



Economic Assumptions & Actuarial Methods

OREGON PUBLIC EMPLOYEES RETIREMENT SYSTEM

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June 4, 2021

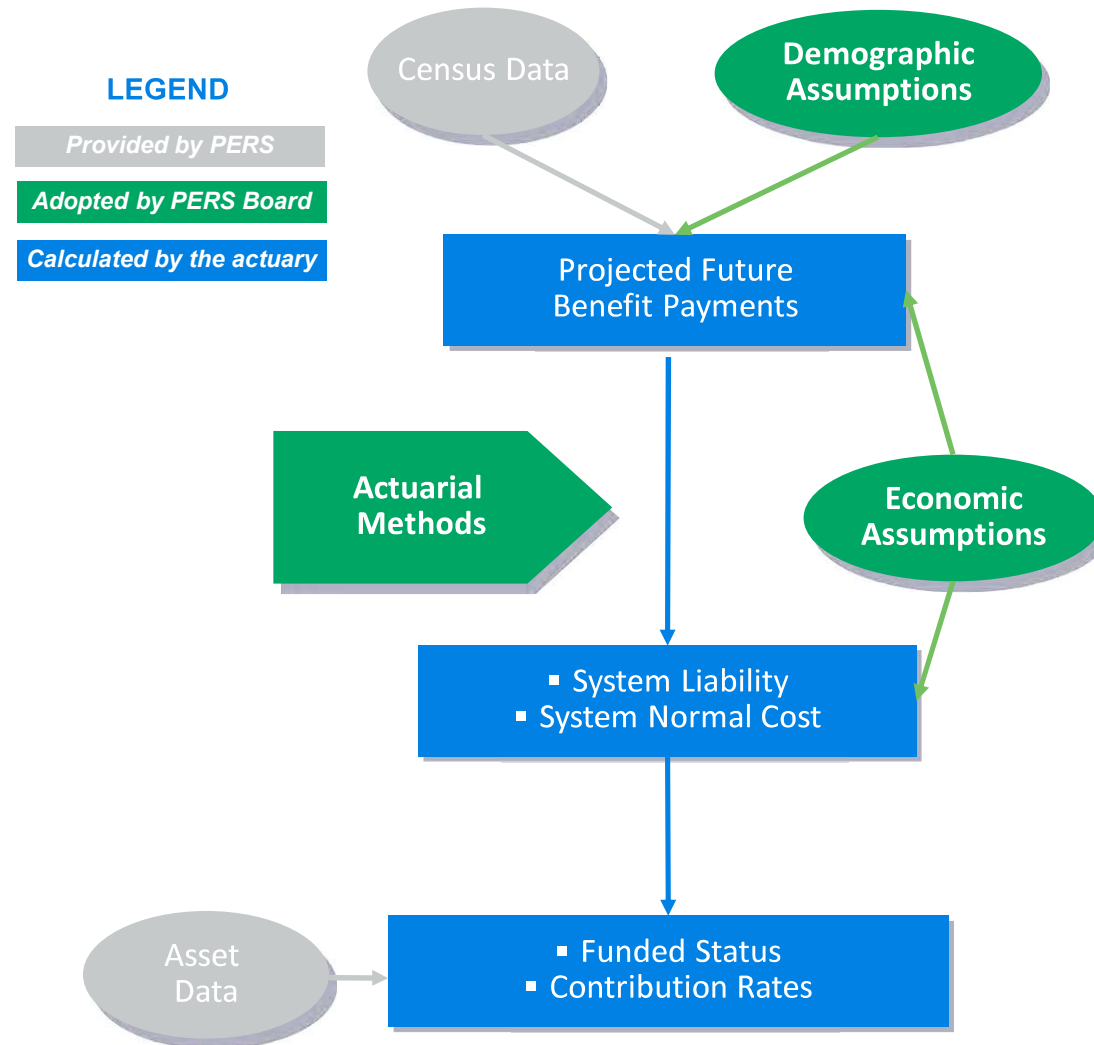
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Four-Meeting Process – Assumptions & Methods

- March 29: Assumed rate, including preliminary Milliman outlook model
- June 2: Joint meeting with Oregon Investment Council (OIC)
 - Assumed rate – outlooks from OIC’s consultants, Milliman
- **June 4: Economic assumptions, system funding methods**
 - **Inflation and system payroll growth**
 - **Assumed rate**
 - **Actuarial methods, including amortization and rate collaring policy**
- July 23: Demographic assumptions, Board direction to actuary
 - Member-specific assumptions based on study of recent PERS experience
 - Assumptions and methods adopted for use in:
 - 12/31/2020 actuarial valuation with advisory 2023-2025 contribution rates
 - 12/31/2021 actuarial valuation with proposed final 2023-2025 contribution rates

Two-Year Rate-Setting Cycle

- **July 2021: Assumptions & methods adopted by Board in consultation with the actuary**
- October 2021: System-wide 12/31/20 actuarial valuation results
- December 2021: Advisory 2023-2025 employer-specific contribution rates
- July 2022: System-wide 12/31/21 actuarial valuation results
- September 2022: Disclosure & adoption of employer-specific **2023-2025 contribution rates**



Valuation Process and Timeline

- Actuarial valuations are conducted annually
 - Alternate between “rate-setting” and “advisory” valuations
 - This valuation as of 12/31/2020 is advisory
- Board adopts contribution rates developed in rate-setting valuations, and those rates go into effect 18 months after the valuation date

Valuation Date	Employer Contribution Rates
12/31/2017	July 2019 – June 2021
12/31/2019	July 2021 – June 2023
12/31/2021	July 2023 – June 2025



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Guiding Objectives - Methods & Assumptions

- Transparent
- Predictable and stable rates
- Protect funded status
- Equitable across generations
- Actuarially sound
- GASB compliant

Some of the objectives can conflict, particularly in periods with significant volatility in investment return or projected benefit levels. Overall system funding policies should seek an appropriate balance between conflicting objectives.

The Fundamental Cost Equation

- Long-term program costs are the contributions, which are governed by the “fundamental cost equation”:

$$\mathbf{BENEFITS = CONTRIBUTIONS + EARNINGS}$$

Governance Structure

- Benefits:
 - Plan design set by Oregon Legislature
 - Subject to judicial review
- Earnings:
 - Asset allocation set by OIC
 - Actual returns determined by market
- Contributions:
 - Funding, including methods & assumptions, set by PERS Board
 - Since contributions are the balancing item in the fundamental cost equation, PERS Board policies primarily affect the **timing** of contributions
 - Different actuarial methods and assumptions produce different projected future contribution patterns



Review of Non-Investment Economic Assumptions

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Assumptions to Be Reviewed

	12/31/2019 Valuation “Current” Assumptions
Inflation	2.5%
Real Wage Growth	<u>1.0%</u>
System Payroll Growth	3.5%
Administrative Expenses	\$40.5 million



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Economic Assumptions

Inflation

- The inflation assumption affects other assumptions, including system payroll growth, investment return, and health care inflation
- Inflation can vary significantly over time
- One estimate of future inflation can be derived from comparing yields on Treasury securities and Treasury Inflation Protected Securities (TIPS)
- Social Security’s current “intermediate cost” 30-year average inflation assumption is 2.4% (down from 2.6% at last review)
- We recommend reducing the assumption from 2.5% to **2.4% or lower**

Period Ending 12/31/2020	Average Inflation
10 years	1.74%
20 years	2.04%
30 years	2.25%
40 years	2.80%

	As of 12/31/20		As of 4/30/21	
	10 Year	30 Year	10 Year	30 Year
Treasury Yield	0.93%	1.65%	1.65%	2.30%
TIPS Yield	<u>(1.06%)</u>	<u>(0.37%)</u>	<u>(0.76%)</u>	<u>0.02%</u>
“Breakeven” Inflation	1.99%	2.02%	2.41%	2.28%



