Colorado PERA

Review of assumptions used to model the Plan's financial situation

Strictly Confidential
August 2024

Definition of RFP

Overview

Request for Proposal to Review the Assumptions Used to Model the Financial Situation of the Colorado Public Employee's Retirement Association (PERA)

Objective stated in the RFP:

- Perform a review of the economic and investment assumptions used to model PERA's financial situation.

To achieve the objective, the study should include:

- Analysis of the validity and appropriateness of the actuarial methods and assumptions. Identifying deviations in actuarial methods and assumptions. Recommendations for any adjustments that should be considered
- Analysis of whether or not PERA is on track to achieve full funding by 2048, including the likelihood of achieving full funding and if not recommendations for corrective actions
- Analysis of the calculated normal costs that will cover current pension benefits and the share of contribution going to cover the unfunded liabilities
- Recommendations about the necessity of continuing the direct distribution to PERA
- Recommendations about the enhancements that PERA could make to the annual analysis that it conducts to determine whether its model assumptions are meeting targets and achieving sustainability
- Any other recommendation the subcommittee could make to PERA regarding assumptions, funding policy, reporting practices, or other operational policies

Goals of the review

Focused on supporting decision makers

We have been mandated to the objective of the RFP cited above.

Underlying goal: Assist the Subcommittee to determine whether any policy action may be appropriate or desirable to ensure that PERA meets the desired funding target.

Accordingly, we:

- Review economic and non-economic assumptions
- Evaluate risks to reaching the funding target (100% funded by 2048)
- Propose options for addressing downside risk

Dr. Elisabeth Bourqui

CEO, Founding Partner

Leading Investment Expertise Across Asset Classes with Large Pension Funds and Asset Owners

Chief Investment Officer expertise for large and complex pools of capital, public and private investment organisation
Experience: CalPERS, ABB, Mercer, Société Générale

Current and Past Board Membership

- Vontobel Bank, Leading Private and Digital Bank, Switzerland
- PE/SWF-owned Athora NL Insurance, No2 Pension and Life Insurance, Netherlands
- State-owned Banque Cantonale Neuchâteloise, Switzerland
- Fondation Louis Jeantet, Medecine Foundation Switzerland
- Fondation Greenbrix, Sustainable green real estate for Swiss pensions, Switzerland
- Ernst von Siemens musikstiftung, Germany
- Swiss Prime Site, largest listed real estate company, Switzerland (former bd member)
- Avadis Innovation, investment innovation for pensions, Switzerland (former bd member)

Chairman Strategic National Venture Capital Fund
Digital Health Fund

Chairman Risk and Investment Oversight Committee
Athora NL

Prof. Didier Cossin

Chairman

Governance Experience with Leading Global Asset Owners and Sovereign Wealth Funds

Research & Academia

Chaired Professor, IMD

Ph.D. Harvard University
Financial Mathematics
(Robert C. Merton Chair)

MIT Fulbright Scholar
Ecole Normale Supérieure
Professor HEC Lausanne

Investment Banker and Asset Manager

M&As
Proprietary Methodology of Good Governance Fund
Asset Manager

Strategist and Advisor

Author of Books and Articles on Governance, Stewardship and Risks

Advisor to large caps, Sovereign wealth funds, central banks and Governments
Strategist
Financial and Behavioral Economist

Governance

IMD Board Center
Founder Executive Director

Stewardship Institute
President of the Non-Profit Excellence Center

Dr. Ethan Kra

Senior Actuary

Expert in US pensions systems with 50-year experience advising public pension funds

Chaired the US Society of Actuaries Pension Section

Research & Academia

B.A., M.A. M Phil. at Yale
Ph.D. at Yale University

Woodrow Wilson Fellow
Prize Teaching Fellowship (Yale)
National Sciencie Foundation Fellow
Phi Beta Kappa

Actuaries' representation

Society of Actuaries
Conference of Consulting Actuaries
American Academy of Actuaries
Joint Discipline Council of US actuarial profession
Funding Reform Advisory Task Force (2006-2008)
National Academy of Social Insurance, etc.

Pensions authority

Author of multiple publications, delivery of 200+ lectures and speeches to practitioners and in academia

Quoted frequently by New York Times, Wall Street Journal, Business Week, Newsweek, Time, Fortune.

Professional experience

Former Senior Partner, Chief Actuary at Mercer

Project team

Dr. Elisabeth Bourqui

CEO, Founding Partner

- Chief Investment Officer for large and complex pools of capital
- Chairman Strategic National Venture Capital Fund & Direct Investments in Digital Health
- Corporate Board member at state-owned, family-owned, PE-owned institutions

chief investment officer

Chief-Investment Officer-of-the-Year
Two consecutive years Award

Prof. Didier Cossin

Chairman, Founding Partner

- Expertise Governance of organization
- Expertise Governance of Pools of Capital
- Value portfolio management and total portfolio thinking
- Investment stewardship

Dr. Ethan Kra

Senior Actuary

- Expertise in pensions and actuarial science
- Former Senior Partner and Chief Actuary at Mercer
- Long-standing leading member of Society of Actuaries and American Academy of Actuaries

Christopher Collie

Managing Director

- Expert in Governance and Supervision of national and supra-national investor entities
- Public policy and catalytic investments.
- Stewardship and sustainability

Xiao Luo

Head Quantitative Solutions

- Risk Management for institutional investors
- Quantitative strategies
- Portfolio modelling and simulations

Sergi Corbatera

Head Governance Solutions

- Investment Governance
- Engagement and shareholder activism
- Private Equity and Hedge Funds

Expertise in Public Pension Governance, Actuarial Science, Investments and Risk Management

Non-economic actuarial assumptions review

Actuarial Experience Review

- 2016: Actuarial Experience Report prepared by Cavanaugh MacDonald
- 2020: Actuarial Experience Report prepared by Segal
- **GRS discovered methodological issues with the analysis of Cavanaugh MacDonald which resulted in understatement of plan liabilities (actuarial losses)**
- GRS noted that Segal's 2020 report corrected the shortcomings
- **GRS recommended that the 2024 scheduled Actuarial Experience Report be accelerated to 2022. The recommendation was not adopted**
- **No reference was made to the GRS report on the Annual Comprehensive Financial Report of the Colorado PERA for years ended in 2021, 2022 and 2023**

Non-economic actuarial assumptions review

Is the 2021-2023 experience indicative of future experience?

