051	2031	2041	2051
5th Percentile	41%	43%	50%	40%	42%	51%	39%	42%	51%	38%	41%	51%	36%	40%	50%
25th Percentile	52%	57%	68%	53%	59%	71%	53%	60%	74%	53%	62%	78%	53%	63%	81%
50th Percentile	62%	71%	86%	64%	76%	94%	66%	80%	103%	68%	85%	113%	69%	89%	124%
75th Percentile	74%	92%	119%	78%	101%	139%	83%	112%	163%	87%	124%	193%	92%	137%	>200%
95th Percentile	93%	147%	>200%	103%	172%	>200%	114%	>200%	>200%	126%	>200%	>200%	139%	>200%	>200%

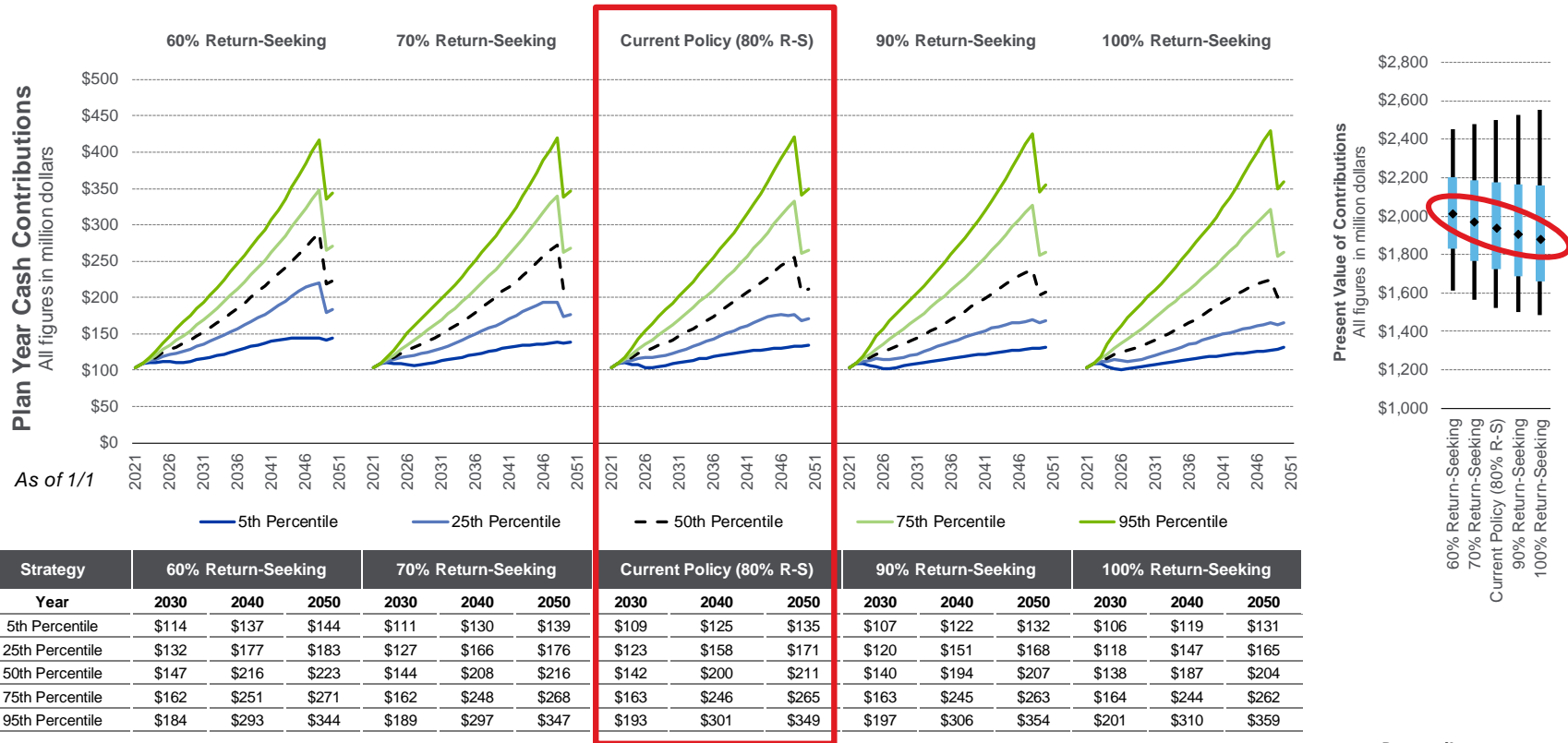
### Key Takeaways:

- The Plan is expected to reach full funding in the central expectation (50th percentile) over the course of the projection period for allocations at or above 80% return-seeking assets
- Higher (or lower) return-seeking strategies adjust the central trend lines

\* Liability projections assume discount rates of 7.50% (for 2021), 7.40% (2022), 7.30% (2023), 7.20% (2024), and 7.00% (2025+) for all investment policies studied

# Asset-Liability Projection Results

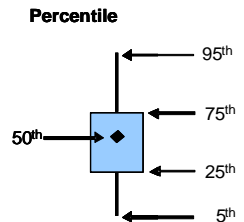
## Total Contribution Amount



### Key Takeaways:

- Contribution amounts are projected to increase over the period with a floor of statutory, payroll-based contributions
- Increases to the return-seeking allocation will lower expected contribution rates (50<sup>th</sup> percentile outcomes) while increasing the volatility of those amounts

\* Liability projections assume discount rates of 7.50% (for 2021), 7.40% (2022), 7.30% (2023), 7.20% (2024), and 7.00% (2025+) for all investment policies studied



# Asset-Liability Projection Results

## Summary and Conclusions

All Scenarios \$ Millions	30-year Economic Cost		30-year Present Value of Contributions		30-year Ending Funded Ratio (MVA / AL)	
	Expected <sup>1</sup>	Downside <sup>2</sup>	Expected <sup>1</sup>	Downside <sup>2</sup>	Expected <sup>1</sup>	Downside <sup>3</sup>
Current Policy (80% R-S)	\$1,902.9	\$2,694.1	\$1,938.4	\$2,501.3	103%	51%
<b>Current Frontier of Results</b>						
0% Return-Seeking	\$2,637.3	\$2,793.5	\$2,321.5	\$2,404.4	55%	44%
10% Return-Seeking	\$2,557.1	\$2,746.0	\$2,267.9	\$2,384.6	59%	46%
20% Return-Seeking	\$2,471.5	\$2,715.9	\$2,216.3	\$2,386.4	63%	48%
30% Return-Seeking	\$2,381.3	\$2,701.1	\$2,165.2	\$2,397.5	68%	49%
40% Return-Seeking	\$2,284.6	\$2,688.8	\$2,113.3	\$2,413.0	73%	50%
50% Return-Seeking	\$2,191.3	\$2,686.1	\$2,063.5	\$2,433.0	79%	50%
60% Return-Seeking	\$2,089.8	\$2,687.4	\$2,015.3	\$2,454.8	86%	50%
70% Return-Seeking	\$1,991.8	\$2,687.7	\$1,973.7	\$2,476.3	94%	51%
80% Return-Seeking	\$1,902.9	\$2,694.1	\$1,938.4	\$2,501.3	103%	51%
90% Return-Seeking	\$1,821.4	\$2,708.4	\$1,905.8	\$2,529.0	113%	51%
100% Return-Seeking	\$1,743.3	\$2,714.8	\$1,880.6	\$2,552.3	124%	50%

### Key Findings:

- The Plan is expected to reach full funding in the central expectation (50th percentile) over the course of the projection period for allocations at or above 80% return-seeking assets
- Higher (or lower) return-seeking strategies adjust the central trend lines

<sup>1</sup> Expected = 50<sup>th</sup> percentile outcome or central expectation across all 5,000 simulations

<sup>2</sup> Downside = 95<sup>th</sup> percentile outcome across all 5,000 simulations

<sup>3</sup> Downside = 5<sup>th</sup> percentile outcome across all 5,000 simulations



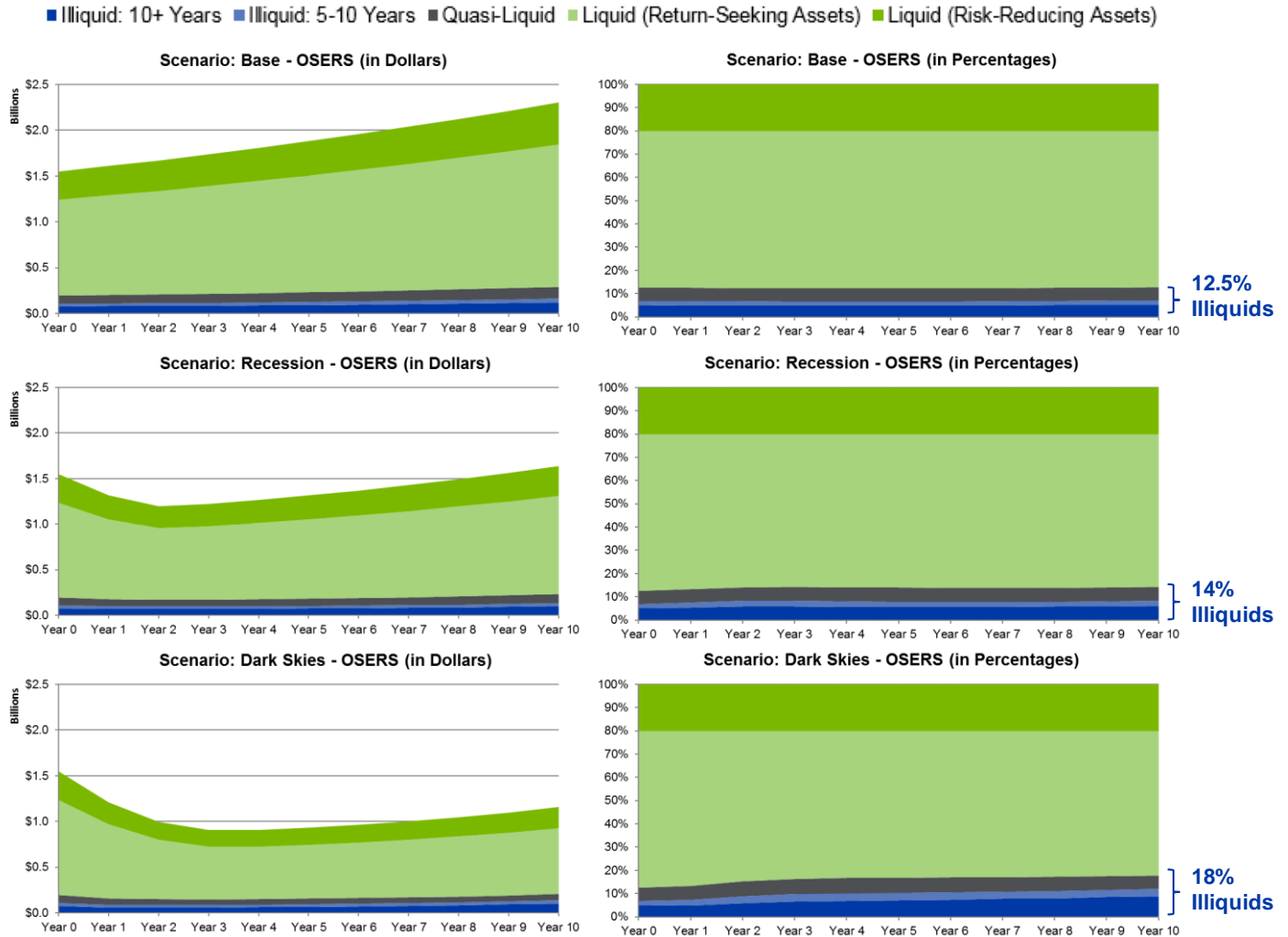
# Liquidity Analysis

## Summary of Results | Current Policy

**Base Case**

**Recession**

**Dark Skies**



Note: Year 0 represents a starting point of March 31, 2022

# Summary & Conclusions

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## Portfolio Analysis

- OSERS' asset allocation (80% return-seeking assets) is diversified across the risk/return spectrum
- Current investment policy has an expected return of 6.47%<sup>1</sup>, trailing the Fiscal Year 2022 actuarial assumed rate of return (7.40%)

## Asset-Liability Projection Analysis

- The plan is expected to reach 103% funded in the central expectation by January 1, 2051 under the current investment policy
- Funded ratio improvement is highly dependent on the plan contributions, which are projected to increase over the period
- Optimistic (or pessimistic) asset performance could lead to better (or worse) outcomes than the central expectation

## Liquidity Analysis

- The current portfolio has sufficient liquidity in the modeled Base Case, Recession, and Dark Skies scenarios
- Actual allocations differing from current targets does not alter the outcomes of this analysis

<sup>1</sup> Expected returns are using Aon Investments' 30-Year Q2 2022 Capital Market Assumptions. Assumptions do not include fees/expenses. All expected returns are geometric (long-term compounded; rounded to the nearest decimal) and net of investment fees. Expected returns presented are models and do not represent the returns of an actual client account. Not a guarantee of future results. See capital market assumptions disclosure pages in the Appendix.



## Additional Analysis

- Additional Asset-Liability Analysis

# Current State Asset-Liability Profile

Asset-Liability Snapshot				
Metric (\$, Millions)	As of 1/1/2021		Est. as of 3/31/2022	
	Value	Fund %	Value	Fund %
Market Value of Assets	\$1,405.4	59.0%	\$1,546.9	62.4%
Actuarial Value of Assets	\$1,467.8	61.6%		
<b>Liability Metrics</b>				
Actuarial Liability (AL) <sup>1</sup>	\$2,381.4		\$2,477.9	

Target Asset Allocation as of 3/31/2022		
Metric (\$, Millions)	Value	Alloc %
<b>Return-Seeking</b>		
- Public Equity	\$889.5	57.5%
- Private Equity	\$77.3	5.0%
- Non-Core Fixed Income <sup>2</sup>	\$154.7	10.0%
- Real Estate	\$116.0	7.5%
- Total	\$1,237.6	80.0%
<b>Risk-Reducing</b>		
- Core Bonds	\$309.4	20.0%
- Total	\$309.4	20.0%
<b>Total</b>	<b>\$1,546.9</b>	<b>100.0%</b>

## Key Observations:

- Pension plan is estimated to be **62.4%** funded on a market value of assets basis as of March 31, 2022
- Asset hurdle rate of **14.85%**, via cash funding and investment returns, needed to maintain or improve actuarial funded status
- The Liability Hurdle Rate exceeds the Total Expected Asset Growth rate (EROA plus Contributions) by **134bps** which is expected to reduce the funded ratio in the near-term

Asset-Liability Growth Metrics			
Metric (\$, Millions)	Value	% Liability	% Assets
AL Discount Cost	\$183.3	7.40%	11.85%
AL Est. Normal Cost	\$46.5	1.88%	3.00%
<b>Total Liability Hurdle Rate</b>	<b>\$229.8</b>	<b>9.28%</b>	<b>14.85%</b>
Expected Return on Assets <sup>3</sup>	\$100.0	4.04%	6.47%
Est. Total Contributions	\$108.9	4.39%	7.04%
<b>Total Exp. Asset Growth</b>	<b>\$208.9</b>	<b>8.43%</b>	<b>13.51%</b>
<b>Hurdle Rate (Shortfall)/Surplus</b>	<b>-\$20.9</b>	<b>-0.85%</b>	<b>-1.34%</b>
Est. Benefit Payments	\$148.2	5.98%	9.58%

<sup>1</sup> Based on a 7.50% discount rate, consistent with the January 1, 2021 valuation results; 7.40% as of March 31, 2022, consistent with January 1, 2022 actuarial assumptions.