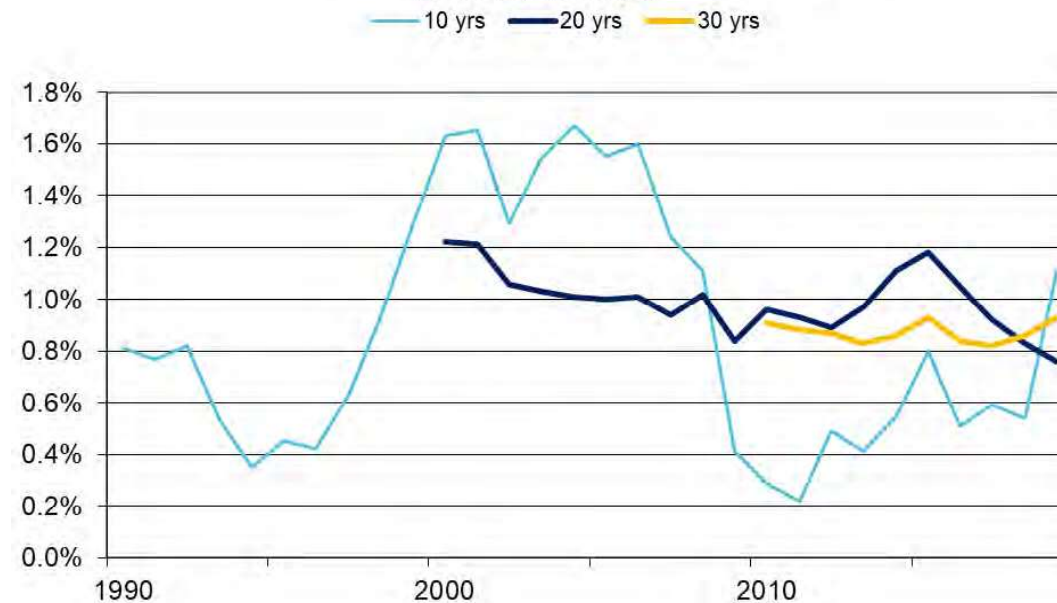
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Economic Assumptions

Real Wage Growth

- An individual member’s assumed annual salary increase is composed of:
 - Inflation, plus
 - Real wage growth, plus
 - Individual merit/longevity component
- Real wage growth represents the increase in wages in excess of inflation for the entire group due to improvements in productivity and competitive market pressures
- Social Security’s long-term “intermediate cost” real wage growth assumption is 1.14%
- In our opinion, the current assumption of **1.0%** is reasonable

Historical Real Growth in National Average Wages
(Trailing Average)



Most Recently Available	Average Real Wage Growth
10 Years	1.11%
20 Years	0.76%
30 Years	0.93%
40 Years	0.86%

Economic Assumptions

System Payroll Growth

- Overall system payroll growth is assumed to equal the sum of:
 - Inflation
 - Real wage growth
- The system payroll growth assumption determines the shape of the curve of payments to amortize the unfunded liability
- With an inflation assumption of 2.4% and a real wage growth assumption of 1.0%, the system payroll growth assumption would be 3.4%
 - A 3.4% assumption is reasonable based on recent historical experience for Oregon PERS
 - Uncertainty in post-pandemic hiring and payroll will warrant continued monitoring, though calendar year 2020 actual pay was **greater** than projected based on 12/31/2019 valuation

Trailing Period as of 12/31/2019	Oregon PERS Average Annualized Growth in Valuation Payroll
5 Years	4.8%
10 Years	3.1%
15 Years	3.6%

- We recommend decreasing the assumption from 3.5% to **3.4% or lower**



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Economic Assumptions

Administrative Expenses

- Actual administrative expenses for recent years are shown below
 - SB 1049 drove increase in pension administrative expenses, expected to persist in near term

(\$ millions)	System-Wide (Tier 1/Tier 2 + OPSRP) Pension Administration Expenses		
Year	Actual Expenses	% of Beginning of Year Assets	% of Projected Payroll
2016	\$41.7	0.08%	0.44%
2017	\$41.0	0.07%	0.42%
2018	\$36.7	0.06%	0.36%
2019	\$44.5	0.07%	0.41%
2020	\$56.5	0.09%	0.49%

- Overall, 2020 administrative expenses were 0.09% of total assets, or 0.49% of projected payroll
- Proposed assumed annual expenses for 2021 and 2022: \$59 million

Assumptions to Be Reviewed

	12/31/2019 Valuation Assumptions	12/31/2020 Valuation Proposed* Assumptions
Inflation	2.5%	2.4% or lower
Real Wage Growth	<u>1.0%</u>	<u>1.0%</u>
System Payroll Growth	3.5%	3.4% or lower
Administrative Expenses	\$40.5 million	\$59 million

No explicit assumption is made for investment-related expenses, which are accounted for implicitly in the analysis of the long-term investment return assumption.

*No action is needed on “proposed” assumptions today, since all assumptions and methods will be adopted at the July 2021 Board meeting



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Long-Term Investment Return Assumption

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Summary - Investment Return Assumption

- No decision on the assumption is made at today's meeting
- In our opinion it is **necessary** to lower the long-term future investment return assumption by **at least 0.20%** from the current 7.20% assumption
 - We **recommend** lowering it **further** to better reflect the current range of outlooks
- OIC's outlook, which is the primary opinion, estimates a long-term average future return of 6.6% under the proposed allocation over the next 20 years
 - The OIC outlook for inflation is 2.1%, while Social Security's outlook is 2.4%
- Per our March presentation, prior to any other assumption changes the uncollared system-average 2023-2025 base employer contribution rate is preliminarily estimated to increase by:
 - **1.5% - 1.6% of payroll** using a **7.00% assumed rate**
 - **3.1% - 3.2% of payroll** using a **6.80% assumed rate**

Long-Term Investment Return Assumption

- Uses of the investment return assumption
 - As a “discount rate” for establishing the:
 - Actuarial accrued liability, which is a net present value
 - Associated unfunded actuarial liability, also called the UAL or actuarial shortfall
 - Guaranteed crediting level for regular Tier 1 active member account balances
 - Annuitization rate for converting member account balances to lifetime money match monthly benefits



Reflecting expectations for both investment earnings and benefit levels for certain members, the assumption helps set a reasonable and appropriate budgeting glide path for projected employer contribution rates

Use of the Assumed Rate

$$B = C + E$$

BENEFITS	=	CONTRIBUTIONS	+	EARNINGS
present value of earned benefits		employer and member funds to pay pension benefits		future returns on invested funds
Design set by: Oregon Legislature		Set by: PERS Board		Managed by: Oregon Investment Council Oregon State Treasury

- “B” is predictable with a relatively high degree of certainty
- “E” is the unpredictable **actual** future investment return on PERS assets
- “C” is the balancing item --- it must provide to “B” what “E” fails to cover
- The **assumed rate** is the Board’s estimate of “E” to prudently set “C”
- The Board’s decision on “E” does **not** affect actual future earnings

Investment Return 50th Percentile Outlooks

- We applied a standard mean/variance model to calculate 50th percentile return estimates based on capital market outlook assumptions from three sources
 - OIC assumption – reflects consensus among OST staff and consultants Meketa & Aon
 - Milliman
 - 2020 Horizon survey of 10-year capital market assumptions (survey of 39 advisors)
 - The Horizon survey was published in July 2020, based on outlooks from the first half of 2020
- Estimates do not reflect any possible “alpha” due to selected managers potentially outperforming market benchmarks over the long term, net of fees
- Today’s speakers are not credentialed investment advisors
 - We are presenting Milliman capital market outlook model results based on assumptions developed by Milliman’s credentialed investment professionals

