



# FINANCIAL MODELING

## OREGON PUBLIC EMPLOYEES RETIREMENT SYSTEM

Presented by:

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December 4, 2020

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# Introduction

- July: System-average valuation results
  - Calculated as of December 31, 2019 for the Tier 1/Tier 2 & OPSRP programs
- October: Employer-specific 2021-2023 contribution rates
  - Based on the December 31, 2019 actuarial valuation
- **Today: Long-term financial modeling projections reflecting published investment results through September 30**
  - System average contribution rates
  - System funded status
  - System unfunded actuarial liability (UAL)

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# Models and Inputs

- System financials are projected using two different models
  - Steady return model – consistent year-to-year future investment returns
  - Variable return model – future investment returns vary from year to year
- Modeling starts with liabilities and actuarial assumptions from the 12/31/2019 system-wide actuarial valuation report
  - This includes the current Board-adopted 7.20% return assumption for valuing liabilities
- Modeling uses 12/31/2019 assets adjusted for **published regular account returns of +0.14% through September 2020**
- Returns for October through December 2020 vary in our models based on scenario

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# Financial Modeling

## Comments on System Average Rates

- Projections depict **system average** funded status and employer contribution rates
  - Comparable to system average rates shown in October 2020 presentation
- Rates shown in this presentation are “employer” rates
  - Redirected member contributions serve as an offset to “total” effective with 2021-2023 rate setting
- No single employer pays the system average rate
  - Contribution rates vary both by employer and by type of payroll
- Under majority of scenarios, average employer rates for the 2023-2025 biennium are projected to increase, due to effect of asset underperformance so far in 2020
  - Actual outcome will vary by rate pool and employer
- Rates shown do not include:
  - Contribution rates for the Individual Account Plan (IAP)
  - Employer contribution rates for the RHIA & RHIPA retiree healthcare programs
  - Debt service payments on employer-specific pension obligation bonds

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## Rate Collaring

- PERS applies a “rate collar” as part of rate-setting process, as discussed in March and July Board meetings
- With the December 31, 2019 valuation, rate collar is not currently limiting rates for the large rate pools
  - Collared and uncollared rates are equal

# Overview of Rate Calculation Structure



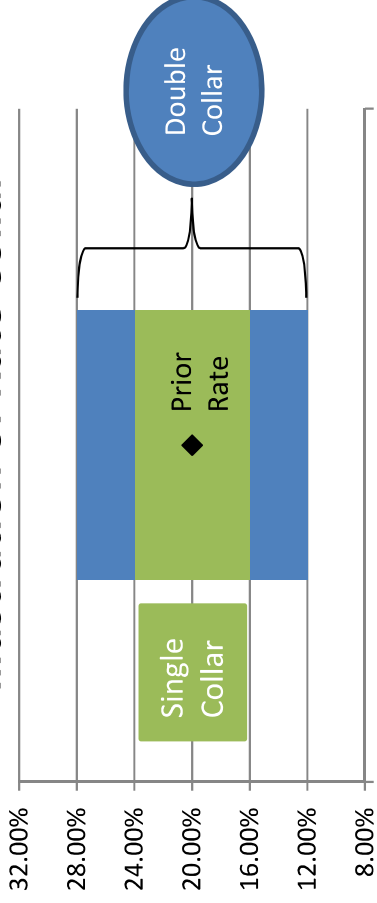
- The **uncollared total rate** is the theoretical contribution rate to reach 100% funded status over a specified amortization period if:
  - Contributions at that rate started on the actuarial valuation date, and
  - Actual future experience mirrors the actuarial valuation’s assumptions, and
  - The normal cost rate does not change in subsequent years
- The rate collar sets a biennium’s **collared total base rate**, limiting the base rate change for a single biennium when there is a large change in the uncollared rate
- **Member redirect offset** reflects estimated portion of collared total base rate paid by redirected member contributions
- Employers pay the **collared net employer rate**, which reflects the member redirect offset and any rate offset adjustments from:
  - Side account rate offsets for employers with side accounts
  - SLGRP charges/offsets (e.g., Transition Liability/Surplus)

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# Width of the Rate Collar - Current Structure

- The maximum change typically permitted by the collar is:
  - 20% of the rate currently in effect (3% of payroll minimum collar width)
  - If funded status excluding side accounts is 60% or lower, the width of the collar doubles
    - 40% of rate currently in effect (6% of payroll minimum collar width)
- If the funded status is between 60% and 70%, the collar size is pro-rated between the single collar width and the double collar width

Illustration of Rate Collar



- Collars are calculated at a rate pool level and limit the biennium to biennium increase in the UAL Rate for a given rate pool

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# Rate Collaring

- As discussed in prior Board meetings, today's financial modeling includes illustration of potential modifications to the collar structure
  - For this purpose, our model treats the entire system as one employer, with the rate pool calculated separately for Tier 1/Tier 2 and OPSRP at the system level
- Illustrations are for informational purposes, no decisions anticipated today
  - Any change to rate collar structure would be adopted with review of actuarial methods and assumptions with next year's experience study
  - If changes are made, Board could consider distinguishing between treatment of Tier 1/Tier 2 rate collar for large rate pools (SLGRP, School District) vs. independent employers
- Alternatives modeled:
  - Elimination or modification of the "double collar" component
  - Rate collar defined as a fixed percent of payroll (4% for Tier 1/Tier 2, 1% for OPSRP), rather than as a percentage of the current rate
  - Rate collar defined as a fixed percent of payroll (4% for Tier 1/Tier 2, 1% for OPSRP), AND rates are not allowed to decrease unless funded status (excluding side accounts) is greater than 90%

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# Steady Return Model with Current Rate-Setting Policy

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# Steady Return Model

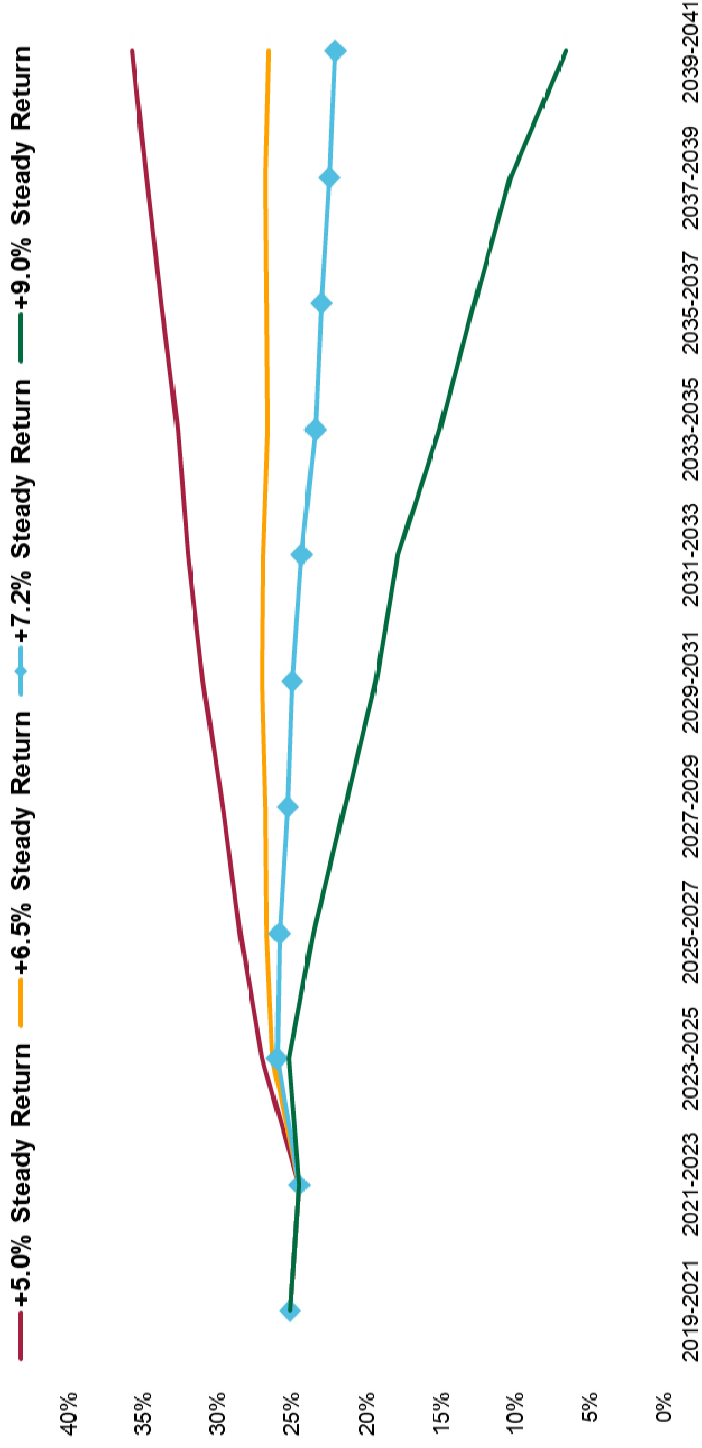
## Current Rate Setting Structure

- The next four slides show financial projections under the current rate setting structure
  - Employer rates adjust each biennium, with changes limited by the rate collar
- Four scenarios for steady annual actual future investment return are shown
  - +5.0%; +6.5%; +7.2%; +9.0%
- While actual future returns won't be steady year-to-year, the steady return model clearly illustrates the financial dynamics
  - More realistic “noisy” future returns will be shown in the variable return model later in this presentation
  - The effects of near-term and/or long-term future returns worse than +5.0% are captured in the variable return model
- Model incorporates published returns through September 2020