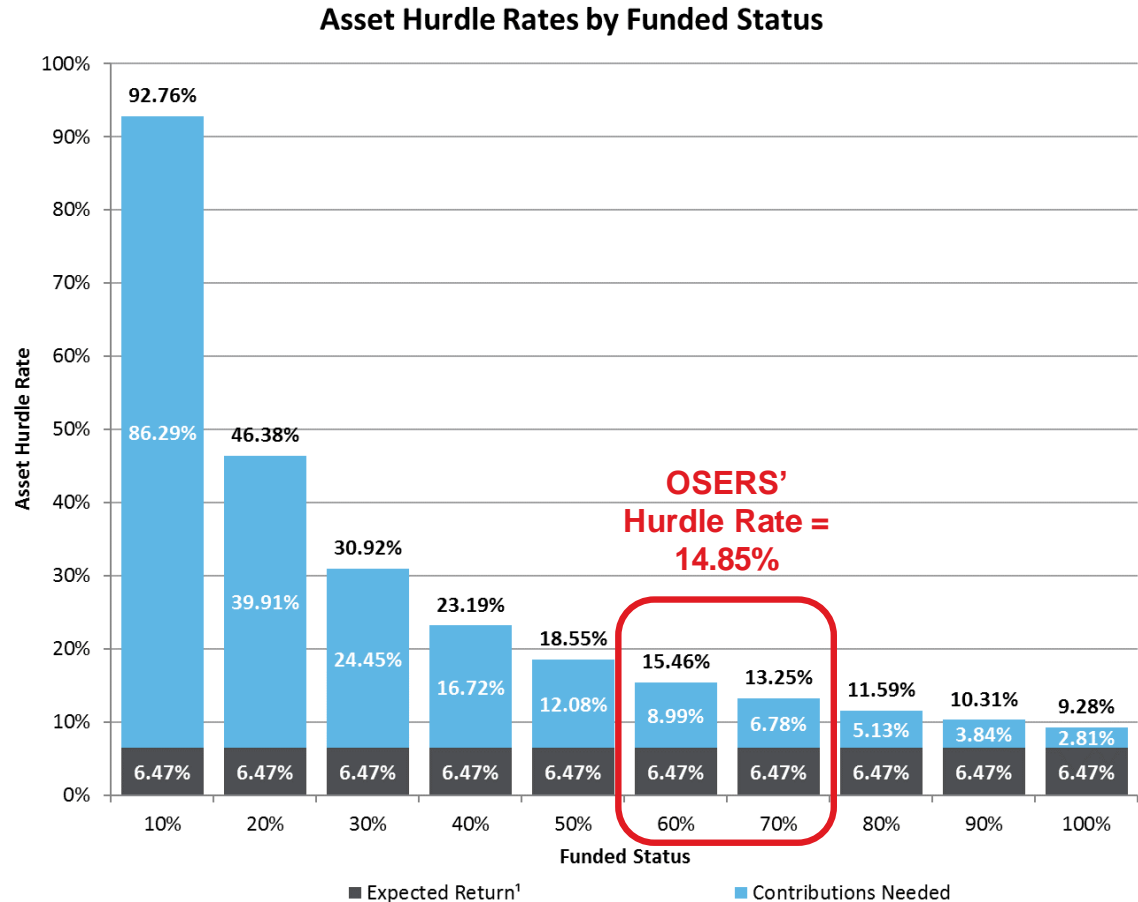
<sup>2</sup> Non-Core Fixed Income modeled as 25% High Yield Bonds/ 25% Bank Loans/ 25% Emerging Market Debt (Sov. USD)/ 25% Intermediate Credit

<sup>3</sup> Expected returns are using Aon Investments' 30-Year Q2 2022 Capital Market Assumptions. Assumptions do not include fees/expenses. See capital market assumptions disclosure pages in the Appendix.

Percentages may not sum to 100% due to rounding.

# Asset Hurdle Rate

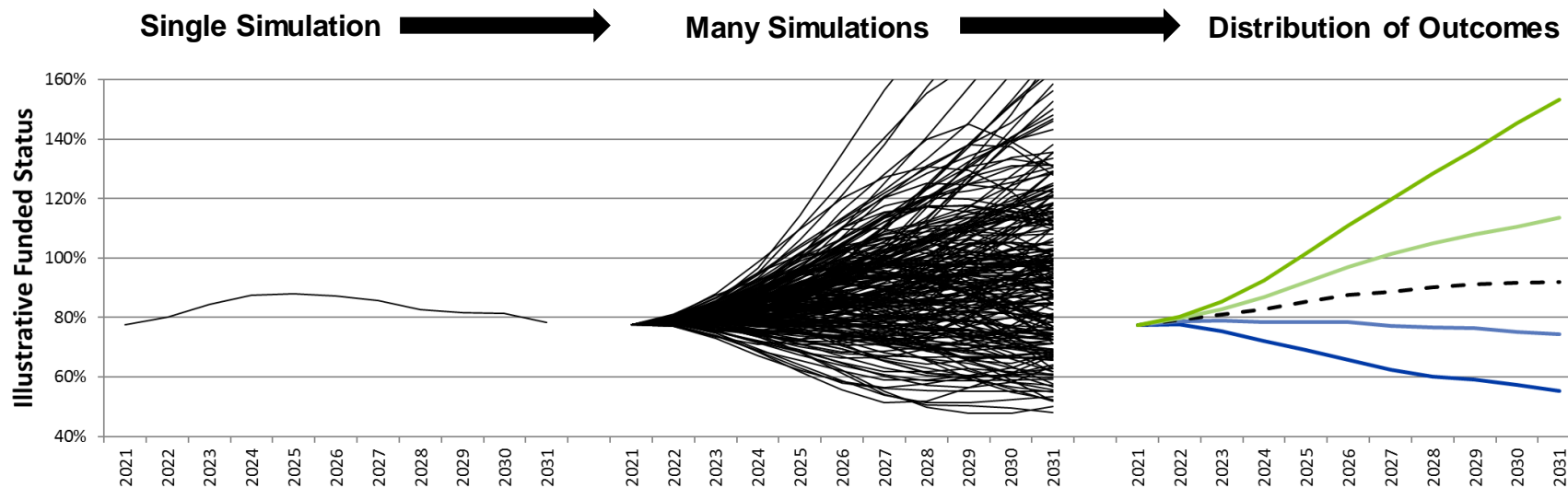
- **Asset Hurdle Rate** is the level of asset growth needed to keep pace with the growth of the Plan liabilities
  - Assets must grow at this rate or more in order to maintain or reduce the existing funding shortfall
- Assets can grow via:
  - Investment performance, and/or
  - Funding contributions
- Asset hurdle rates increase as funded ratio declines, as shown in the chart to the right



Expected returns are using Aon Investments' 30-Year Q2 2022 Capital Market Assumptions. Assumptions do not include fees/expenses. All expected returns are geometric (long-term compounded; rounded to the nearest decimal) and net of investment fees. Expected returns presented are models and do not represent the returns of an actual client account. Not a guarantee of future results. See capital market assumptions disclosure pages in the Appendix.

# Asset-Liability Simulation Overview

- Thousands of simulations plotted in one graph would be impossible to interpret
- Instead, we rank the simulations at each point over the future
- This produces a distribution of outcomes illustrating the degree of uncertainty of a plan's financial position over the projection period
- Different investment strategies will produce different distributions of outcomes



\* The path of a given scenario will follow a much less smooth pattern than the distribution suggests, as illustrated above

# Asset-Liability Projection Results

## Total Contribution Percentage of Payroll



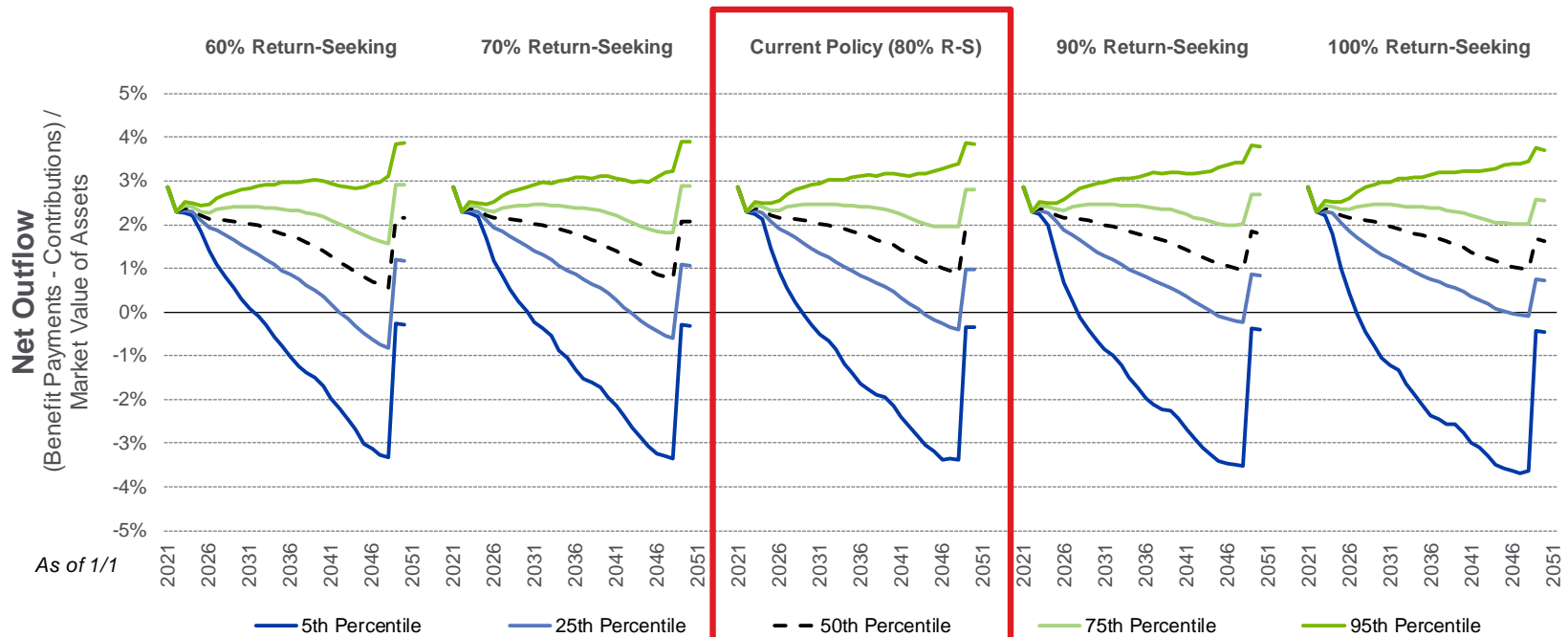
### Key Takeaways:

- Contributions as a percent of payroll are expected to increase in the central expectation (50<sup>th</sup> percentile outcome) under the Current Policy
- Higher (or lower) return-seeking strategies adjust the central trend lines
- Statutory levels serve as the floor of the contribution projections

\* Liability projections assume discount rates of 7.50% (for 2021), 7.40% (2022), 7.30% (2023), 7.20% (2024), and 7.00% (2025+) for all investment policies studied

# Asset-Liability Projection Results

## Net Outflow Analysis: (Benefit Payments less Contributions) / Market Value of Assets



Strategy	60% Return-Seeking			70% Return-Seeking			Current Policy (80% R-S)			90% Return-Seeking			100% Return-Seeking		
Year	2030	2040	2050	2030	2040	2050	2030	2040	2050	2030	2040	2050	2030	2040	2050
5th Percentile	0.3%	-1.7%	-0.3%	0.0%	-1.9%	-0.3%	-0.3%	-2.2%	-0.3%	-0.7%	-2.4%	-0.4%	-1.0%	-2.8%	-0.5%
25th Percentile	1.5%	0.4%	1.2%	1.5%	0.4%	1.1%	1.4%	0.5%	1.0%	1.4%	0.5%	0.8%	1.3%	0.5%	0.7%
50th Percentile	2.0%	1.4%	2.1%	2.1%	1.5%	2.1%	2.1%	1.5%	1.9%	2.0%	1.5%	1.8%	2.0%	1.5%	1.6%
75th Percentile	2.4%	2.2%	2.9%	2.4%	2.3%	2.9%	2.5%	2.3%	2.8%	2.5%	2.3%	2.7%	2.5%	2.3%	2.6%
95th Percentile	2.8%	3.0%	3.9%	2.9%	3.1%	3.9%	2.9%	3.2%	3.9%	2.9%	3.2%	3.8%	3.0%	3.2%	3.7%

### Key Takeaway:

- Net outflow is consistent across the policies modeled with central expectations (50<sup>th</sup> percentile outcome) in the 0-3% range

\* Liability projections assume discount rates of 7.50% (for 2021), 7.40% (2022), 7.30% (2023), 7.20% (2024), and 7.00% (2025+) for all investment policies studied

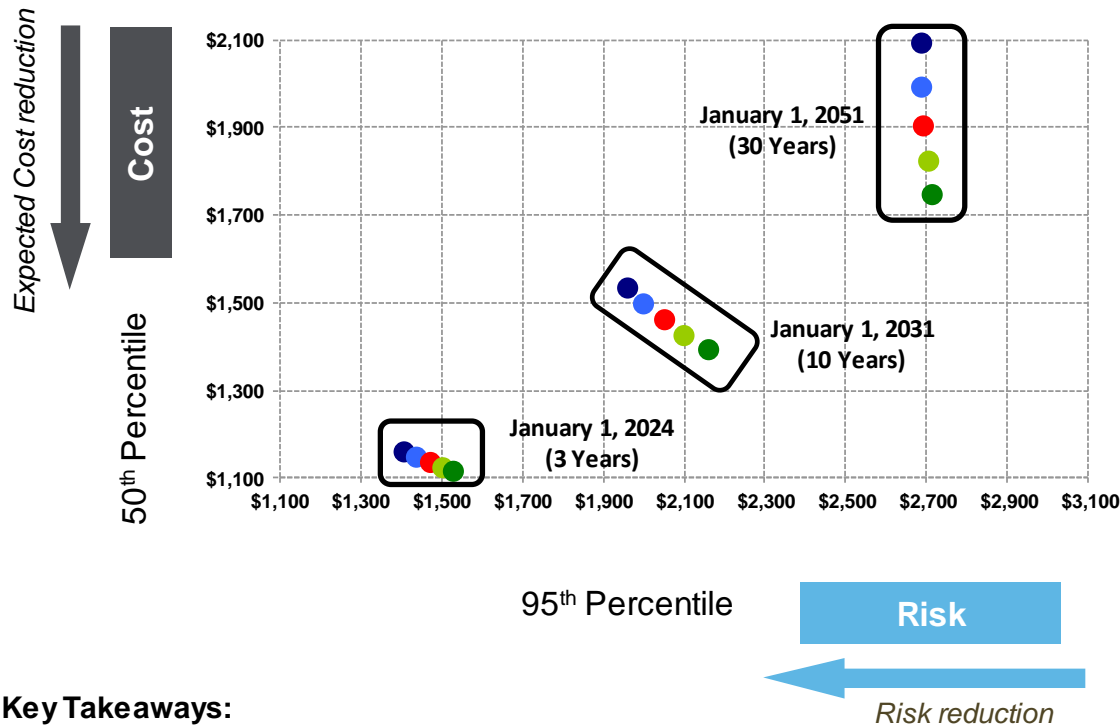


# Asset-Liability Projection Results

## Economic Cost Analysis—3-Year, 10-Year, and 30-Year Horizons

### Economic Cost

Present Value of Contributions plus AL Funding Shortfall/(Surplus)\* at 7.00%, \$millions