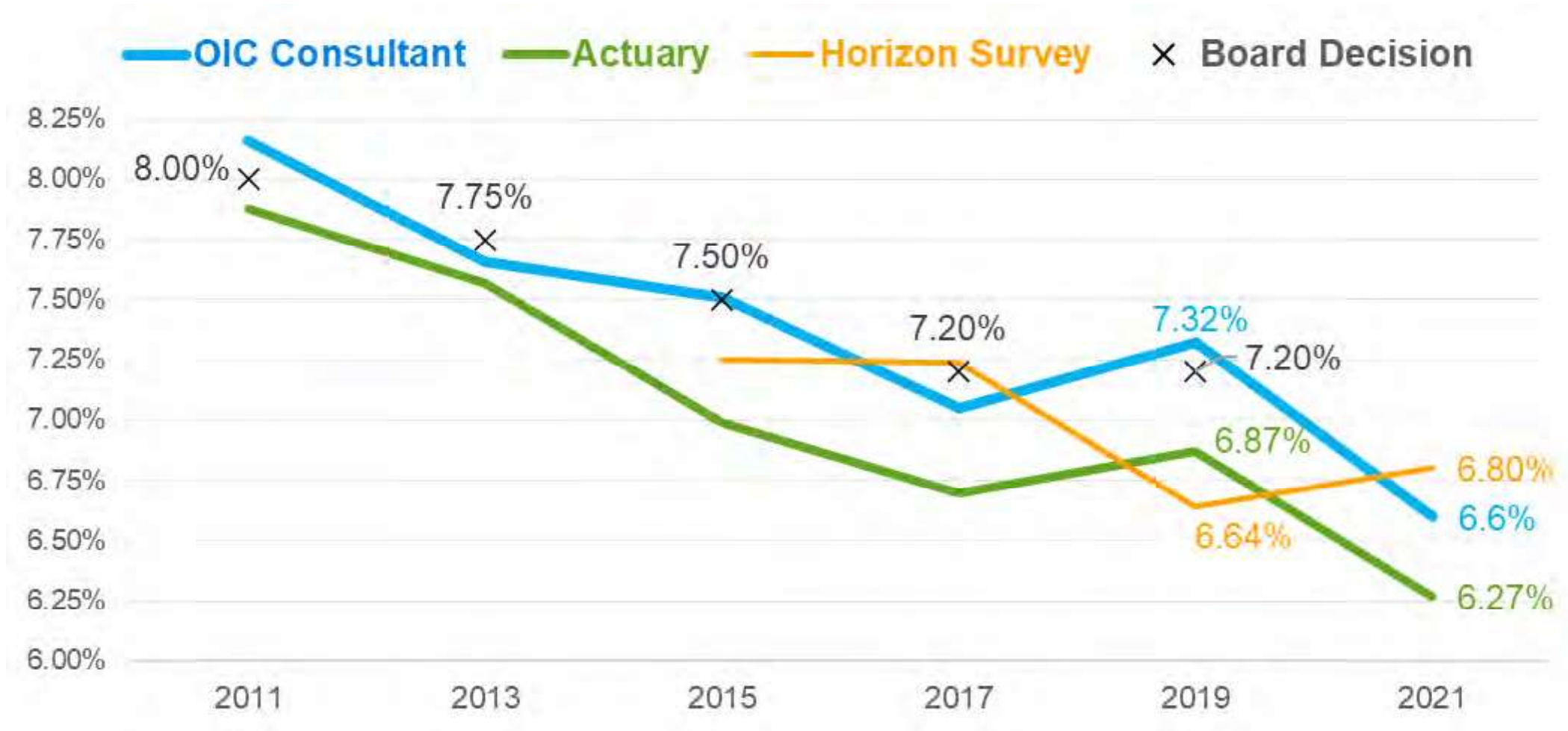
Details on Milliman and Horizon outlook assumptions are in the Appendix



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Investment Return 50th Percentile Outlooks

Geometric Returns from Outlook Models in Current and Prior Five Reviews



Investment Return 50th Percentile Outlooks

- Estimates are shown based on the OIC's long-term asset allocation, including proposed revisions

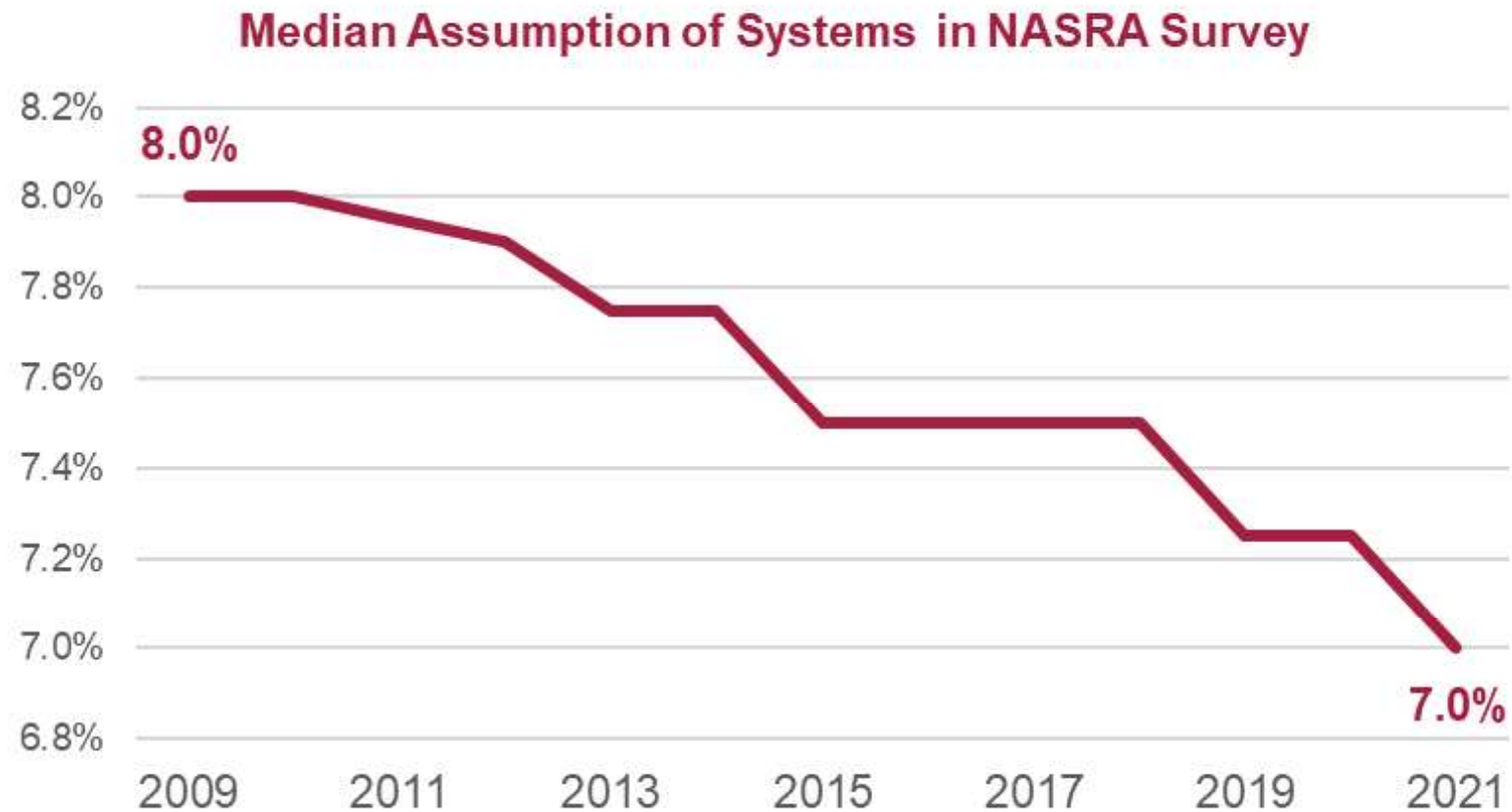
	OIC	Milliman*	Horizon
Median Annualized Return	6.6%	6.27%	6.80%
Assumed Inflation	2.1%	2.40%	1.98%
Timeframe Modeled	20 years	20 years	10 years

**Reflects real returns from Milliman capital market outlook assumptions adjusted for potential 2.40% inflation assumption*

The median returns shown above are geometric annualized average returns over the timeframes indicated above for each provided set of capital market assumptions