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# Employer Collared Base Pension Rates (System Average)

## Current Rate Setting Structure

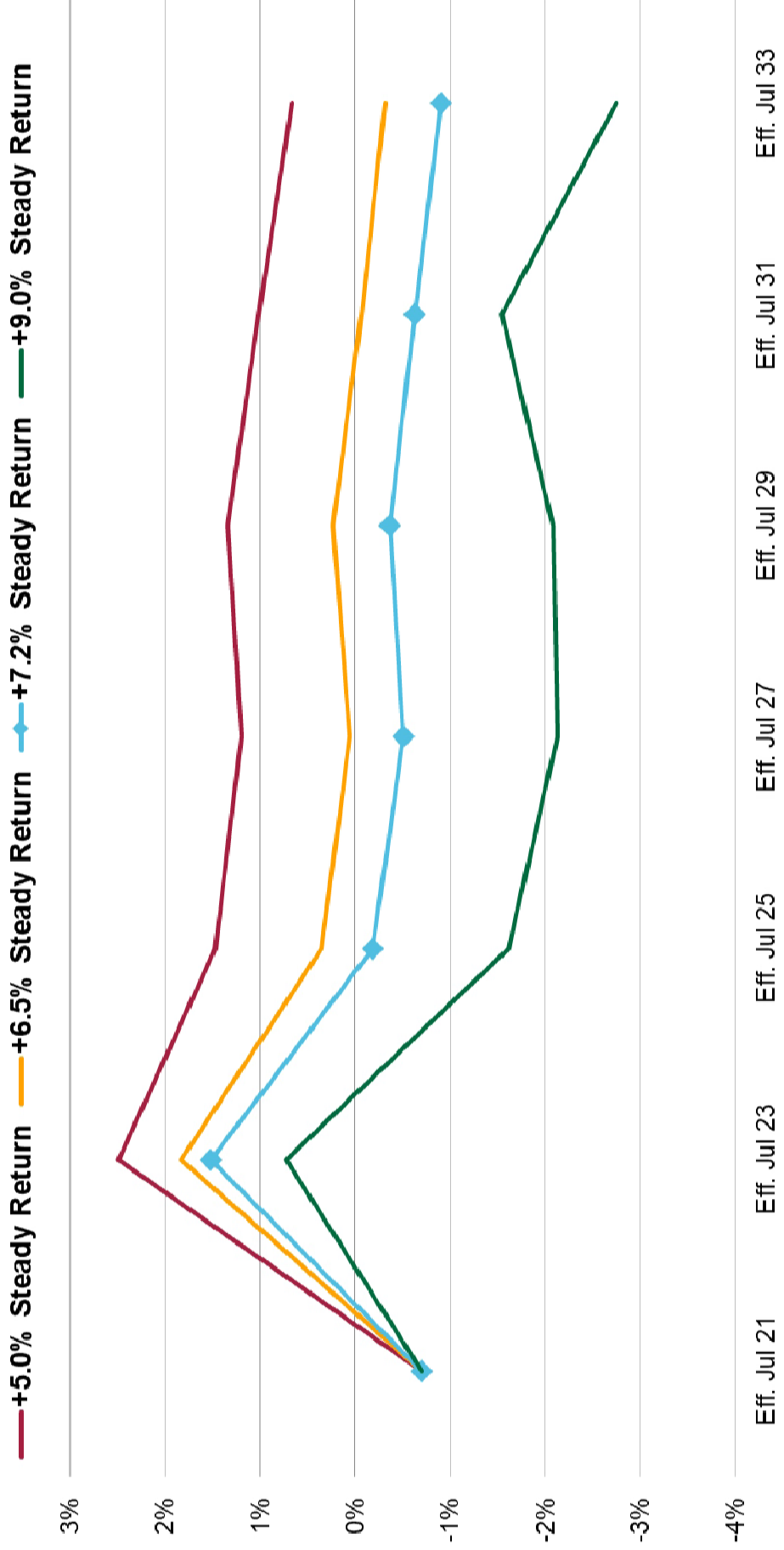


- If future investment results are near assumption, system average employer collared base pension rates in 2023-25 are projected to increase from 2021-23 rates, due to asset underperformance so far during 2020
- Blue line: rates decrease as new OPSRP members replace exiting Tier 1 / Tier 2s
- 2023-25 rates are based on asset returns through December 31, 2021, along with assumptions and methods adopted after the upcoming Experience Study

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# Biennial Change in Collared Base Rate (System Average)

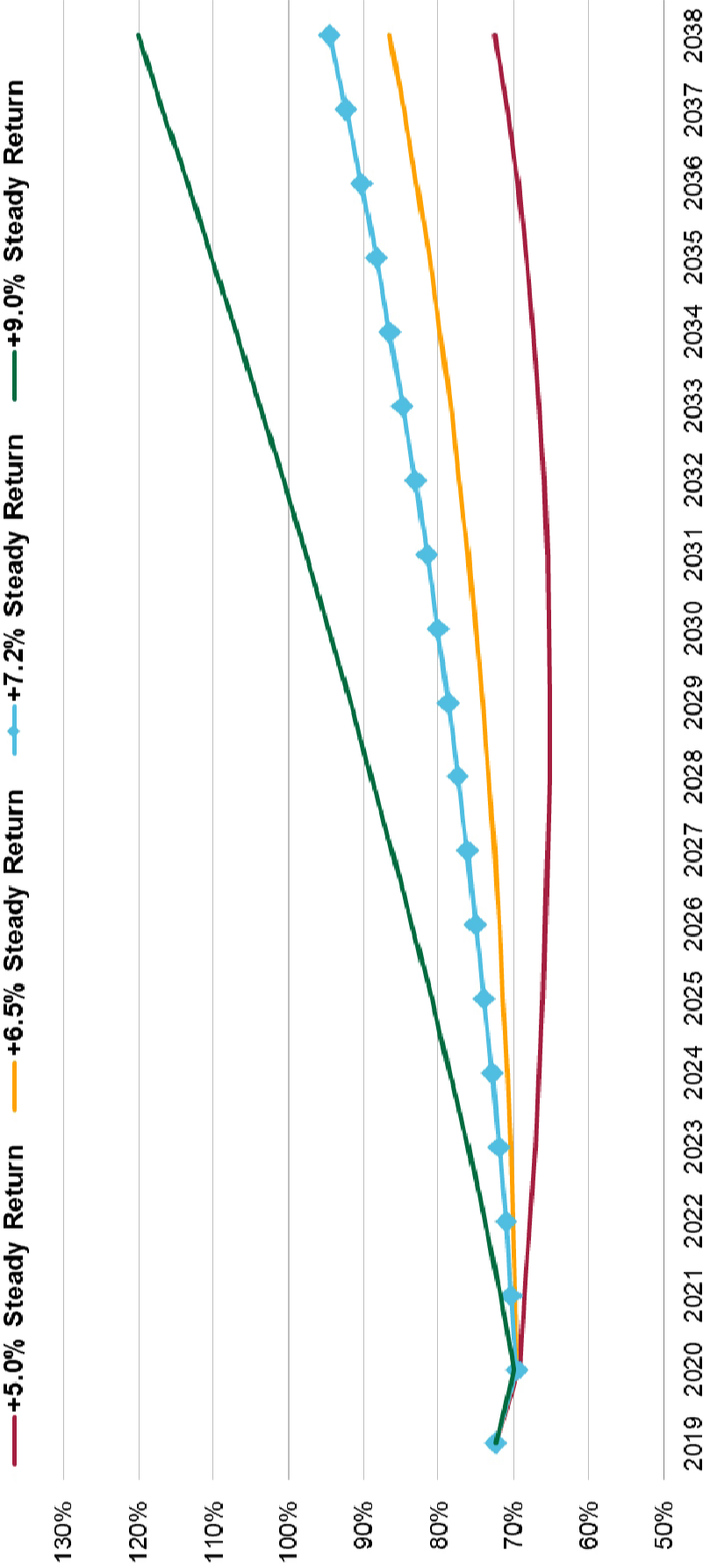
## Current Rate Setting Structure



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# System Funded Status (Excluding Side Accounts)