### Key Takeaways:

- The magnitude of the risk/reward trade-off changes over a longer-term projection
- Longer time horizons are expected to reward higher levels of risk; shorter time horizons are not
- Under the Current Policy over a 30-year time horizon, the expected Economic Cost is \$1,902.9 million and the potential risk is \$2,694.1 million

\* Liability projections assume discount rates of 7.50% (for 2021), 7.40% (2022), 7.30% (2023), 7.20% (2024), and 7.00% (2025+) for all investment policies studied; Reflects a utility function: Excludes 50% of surplus in excess of 120% of Actuarial liability, and includes twice the shortfall below 40% of Actuarial liability, on a market value basis

Economic Cost		
January 1, 2024		
Strategy (\$Millions)	Cost	Risk
60% Return-Seeking	\$1,156.4	\$1,412.0
70% Return-Seeking	\$1,145.0	\$1,443.1
Current Policy (80% R-S)	\$1,133.8	\$1,474.6
90% Return-Seeking	\$1,122.6	\$1,505.7
100% Return-Seeking	\$1,112.3	\$1,534.2

January 1, 2031		
Strategy (\$Millions)	Cost	Risk
60% Return-Seeking	\$1,533.5	\$1,964.4
70% Return-Seeking	\$1,493.9	\$2,003.0
Current Policy (80% R-S)	\$1,458.4	\$2,052.2
90% Return-Seeking	\$1,425.0	\$2,101.6
100% Return-Seeking	\$1,391.3	\$2,161.3

January 1, 2051		
Strategy (\$Millions)	Cost	Risk
60% Return-Seeking	\$2,089.8	\$2,687.4
70% Return-Seeking	\$1,991.8	\$2,687.7
Current Policy (80% R-S)	\$1,902.9	\$2,694.1
90% Return-Seeking	\$1,821.4	\$2,708.4
100% Return-Seeking	\$1,743.3	\$2,714.8



## Additional Analysis

- Liquidity Analysis

# Liquidity Analysis

## Background

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- OSERS' liquidity analysis is performed under the Current Policy (outlined on the next slide)
  - 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, core real estate)
  - **Illiquid: Potential lock-up of 5–10 years,** depending on economic environment (e.g., closed-end real estate)
  - **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
- Not surprisingly, varying economic and contribution scenarios would lead OSERS' percentage allocation to alternative assets to differ from its targets due to liquidity differences in asset classes
- Additional information on the liquidity analysis can be found in the Appendix

# Liquidity Analysis

## Asset Allocation and Liquidity Category

	Current Target Policy	Actual 3/31/2022 Allocations
<b>Liquid (Risk-Reducing Assets)</b>		
Core Bonds	20.0%	25.5%
<i>Subtotal</i>	20.0%	25.5%
<b>Liquid (Return-Seeking Assets)</b>		
Public Equity	57.5%	54.3%
Non-Core Fixed Income	10.0%	0.0%
<i>Subtotal</i>	67.5%	54.3%
<b>Quasi-Liquid Assets</b>		
Hedge Funds	0.0%	0.5%
Real Estate (Core)	5.6%	3.0%
<i>Subtotal</i>	5.6%	3.5%
<b>Illiquid 5-10 Years</b>		
Real Assets	0.0%	1.5%
Real Estate (Non-Core)	1.9%	4.1%
<i>Subtotal</i>	1.9%	5.6%
<b>Illiquid 10+ Years</b>		
Private Equity	5.0%	11.1%
<i>Subtotal</i>	5.0%	11.1%
<b>Total</b>	<b>100.0%</b>	<b>100.0%</b>
<b>Illiquid + Quasi-Liquid Assets</b>	<b>12.5%</b>	<b>20.2%</b>

# Liquidity Analysis

## Economic Scenarios

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- **Base Case Scenario**

- Markets perform consistent with our Capital Market Assumptions (~50th percentile)

- **Recession Scenario**

- Somewhat pessimistic outlook for the markets (~95<sup>th</sup> percentile)
- Return-seeking assets decline in the first two years with a modest rebound in later years

- **Dark Skies Scenario**

- Very pessimistic outlook for markets (~99th percentile)
- Return-seeking assets decline significantly
- The value of public equities declines approximately 50% over three years, without an immediate rebound

# Liquidity Analysis

## Conclusions

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- **OSERS has sufficient liquidity in the modeled Base Case, Recession, and Dark Skies scenarios**
  - The total illiquid and quasi-liquid assets can be maintained near the target allocation with no cash flow problems
  - In pessimistic scenarios, the allocation could drift enough from the target allocation that OSERS may want to rebalance
  
- Actual allocations differing from current targets does not alter the conclusions of this analysis
  
- This analysis is highly sensitive to the assumed contributions
  - If OSERS receives less contributions than assumed, especially in a Dark Skies environment, then illiquid and quasi-liquid investments could drift even further from target and the potential for liquidity issues would increase



## Additional Analysis

- Portfolio Analysis | Impact of Additional Diversification

# Portfolio Analysis

## Spectrum of Aon Model Portfolios

- Aon's Model Portfolios reflect Aon's best ideas for a *typical* total return defined benefit plan across a range of circumstances noted below
  - Intended as a **starting point** for asset allocation analysis and decision-making and to be customized based on client-specific needs and circumstances

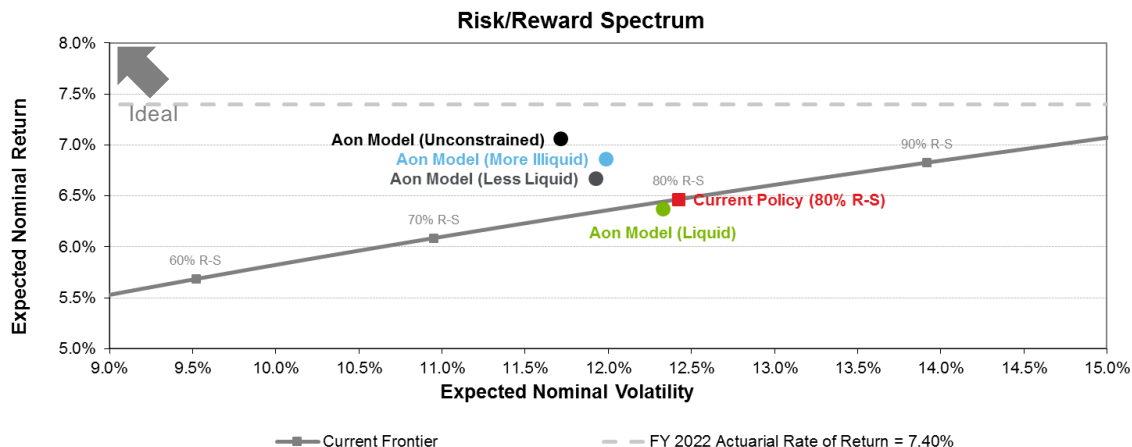
	Liquid	Less Liquid	More Illiquid	Unconstrained
Complexity	Simple		Complex	
Costs	Low Cost		Higher Cost	
Resources	Light Resources		Deep Resources	
Governance	Modest Governance		Strong Governance	
Liquidity	More Liquid		Less Liquid	

- As a general statement, moving from left-to-right on the above spectrum increases both investment portfolio return potential and risk-adjusted return potential, based on our capital markets modelling
  - It also increases the reliance on "alpha" (manager skill) and reduces the emphasis on market "beta" (market risk premiums); alpha is not guaranteed



# Portfolio Analysis

## Risk/Reward Spectrum



### Key Takeaway:

- Additional diversification with assets such as private equity, liquid alternatives, private debt, and non-core real assets are expected to improve the risk/return characteristics of the Plan, if desired

				Return-Seeking Assets							Risk-Reducing / Safety Assets
	Expected Nominal Return	Expected Nominal Volatility	Sharpe Ratio	Public Equity	Private Equity	Liquid Alts	Liquid Return-Seeking Fixed Income	Illiquid Return-Seeking Fixed Income	Open-End Real Assets	Closed-End Real Assets	Core / Core Plus Bonds
<b>Current Policy (80% R-S)</b>	<b>6.47%</b>	<b>12.42%</b>	<b>0.344</b>	<b>58%</b>	<b>5%</b>	<b>0%</b>	<b>10%</b>	<b>0%</b>	<b>6%</b>	<b>2%</b>	<b>20%</b>
<b>Aon Model (Liquid)</b>	<b>6.37%</b>	<b>12.33%</b>	<b>0.338</b>	<b>60%</b>	<b>0%</b>	<b>0%</b>	<b>8%</b>	<b>0%</b>	<b>13%</b>	<b>0%</b>	<b>20%</b>
<b>Aon Model (Less Liquid)</b>	<b>6.67%</b>	<b>11.92%</b>	<b>0.375</b>	<b>50%</b>	<b>5%</b>	<b>5%</b>	<b>8%</b>	<b>0%</b>	<b>8%</b>	<b>5%</b>	<b>20%</b>
<b>Aon Model (More Illiquid)</b>	<b>6.86%</b>	<b>11.99%</b>	<b>0.389</b>	<b>45%</b>	<b>10%</b>	<b>8%</b>	<b>5%</b>	<b>3%</b>	<b>5%</b>	<b>5%</b>	<b>20%</b>
<b>Aon Model (Unconstrained)</b>	<b>7.06%</b>	<b>11.71%</b>	<b>0.415</b>	<b>35%</b>	<b>15%</b>	<b>8%</b>	<b>5%</b>	<b>5%</b>	<b>5%</b>	<b>8%</b>	<b>20%</b>
<b>Current Frontier</b>											
60% Return-Seeking	5.68%	9.52%	0.366	43%	4%	0%	8%	0%	4%	1%	40%
70% Return-Seeking	6.09%	10.95%	0.355	50%	4%	0%	9%	0%	5%	2%	30%
80% Return-Seeking	6.47%	12.42%	0.344	58%	5%	0%	10%	0%	6%	2%	20%
90% Return-Seeking	6.83%	13.92%	0.332	65%	6%	0%	11%	0%	6%	2%	10%
100% Return-Seeking	7.17%	15.43%	0.322	72%	6%	0%	13%	0%	7%	2%	0%

Expected returns are using Aon Investments' 30-Year Q2 2022 Capital Market Assumptions. Assumptions do not include fees/expenses. All expected returns are geometric (long-term compounded; rounded to the nearest decimal) and net of investment fees. Expected returns presented are models and do not represent the returns of an actual client account. Not a guarantee of future results. See capital market assumptions disclosure pages in the Appendix.

Percentages may not sum to 100% due to rounding.

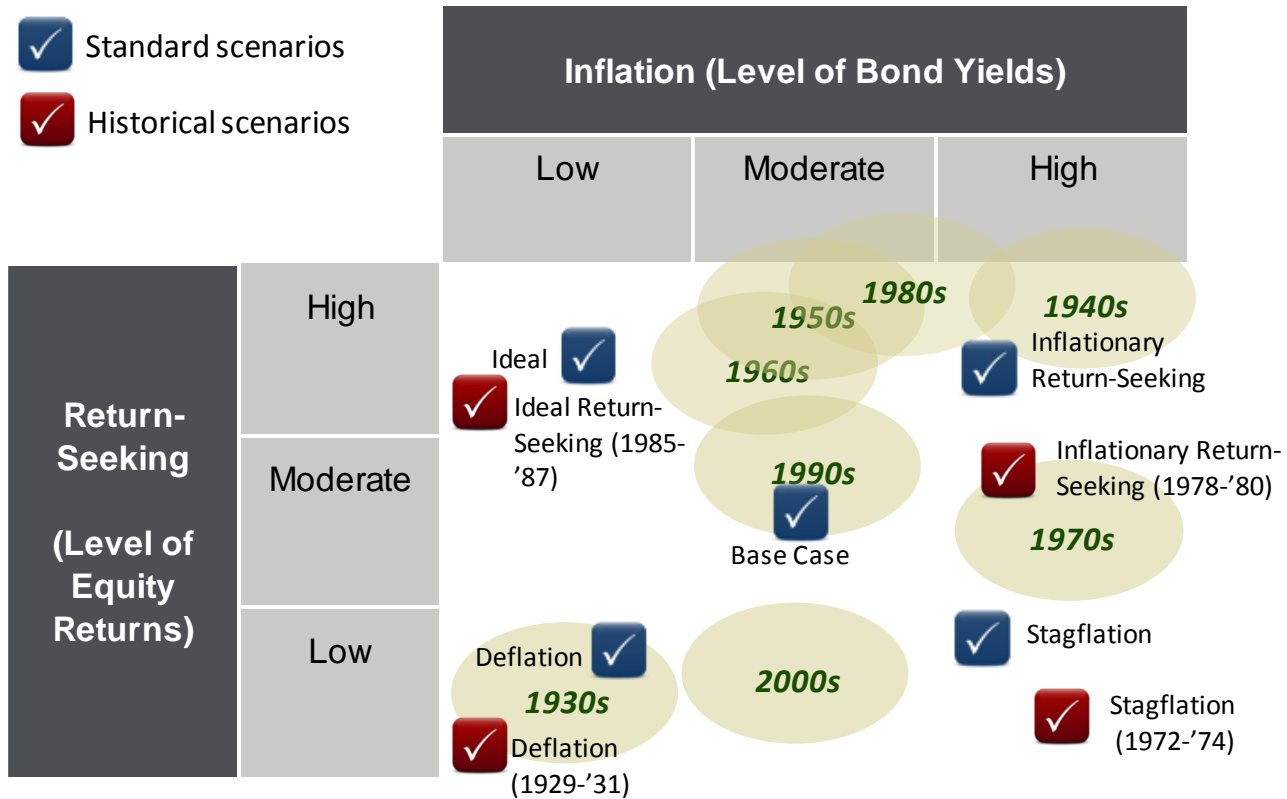


## Additional Analysis

- Scenario Analysis

# Asset-Liability Projection Results

## Scenario Analysis



- Five economic scenarios were modeled in this report
- The economic scenarios vary by the average level of growth and inflation over the forecast period
- The chart above provides historical context for the five scenarios