Comparison to Peer Systems

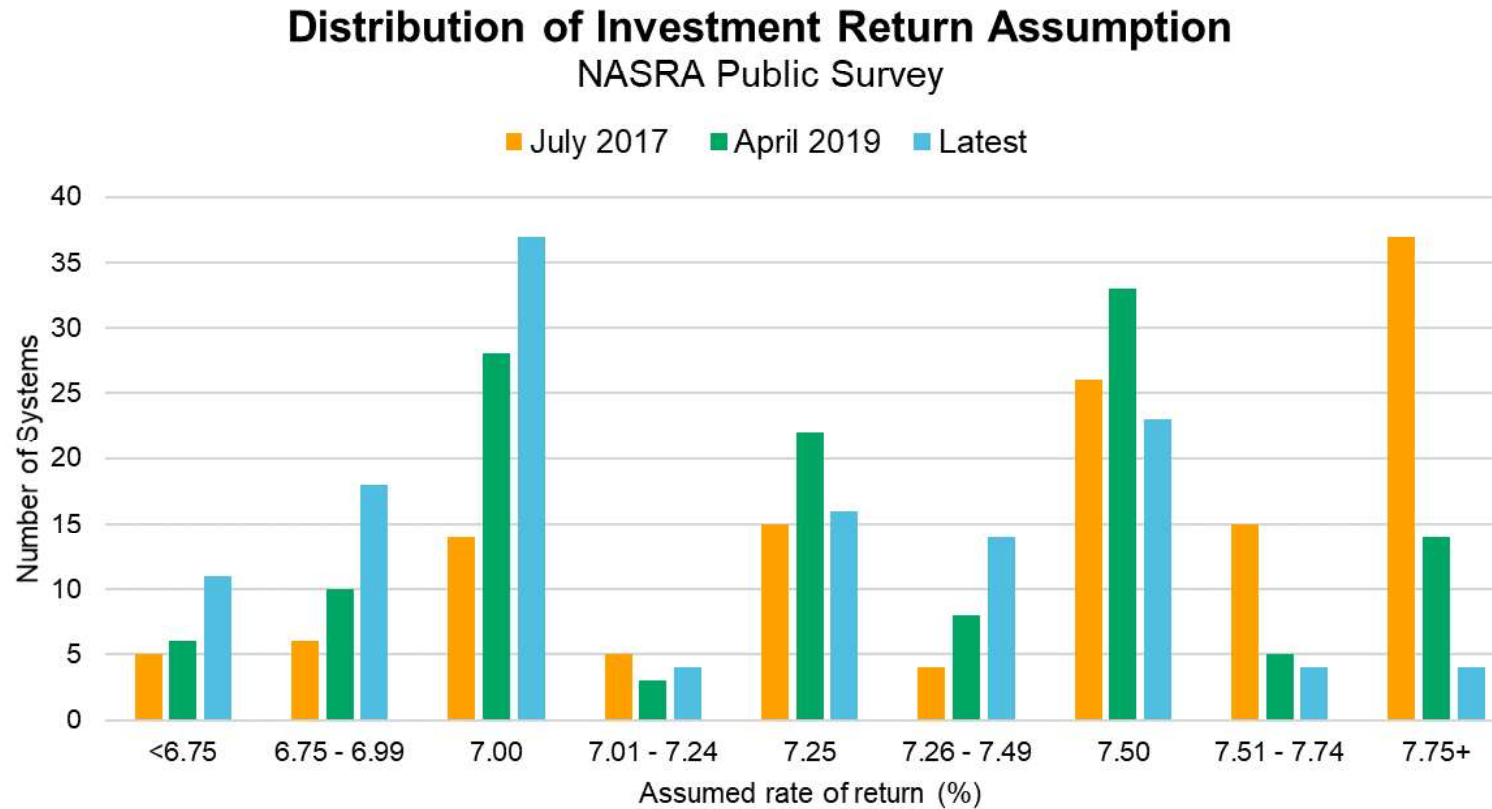
- There is a downward trend in public plan return assumptions, with a current median assumption for large public systems of 7.00%



Source: NASRA (May 2021)

Comparison to Peer Systems

- The distribution of about 130 systems tracked by the NASRA Public Fund Survey is shown below
- Two years ago, the most common assumption was 7.50%; now the most common assumption is 7.00% and over half of all plans have an assumption of 7.00% or lower



Source: NASRA (May 2021)



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Effects of Lowering the Assumed Return

- A lower investment return assumption would produce higher calculated liabilities and contribution rates as of the actuarial valuation date
- Liabilities are net present values, as of the valuation date, of a benefit payment projection that stretches far into the future
 - Changing the assumption modifies the projected balance of the fundamental cost equation between future investment earnings and future contributions
 - The actual balance will depend on actual investment earnings, not on the assumed return adopted by the PERS Board
- The increase in the uncollared 2023-25 system average base employer contribution rate resulting from lowering the assumed return was estimated in our March presentation as:
 - Assumed rate of 7.00% increases system average uncollared contribution rates by **1.5%-1.6%** of payroll
 - Assumed rate of 6.80% increases system average uncollared contribution rates by **3.1%-3.2%** of payroll
- For PERS, such an assumption change would also lower benefits for future retirements calculated under Money Match

Considerations in Setting the Return Assumption

- At the July meeting, we will ask the Board to adopt an assumption for use in the upcoming valuations
- Based on current data from the capital market outlook models, the guiding objectives, and Actuarial Standards of Practice:
 - In our opinion it is **necessary** to lower the long-term future investment return assumption by **at least 0.20%**
 - We **recommend** reducing the assumption **further** to more closely reflect the current range of outlooks
- The OIC, working with Meketa (primary investment consultant) and Aon (secondary investment consultant), estimates a long-term average future return of 6.6% under the proposed allocation over the next 20 years
 - The OIC outlook for inflation is 2.1%, while Social Security's outlook is 2.4%

Rate Collar

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Rate Collar

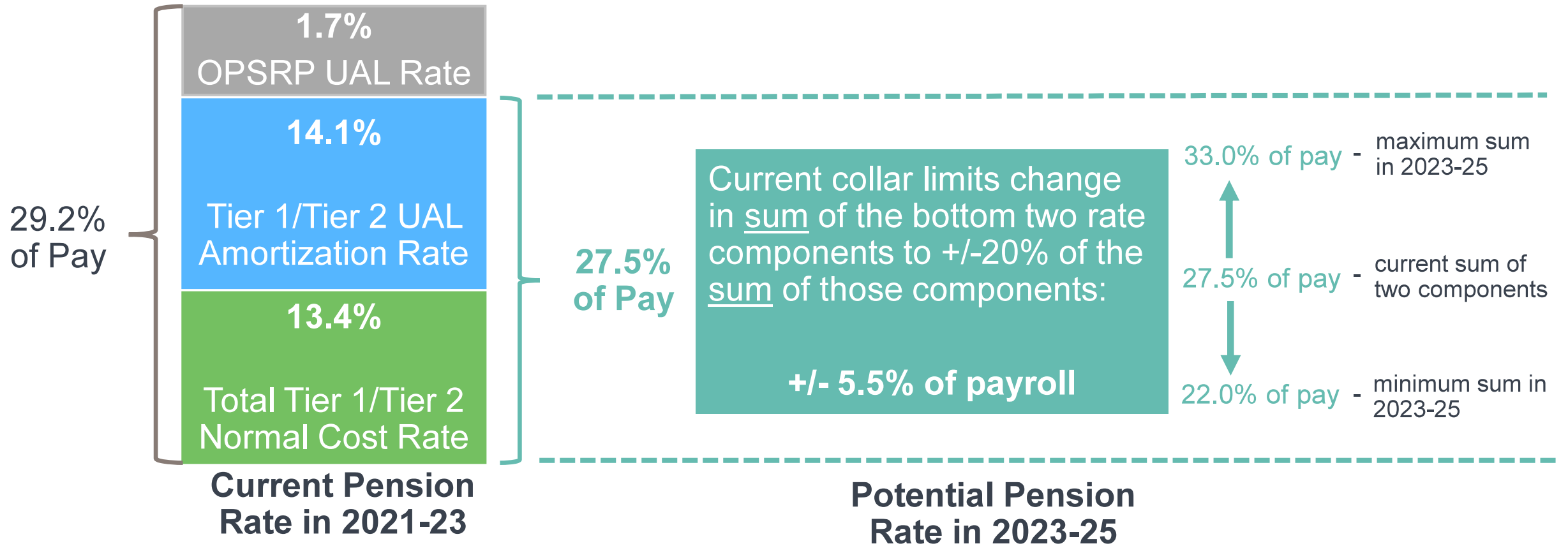
- PERS applies a “rate collar” as part of rate-setting process, as discussed in detail at recent Board meetings
 - Current rate collar parameters designed in 2005-2006, when system-wide rates were lower
 - Uses 20% of current rate as a starting point; this is a much larger amount now than in 2005-2006
 - December 2020 modeled potential changes to rate collar, reflecting current rates and funded status
 - Illustrated options that included narrower rate collar, while preserving responsiveness in down scenarios
- Feedback and additional considerations from December meeting and subsequent follow-up:
 - Positive reaction to simpler “fixed percent of pay” approach
 - Interest in contingent contribution rate decrease restrictions, which would not allow downward contribution rate movement unless a specific funding threshold is satisfied
 - Recognition that large experience sharing pools (SLGRP and School Districts for Tier 1/Tier 2, along with OPSRP) may merit different treatment than Tier 1/Tier 2 independent employers
 - Independent employers cover a diverse range and can be smaller with less stable experience
- Rate collar interacts with contribution rate changes from any movement in assumed rate, as discussed in March