## Current Rate Setting Structure



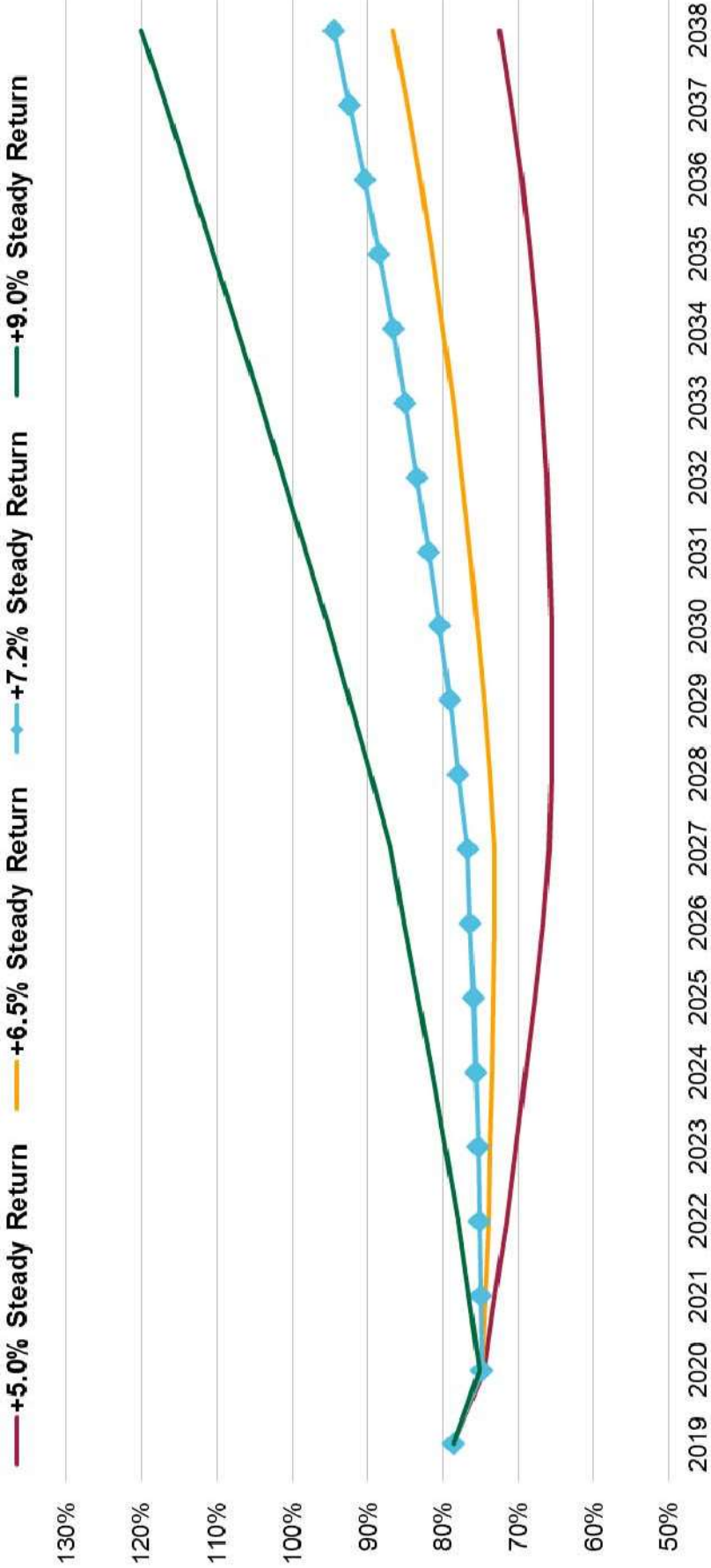
- 2020 funded status decreases due to estimated year-end 2020 investment returns
- In steady +7.2% return scenario, funded status projected to reach 95% in 2038

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# System Funded Status (Including Side Accounts)

## Current Rate Setting Structure

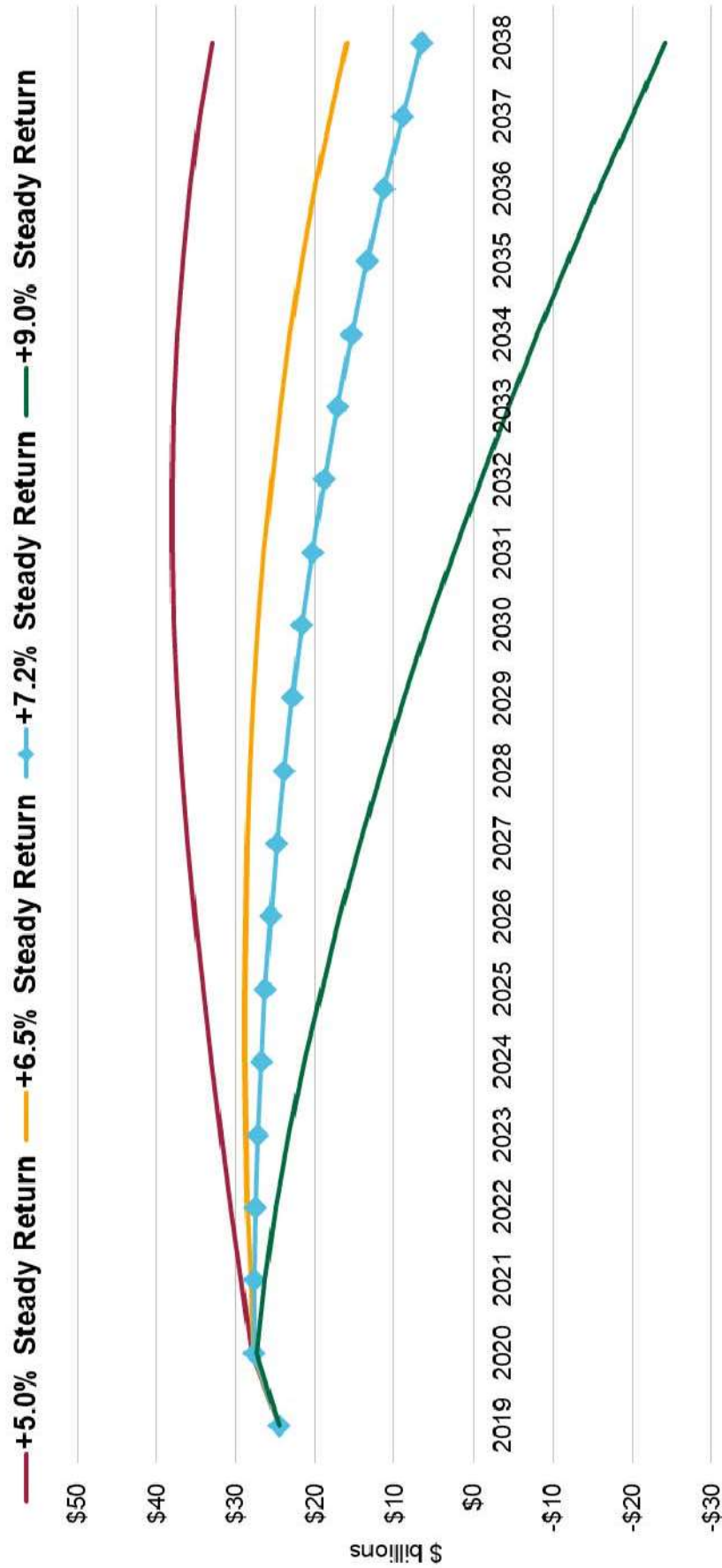


- 2020 funded status decreases due to estimated year-end 2020 investment returns
- In steady +7.2% return scenario, funded status projected to reach 95% in 2038

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# UAL (Unfunded Actuarial Liability) Excluding Side Accounts