# Asset-Liability Projection Results

## Scenario Analysis

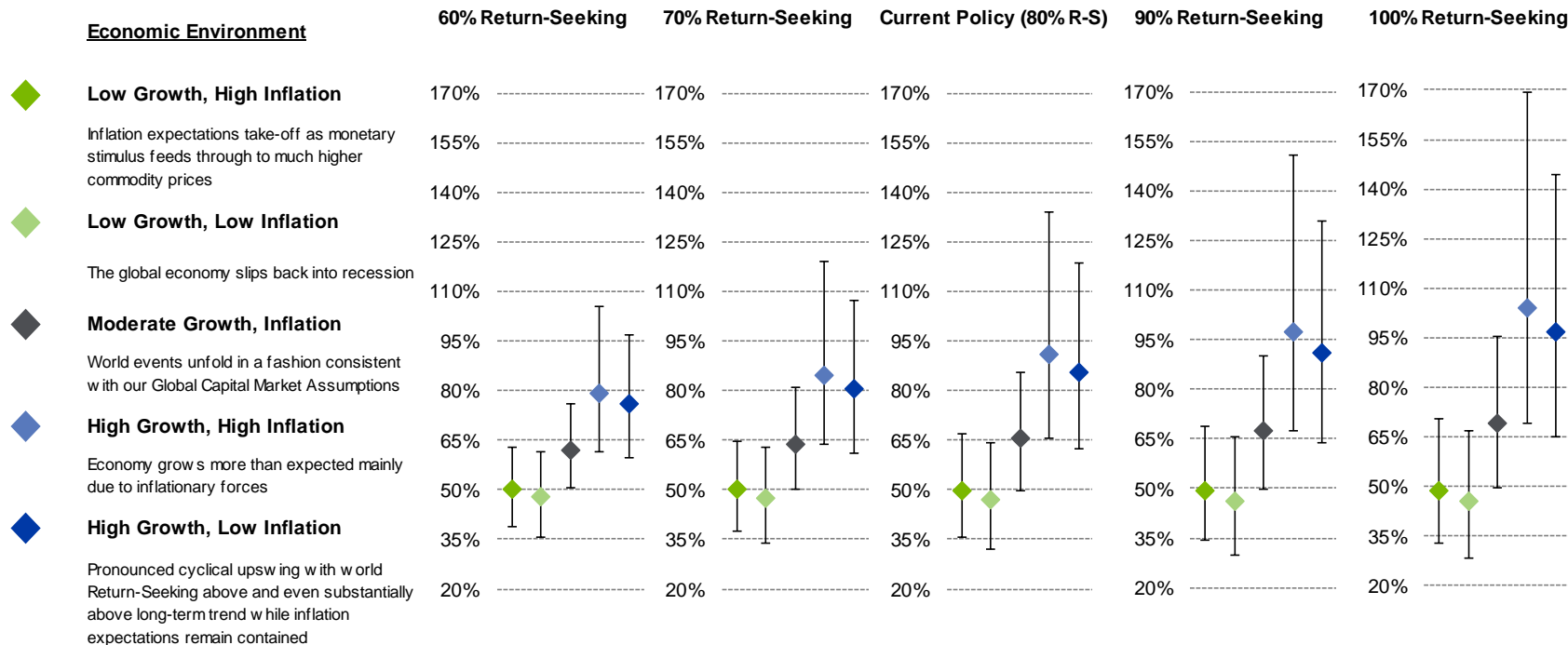
		Inflation (Level of Bond Yields)		
		Low Avg yield = 1.4%	Moderate Avg yield = 2.6%	High Avg yield = 4.2%
Return-Seeking (Level of Equity Returns)	High Avg return = 15.4%	✓ 6% weight	11% weight	✓ 13% weight
	Moderate Avg return = 8.5%	12% weight	✓ 17% weight	11% weight
	Low Avg return = 1.8%	✓ 12% weight	12% weight	✓ 6% weight

- Simulations reflecting these characteristics were drawn from the total of all simulations.
- Level of Inflation was based on the average yield on 10yr Treasuries.
- Level of Growth was based on the average return on Global Equity.
- Simulations were then grouped into scenarios based on the deciles of inflation and growth: 1<sup>st</sup> through 3<sup>rd</sup> deciles were considered “Low”, 4<sup>th</sup> through 7<sup>th</sup> considered “Moderate”, and 8<sup>th</sup> through 10<sup>th</sup> considered “High”.

# Asset-Liability Projection Results

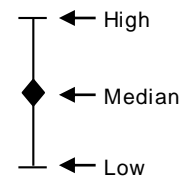
## "What if?" Scenario Analysis | Market Value of Assets / Actuarial Liability Funded Ratio

### MVA / AL Funded Ratio (January 1, 2031)



### Key Takeaways:

- The Plan performs best in high growth / high inflation scenarios
- Growth scenarios are expected to be the driving force behind funded ratio projections over the next ten years



# Asset-Liability Projection Results

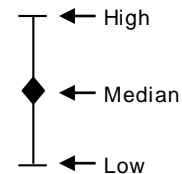
## "What if?" Scenario Analysis | Total Contribution Amount

### Contributions (January 1, 2031) (in \$millions)



### Key Takeaway:

- Higher contributions are expected in low growth scenarios





# Appendix

- Actuarial Assumptions and Methods

# Actuarial Assumptions and Methods

- Actuarial projections provided by the plan actuary as of January 1, 2021
- Actuarial assumptions:

Fiscal Year	Investment Return	Inflation	Payroll Growth
2021	7.50%	2.75%	3.25%
2022	7.40%	2.70%	3.20%
2023	7.30%	2.60%	3.10%
2024	7.20%	2.55%	3.05%
2025+	7.00%	2.35%	2.85%

- Actuarial Value of Assets: equal to the expected asset value, based on the actuarial value in the prior valuation and the assumed investment returns, plus 25% of the difference between the actual market value and the expected value; the resulting value must be no less than 80% of market value and no more than 120% of market value
  - All other assumptions as documented in the July 1, 2021 actuarial valuation report
- Actuarially Determined Contribution Calculation = Normal Cost plus a level percent amortization of the unfunded liability with layered, closed periods (legacy periods were 30 years; starting 2022, the periods will be 25 years)
- Contributions:
  - Member = 9.78% of annual compensation
  - Employer = 9.88% of the members' contributions (101% of member rate)
  - State = 2.00% of annual compensation
  - Additional contributions that are necessary each year to pay the excess of the actuarially-determined contributions over Member, Employer, and State statutory amounts
- Actual asset performance from January 1, 2021 to March 31, 2022 was incorporated into the analysis





# Appendix

- Capital Market Assumptions

# Aon Investments' Capital Market Assumptions

## As of March 31, 2022 (30 Years)

	Expected Real Return <sup>1</sup>	Expected Nominal Return <sup>1</sup>	Expected Nominal Volatility
<b>Equity</b>			
1 Large Cap U.S. Equity	4.0%	6.5%	17.5%
2 Small Cap U.S. Equity	4.5%	7.0%	23.5%
3 Global Equity IMI	4.8%	7.3%	18.5%
4 International Equity (Developed)	5.0%	7.5%	21.0%
5 Emerging Markets Equity	5.6%	8.1%	24.5%
<b>Fixed Income</b>			
6 Cash (Gov't)	-0.2%	2.2%	1.5%
7 Core Fixed Income	0.4%	2.8%	4.5%
8 Core Plus Fixed Income	0.8%	3.2%	5.0%
9 Intermediate Corporate Bonds (4-Year Duration)	0.7%	3.1%	4.0%
10 High Yield Bonds	2.2%	4.7%	10.5%
11 Bank Loans	2.6%	5.1%	7.5%
12 Emerging Market Bonds	2.2%	4.7%	12.0%
13 Multi-Asset Credit <sup>3</sup>	3.4%	5.9%	9.0%
<b>Alternatives</b>			
14 Direct Hedge Funds <sup>2,3</sup>	2.7%	5.2%	10.0%
15 Core Real Estate	2.7%	5.2%	15.5%
16 Non-Core Real Estate	4.3%	6.8%	25.5%
17 Private Equity	6.8%	9.4%	25.5%
18 Closed-End Real Assets	5.7%	8.2%	16.0%
19 Private Debt	3.9%	6.4%	17.5%
<b>Inflation</b>			
20 Inflation	0.0%	2.4%	1.5%

### Notes

<sup>1</sup> Expected returns are geometric (long-term compounded; rounded to the nearest decimal) and net of investment fees

<sup>2</sup> Represents diversified portfolio of Direct hedge fund investments

<sup>3</sup> Alpha incorporated in Expected Nominal Return

# Aon Investments' Capital Market Assumptions

## As of March 31, 2022

Nominal Correlations		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	Large Cap U.S. Equity	1.00	0.93	0.97	0.81	0.73	0.08	0.02	0.07	0.04	0.59	0.44	0.44	0.59	0.66	0.34	0.45	0.62	0.52	0.36	0.07
2	Small Cap U.S. Equity	0.93	1.00	0.93	0.75	0.68	0.07	0.02	0.07	0.04	0.56	0.42	0.41	0.55	0.62	0.33	0.43	0.60	0.50	0.34	0.07
3	Global Equity IMI	0.97	0.93	1.00	0.91	0.83	0.07	0.02	0.07	0.04	0.64	0.47	0.47	0.63	0.64	0.36	0.48	0.63	0.54	0.38	0.08
4	International Equity (Developed)	0.81	0.75	0.91	1.00	0.76	0.04	0.01	0.06	0.03	0.59	0.44	0.43	0.59	0.55	0.35	0.45	0.56	0.50	0.36	0.09
5	Emerging Markets Equity	0.73	0.68	0.83	0.76	1.00	0.06	0.02	0.07	0.04	0.65	0.47	0.47	0.62	0.46	0.32	0.41	0.53	0.46	0.38	0.07
6	Cash (Gov't)	0.08	0.07	0.07	0.04	0.06	1.00	0.42	0.36	0.43	0.11	-0.08	0.14	0.04	-0.02	0.13	0.12	0.08	0.15	-0.16	0.40
7	Core Fixed Income	0.02	0.02	0.02	0.01	0.02	0.42	1.00	0.98	0.97	0.29	0.17	0.48	0.26	0.04	0.05	0.04	0.02	0.05	0.09	0.01
8	Core Plus Fixed Income	0.07	0.07	0.07	0.06	0.07	0.36	0.98	1.00	0.98	0.42	0.35	0.58	0.40	0.18	0.06	0.07	0.07	0.08	0.25	0.01
9	Intermediate Corporate Bonds (4-Year Duration)	0.04	0.04	0.04	0.03	0.04	0.43	0.97	0.98	1.00	0.33	0.29	0.51	0.32	0.13	0.06	0.06	0.05	0.07	0.19	0.04
10	High Yield Bonds	0.59	0.56	0.64	0.59	0.65	0.11	0.29	0.42	0.33	1.00	0.86	0.77	0.92	0.63	0.25	0.32	0.44	0.37	0.70	0.14
11	Bank Loans	0.44	0.42	0.47	0.44	0.47	-0.08	0.17	0.35	0.29	0.86	1.00	0.59	0.85	0.69	0.18	0.23	0.35	0.27	0.83	0.02
12	Emerging Market Bonds	0.44	0.41	0.47	0.43	0.47	0.14	0.48	0.58	0.51	0.77	0.59	1.00	0.79	0.55	0.18	0.23	0.31	0.26	0.47	0.04
13	Multi-Asset Credit	0.59	0.55	0.63	0.59	0.62	0.04	0.26	0.40	0.32	0.92	0.85	0.79	1.00	0.69	0.21	0.28	0.38	0.32	0.69	0.08
14	Direct Hedge Funds	0.66	0.62	0.64	0.55	0.46	-0.02	0.04	0.18	0.13	0.63	0.69	0.55	0.69	1.00	0.21	0.29	0.41	0.33	0.57	0.03
15	Core Real Estate	0.34	0.33	0.36	0.35	0.32	0.13	0.05	0.06	0.06	0.25	0.18	0.18	0.21	0.21	1.00	0.96	0.32	0.85	0.14	0.08
16	Non-Core Real Estate	0.45	0.43	0.48	0.45	0.41	0.12	0.04	0.07	0.06	0.32	0.23	0.23	0.28	0.29	0.96	1.00	0.37	0.89	0.18	0.08
17	Private Equity	0.62	0.60	0.63	0.56	0.53	0.08	0.02	0.07	0.05	0.44	0.35	0.31	0.38	0.41	0.32	0.37	1.00	0.45	0.28	0.07
18	Closed-End Real Assets	0.52	0.50	0.54	0.50	0.46	0.15	0.05	0.08	0.07	0.37	0.27	0.26	0.32	0.33	0.85	0.89	0.45	1.00	0.21	0.10
19	Private Debt	0.36	0.34	0.38	0.36	0.38	-0.16	0.09	0.25	0.19	0.70	0.83	0.47	0.69	0.57	0.14	0.18	0.28	0.21	1.00	-0.01
20	Inflation	0.07	0.07	0.08	0.09	0.07	0.40	0.01	0.01	0.04	0.14	0.02	0.04	0.08	0.03	0.08	0.08	0.07	0.10	-0.01	1.00

# Aon Investments' Capital Market Assumptions

## Explanation of Capital Market Assumptions—Q2 2022

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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 first quarter of 2022. 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.

### **Inflation – Expected Level (2.4%)**

Based on Consensus Economics long-term estimates and our near-term economic outlook, we expect U.S. consumer price inflation to be approximately 2.4% during the next 30 years.

### **Real Returns for Asset Classes**

#### ***Fixed Income***

- **Cash (-0.2%)** – Over the long run, we expect the real yield on cash and money market instruments to produce a real return of -0.2% in a moderate to low-inflationary environment.
- **TIPS (0.0%)** – We expect intermediate duration Treasury Inflation-Protected Securities to produce a real return of about 0.0%.
- **Core Fixed Income (i.e., Market Duration) (0.4%)** – We expect intermediate duration Treasuries to produce a real return of about -0.2%. We estimate the fair value credit spread (credit risk premium - expected losses from defaults and downgrades) to be 0.6%, resulting in a long-term real return of 0.4%.
- **Core Plus Bonds (0.8%)** – Modeled as 20% 5 duration gov't with real return of -0.2% and 80% 5 duration corporate bonds with real return of 1.0%.