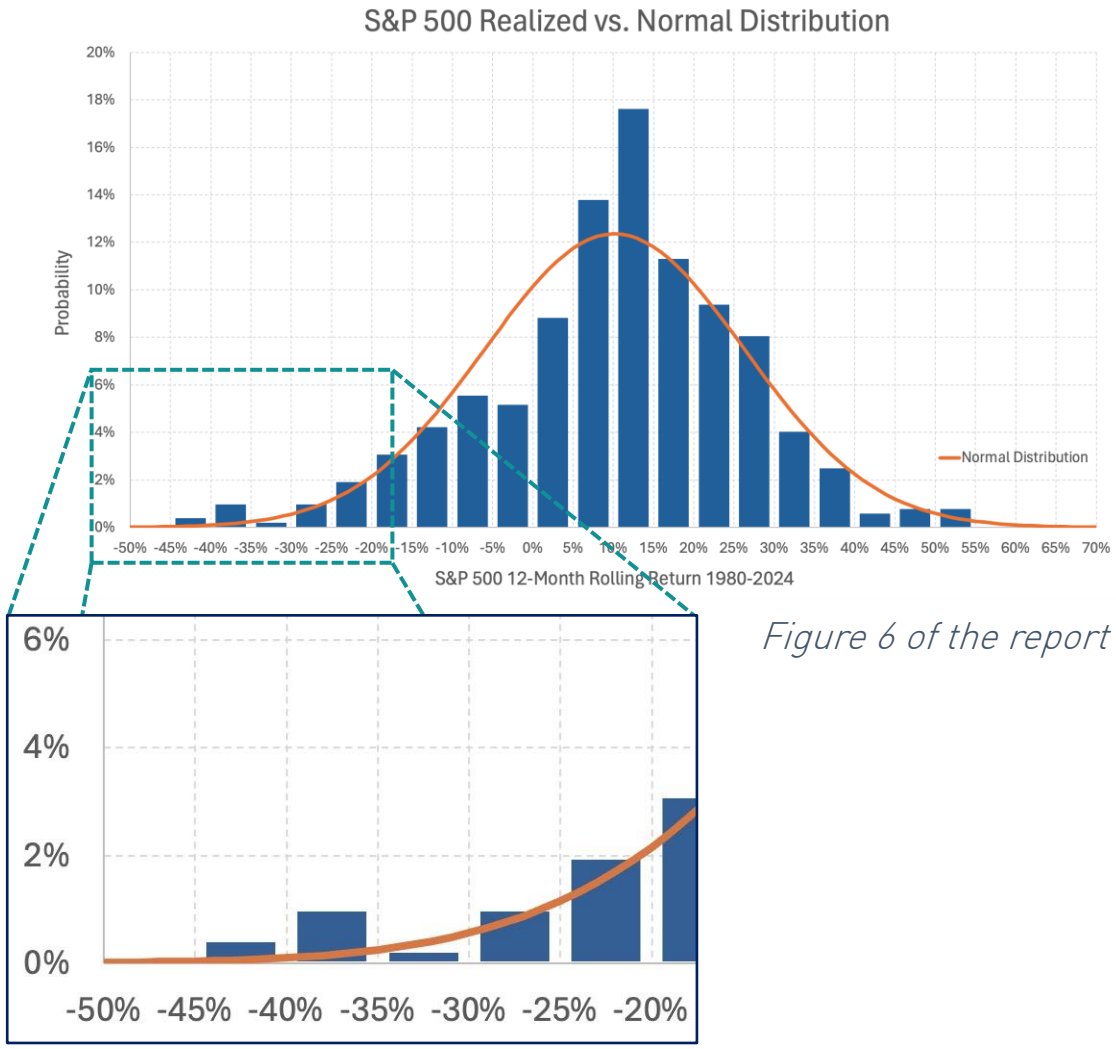
- Consistent pattern of modest actuarial losses from unidentified sources of approx. 1% per year.
- Losses totaled approximately 0.4% of the Plans' liabilities over last three years.
- Suggest asking Segal Group to determine the primary sources of these consistent losses.

As a consequence, Accrued Actuarial Liabilities may be 10% higher than reported.

We recommend further in-depth studies review.

Economic assumptions review

C.1 - PNYX modelling and risk approach



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Improved simulations

Modeling correlations and change over time, skewness and kurtosis in distributions.