## Current Rate Setting Structure



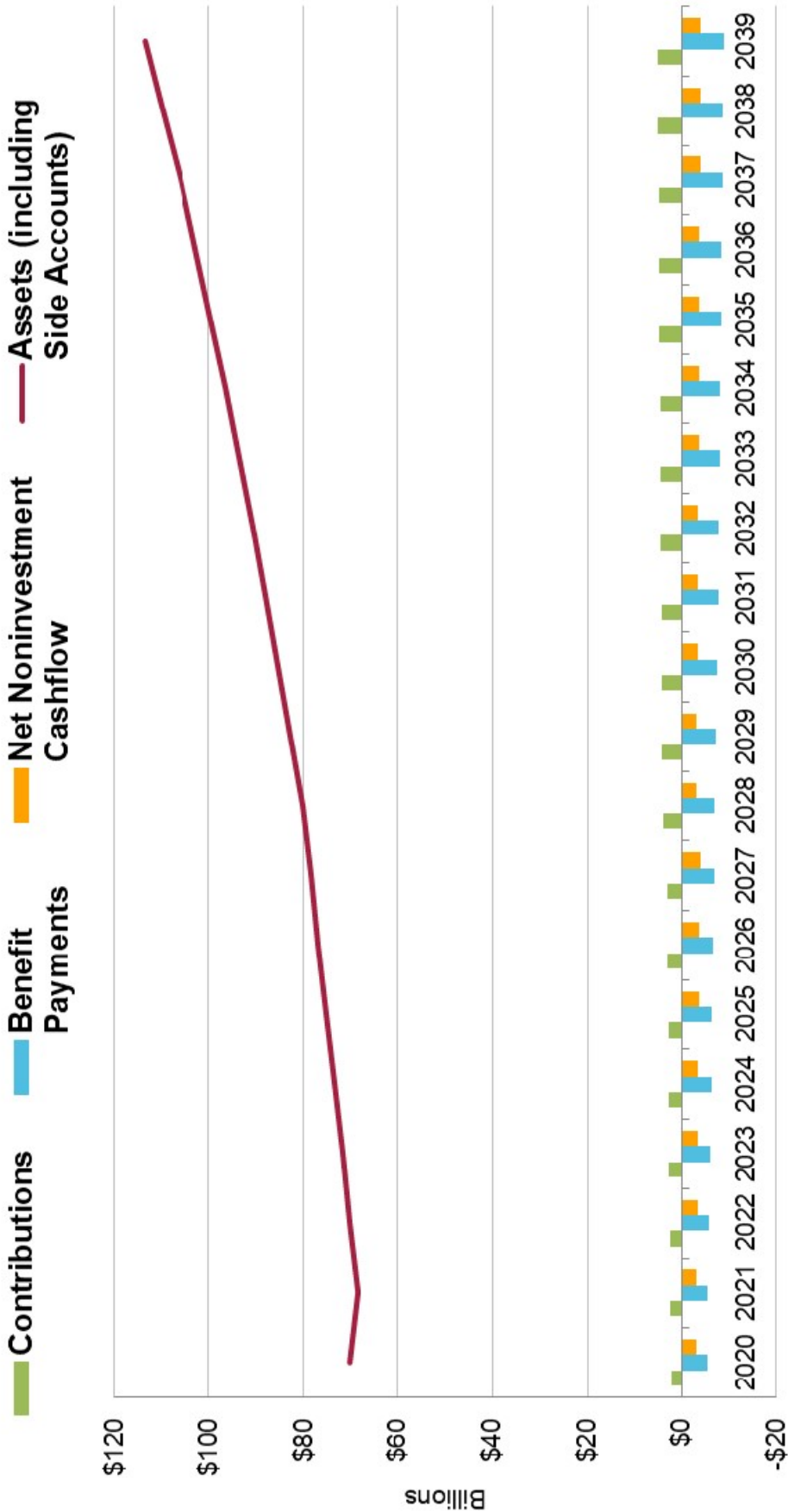
- 2020 UAL increases due to estimated year-end 2020 investment returns
- At steady +7.2% returns, UAL remains relatively level for several years before declining to below \$7 billion at year-end 2038

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# Cash Flow and Asset Balance at +7.20% Actual Return

## Current Rate Setting Structure

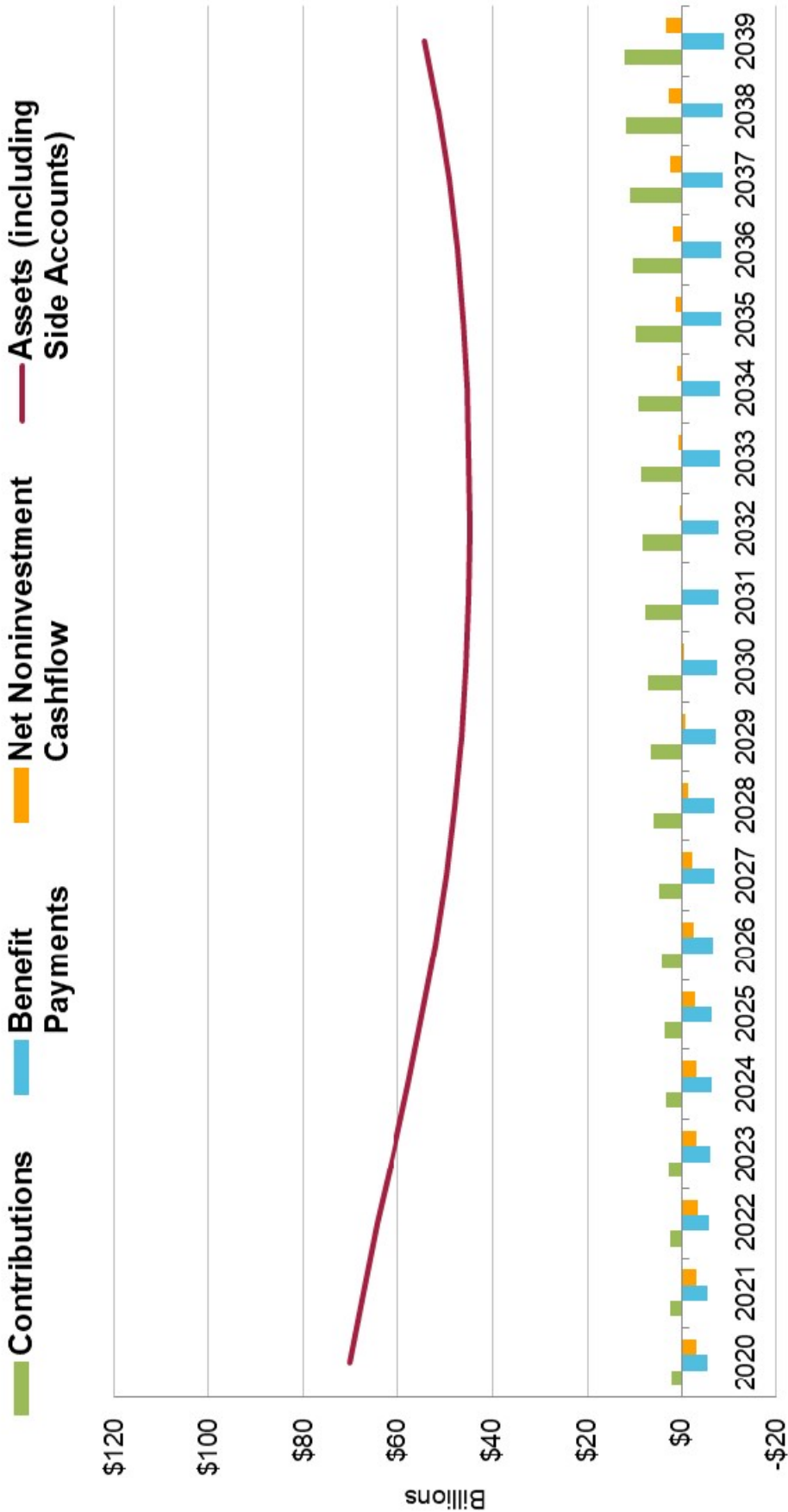


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# Cash Flow and Asset Balance at +0.00% Actual Return

## Current Rate Setting Structure



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# Variable Return Model with Current Rate-Setting Policy