Rate Collar

- Further refinement of the “fixed percent of pay” approach could focus the rate collar **only** on limiting the magnitude of biennium-to-biennium change in the **UAL Rate component**
 - Changes in the Normal Cost Rate component – whether due to experience or assumption changes – would pass through
 - Would allow the fixed percent of pay rate collar’s width to be narrower, since any Normal Cost Rate increases would occur in addition and could not crowd out part of overall allowable changes related to assumed rate changes, actual investment returns, or other experience
 - May want somewhat wider rate collar width for the Tier 1/Tier 2 rates of independent employers, and policies for certain scenarios for that group
- Illustration of a fixed percent of pay rate collar of:
 - 3% of pay for the Tier 1/Tier 2 UAL Rate for the two large Tier 1/Tier 2 experience sharing pools
 - 1% of pay for OPSRP UAL Rate (OPSRP experience is pooled at a state-wide level)
 - OPSRP rate collar is narrower since OPSRP asset base is much smaller than that of the large Tier 1/Tier 2 experience sharing pools; OPSRP collar could be widened over time as the program grows
 - For independent employers, the Tier 1/Tier 2 UAL rate fixed percent of pay rate collar may be wider and/or include additional provisions

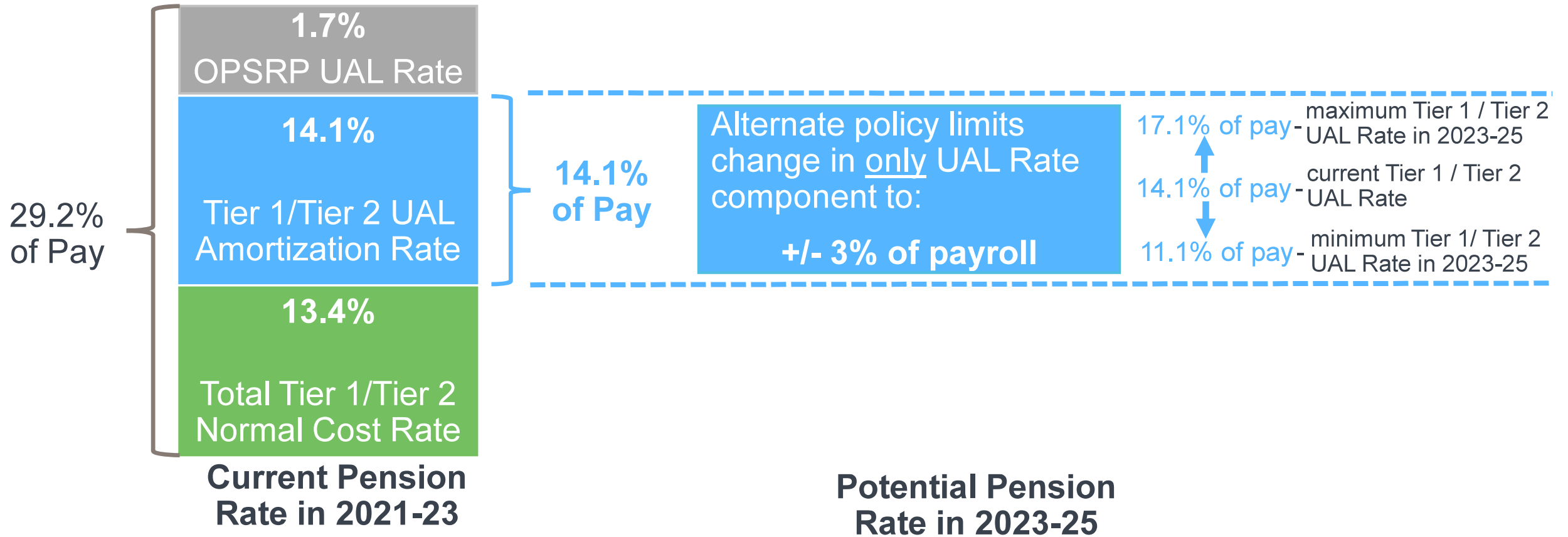
Rate Collar – Current Policy Limits Sum of Two Rate Components

- School district without a side account – pension contribution rate on Tier 1/Tier 2 payroll



Rate Collar – Alternate Policy Limits Only UAL Rate Components

- School district without a side account – pension contribution rate on Tier 1 / Tier 2 payroll



Reasons for Proposing a UAL Rate-Only Collar

- Managing amortization of the at-times volatile UAL is prudent, acceptable financial practice
 - The more predictable, stable Normal Cost Rate is always contributed in full under either policy
- The variable UAL Rate is an employer-only funding obligation
 - Normal Cost Rate funding is a combined obligation of members and employers
- Under current policy if the Tier 1/Tier 2 Normal Cost Rate decreases, then the Tier 1 / Tier 2 UAL Rate can increase by more than the width of the rate collar
 - The Tier 1 / Tier 2 Normal Cost Rate is paid on Tier 1 / Tier 2 payroll only
 - The Tier 1 / Tier 2 UAL Rate is paid on all payroll (Tier 1 / Tier 2 and OPSRP)
- Small independent employers can have large, unpredictable Tier 1 / Tier 2 Normal Cost Rate changes
 - Under current policy, those Tier 1 / Tier 2 Normal Cost Rate changes can lead to large, and potentially counterintuitive, offsetting changes in the employer's Tier 1 / Tier 2 UAL Rate

Assessing Alternative Rate Collar Policies

- Collars are meant to manage the contribution response to unpredictable future events
 - Example: actual investment returns different than assumption
- Properly assessing alternative policies requires modeling each policy's response to potential volatile future experience
- Alternatives were stress tested using 10,000 scenarios for future investment experience
 - Stress testing has been performed annually for over a decade
- Stress test results let the Board weigh alternatives and balance competing objectives
 - Protect funded status
 - Predictable and stable rates
 - Equitable across generations

Rate Collar – Stress Test of Alternative Policies

- Next slides have stress testing of proposed alternative collars using same financial modeling basis presented in December 2020 Board meeting, updated to reflect published 2020 investment returns

12/31/2038 Funded Status (Excluding Side Accounts)			
	Current Policy	Fixed Percent of Pay UAL Rate Collar (3% / 1%)	Fixed Percent of Pay UAL Rate Collar (3% / 1%) with UAL Rate Decrease Restrictions
75 th Percentile	121%	127%	134%
50 th Percentile	91%	92%	96%
25 th Percentile	71%	69%	71%
10 th Percentile	57%	53%	56%
5 th Percentile	51%	46%	48%

- Model uses 12/31/2019 member census data along with projected post-2019 new entrants
- Model uses 12/31/2019 actuarial valuation assumptions, including 7.20% assumed rate

Rate Collar – Stress Test of Alternative Policies

Likelihood of Event Occurring in at Least One Actuarial Valuation in Next 20 Years			
	Current Policy	Fixed Percent of Pay UAL Rate Collar (3% / 1%)	Fixed Percent of Pay UAL Rate Collar (3% / 1%) with UAL Rate Decrease Restrictions
Funded Status > 100%	60%	59%	62%
Funded Status < 60%	53%	53%	50%
Funded Status < 40%	8%	11%	10%

- Funded status is the funded status excluding side accounts
 - Model reflects published 2020 full-year investment returns
 - Model uses 12/31/2019 member census data along with projected post-2019 new entrants
 - Model uses 12/31/2019 actuarial valuation assumptions, including 7.20% assumed rate

Rate Collar – Stress Test of Alternative Policies

Likelihood of Event Occurring in at Least One Biennium in Next 20 Years			
	Current Policy	Fixed Percent of Pay UAL Rate Collar (3% / 1%)	Fixed Percent of Pay UAL Rate Collar (3% / 1%) with UAL Rate Decrease Restrictions
Base Contribution Rate < 10% of Pay	38%	28%	27%
Base Contribution Rate > 30% of Pay	60%	53%	52%
Base Contribution Rate > 40% of Pay	25%	21%	20%

- Collared Base Employer Rate excluding the retiree healthcare rates is shown
 - Model reflects published 2020 full-year investment returns
 - Model uses 12/31/2019 member census data along with projected post-2019 new entrants
 - Model uses 12/31/2019 actuarial valuation assumptions, including 7.20% assumed rate