Better risk metrics

Conditional Value at Risk (VaR)

A 5% CVaR is the extent of the loss that could occur in the worst year of a 20-year period

P10 and P90

The P10 and P90 risk measures represent the 10th and 90th percentiles of a portfolio's return distribution

Economic assumptions review

C.2 - PNYX Capital Market Assumptions

Segal assumptions

Asset Classes[1]	Long-Term Asset Allocation[1]	Expected Nominal Return[1]	Expected Risk[1,2]
Global Equity	53.0%	8.00%	19.00%
Fixed Income	23.0	3.60	5.00
Real Estate	8.5	6.65	20.00
Private Equity	8.5	9.60	24.50
Opportunity Fund[3]	6.0	7.12	9.46
Cash	1.0	2.70	2.00
Inflation		2.30	
Total Fund:			
Expected Return		7.47%	
Expected Risk		13.00%	

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PNYX assumptions

Asset class	PNYX expected nominal return	PNYX expected std dev (volatility)	PNYX CVaR
Global Equity	7.26%	17.55%	-31.17%
Fixed Income	4.11%	6.87%	-9.57%
Real Estate	7.01%	19.17%	-29.38%
Private Equity	9.59%	30.87%	-40.78%
Opportunity Fund / Alternatives	7.08%	8.14%	-10.70%
Total Fund	6.71%	12.47%	-20.34%

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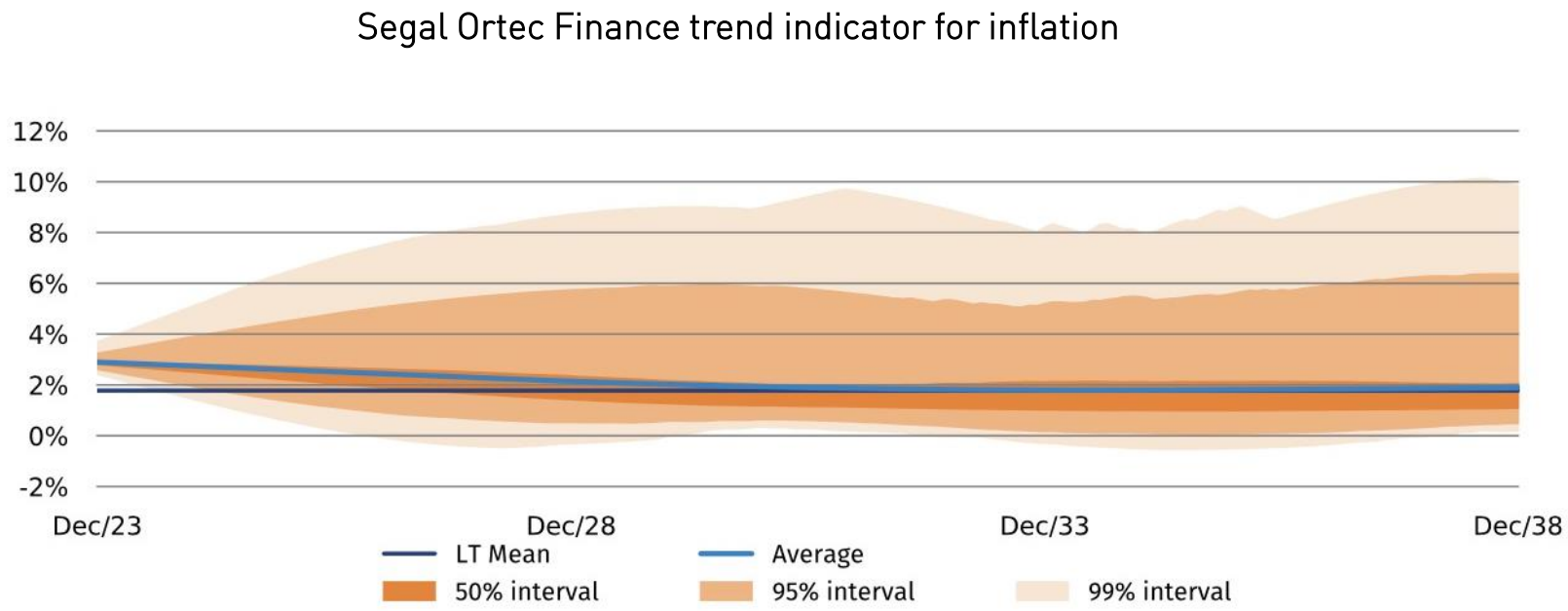
Economic assumptions review

C.2 – Inflation assumptions

Our trend assumption for inflation is 2.12%.

Though currently elevated, we expect the rate to converge to central bank targets due to policy action.