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# Variable Return Model

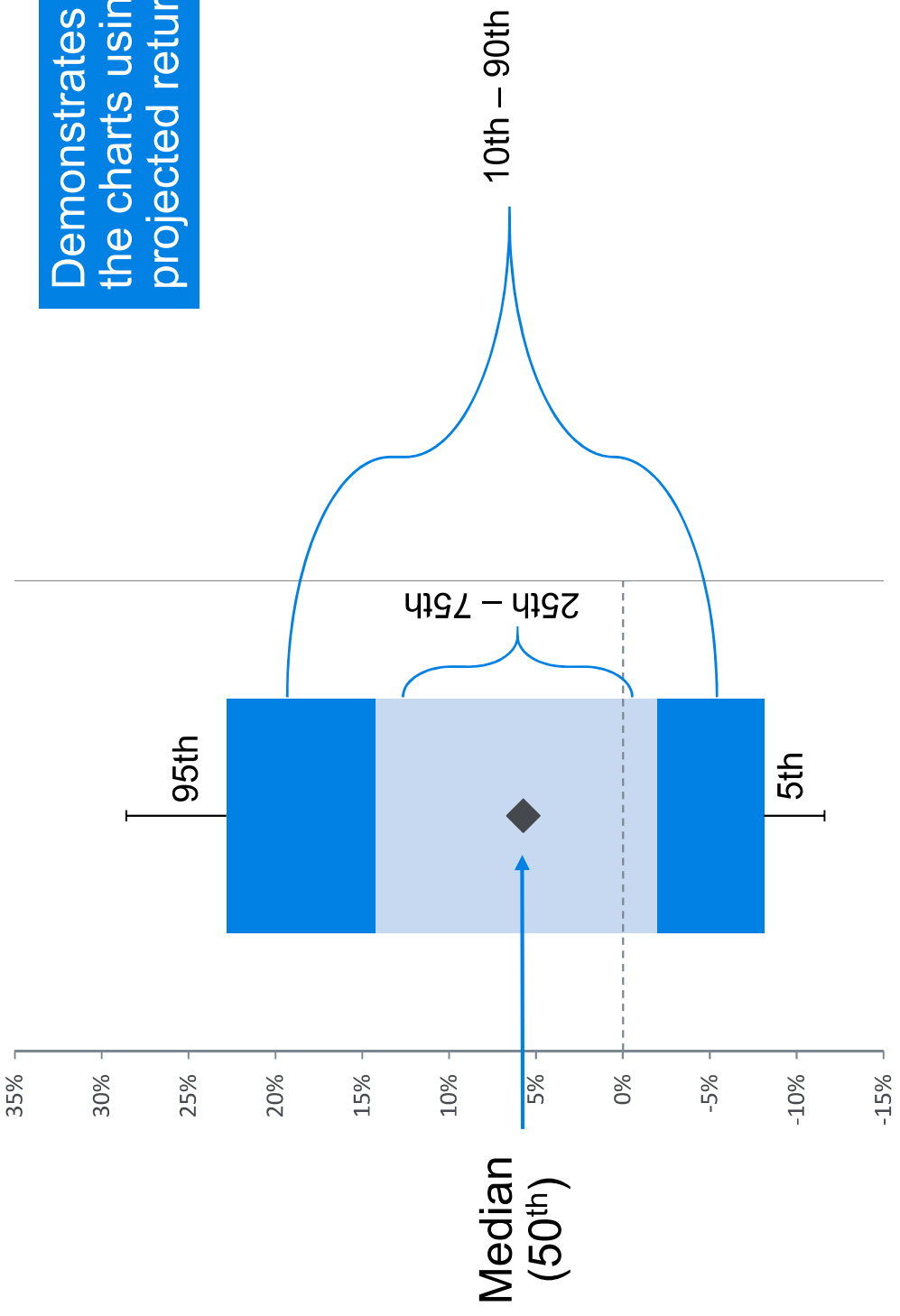
## Current Rate Setting Structure

- Model results are likelihood ranges instead of a single amount
- The range's distribution is based on a stochastic simulation using 10,000 trials
- Scenarios were developed by our national capital market specialists, and use the current OPERF target asset allocation policy; for these scenarios, the **median annualized average geometric 20-year return is 6.68%**
  - When the PERS Board last reviewed the return assumption in July 2019, the median annualized future return was 6.87% using Milliman's capital market outlook assumptions
  - In that review, the median 10-year annualized future return using outlook assumptions from Callan (the outside advisors to Oregon Investment Council) was 7.32%
  - In June 2020, the OIC lowered their expected annual policy return to 7.1%
- **Model incorporates published returns through September 2020**
- In our results charts, the dots represent median (50<sup>th</sup> percentile) outcomes
- We display model results from the 5<sup>th</sup> to 95<sup>th</sup> percentiles
  - Ten percent of model outcomes fall outside of the depicted range
- The chart format is demonstrated on the next slide

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# PERS Fund Rate of Return

## Projected 2021 Investment Returns



2021

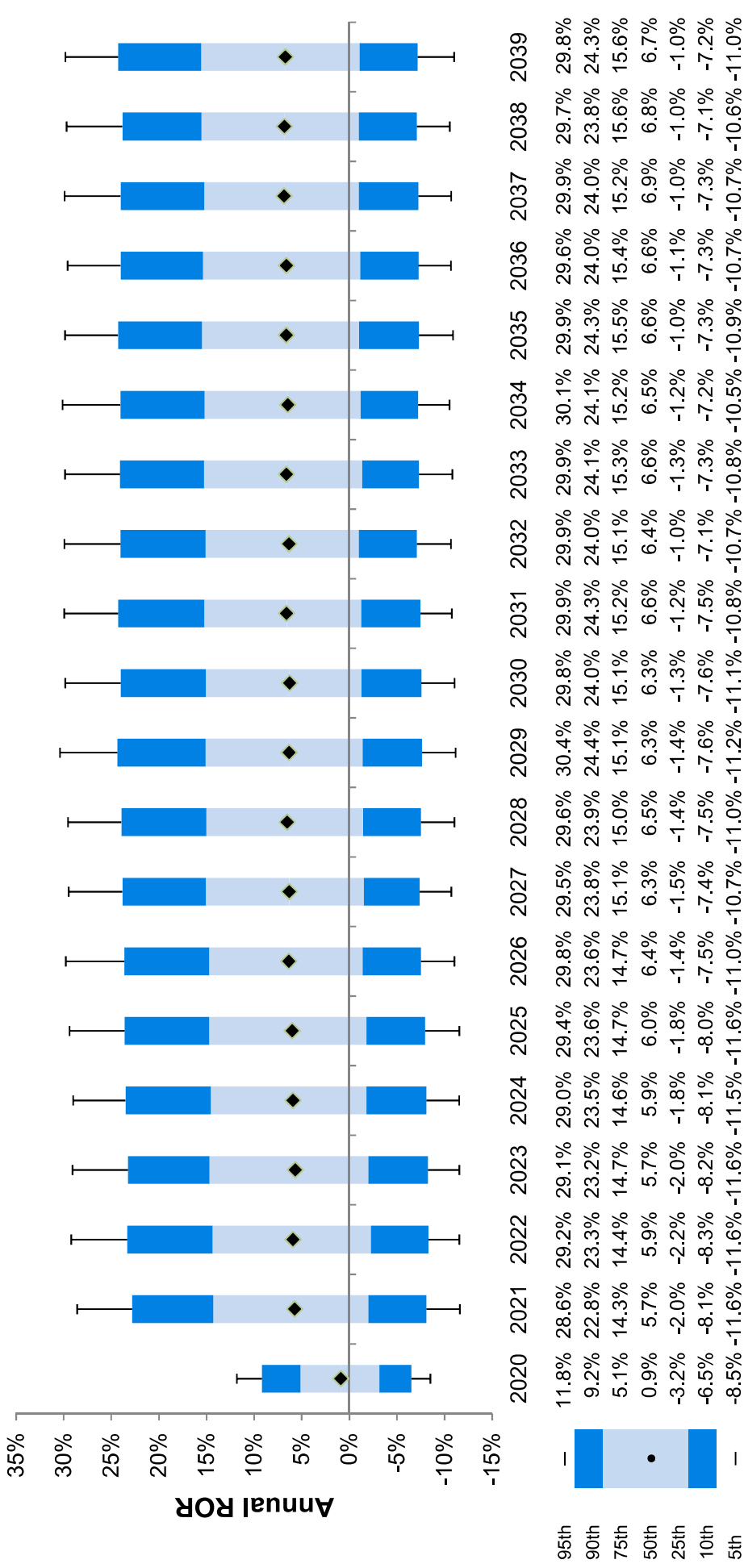
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# PERS Fund Rate of Return

## Single Calendar Year Investment Returns

Our capital market outlook model projects lower median returns in the first few years following 2020 due to current low yields on fixed income. Higher median returns are projected in the latter portion of the modeling period.

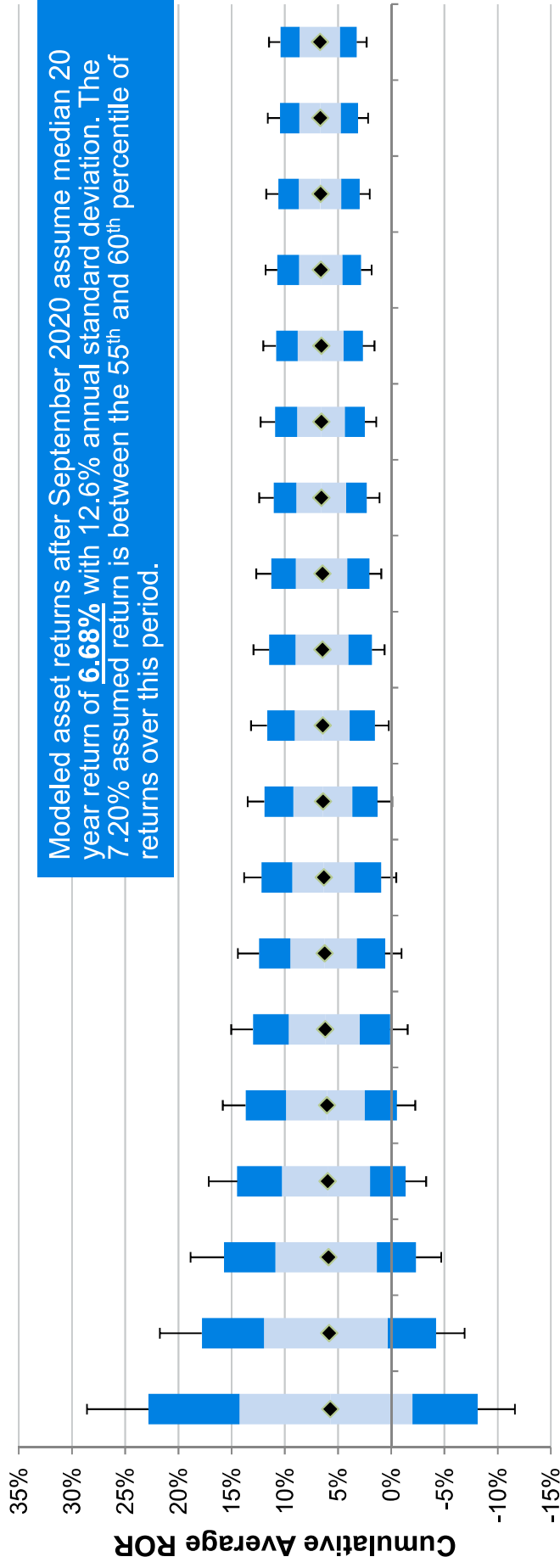


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# Average Annualized Rate of Investment Return