Other Actuarial Methods

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Key Actuarial Methods

	12/31/2019 Valuation Methods	12/31/2020 Valuation Proposed* Methods
Cost Allocation Method	Entry Age Normal	No change
UAL (Shortfall) Amortization Method	Level percent of pay, layered fixed periods: <i>Tier 1/Tier 2:</i> <ul style="list-style-type: none"> • Reamortized over 22 years as of 12/31/2019 per SB 1049 • 20 years as ongoing Board policy <i>OPSRP: 16 years</i> <i>RHIA/RHIPA: 10 Years</i>	No change
Rate Collar	Limits change in base contribution rate to larger of 20% of current rate or 3.00% of payroll; Collar widens incrementally when funded status below 70%	Consider modifying structure as discussed in prior section

*No action is needed on “proposed” methods today, since all assumptions and methods will be adopted at the July 2021 Board meeting



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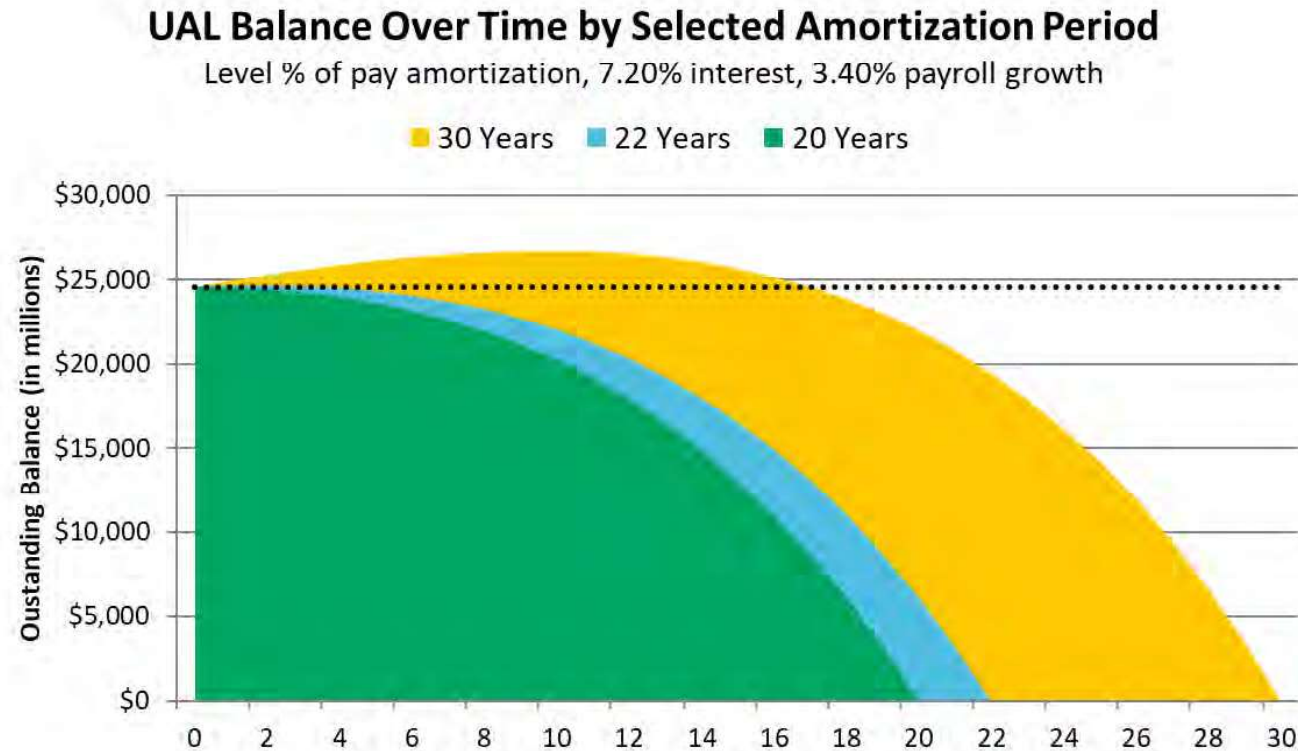
Cost Allocation Method

- Rates are calculated to pre-fund retirement benefits during a member's working career if all assumptions are met
- The present-day value of projected future benefits allocated to a particular working year is the Normal Cost
- The present-day value of projected future benefits allocated to prior years is the Accrued Liability
- The division between past, current & future service is done through use of an actuarial cost allocation method
- PERS currently uses GASB-compliant cost allocation method of Entry Age Normal (EAN)
 - We recommend no change to the cost allocation method

Shortfall Amortization Periods

- A key part of contribution rate calculations is amortization of Tier 1 / Tier 2 shortfalls over twenty years as a level percentage of payroll
 - As required by Senate Bill 1049, Tier 1/Tier 2 UAL as of December 31, 2019 was re-amortized over 22 years
 - Prior to that, Board policy has been to amortize gains or losses in separate layers over 20 years from the rate-setting valuations in which the gain or loss was first recognized
- Twenty years avoids significant negative amortization, where unamortized shortfall materially increases in the initial “pay down” years even if actual investment returns match assumptions and contributions are made
 - The following slide illustrates amortization as a level percentage of projected payroll of a \$24.6 billion shortfall over periods of 20, 22 or 30 years

Remaining Balances for 20-, 22-, & 30-Year Amortizations



Current ongoing policy

- Tier 1 / Tier 2:
20 years
- OPSRP:
16 years

- **Why 20 years or less?** If actual experience matches the assumption...
 - with 22 years zero progress is made in decreasing the initial UAL until year 4
 - with 30 years the UAL has increased by about 9% after the first decade, and zero progress is made in decreasing the initial UAL until year 17

Agenda for July Meeting

- Review demographic assumptions
 - Member-specific assumptions based on study of recent PERS experience
- Adopt all methods and assumptions for use in:
 - 12/31/2020 actuarial valuation with advisory 2023-2025 contribution rates
 - 12/31/2021 actuarial valuation with 2023-2025 contribution rates proposed for adoption

Appendix

Certification

This presentation discusses actuarial methods and assumptions for use in the valuation of the Oregon Public Employees Retirement System (“PERS” or “the System”). For the most recent complete actuarial valuation results, including cautions regarding the limitations of use of valuation calculations, please refer to our formal Actuarial Valuation Report as of December 31, 2019 (“the Valuation Report”) published on September 17, 2020. The Valuation Report, including all supporting information regarding data, assumptions, methods, and provisions, is incorporated by reference into this presentation. The statements of reliance and limitations on the use of this material is reflected in the actuarial report and still apply to this presentation. The Valuation Report, along with prior presentations to the PERS Board, including the December 2020, February 2021, and March 2021 presentations to the PERS Board should be referenced for additional detail on the data, assumptions, methods, and plan provisions underlying this presentation.

In preparing this presentation, we relied, without audit, on information (some oral and some in writing) supplied by the System’s staff as well as capital market expectations provided by Meketa, capital market information published by Horizon Actuarial Services, and information presented to the Oregon Investment Council. This information includes, but is not limited to, statutory provisions, employee data, and financial information. We found this information to be reasonably consistent and comparable with information used for other purposes. The results depend on the integrity of this information. If any of this information is inaccurate or incomplete our results may be different and our calculations may need to be revised.

In assessing the Milliman capital market expectations presented in this report, per Actuarial Standards of Practice we disclose reliance upon a model developed by Milliman colleagues who are credentialed investment professionals with expertise in capital outlook modeling.

All costs, liabilities, rates of interest, and other factors for the System have been determined on the basis of actuarial assumptions and methods which in our professional opinion are individually reasonable (taking into account the experience of the System and reasonable expectations); and which, in combination, offer a reasonable estimate of anticipated experience affecting the System. The valuation results were developed using models intended for valuations that use standard actuarial techniques.

Future actuarial measurements may differ significantly from the current measurements presented in this report due to such factors as the following: plan experience differing from that anticipated by the economic or demographic assumptions; changes in economic or demographic assumptions; increases or decreases expected as part of the natural operation of the methodology used for these measurements (such as the end of an amortization period or additional cost or contribution requirements based on the plan's funded status); and changes in plan provisions or applicable law. Due to the limited scope of our assignment, we did not perform an analysis of the potential range of future measurements. Our annual financial modeling presentation to the PERS Board should be referenced for additional analysis of the potential variation in future measurements. The PERS Board has the final decision regarding the assumptions used in the actuarial valuation.



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Certification

The calculations in this report have been made on a basis consistent with our understanding of the plan provisions described in the appendix of the Valuation Report. Determinations for purposes other than meeting these requirements may be significantly different from the results contained in this report. Accordingly, additional determinations may be needed for other purposes.