# Aon Investments' Capital Market Assumptions

## Explanation of Capital Market Assumptions—Q2 2022

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- **Long Duration Bonds – Government and Credit (0.9%)** – We expect Treasuries with a duration comparable to the Long Government Credit Index to produce a real return of 0.3%. We estimate the fair value credit spread (credit risk premium - expected losses from defaults and downgrades) to be 0.6%, resulting in an expected real return of 0.9%.
- **Long Duration Bonds – Credit (1.3%)** – We expect Treasuries with a duration comparable to the Long Credit Index to produce a real return of 0.3%. We estimate the fair value credit spread (credit risk premium - expected losses from defaults and downgrades) to be 1.0%, resulting in an expected real return of 1.3%.
- **Long Duration Bonds – Government (0.3%)** – We expect Treasuries with a duration of ~12 years to produce a real return of 0.3% during the next 30 years.
- **High Yield Bonds (2.2%)** – We expect intermediate duration Treasuries to produce a real return of about -0.2%. We estimate the fair value credit spread (credit risk premium - expected losses from defaults and downgrades) to be 2.4%, resulting in an expected real return of 2.2%.
- **Bank Loans (2.6%)** – We expect LIBOR to produce a real return of about 0.2%. We estimate the fair value credit spread (credit risk premium - expected losses from defaults) to be 2.4%, resulting in an expected real return of 2.6%.
- **Non-US Developed Bonds: 50% Hedged (0.1%)** – We forecast real returns for non-US developed market bonds to be 0.1% 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) (2.2%)** – We forecast real returns for emerging market sovereign bonds denominated in US dollars to be 2.2% over a 30-year period.
- **Emerging Market Bonds (Corporate; USD) (2.0%)** – We forecast real returns for emerging market corporate bonds denominated in US dollars to be 2.0% over a 30-year period.
- **Emerging Market Bonds (Sovereign; Local) (3.1%)** – We forecast real returns for emerging market sovereign bonds denominated in local currency to be 3.1% over a 30-year period.

# Aon Investments' Capital Market Assumptions

## Explanation of Capital Market Assumptions—Q2 2022

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- **Multi Asset Credit (MAC) (3.4%)** – We assume real returns from beta exposure to high yield, bank loans and emerging market debt to add 2.6% plus 0.8% from alpha (net of fees) over a 30-year period.
- **Private Debt-Direct Lending (3.9%)** – The base building block is bank loans 2.6% + spread 1.3% (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 U.S. Equity (4.0%)** – 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 (4.5%)** – 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 4.5%. 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. In recent years, higher small cap valuations relative large cap equity has reduced the small cap premium.
- **Global Equity (Developed & Emerging Markets) (4.8%)** – 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 4.8% for global equity.
- **International (Non-U.S.) Equity, Developed Markets (5.0%)** – 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 (5.6%)** - 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 (3.1%)** – We expect real returns from 50% equity + 50% cash beta of 2.2% plus 0.9% insurance risk premium over the next 30 years.

# Aon Investments' Capital Market Assumptions

## Explanation of Capital Market Assumptions—Q2 2022

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### **Alternative Asset Classes**

- **Hedge Fund-of-Funds Universe (1.4%)** – The generic category “hedge funds” encompasses a wide range of strategies accessed through “fund-of-funds” vehicles. We also assume the *median* manager is selected and also allow for the additional costs associated with Fund-of-Funds management. A top-tier portfolio of funds (hedge fund-of-funds buy-list) could add an additional 1.2% in return at similar volatility based on alpha, lower fees and better risk management.
- **Hedge Fund-of-Funds Buy List (2.5%)** – The generic category of top-tier “hedge funds” encompasses a wide range of strategies accessed through “fund-of-funds” vehicles. We assume additional costs associated with Funds-of-Funds management. To use this category the funds must be buy rated or we advise on manager selection.
- **Broad Hedge Funds Universe (2.7%)** – Represents a diversified portfolio of direct hedge fund investments. This investment will tend to be less diversified than a typical “fund-of-funds” strategy as there will be fewer underlying managers and will not include the extra layer of fees found in a Fund-of-Funds structure.
- **Broad Hedge Funds Buy List (4.1%)** – Represents a diversified portfolio of top-tier direct hedge fund investments. This investment will tend to be less diversified than a typical “fund-of-funds” strategy as there will be fewer underlying managers and will not include the extra layer of fees found in a Fund-of-Funds structure. To use this category the funds must be buy rated or we advise on manager selection.
- **Core Real Estate (2.7%)** -- Our real return assumption for core real estate is based a gross income of about 2.7%, 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 (4.3%)** -- 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 3%. We assume a 50/50 mix of value-add and opportunistic investments.

# Aon Investments' Capital Market Assumptions

## Explanation of Capital Market Assumptions—Q2 2022

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- **U.S. REITs (3.0%)** – Our real return assumption for U.S. REITs is based on income of about 3.0% 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.
- **Commodities (2.5%)** – Our commodity 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., 2.4%). Collateral is assumed to be LIBOR cash (0.2%). Also, we believe the roll effect will be near zero, resulting in a real return of about 2.5% for commodities.
- **Private Equity (6.8%)** – Our private equity assumption reflects a diversified fund of funds with exposure to buyouts, venture capital, distressed debt, and mezzanine debt.
- **Infrastructure (5.5%)** – 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 5.5% for infrastructure.
- **Equity Risk Insurance Premium Strategies-Low Beta (2.2%)** – We assume real returns from cash of  $-0.2\% + 2.4\%$  from alpha.
- **Alternative Risk Premia (ARP) (4.1%)** – Real return target LIBOR 0.2% plus 3.9% alpha (net of fees)
- **eLDI (1.8%)** – 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 (5.7%)** – Modeled as 50% Non-Core Real Estate and 50% Infrastructure



# Aon Investments' Capital Market Assumptions

## Explanation of Capital Market Assumptions—Q2 2022

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### **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.



# Appendix

- 2021 Horizon Survey Results

# 2021 Horizon Survey Results

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## ▪ What is the Horizon Survey?

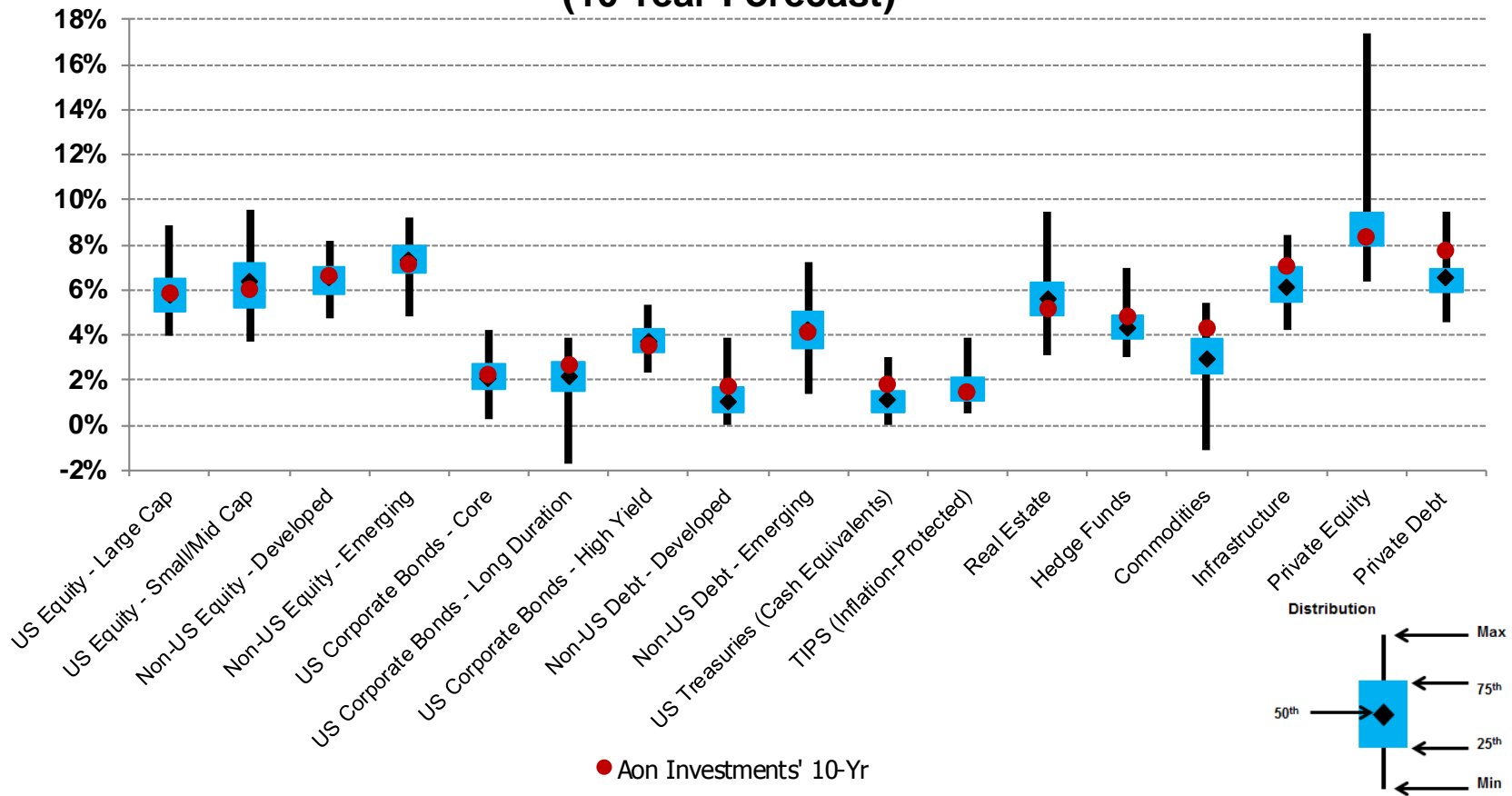
- Since 2010, Horizon Actuarial Services, LLC has conducted a capital market assumption survey of investment firms to aid in determining reasonable assumptions for a pension plan's expected return on assets
  - While Aon does not seek to change our approach based on how we stack up to peers, it is a helpful double-check to make sure we are not too far off from others in the industry

## ▪ How does Aon compare to the 2021 survey results?

- Aon Investments' 2021 10-year forecast assumptions (as of March 31, 2021)
  - **Equities:** approximately middle of the pack for U.S. and Non-U.S. equities
  - **Fixed Income:** approximately middle of the pack relative to the survey's median level; higher for U.S. Treasuries
  - **Alternatives:** approximately middle of the pack relative to the survey's median level; higher for Commodities and Private Debt

# Aon Investments' Capital Market Assumptions vs. Horizon Survey

## Expected Geometric Returns of 39 Investment Advisors (10 Year Forecast)



**SOURCE:** Horizon Actuarial Solutions, LLC survey of 2021 capital market assumptions from 39 independent investment advisors  
 Expected returns of the survey are annualized over 10-years (geometric).  
 Aon Investments' expected returns are annualized over 10-years as of 2Q 2021 (3/31/2021)

# Aon Investments vs. Peers (2021 Horizon Survey)—10-Year Forecast

Asset Class	Horizon Survey		Aon Investments		Difference	
	10 Year Horizon		10 Year Forecasts		Aon Investments - Horizon Survey	
	Expected Return	Expected Risk	Expected Return	Expected Risk	Expected Return	Expected Risk
US Equity - Large Cap	5.7%	16.4%	5.8%	17.0%	0.1%	0.6%
US Equity - Small/Mid Cap	6.3%	20.2%	6.0%	23.0%	-0.3%	2.8%
Non-US Equity - Developed	6.5%	18.3%	6.6%	20.0%	0.1%	1.7%
Non-US Equity - Emerging	7.3%	24.3%	7.1%	27.0%	-0.2%	2.7%
US Fixed Income - Core	2.0%	5.5%	2.2%	4.0%	0.2%	-1.5%
US Fixed Income - Long Duration Corp	2.1%	10.4%	2.6%	9.0%	0.5%	-1.4%
US Fixed Income - High Yield	3.7%	9.9%	3.5%	12.0%	-0.2%	2.1%
Non-US Fixed Income - Developed	1.0%	7.2%	1.7%	5.5%	0.7%	-1.7%
Non-US Fixed Income - Emerging	4.2%	11.3%	4.1%	13.0%	-0.1%	1.7%
Treasuries (Cash Equivalents)	1.1%	1.3%	1.8%	1.5%	0.7%	0.2%
TIPS (Inflation-Protected)	1.4%	5.6%	1.4%	3.5%	0.0%	-2.1%
Real Estate	5.6%	17.6%	5.1%	15.0%	-0.5%	-2.6%
Hedge Funds	4.3%	8.1%	4.8%	9.0%	0.5%	0.9%
Commodities	2.9%	17.3%	4.3%	17.0%	1.4%	-0.3%
Infrastructure	6.1%	17.0%	7.0%	14.5%	0.9%	-2.5%
Private Equity	8.3%	22.3%	8.3%	25.0%	0.0%	2.8%
Private Debt	6.5%	11.4%	7.7%	16.5%	1.2%	5.1%
Inflation	2.0%	2.1%	2.1%	1.0%	0.1%	-1.1%

## Notes (Horizon Survey):

Source: Horizon Actuarial survey of 2021 capital market assumptions from 39 independent investment advisors

Expected returns are median annualized (geometric).

## Notes (Aon Investments' Forecasts):

Aon Investments' Forecasts are for Q2 2021

- US Equity - Small/Mid Cap forecasts represents Aon Investments' forecasts for US Small Cap
- US Fixed Income - Long Duration forecasts represents Aon Investments' forecasts for Long Duration Credit
- Non-US Fixed Income - Developed forecasts represents Aon Investments' forecasts for Non-US Fixed Income - Developed (50% Hedged)
- Non-US Fixed Income - Emerging forecasts represents Aon Investments' forecasts for Emerging Market Bonds - Sovereign USD
- Real Estate forecasts represents Aon Investments' forecasts for Core Real Estate
- Hedge Fund forecasts represents Aon Investments' forecasts for Direct Hedge Funds (Universe)

# Leading Methodologies & Reasons for Differences

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## Leading Methodologies

- Building Block
- Global Capital Asset Pricing Model (Global CAPM)
- Surveys
- Historical data (as a guide to future)
- Black-Litterman (combination of building block and CAPM)

## Reasons for Differences

- Methodology
- Time Horizon
- Arithmetic vs. Geometric forecasts\*
- Alpha (active management)\*
- Inflation
- Investment Fees\*
- Asset class definition

\* While some firms in the Horizon survey responded with arithmetic forecasts, the results have been converted to geometric forecasts for comparison purposes. Additionally, the return expectations included in the Horizon survey are generally market returns that do not reflect active management. Returns for asset classes where passive investments are not available (e.g., hedge funds and private equity) are net of fees.