## Post-2020 Modeled Returns (Geometric Average)

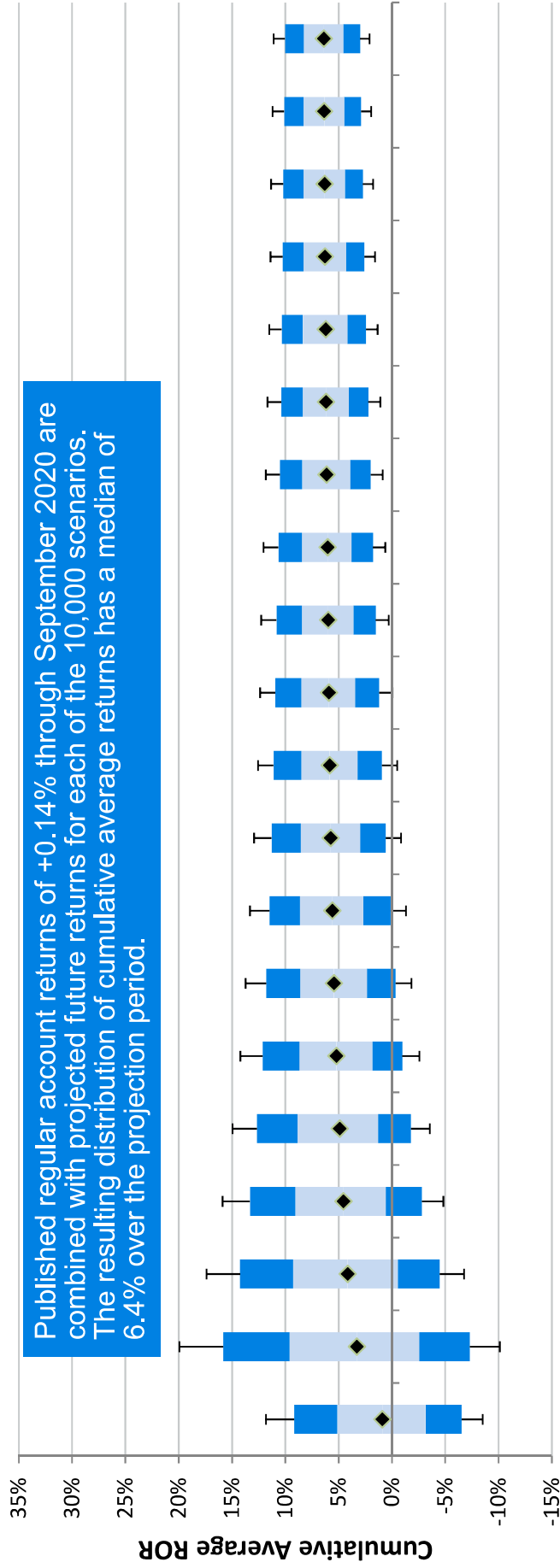


	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039
95th	28.6%	21.8%	18.9%	17.1%	15.8%	15.0%	14.4%	13.8%	13.5%	13.2%	13.0%	12.7%	12.4%	12.3%	12.0%	11.8%	11.7%	11.6%	11.5%
90th	22.8%	17.8%	15.7%	14.5%	13.7%	13.0%	12.4%	12.2%	11.9%	11.7%	11.5%	11.3%	11.0%	10.9%	10.8%	10.7%	10.6%	10.5%	10.4%
75th	14.3%	12.0%	10.9%	10.3%	9.9%	9.6%	9.5%	9.3%	9.2%	9.1%	9.0%	9.0%	8.9%	8.8%	8.8%	8.7%	8.7%	8.6%	8.6%
50th	5.7%	5.8%	5.9%	6.0%	6.0%	6.2%	6.3%	6.3%	6.4%	6.4%	6.5%	6.5%	6.6%	6.6%	6.6%	6.6%	6.7%	6.7%	6.7%
25th	-2.0%	0.3%	1.4%	2.0%	2.5%	3.0%	3.2%	3.5%	3.7%	3.9%	4.0%	4.2%	4.3%	4.4%	4.5%	4.6%	4.7%	4.8%	4.8%
10th	-8.1%	-4.2%	-2.3%	-1.3%	-0.5%	0.1%	0.6%	1.0%	1.3%	1.5%	1.8%	2.1%	2.3%	2.5%	2.7%	2.8%	3.0%	3.1%	3.2%
5th	-11.6%	-6.9%	-4.7%	-3.3%	-2.3%	-1.6%	-1.0%	-0.5%	-0.1%	0.2%	0.6%	0.9%	1.1%	1.4%	1.6%	1.8%	2.0%	2.2%	2.3%

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# Average Annualized Rate of Investment Return

## Post-2019 Modeled Returns (Geometric Average)



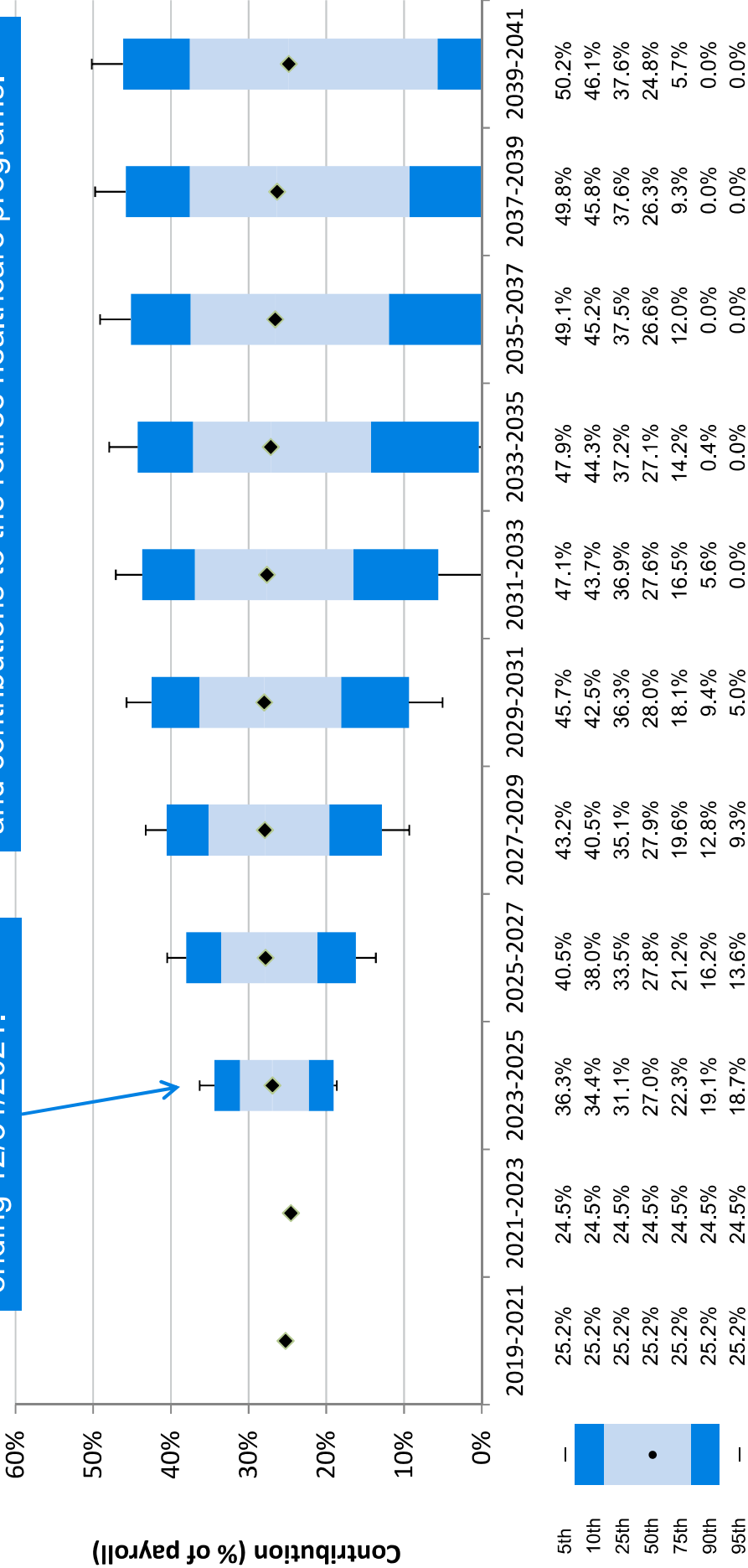
	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039
95th	11.8%	19.9%	17.4%	15.9%	15.0%	14.2%	13.7%	13.3%	12.9%	12.6%	12.4%	12.3%	12.0%	11.8%	11.7%	11.5%	11.4%	11.4%	11.2%	11.1%
90th	9.2%	15.8%	14.2%	13.3%	12.7%	12.1%	11.8%	11.5%	11.3%	11.1%	11.0%	10.8%	10.7%	10.5%	10.4%	10.3%	10.2%	10.2%	10.1%	10.0%
75th	5.1%	9.6%	9.3%	9.1%	8.9%	8.7%	8.6%	8.6%	8.6%	8.5%	8.5%	8.5%	8.5%	8.4%	8.4%	8.4%	8.3%	8.3%	8.3%	8.3%
50th	0.9%	3.3%	4.2%	4.6%	4.9%	5.2%	5.5%	5.6%	5.8%	5.8%	5.9%	6.0%	6.0%	6.1%	6.2%	6.2%	6.3%	6.3%	6.4%	6.4%
25th	-3.2%	-2.6%	-0.5%	0.6%	1.3%	1.9%	2.4%	2.7%	3.0%	3.2%	3.5%	3.6%	3.8%	3.9%	4.1%	4.2%	4.3%	4.4%	4.5%	4.6%
10th	-6.5%	-7.3%	-4.5%	-2.8%	-1.8%	-1.0%	-0.4%	0.1%	0.6%	0.9%	1.2%	1.5%	1.8%	2.0%	2.2%	2.4%	2.6%	2.7%	2.9%	3.0%
5th	-8.5%	-10.1%	-6.8%	-4.8%	-3.6%	-2.6%	-1.8%	-1.3%	-0.8%	-0.5%	-0.1%	0.3%	0.6%	0.9%	1.1%	1.4%	1.6%	1.8%	1.9%	2.1%