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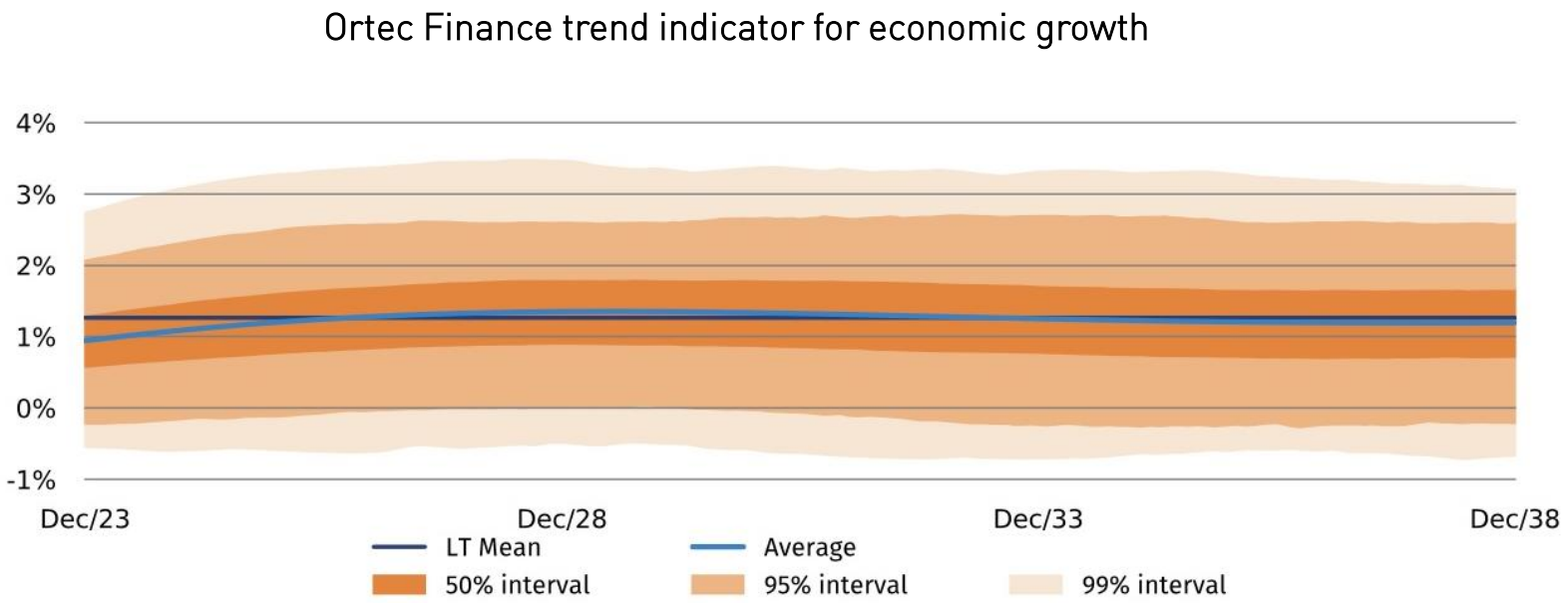
Economic assumptions review

C.2 – Growth assumptions

Our estimated real US GDP growth rate is 1.83%.



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Economic assumptions review

C.3 - Portfolio performance and return assumptions

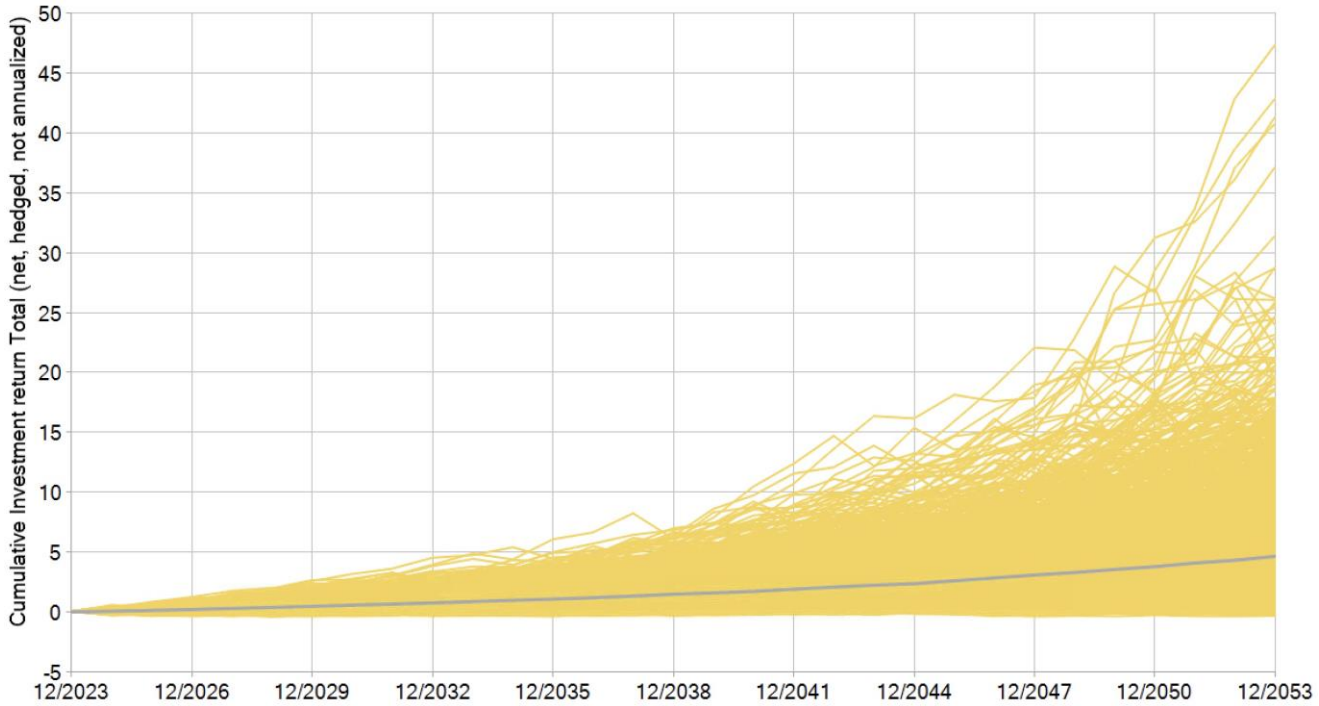
PNYX portfolio characteristics:

- Nominal rate of return of 6.71%
- Volatility of 12.47%
- CVaR of -20.34%.
- Less 2.12% inflation → 4.59% real return over a 30-year horizon.

This is materially lower than the assumed 7.25% nominal and 4.95% real return assumed by PERA.

On this basis PERA could consider revising its assumed rate of return.