# Appendix

- Liquidity Analysis Detail

# Background

## Aon Investments' Approach to Analyzing Liquidity Risk from Alternatives

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- Intended as a stress-testing model
- Develops multi-year projections of assets and spending needs
- Uses different scenarios for economic environments and other relevant events
- Shows how the portfolio's liquidity profile could evolve with a given investment strategy
- Incorporates the profile of the liabilities as well as expected future contributions



# Background

## Process Inputs and Outputs

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# Background

## Modeling Parameters – Degrees of Illiquidity

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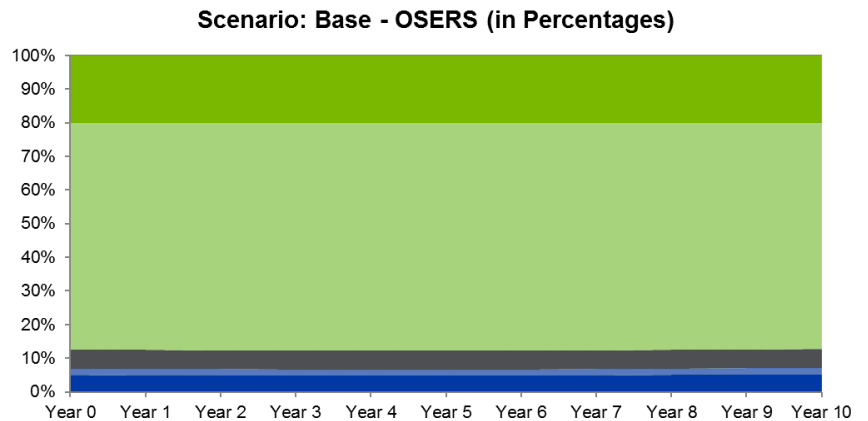
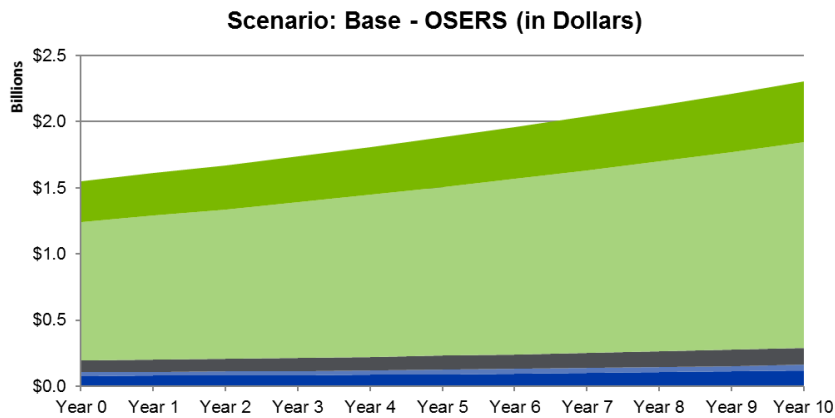
- We categorized investments by liquidity into five buckets
  - **Liquid (Risk-Reducing Assets):** less than 3 months needed for return of capital (e.g., publicly traded securities)
  - **Liquid (Return-Seeking Assets):** less than 3 months needed for return of capital (e.g., publicly traded securities)
  - **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, core real estate)
  - **Illiquid: Potential lock-up of 5–10 years,** depending on economic environment (e.g., closed-end real estate)
  - **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
- We started with the target asset allocations, then see how the actual allocations would change in different economic scenarios, continuing new commitments to private assets, as expected.
- Assumptions
  - Asset-liability information based on the results of the January 1, 2021 actuarial valuation; Liability projections assume discount rates of 7.50% (for 2021), 7.40% (2022), 7.30% (2023), 7.20% (2024), and 7.00% (2025+)
  - Starting assets based on the estimated March 31, 2022 market value of assets, reflecting known asset returns through that date
  - The plan's contribution policy is determined in accordance with the methodology outlined in this asset-liability study
  - Assumes the portfolio starts at the target asset allocation levels for illiquid assets, maintaining close to the portfolio targets over the next 10 years

# Liquidity Analysis: Base Case Economic Scenario

## Current Policy

- The exhibit below shows the projected liquidity lock-up of the Current Policy allocation in the Base Case economic scenario, assuming commitments are continued as expected

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



### Key Takeaway:

- Total illiquid and quasi-liquid assets are projected to stay near 12.5% of the Plan and can be maintained close to target with no cash flow problems

Note: Year 0 represents a starting point of March 31, 2022

# Liquidity Analysis: Base Case Economic Scenario (continued)

## Current Policy

- The exhibit below shows the projected liquidity lock-up of the Current Policy allocation in the Base Case economic scenario

Asset Allocation	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Risk-Reducing Assets	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
Liquid Return-Seeking	68	68	68	68	68	68	68	68	68	67	67
<b>Total Liquid</b>	<b>88%</b>	<b>88%</b>	<b>88%</b>	<b>88%</b>	<b>88%</b>	<b>88%</b>	<b>88%</b>	<b>88%</b>	<b>88%</b>	<b>87%</b>	<b>87%</b>
Quasi-Liquid	6%	6%	6%	6%	6%	6%	6%	6%	6%	6%	6%
Illiquid: 5-10 Year Lock-up	2	2	2	2	2	2	2	2	2	2	2
Illiquid: 10+ Year Lock-up	5	5	5	5	5	5	5	5	5	5	5
<b>Total Quasi + Illiquid</b>	<b>13%</b>	<b>12%</b>	<b>12%</b>	<b>12%</b>	<b>12%</b>	<b>12%</b>	<b>12%</b>	<b>12%</b>	<b>12%</b>	<b>13%</b>	<b>13%</b>

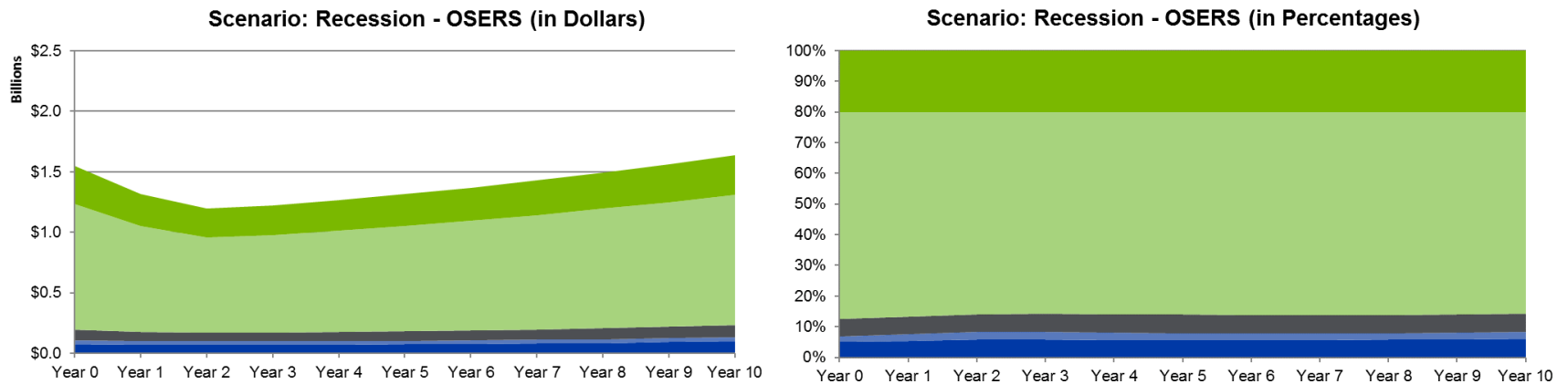
Note: Year 0 represents a starting point of March 31, 2022; Percentages may not sum to 100% due to rounding

# Liquidity Analysis: Recession Economic Scenario

## Current Policy

- The exhibit below shows the projected liquidity lock-up of the Current Policy allocation in the Recession economic scenario, assuming commitments are continued as expected

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



### Key Takeaways:

- Commitments to illiquid alternatives are maintained at the steady state level, but recessionary markets cause the total portfolio to shrink
- Total illiquid and quasi-liquid assets are projected to reach as high as 14% of the Plan due to the shrinking market value of the total Plan in this scenario
- There would not be a concern with the ability to pay benefits
- OSERS may want to redeem some quasi-liquid assets to stay closer to the target allocations (12.5% illiquid assets)

Note: Year 0 represents a starting point of March 31, 2022

# Liquidity Analysis: Recession Economic Scenario (continued)

## Current Policy

- The exhibit below shows the projected liquidity lock-up of the Current Policy allocation in the Recession economic scenario

Asset Allocation	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Risk-Reducing Assets	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
Liquid Return-Seeking	68	67	66	66	66	66	66	66	66	66	66
<b>Total Liquid</b>	<b>88%</b>	<b>87%</b>	<b>86%</b>	<b>86%</b>	<b>86%</b>	<b>86%</b>	<b>86%</b>	<b>86%</b>	<b>86%</b>	<b>86%</b>	<b>86%</b>
Quasi-Liquid	6%	6%	6%	6%	6%	6%	6%	6%	6%	6%	6%
Illiquid: 5-10 Year Lock-up	2	2	3	2	2	2	2	2	2	2	2
Illiquid: 10+ Year Lock-up	5	5	6	6	6	6	6	6	6	6	6
<b>Total Quasi + Illiquid</b>	<b>13%</b>	<b>13%</b>	<b>14%</b>	<b>14%</b>	<b>14%</b>	<b>14%</b>	<b>14%</b>	<b>14%</b>	<b>14%</b>	<b>14%</b>	<b>14%</b>

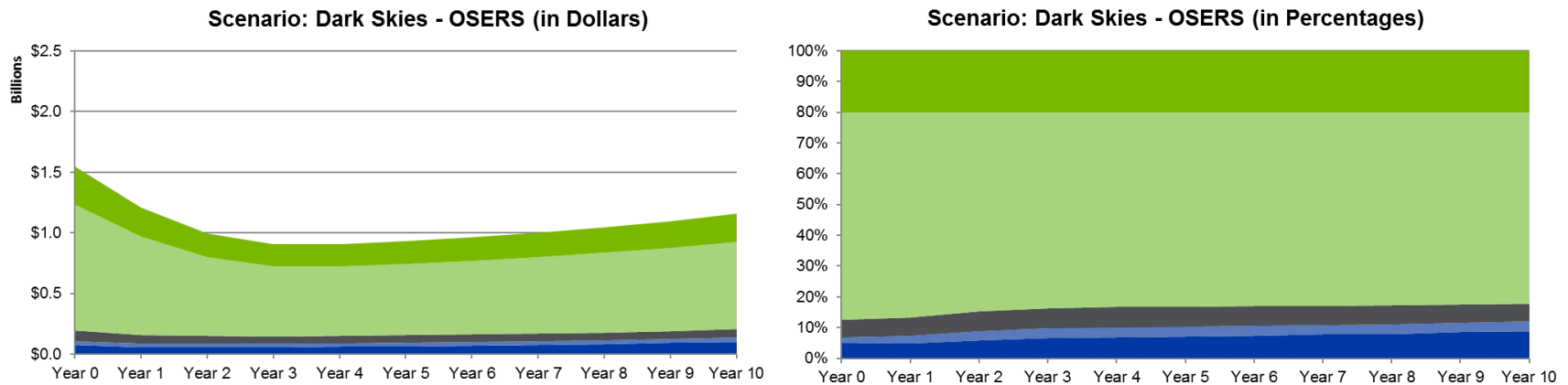
Note: Year 0 represents a starting point of March 31, 2022; Percentages may not sum to 100% due to rounding

# Liquidity Analysis: Dark Skies Economic Scenario

## Current Policy

- The exhibit below shows the projected liquidity lock-up of the Current Policy allocation in the Dark Skies economic scenario, assuming commitments are continued as expected

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



### Key Takeaways:

- Commitments to illiquid alternatives are maintained at the steady state level, but subpar markets cause the total portfolio to shrink
- Total illiquid and quasi-liquid assets are projected to reach as high as 18% of the Plan due to the shrinking market value of the total Plan in this scenario
- There would not be a concern with the ability to pay benefits
- OSERS may want to redeem some quasi-liquid assets to stay closer to the target allocations (12.5% illiquid assets)

Note: Year 0 represents a starting point of March 31, 2022

# Liquidity Analysis: Dark Skies Economic Scenario (continued)

## Current Policy

- The exhibit below shows the projected liquidity lock-up of the Current Policy allocation in the Dark Skies economic scenario

Asset Allocation	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Risk-Reducing Assets	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
Liquid Return-Seeking	68	67	65	64	63	63	63	63	63	62	62
<b>Total Liquid</b>	<b>88%</b>	<b>87%</b>	<b>85%</b>	<b>84%</b>	<b>83%</b>	<b>83%</b>	<b>83%</b>	<b>83%</b>	<b>83%</b>	<b>82%</b>	<b>82%</b>
Quasi-Liquid	6%	6%	6%	7%	7%	7%	6%	6%	6%	6%	6%
Illiquid: 5-10 Year Lock-up	2	2	3	3	3	3	3	3	3	3	3
Illiquid: 10+ Year Lock-up	5	5	6	6	7	7	7	8	8	8	9
<b>Total Quasi + Illiquid</b>	<b>13%</b>	<b>13%</b>	<b>15%</b>	<b>16%</b>	<b>17%</b>	<b>17%</b>	<b>17%</b>	<b>17%</b>	<b>17%</b>	<b>18%</b>	<b>18%</b>

Note: Year 0 represents a starting point of March 31, 2022; Percentages may not sum to 100% due to rounding

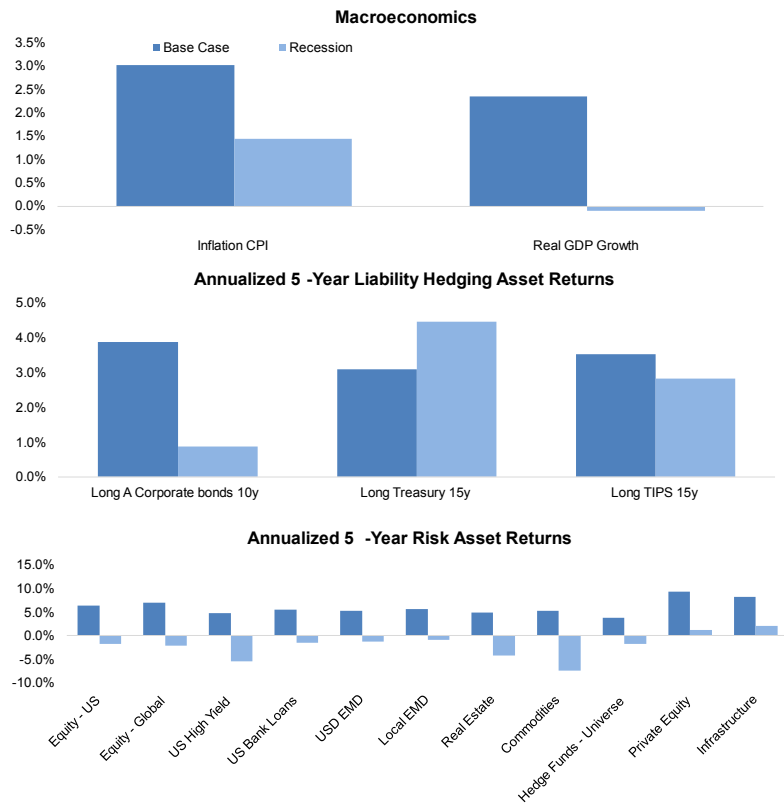


# Recession Scenario

## Description

### The US economy slips into recession in 2022

- 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 spillover effects from geopolitical volatility and reduced consumer and business spending, as real incomes are squeezed by high inflation, lead to a deep recession in the US in 2022/23.
- The economic slowdown leads to developed economies implementing modest fiscal stimulus measures and monetary policy becomes more accommodative. 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 US 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 31 March 2022

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.