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# Employer Collared Base Pension Rates (System Average)

Rates for 2023-2025 are based on the modeled returns for the period ending 12/31/2021.

“Base” rates are system average Tier 1/Tier 2/OPSRP contribution rates excluding IAP contributions, the effect of side accounts & pension bond debt service, and contributions to the retiree healthcare programs.



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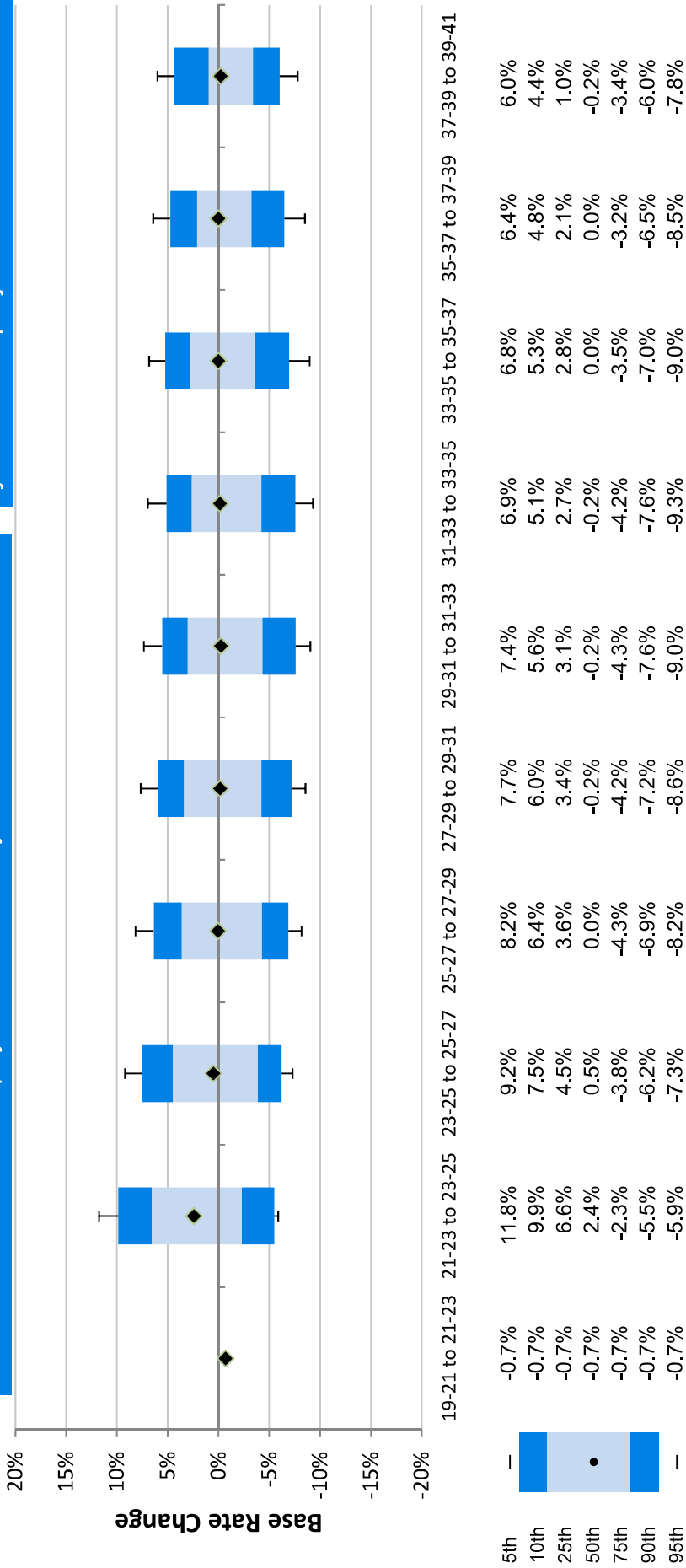


# Biennial Change in Collared Base Pension Rate

## System Average Rates

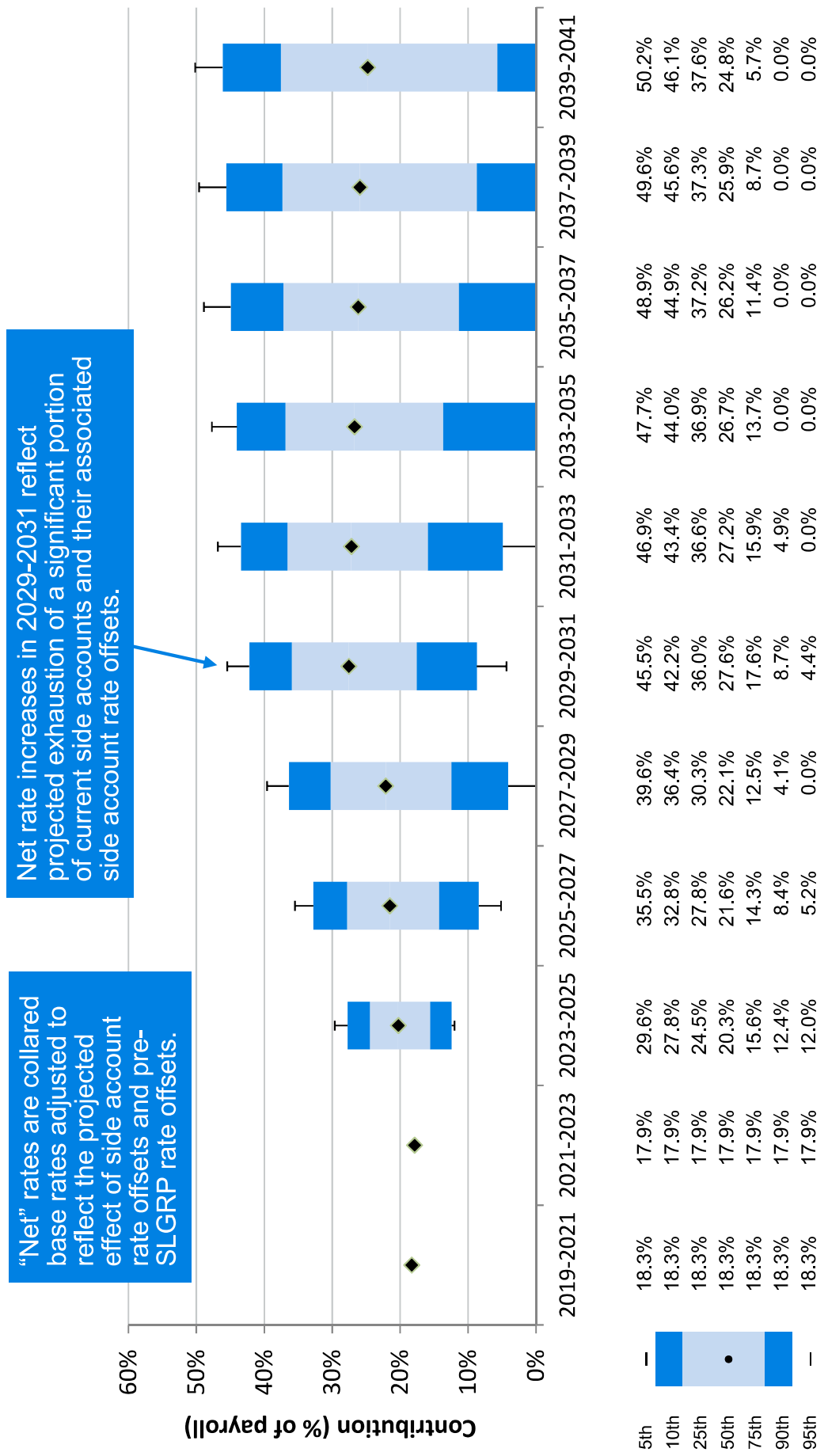
Due to the reamortization of Tier 1/ Tier 2 UAL, there is no longer a significant rate decrease at the median in later years of the projection