Portfolio performance projections, PNYX assumptions



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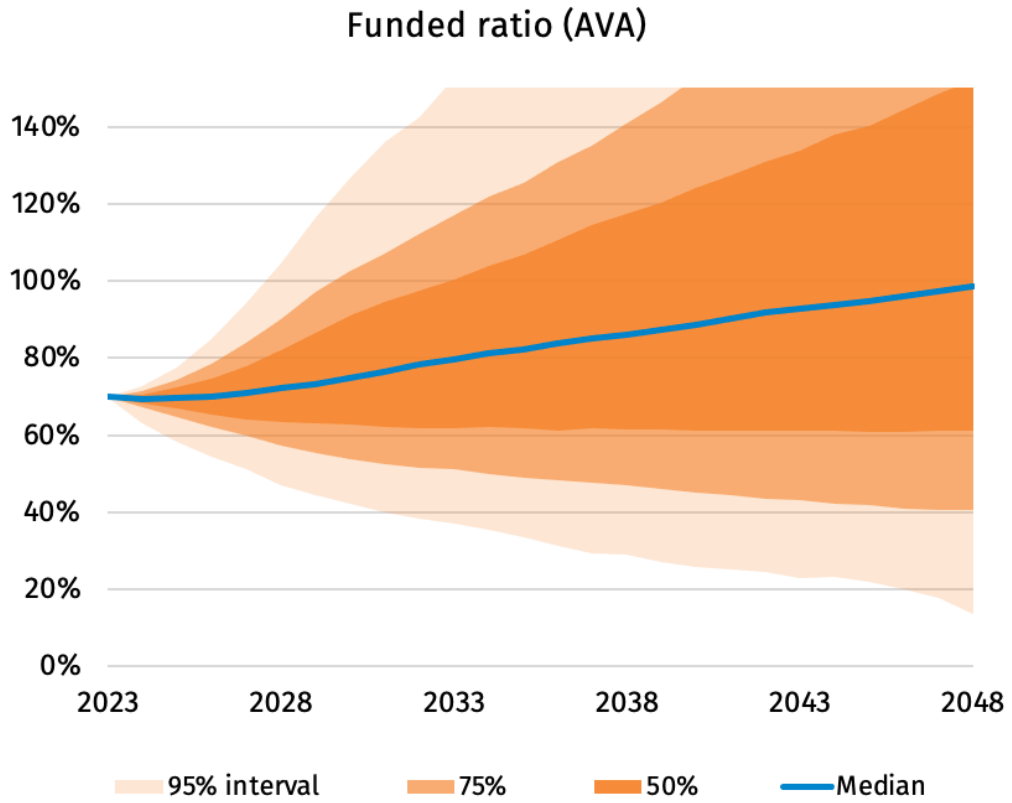
Timing to full funding status

Probability of achieving the funding target

Dispersion is a key part of assessing risk, and therefore whether PERA is on track to meet its funding target on a holistic basis.

Significant risk of failing to meet the funding target (51% probability by 2048), including material risk of reaching less than 50% funded (18% probability by 2048).



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Probability of achieving full funding

Scenario	Description	Funded ratio median	Funded ratio P10	Funded ratio P90
Baseline	all simulations	99%	36%	216%
High growth	top 10% GDP (*avg. 2.98%*)	136%	60%	259%
Low growth	bottom 10% GDP (*avg. 0.72%*)	72%	21%	198%
High inflation	top 10% CPI (*avg. 3.80%*)	70%	26%	166%
Low inflation	bottom 10% CPI (*avg. 1.14%*)	97%	43%	224%
Stagflation	Bottom 20% GDP with top 20% CPI (*avg. 1.09% and 3.14% respectively*)	54%	25%	119%

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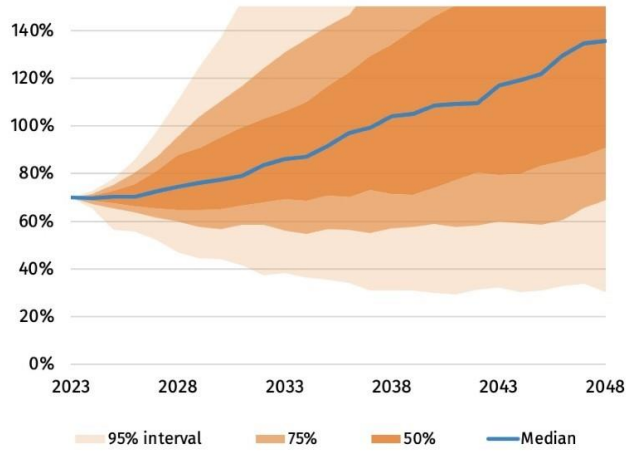
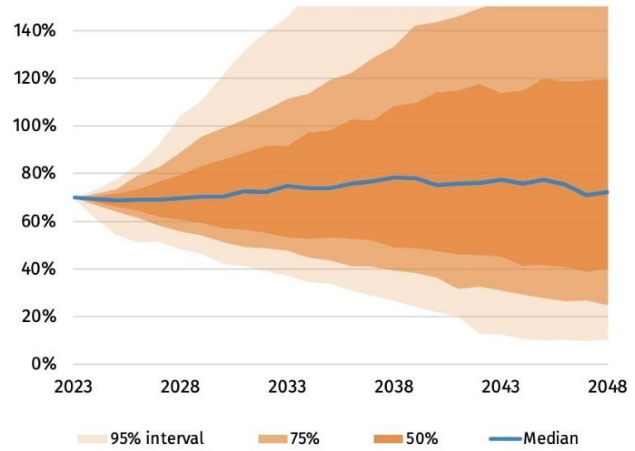
Timing to full funding status