# Recession Scenario

## Data Table

### RECESSION SCENARIO

	Year 0	1	2	3	4	5	6	7	8	9	10
<b>Yields (BOY)</b>											
Treasury yield 5y	2.5%	0.5%	0.3%	0.8%	1.0%	1.3%	1.3%	1.4%	1.5%	1.6%	1.7%
Long Treasury yield 15y	2.5%	0.6%	0.5%	1.3%	1.4%	1.6%	1.7%	1.8%	1.9%	2.0%	2.0%
TIPS yield 5y	-0.8%	-1.7%	-1.8%	-1.6%	-1.5%	-1.4%	-1.3%	-1.2%	-1.0%	-0.9%	-0.7%
Long TIPS yield 15y	-0.3%	-1.4%	-1.4%	-1.1%	-1.0%	-0.8%	-0.7%	-0.6%	-0.5%	-0.4%	-0.2%
Breakeven price inflation 15y	2.8%	2.1%	1.9%	2.3%	2.4%	2.5%	2.5%	2.4%	2.4%	2.3%	2.2%
A Corporate bond yield 5y	3.4%	4.5%	5.0%	4.9%	4.5%	4.3%	4.2%	4.0%	3.8%	3.7%	3.6%
Long A Corporate bond yield 10y	3.5%	4.0%	4.3%	4.6%	4.3%	4.2%	4.2%	4.1%	4.1%	4.1%	4.1%
A Corporate spread 5y	0.9%	4.0%	4.7%	4.1%	3.4%	3.1%	2.8%	2.6%	2.4%	2.2%	1.9%
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%
<b>Expected nominal return on assets</b>											
Equity - US		-18.1%	-10.1%	10.6%	5.7%	5.7%	5.8%	5.8%	5.9%	5.9%	6.0%
Equity - Global		-20.2%	-11.1%	11.7%	6.3%	6.3%	6.3%	6.4%	6.5%	6.5%	6.6%
A Corporate bonds 5y		-1.5%	0.1%	2.8%	4.5%	3.3%	3.6%	3.5%	3.4%	3.2%	3.2%
Long A Corporate bonds 10y		-1.7%	-2.0%	-0.7%	5.6%	3.3%	3.3%	3.6%	3.8%	3.9%	4.1%
Treasury 5y		10.4%	0.4%	-2.5%	-0.7%	-0.4%	0.6%	0.6%	0.5%	0.5%	0.5%
Long Treasury 15y		33.6%	3.2%	-8.9%	-0.3%	-0.5%	1.1%	1.2%	1.4%	1.4%	1.5%
TIPS 5y		5.7%	-0.2%	-1.6%	-1.1%	-0.7%	-0.4%	-0.4%	-0.3%	-0.2%	-0.1%
Long TIPS 15y		21.1%	0.9%	-4.7%	-0.7%	-0.6%	0.0%	0.0%	0.1%	0.1%	0.3%
US High Yield		-20.3%	-14.4%	5.3%	3.2%	1.6%	2.5%	2.6%	2.6%	2.7%	2.7%
Bank Loans		-11.6%	-7.4%	6.1%	3.4%	3.2%	3.4%	3.6%	3.8%	4.1%	4.3%
USD Emerging Market Debt		-13.7%	-8.5%	7.9%	5.0%	4.7%	5.0%	5.0%	5.0%	5.1%	5.1%
Local Emerging Market Debt		-13.3%	-8.1%	8.3%	5.4%	5.1%	5.4%	5.4%	5.4%	5.5%	5.5%
Real Estate		-13.4%	-8.3%	-3.1%	0.3%	4.2%	4.3%	4.3%	4.4%	4.5%	4.5%
Commodities		-27.1%	-21.2%	7.8%	4.4%	4.4%	4.5%	4.6%	4.7%	4.8%	4.8%
Hedge Funds - FoHF - Universe		-14.2%	-8.9%	6.6%	5.5%	3.7%	3.7%	3.7%	3.7%	3.7%	3.7%
Private Equity		-17.9%	-5.4%	14.1%	9.2%	9.4%	9.4%	9.4%	9.4%	9.4%	9.4%
Infrastructure - US		-4.6%	-0.2%	3.3%	4.1%	7.7%	7.7%	7.8%	7.8%	7.9%	7.9%
Cash		1.5%	0.0%	0.1%	0.5%	0.7%	0.8%	0.9%	0.9%	1.0%	1.1%
CPI		2.4%	1.5%	0.8%	1.1%	1.4%	1.5%	1.6%	1.7%	1.8%	1.9%

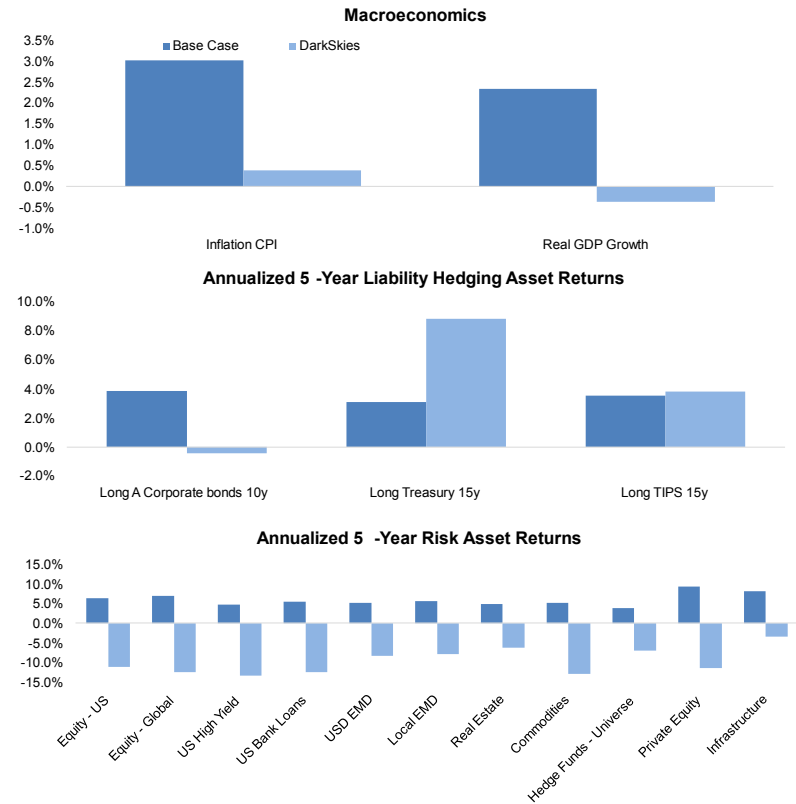
Scenario information as of March 31, 2022

# 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, and a renewed flare up of the pandemic, disrupts to the global economy, as additional restrictions are required over the next few years. China experiences a sharp deterioration in economic growth, due to stricter COVID restrictions and structural issues.
- 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 and severe levels of financial distress (due to high debt levels and political crisis) lead to a global recession followed by stagnation.
- Inflation falls sharply in 2022 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 31 March 2022

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

## Data Table

### DARK SKIES SCENARIO

	Year										
	0	1	2	3	4	5	6	7	8	9	10
<b>Yields (BOY)</b>											
Treasury yield 5y	2.5%	0.0%	-0.8%	-0.9%	-0.8%	-0.7%	-0.5%	-0.3%	0.0%	0.2%	0.5%
Long Treasury yield 15y	2.5%	0.1%	-0.3%	-0.4%	-0.3%	-0.2%	0.0%	0.2%	0.5%	0.7%	0.9%
TIPS yield 5y	-0.8%	-1.8%	-2.4%	-2.5%	-2.5%	-2.4%	-2.2%	-2.0%	-1.8%	-1.6%	-1.4%
Long TIPS yield 15y	-0.3%	-1.7%	-2.1%	-2.1%	-2.1%	-2.0%	-1.8%	-1.6%	-1.4%	-1.2%	-1.0%
Breakeven price inflation 15y	2.8%	1.9%	1.7%	1.7%	1.7%	1.7%	1.8%	1.9%	1.9%	1.9%	1.9%
A Corporate bond yield 5y	3.4%	5.4%	5.3%	4.9%	4.3%	3.9%	3.8%	3.7%	3.6%	3.6%	3.5%
Long A Corporate bond yield 10y	3.5%	4.5%	4.5%	4.2%	3.8%	3.6%	3.6%	3.6%	3.6%	3.7%	3.7%
A Corporate spread 5y	0.9%	5.5%	6.1%	5.8%	5.1%	4.7%	4.3%	4.0%	3.7%	3.4%	3.0%
Long A Corporate spread 10y	1.1%	4.4%	4.9%	4.7%	4.2%	3.9%	3.7%	3.5%	3.2%	3.0%	2.8%
<b>Expected nominal return on assets</b>											
Equity - US		-27.1%	-19.5%	-10.7%	2.7%	2.7%	3.1%	3.5%	3.8%	4.2%	4.5%
Equity - Global		-30.1%	-21.6%	-11.7%	3.0%	3.0%	3.4%	3.8%	4.2%	4.6%	5.0%
A Corporate bonds 5y		-5.7%	0.4%	0.8%	1.7%	0.4%	-0.2%	0.3%	0.7%	1.0%	1.4%
Long A Corporate bonds 10y		-7.4%	-0.8%	1.7%	3.3%	1.4%	-0.1%	0.5%	1.0%	1.4%	1.9%
Treasury 5y		12.4%	2.0%	-1.5%	-2.0%	-2.4%	-2.7%	-2.4%	-2.2%	-2.0%	-1.8%
Long Treasury 15y		43.3%	7.3%	1.3%	-0.4%	-1.4%	-2.9%	-2.6%	-2.3%	-2.1%	-1.8%
TIPS 5y		4.5%	-0.3%	-2.0%	-2.8%	-2.9%	-2.8%	-2.6%	-2.3%	-2.0%	-1.8%
Long TIPS 15y		24.2%	2.8%	-0.6%	-2.4%	-2.7%	-3.4%	-3.2%	-2.9%	-2.7%	-2.4%
US High Yield		-24.9%	-18.1%	-13.2%	-3.5%	-4.8%	-5.0%	-4.0%	-3.1%	-2.2%	-1.4%
Bank Loans		-24.8%	-20.2%	-12.7%	-1.0%	-1.2%	-0.7%	-0.1%	0.6%	1.2%	1.8%
USD Emerging Market Debt		-20.0%	-14.1%	-8.2%	1.6%	1.1%	1.1%	1.6%	2.0%	2.5%	2.9%
Local Emerging Market Debt		-19.6%	-13.7%	-7.8%	2.0%	1.5%	1.5%	2.0%	2.4%	2.9%	3.3%
Real Estate		-15.0%	-10.7%	-5.1%	-0.8%	1.4%	1.7%	2.1%	2.4%	2.7%	3.1%
Commodities		-34.2%	-26.2%	-2.7%	3.0%	3.0%	3.3%	3.5%	3.7%	3.9%	4.1%
Hedge Funds - FoHF - Universe		-17.0%	-11.9%	-6.2%	0.7%	0.7%	1.0%	1.3%	1.6%	1.9%	2.2%
Private Equity		-29.8%	-21.3%	-10.7%	5.2%	5.2%	5.6%	6.0%	6.4%	6.8%	7.2%
Infrastructure - US		-11.4%	-7.2%	-3.4%	1.6%	4.2%	4.6%	5.0%	5.4%	5.8%	6.2%
Cash		1.5%	-0.4%	-0.7%	-0.7%	-0.7%	-0.6%	-0.4%	-0.2%	0.0%	0.2%
CPI		1.0%	-0.2%	0.2%	0.4%	0.6%	0.8%	0.9%	1.1%	1.3%	1.5%

Scenario information as of March 31, 2022



# Appendix

- How Do Public Pensions Impact Credit Ratings?

# How Do Public Pensions Impact Credit Ratings?

## Summary and Conclusions

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### Pension Impact on Credit Ratings

- Pension plans have a direct impact on the ultimate state or local credit rating
- Rating agencies are not just looking at where public pension plans stand today; they are looking at the expected future trajectory of the plan based on how it is managed

### Credit Ratings and Borrowing Costs

- Taxpayers in lower credit rated jurisdictions are paying higher borrowing costs and could save money through healthier pension plan management




### Call to Action

- The Big Three value selecting appropriate actuarial assumptions, avoiding excessive risk taking, and developing an adequate funding policy
- While debt priorities and revenue framework to service such debt will vary on a case-by-case basis, every jurisdiction has the ability to thoughtfully develop a funding policy and set appropriate assumptions
- These initial steps will help pension stakeholders better understand the true economic costs, improve the funding outlook for public pensions, and potentially reduce borrowing costs and further taxpayer burden

# How Do Public Pensions Impact Credit Ratings?

## Call to Action: Plan Sponsors Have Ability to Impact Credit Rating

Below are three specific actions plan sponsors can take today to directly improve the impact a pension plan will have on the credit rating of its locality:

	Action	Considerations
	<p><b>1. Conduct an actuarial assumption audit</b></p> <ul style="list-style-type: none"><li>Review reasonability of key assumptions:<ul style="list-style-type: none"><li>Salary scale, Mortality, Retirement rates, Turnover rates</li></ul></li></ul>	<ul style="list-style-type: none"><li>Assumptions set to plan-specific expectations will lead to lower contribution volatility</li><li>Aggressive assumptions may provide short-term relief but may have long-term consequences</li></ul>
	<p><b>2. Consider adjustments to expected return assumption</b></p> <ul style="list-style-type: none"><li>Adjustments should be in line with forward-looking expectations for asset returns</li></ul>	<ul style="list-style-type: none"><li>Contributing an actuarial amount?<ul style="list-style-type: none"><li><b>Yes:</b> Failing to achieve target returns will necessitate increases in future contributions and make what was intended to be a smooth, budget-friendly progression of contribution increases far more volatile</li><li><b>No:</b> The funding gap will widen and become highly volatile as contribution policy will not add enough dollars to replenish losses</li></ul></li></ul>
	<p><b>3. Review the plan's funding policy</b></p> <ul style="list-style-type: none"><li>Look far enough into the future to identify potential pain points</li></ul>	<ul style="list-style-type: none"><li>Conduct "tread water"/hurdle rate analysis to ensure short-term contributions are sufficient to keep pace with growth of plan liabilities</li><li>Consider asset-liability study to understand range of potential future outcomes rather than a single deterministic scenario</li></ul>