Milliman's work is prepared solely for the internal business use of the Oregon Public Employees Retirement System. Milliman does not intend to benefit or create a legal duty to any third-party recipient of its work product.

No third-party recipient of Milliman's work product should rely upon Milliman's work product. Such recipients should engage qualified professionals for advice appropriate to their own specific needs.

The consultants who worked on this assignment are retirement actuaries. Milliman's advice is not intended to be a substitute for qualified legal or accounting counsel.

The signing actuaries are independent of the System. We are not aware of any relationship that would impair the objectivity of our work.

On the basis of the foregoing, we hereby certify that, to the best of our knowledge and belief, this report is complete and accurate and has been prepared in accordance with generally recognized and accepted actuarial principles and practices which are consistent with the principles prescribed by the Actuarial Standards Board and the *Code of Professional Conduct and Qualification Standards for Actuaries Issuing Statements of Actuarial Opinion in the United States* published by the American Academy of Actuaries. We are members of the American Academy of Actuaries and meet the Qualification Standards to render the actuarial opinion contained herein.



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Appendix

Capital Market Outlook

- Capital market outlooks change over time in response to changing market conditions
 - Milliman outlook updated every six months
 - Recent changes and key factors shown below for Milliman model of PERS asset allocation
 - Outlooks shown reflect Milliman’s real return outlook at each date combined with a 2.50% inflation assumption as of 12/31/16 and 12/31/18, and a 2.40% inflation assumption as of 12/31/20

Milliman 20-year outlook	12/31/16	12/31/18	12/31/20
Median Annualized Return	6.70%	6.87%	6.27%
Global Equity	6.74%	6.99%	5.85%
Private Equity	7.82%	8.33%	7.71%
US Core Fixed Income	3.49%	4.07%	2.73%
US Short-term Bonds	3.38%	3.68%	2.47%
Real Estate	5.51%	5.55%	5.66%

Asset category returns shown above are 20-year annualized geometric mean returns and reflect reduction for assumed investment management expenses

Appendix

Actuarial Basis

Capital Market Assumptions – Milliman Real Return Outlook Adjusted for 2.40% Inflation Assumption

For assessing the expected portfolio return under Milliman’s capital market assumptions (adjusted for inflation assumption shown below), we considered the Oregon PERS Fund to be allocated among the model’s asset classes as shown below. This allocation is based on input provided by Meketa (OIC’s primary consultant) and reflects proposed changes to the Oregon Investment Council’s target allocation for the Oregon PERS Fund that are expected to be adopted in June 2021.

	Annual Arithmetic Mean	20-Year Annualized Geometric Mean	Annual Standard Deviation	Policy Allocation
Global Equity	7.11%	5.85%	17.05%	30.62%
Private Equity	11.35%	7.71%	30.00%	25.50%
US Core Fixed Income	2.80%	2.73%	3.85%	23.75%
Real Estate	6.29%	5.66%	12.00%	12.25%
Master Limited Partnerships	7.65%	5.71%	21.30%	0.75%
Infrastructure	7.24%	6.26%	15.00%	1.50%
Commodities	4.68%	3.10%	18.85%	0.63%
Hedge Fund of Funds – MultiStrategy	5.42%	5.11%	8.45%	1.25%
Hedge Fund Equity-Hedge	5.85%	5.31%	11.05%	0.63%
Hedge Fund – Macro	5.33%	5.06%	7.90%	5.62%
US Cash	1.77%	1.76%	1.20%	(2.50%)
US Inflation (CPI-U)		2.40%	1.65%	N/A
Fund Total (reflecting asset class correlations)	7.06%	6.31%*	13.08%	100.00%

* Reflects 0.09% average reduction to model passive investment expenses. The model does not try to assess the actual investment expenses for active management. The model’s 20-year annualized geometric median is 6.27%.



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Appendix

Actuarial Basis

Capital Market Assumptions - Horizon

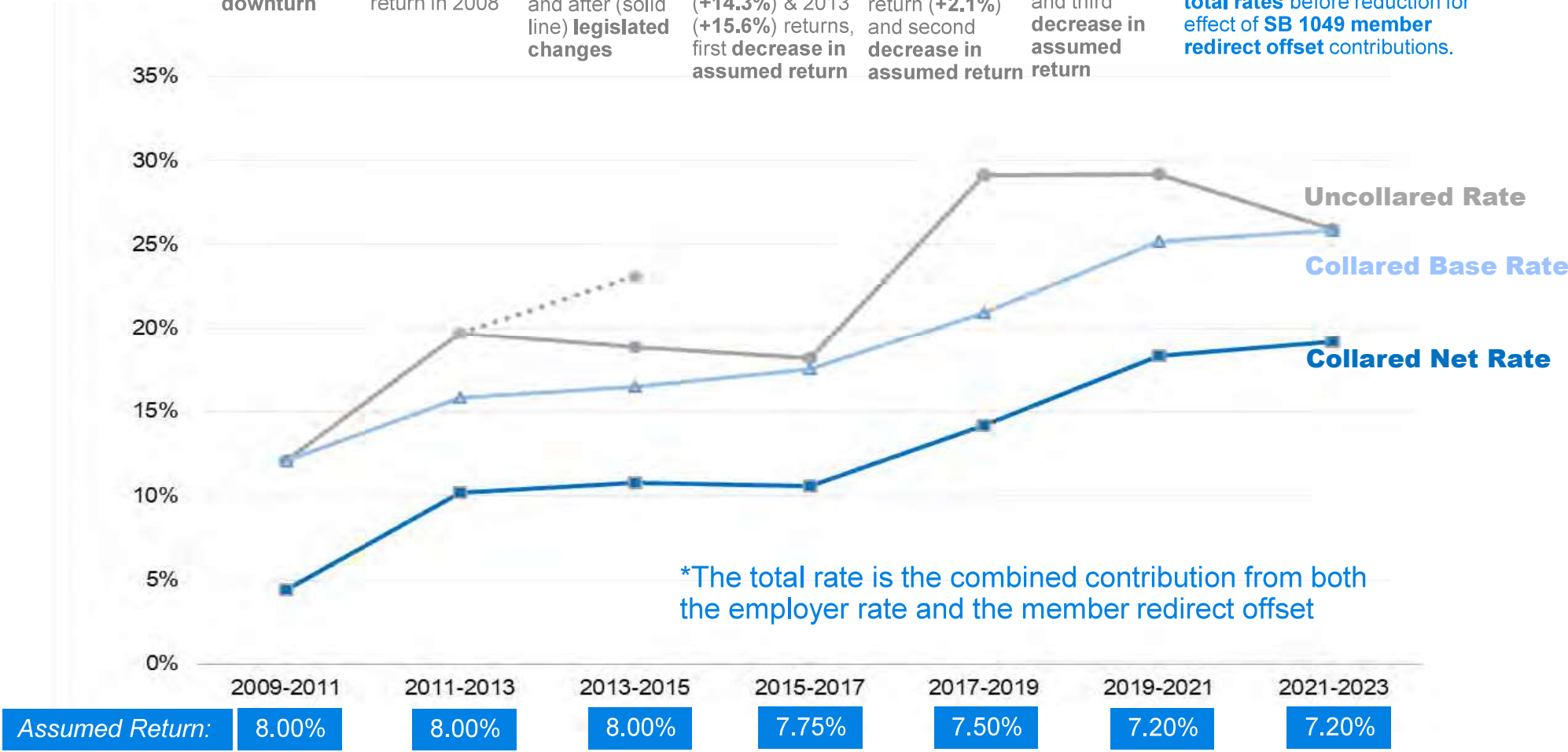
For assessing the expected portfolio return under an additional set of capital market assumptions, we applied the assumptions from the 2020 Survey of Capital Market Assumptions published by Horizon Actuarial Services, LLC. According to the survey report, the 10-year return assumptions shown below represent an average of the expectations for 39 investment advisors responding to the survey.

	10-Year Annualized Geometric Mean	Annual Standard Deviation	Policy Allocation
US Equity – Large Cap	6.16%	16.22%	13.78%
Non-US Equity – Developed	6.80%	18.05%	13.78%
Non-US Equity – Emerging	7.85%	24.23%	3.06%
US Corporate Bonds – Core	2.60%	5.47%	23.75%
US Treasuries (Cash Equivalents)	1.56%	1.78%	(2.50%)
Real Estate	5.75%	16.84%	12.25%
Hedge Funds	4.74%	8.00%	7.50%
Commodities	3.19%	17.60%	0.63%
Infrastructure	6.94%	14.58%	2.25%
Private Equity	9.08%	21.99%	25.50%
Inflation	1.98%		N/A
Fund Total (reflecting asset class correlations)	6.87%*		100.00%

* 10-year annualized geometric median is **6.80%**.