Probability of achieving the funding target under different scenarios

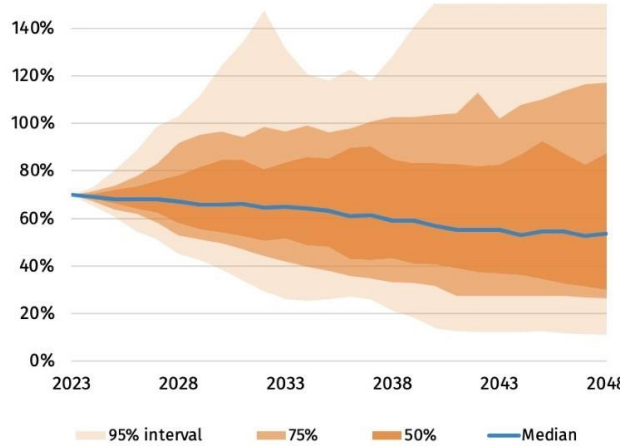
High growth scenario



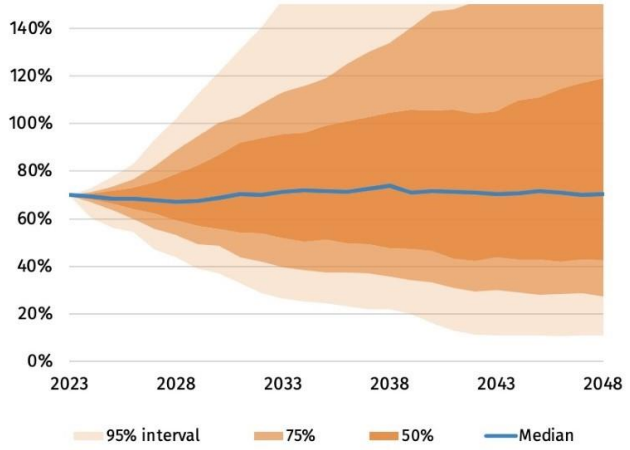
Low growth scenario



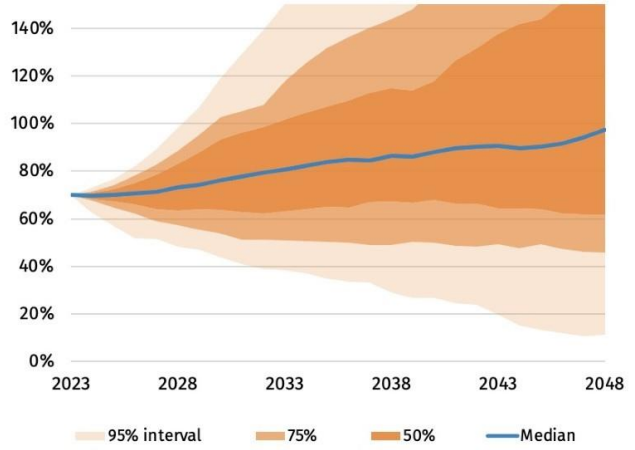
Stagflation scenario



High inflation scenario



Low inflation scenario



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Option E-3 – Standalone $2bn State wealth fund

Excess returns to support PERA in 2048 through a national wealth fund strategy

An allocation and strategy used in other similar cases could deliver an average return of 9.93%.

Assets in the state wealth fund would grow faster than in PERA thanks to different objectives and constraints.

Investments would leverage Colorado's distinct advantages.

	Weights
Total assets	**100.00%**
Listed Allocation	**50.00%**
Listed Equity	30.00%
Listed Defensive	10.00%
Listed Debt	10.00%
Private Allocation	**50.00%**
Illiquid Equity & Co-investments	35.00%
Illiquid Credit	15.00%
Mean return	**9.93%**
Standard deviation	**17.06%**
CVaR 5.00 %	**-18.38%**

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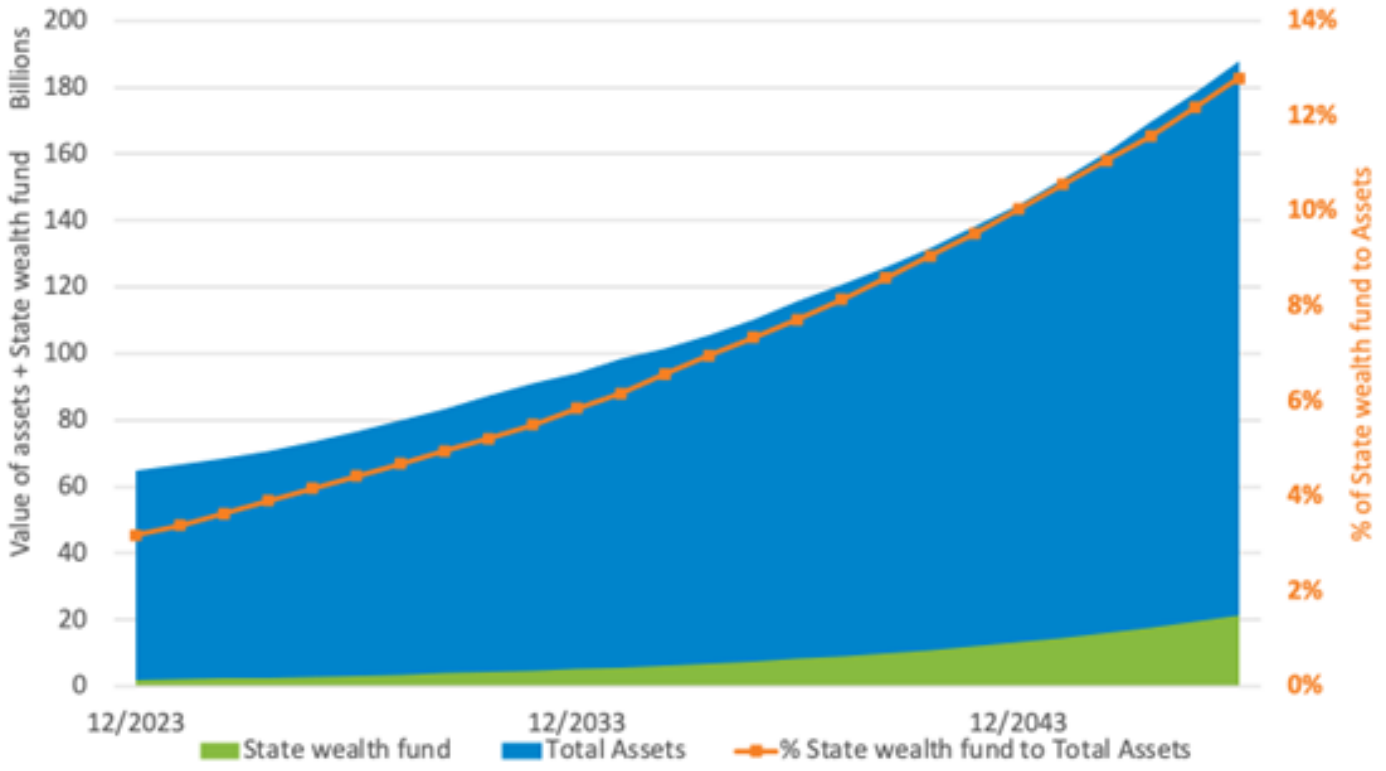