# Appendix

- Asset-Liability Management Background



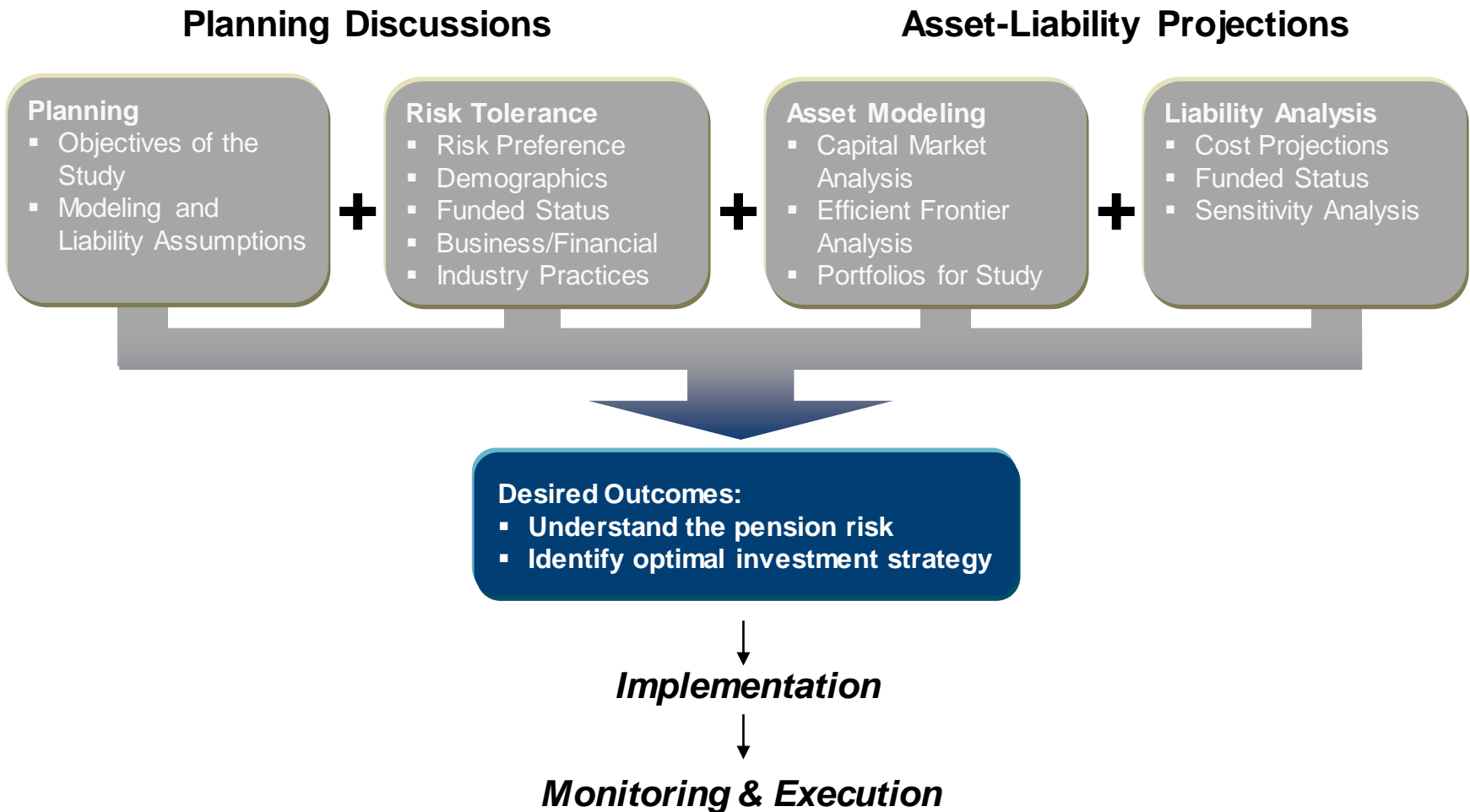
# Asset-Liability Management Background

## Key Risks for Public Pension Plans

Types of Risk	Time Horizon	Risk Management Tools and Controls
<b>Return Shortfall</b> <ul style="list-style-type: none"> <li>▪ Assets do not grow with liabilities</li> <li>▪ Investment Return &amp; Contribution less than Liability Growth</li> </ul>	<b>Long Term</b> (10+ years)	<ul style="list-style-type: none"> <li>▪ Funding Policy</li> <li>▪ Plan Design</li> <li>▪ Investment Policy</li> <li>▪ Assumptions &amp; Methods</li> </ul>
<b>Liquidity</b> <ul style="list-style-type: none"> <li>▪ Cannot liquidate assets efficiently to meet needs</li> <li>▪ Lost control of asset allocation</li> </ul>	<b>Short to Medium Term</b> (<5 years)	<ul style="list-style-type: none"> <li>▪ Funding Policy</li> <li>▪ Benefit Accruals</li> <li>▪ Use of Illiquid Investments</li> <li>▪ Scenario Analysis</li> <li>▪ Monitoring</li> </ul>
<b>Investment</b> <ul style="list-style-type: none"> <li>▪ Asset Allocation (Policy)</li> <li>▪ Investment Structure</li> <li>▪ Manager Selection</li> <li>▪ Rebalancing</li> <li>▪ Scenario (or Path Risk)</li> <li>▪ Factor</li> </ul>	<b>Short to Medium Term</b> (<5 years)	<ul style="list-style-type: none"> <li>▪ Investment Policy Statement             <ul style="list-style-type: none"> <li>– Static/Dynamic</li> <li>– Asset Allocation</li> <li>– Rebalancing</li> <li>– Manager Guidelines</li> <li>– Monitoring/Roles &amp; Responsibilities</li> </ul> </li> <li>▪ Risk Budgeting Tools</li> <li>▪ Monitoring / Dashboards</li> <li>▪ Medium Term Views</li> <li>▪ Regression and Scenario Analysis</li> </ul>
<b>Other</b> (e.g., Operational)	<b>Ongoing</b>	<ul style="list-style-type: none"> <li>▪ Operational and Specialty Due Diligence</li> </ul>

# Asset-Liability Management Background

## Overview of the Asset-Liability Study Process



# Asset-Liability Management Background

## Modeling Process

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- Goals of an asset-liability study:
  - Understand the pension plan's asset-liability risk, and
  - Identify the optimal investment strategies
  
- Stochastic, Monte Carlo simulation analysis used
  - 5,000 independent economic trials
  - Building block approach
    - Starts with inflation and interest rates
    - Using a multi-factor regression analysis, other asset classes are then modeled
  - Assets and liabilities are modeled over the projection period
    - Projections include contribution requirements and funded ratios
  
- Asset-liability studies are best-suited to determine the optimal mix of return-seeking (e.g., equity) and fixed income assets for the pension fund
  - Asset mix is the single most important investment decision for the plan sponsor
    - Is it worthwhile to have a more aggressive allocation in order to reduce long term cost in exchange for risk of higher costs in a bad outcome?
    - Is it worthwhile to have a more conservative allocation in order to have a more predictable cost in exchange for potentially higher average costs?

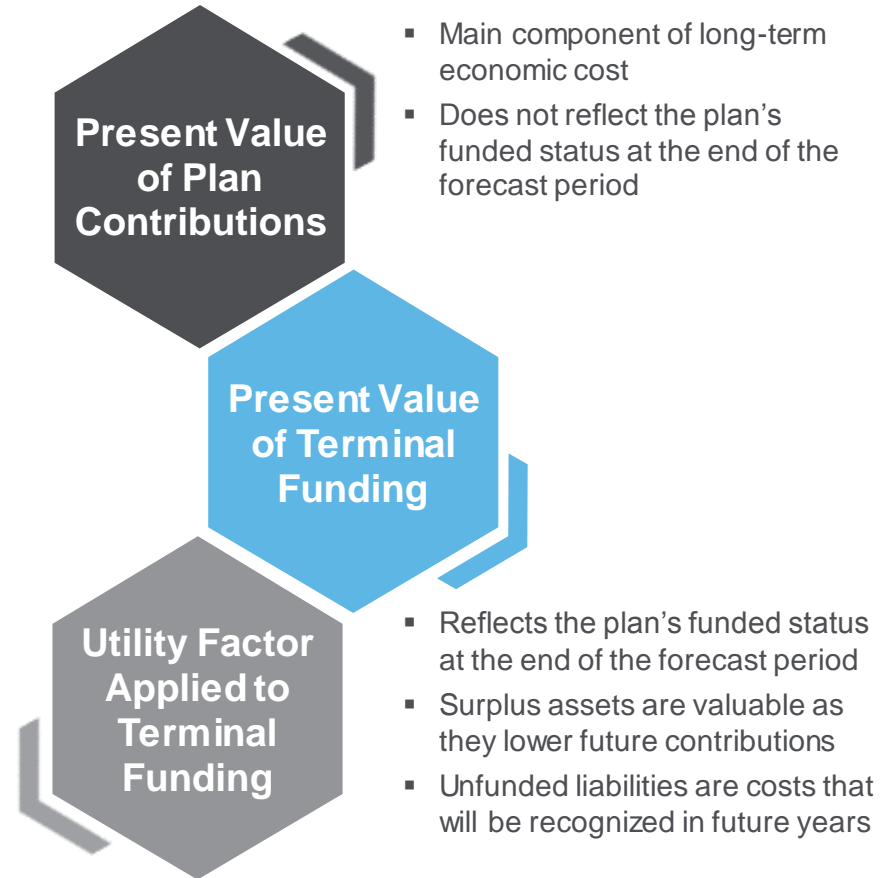
# Asset-Liability Management Background

## Long-Term Economic Cost of Plan

**Long-Term Economic Cost =**

- **Present Value of Plan Contributions +**
- **Present Value of Terminal Funding, adjusted by a utility factor**

Terminal Funding	Surplus	Shortfall
Utility Rationale	Declining value, or utility, from very high funded ratios	Increasing “pain” as unfunded amounts grow to high levels
Threshold	PVB / AL	(5 Yrs. of Benefit Payments) / AL
Utility Factor above/below threshold	50%	200%



# Asset-Liability Management Background

## Utility Factor For Terminal Funded Status

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- Modest deviations from 100% funding are normal, and no special adjustment is needed for these scenarios – the amount of surplus or unfunded liability can be reflected at its dollar value
  
- As surplus amounts grow to very high levels, there is a declining value, or utility, to the surplus:
  - Contributions cannot go below zero
  - Long contribution holidays may create a false sense of how much the plan really costs, and lead to confusion when cost levels revert to “normal”
  - Large surplus amounts can become a potential target for non-pension applications
  
- As unfunded amounts grow to very high levels, there is an increasing amount of “pain” as contributions rise to unacceptable levels:
  - May be viewed as “breaking trust” with future taxpayers
  - Freezing of the pension plan becomes a possibility

# Asset-Liability Management Background

## Risk and Return in an Asset-Liability Context

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- **Traditional:**

- Return = Investment performance
- Risk = Annual volatility of investment gains and losses (e.g., weak/negative capital market returns)

- **Asset-Liability:**

- Return = Potential cost reduction or funded status improvement under average economic conditions
- Risk = During the worst economic conditions, contributions need to increase or funded status declines (e.g., stocks decline, inflation/deflation shocks and/or interest rates decline)

# Asset-Liability Management Background

## Key Factors Affecting the Risk/Reward Trade-off

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- The key take-away from the AL study is the allocation between equity (“return-seeking”) vs. fixed income (“risk-reducing”)
- Major factors affecting the ultimate mix are:
  - Time horizon (or amortization period of unfunded liability) to fund the liability: a longer time horizon supports more risk taking
  - Characteristics of plan participants: a growing population of active participants supports more risk taking; a mature population with significant retirees might need a more conservative policy
  - Funded status: a less funded plan can utilize additional returns from equity investments
  - Nature of plan benefits: a pension with sensitivity to wage inflation growth can benefit from equities in the long-term; an increased need in liquidity due to significant benefit payments in the near future can have a more conservative policy

# Asset-Liability Management Background

## Limitations of Asset-Liability Modeling

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- Asset-liability studies are best-suited to determine the optimal mix of return-seeking (e.g., equity) and liability-hedging (e.g., fixed income) assets for the retirement fund
  - Asset mix is the single most important investment decision for the plan sponsor
  - Studies have found that more than 90% of the variability of a portfolio's return is determined by the asset allocation
  - Decisions regarding how to divide allocations among various sub-categories are less important in an asset-liability context and can be addressed in the implementation phase, following the asset-liability study
- Asset-liability modeling can capture the likelihood of a strategy meeting the objectives
  - It does not 'predict' the future, i.e., we cannot say which of the economic scenarios will actually occur
  - The results depend on the assumptions underlying the model and the structure of the model itself
- There are elements that cannot be modeled and must be thought of in addition to the results of any analysis:
  - E.g., idiosyncratic manager risk, liquidity requirements
  - Black swans





# Appendix

- About This Material

## About This Material

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This material includes a summary of calculations and consulting related to the finances of Omaha School Employees' Retirement System (OSERS). The following variables have been addressed:

- Contributions, Economic Cost, Funded Ratio, Hurdle Rate, Liquidity, Net Outflow

This analysis is intended to assist the Investment Committee with a review of the associated issues and options, and its use may not be appropriate for other purposes. This analysis has been prepared solely for the benefit of the Investment Committee. Any further dissemination of this report is not allowed without the written consent of Aon Investments USA Inc.

Our calculations were generally based on the methodologies identified in the actuary's valuation report for OSERS. We believe the methodology used in these calculations conforms to the applicable standards identified in the report.

Models are used to develop alternative scenarios based on the underlying valuation model and project financial results under those scenarios. The models were developed by experts outside and within Aon. Where outside models were used, the models were reviewed by experts within Aon. The models were selected as appropriate for these projections by the undersigned.

Experience different than anticipated could have a material impact on the ultimate costs of the benefits. In addition, changes in plan provisions or applicable laws could have a significant impact on cost. Actual experience may differ from our modeling assumptions.

Our calculations were based on data provided by the plan actuary. The actuarial assumptions and methods and plan provisions reflected in these projections are the same as those used for the 2021 Fiscal Year actuarial valuations for OSERS as noted in the actuarial reports, except where noted in this report. Unless specifically noted, our calculations do not reflect any other changes or events after January 1, 2021. Reflecting events after such dates would impact the results of the projection.

In conducting these projections, we have relied on plan design, demographic and financial information provided by other parties, including the plan's actuary and plan sponsor. While we cannot verify the accuracy of all of the information, the supplied information was reviewed for consistency and reasonableness. As a result of this review, we have no reason to doubt the substantial accuracy or completeness of the information and believe that it has produced appropriate results.

These projections have been conducted in accordance with generally accepted actuarial principles and practices, including applicable Actuarial Standards of Practice as issued by the Actuarial Standards Board. The undersigned actuary is familiar with the near-term and long-term aspects of pension valuations and meets the Qualification Standards of the American Academy of Actuaries necessary to render the actuarial opinions contained herein. All sections of this report are considered an integral part of the actuarial opinions.

To our knowledge, no colleague of Aon Investments USA Inc. providing services to OSERS has any direct financial interest or indirect material interest in OSERS. Thus, we believe there is no relationship existing that might affect our capacity to prepare and certify this report for OSERS.

Aon Investments USA Inc.

Phil Kivarkis FSA, CFA

# Legal Disclosures and Disclaimers

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