System-average Weighted Total* Pension-Only rates

2009-2011 rates set prior to economic downturn
2011-2013 rates first to reflect -27% return in 2008
2013-2015 shown before (dotted line) and after (solid line) legislated changes
2015-2017 set pre-Moro reflecting 2012 (+14.3%) & 2013 (+15.6%) returns, first decrease in assumed return
2017-2019 set post-Moro, reflecting 2015 return (+2.1%) and second decrease in assumed return
2019-2021 reflects 2017 return (+15.4%) and third decrease in assumed return
2021-2023 reflects legislatively-mandated Tier 1/Tier 2 UAL reamortization; rates shown are total rates before reduction for effect of SB 1049 member redirect offset contributions.

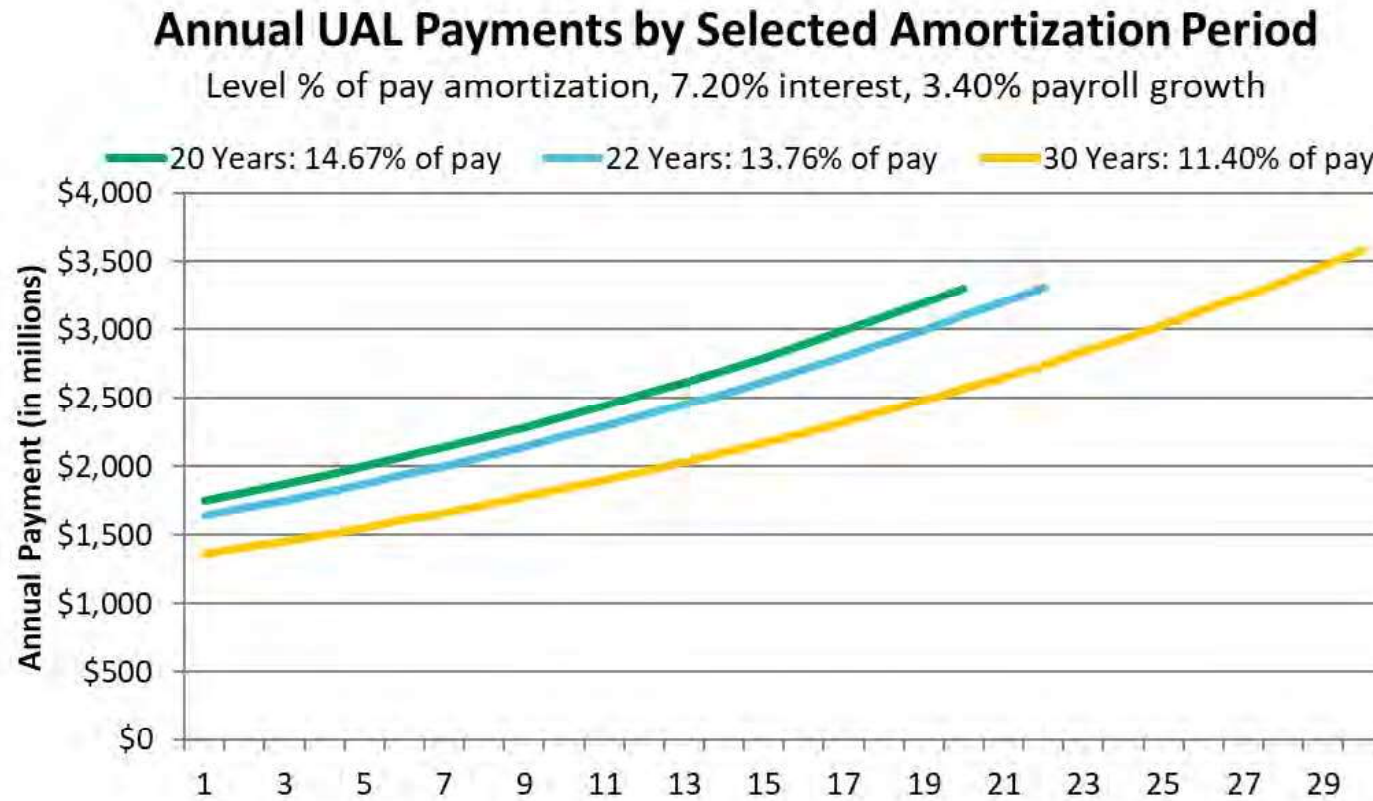


*The total rate is the combined contribution from both the employer rate and the member redirect offset



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Illustration of UAL Amortization Periods

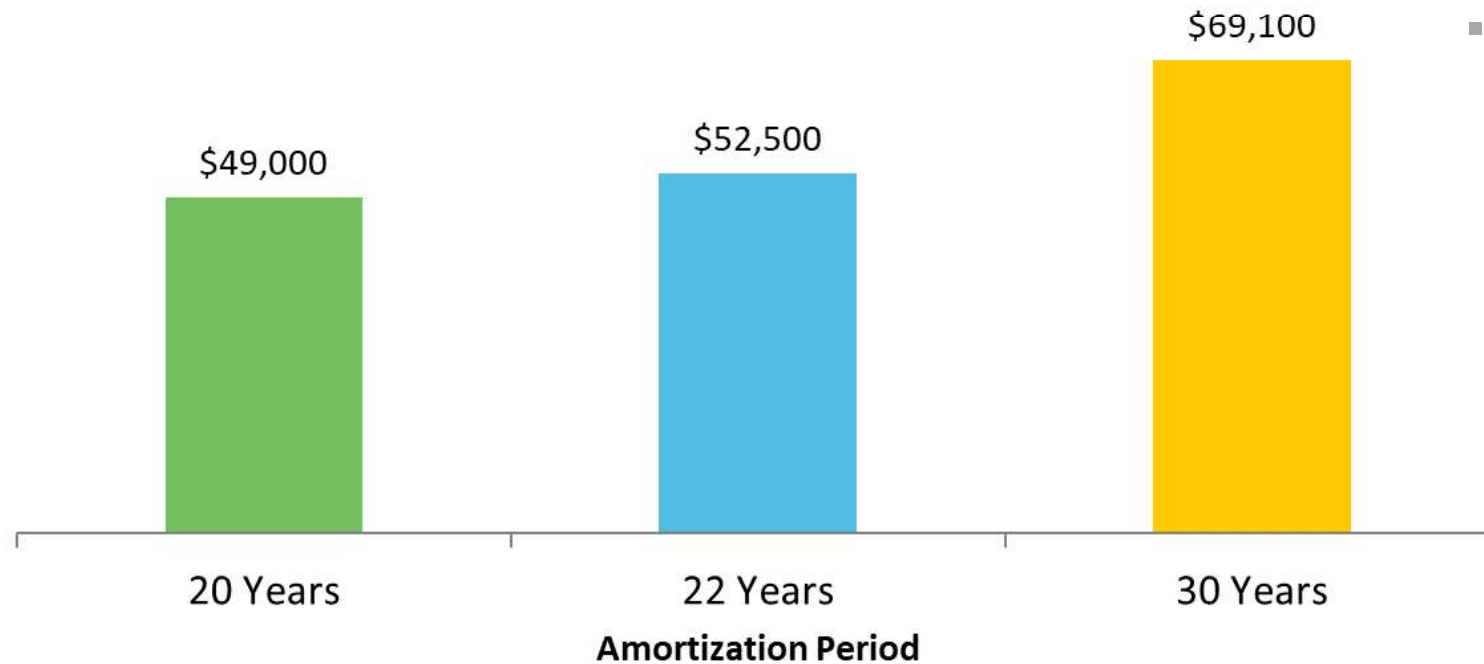


Current policy

- Tier 1 / Tier 2:
20 years
- OPSRP:
16 years

Illustration of UAL Amortization Periods

Total Repayment (\$M) by Selected Amortization Period
Level % of pay amortization, 7.20% assumed return, 3.40% payroll growth



Current policy

- Tier 1 / Tier 2:
20 years
- OPSRP:
16 years

This illustrates total amortization payments for a \$24.6 billion shortfall over periods of 20, 22 or 30 years