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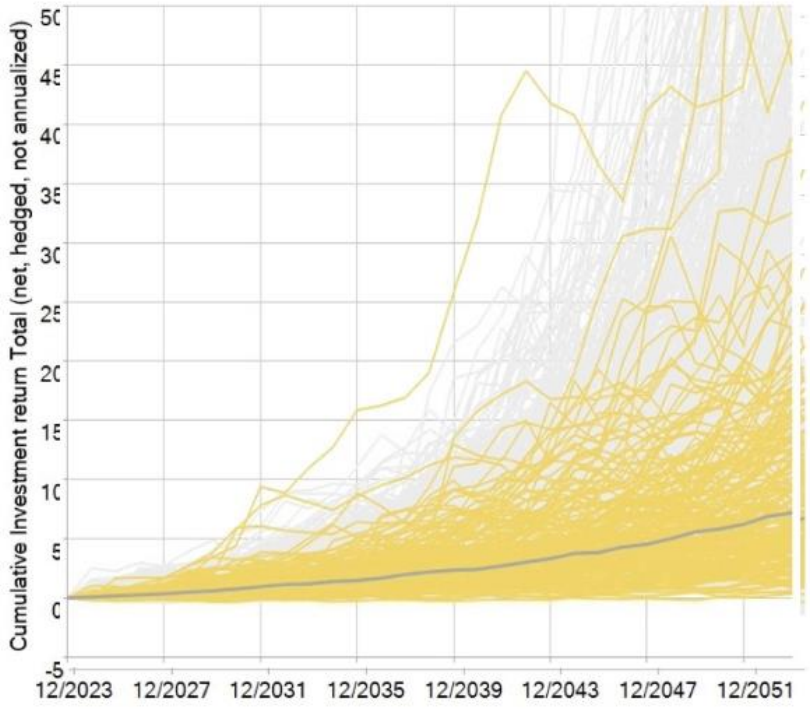
Option E-3 – Standalone $2bn State wealth fund

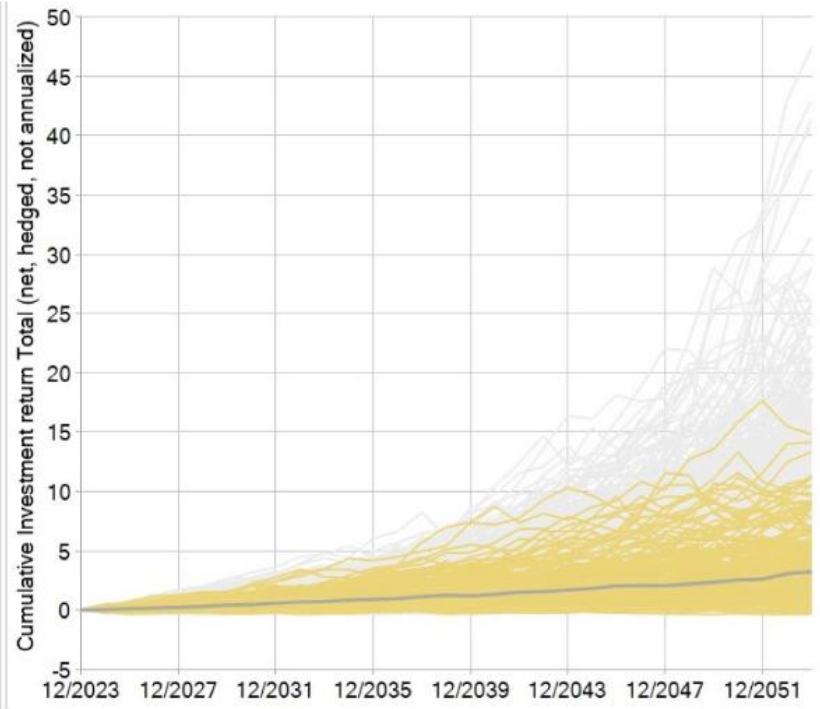
Outperformance including in adverse conditions

The state fund should outperform PERA even in low-growth conditions.

State wealth fund portfolio performance
(low growth highlighted)



PERA portfolio performance
(low growth highlighted)



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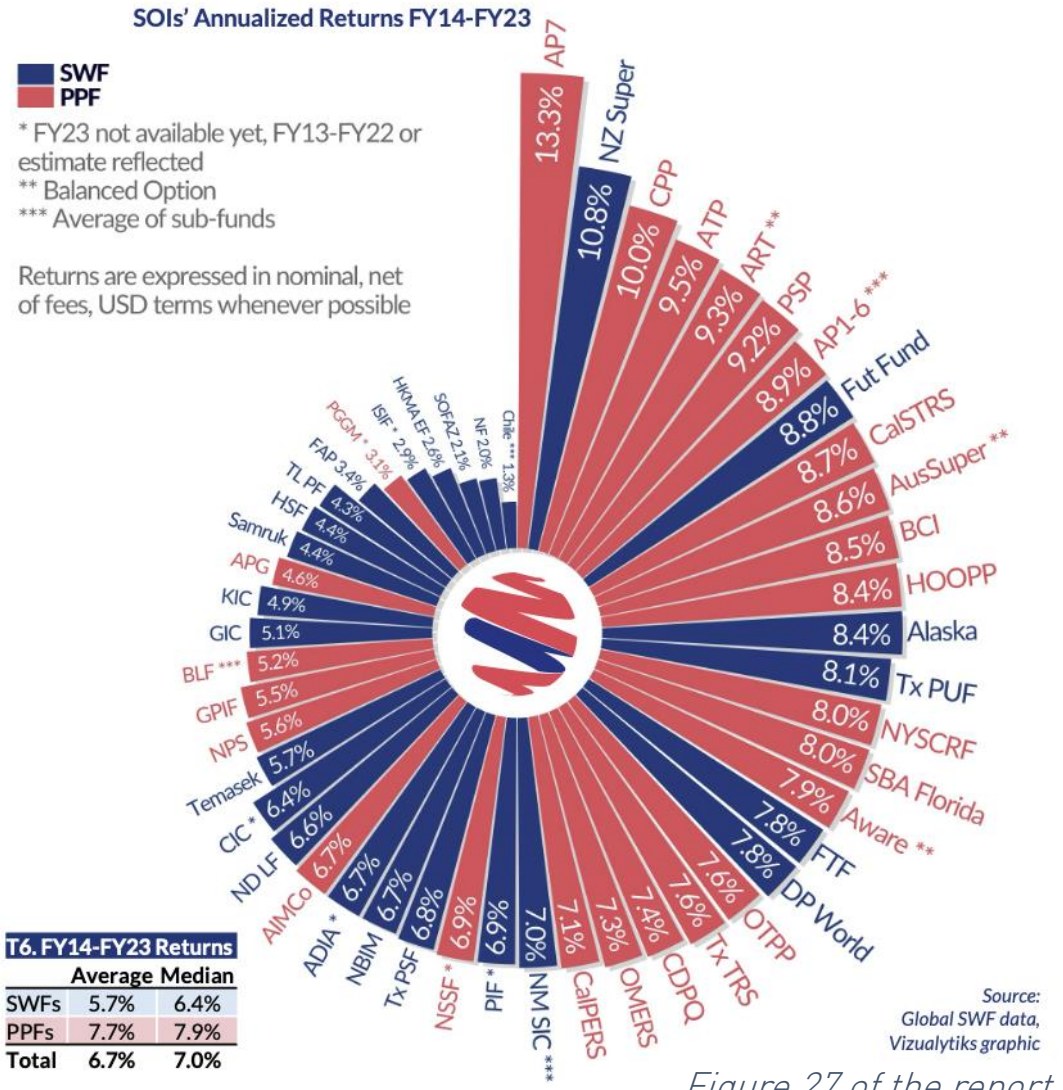
Options for improving PERA's funding position

Precedent for a state wealth fund

- While still uncommon at sub-state level, national wealth funds are becoming more widespread.
- They have also been set up with the specific purpose of funding future unfunded pension liabilities, although they are not themselves pension funds.
- Recent examples from jurisdictions with similar culture and values to Colorado:
  - Australia's Future Fund
  - New Zealand's NZ Super
- These have grown quickly to join established funds such as those of Singapore.
- They earn superior returns while providing strategic benefits



T6. FY14-FY23 Returns

	Average	Median
SWFs	5.7%	6.4%
PPFs	7.7%	7.9%
Total	6.7%	7.0%

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Executive Summary of Options Available

Options for improving the funded ratio

- Adjust allocation within bands and widen them, optimising for either return or downside limitation
- $2bn lump sum contribution to the Plan
- 1% increase in annual contributions
- Create $2bn Colorado state wealth fund to cover potential long-term shortfalls

Conclusions (1)

Economic assumptions

- Return assumption: our modeling of the current asset allocation indicates 6.71% vs 7.25% and a CVAR of –20.34%.
- Significant risk of failing to meet the funding target (51% probability by 2048), including material risk of reaching less than 50% funded (18% probability by 2048).
- Low funded status & negative cash flow leads to disperse funding ratio projections. Funded ratio status is sensitive to portfolio returns.
- Current financial modeling and risk measurement approach have important shortcomings, particularly in asset and macro factors distributions and correlations and the recognition of return and risk asymmetry/tail risk.
- Improved modelling will give a better picture of likely funded ratio evolution and risks to the funding target.

Conclusions (2)

Non-economic assumptions

- Consistent annual actuarial losses of approximately 1%. These appear to be connected with partial retention of former assumptions from a previous actuary.
- As an estimate, actuarial accrued liability may be 10% higher than reported. Further analysis would be required to quantify this with precision.