About 47% of modeled scenarios show base contribution rate increases above 3% of payroll effective July 2023.



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# Employer Collared Net Pension Rates (System Average)



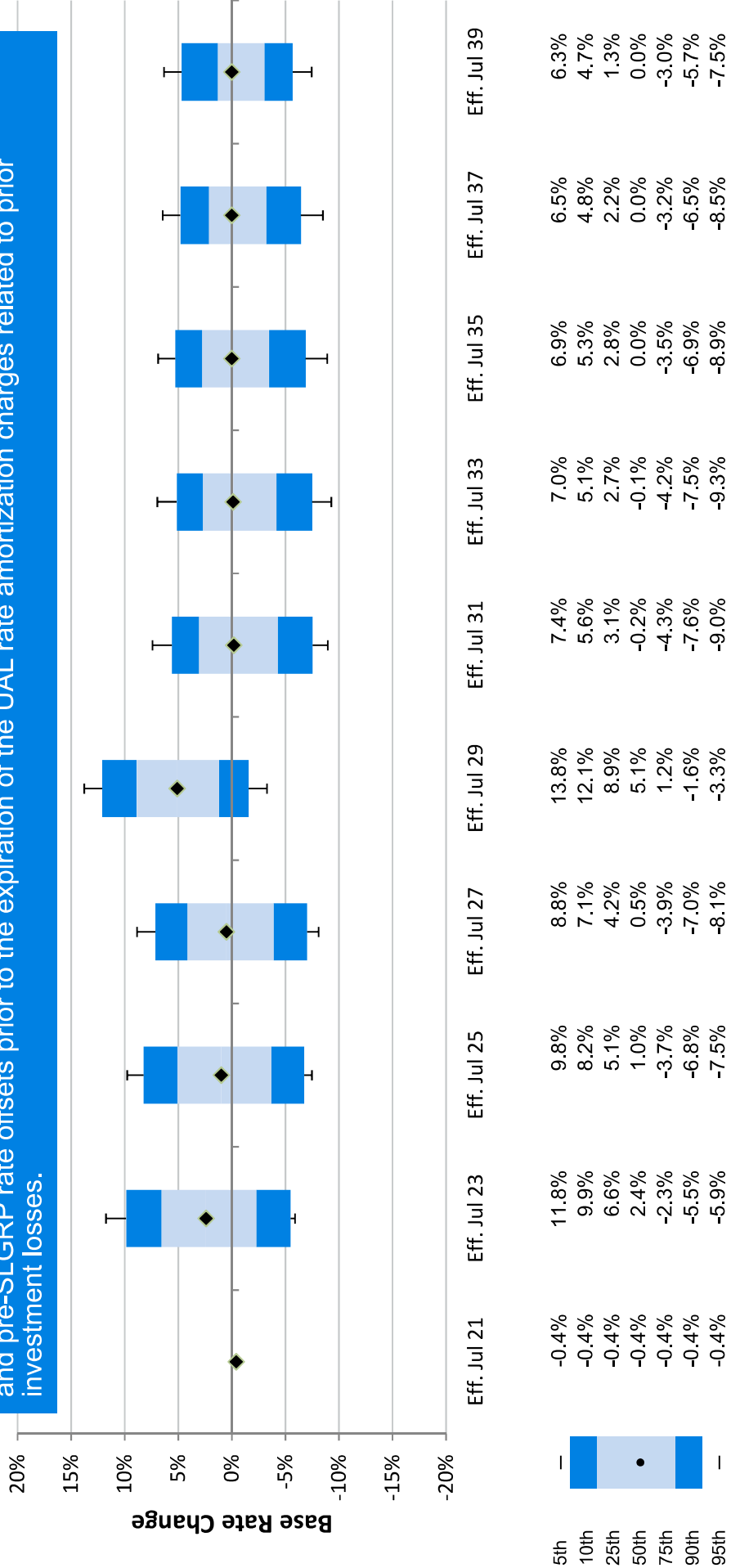
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# Biennial Change in Collared Net Pension Rate

## System Average Rates

The July 2029 increase is related to the projected exhaustion of a significant portion of current side accounts and pre-SLGRP rate offsets prior to the expiration of the UAL rate amortization charges related to prior investment losses.

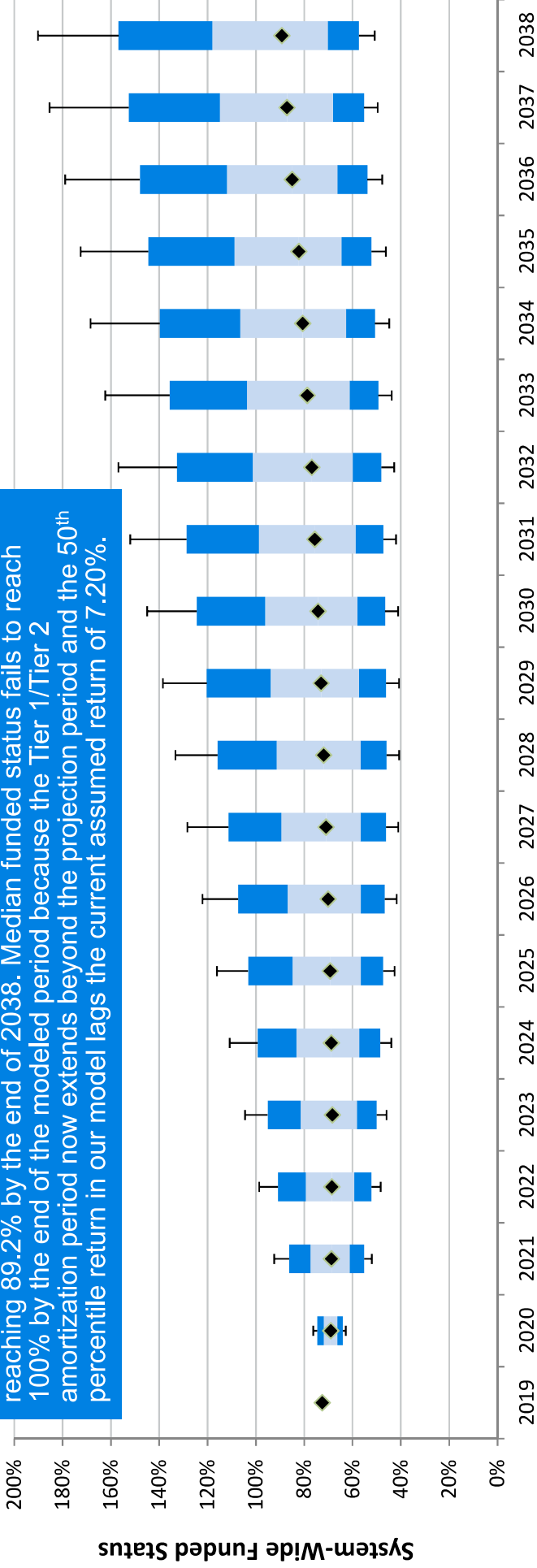


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# Funded Status (Excluding Side Accounts)

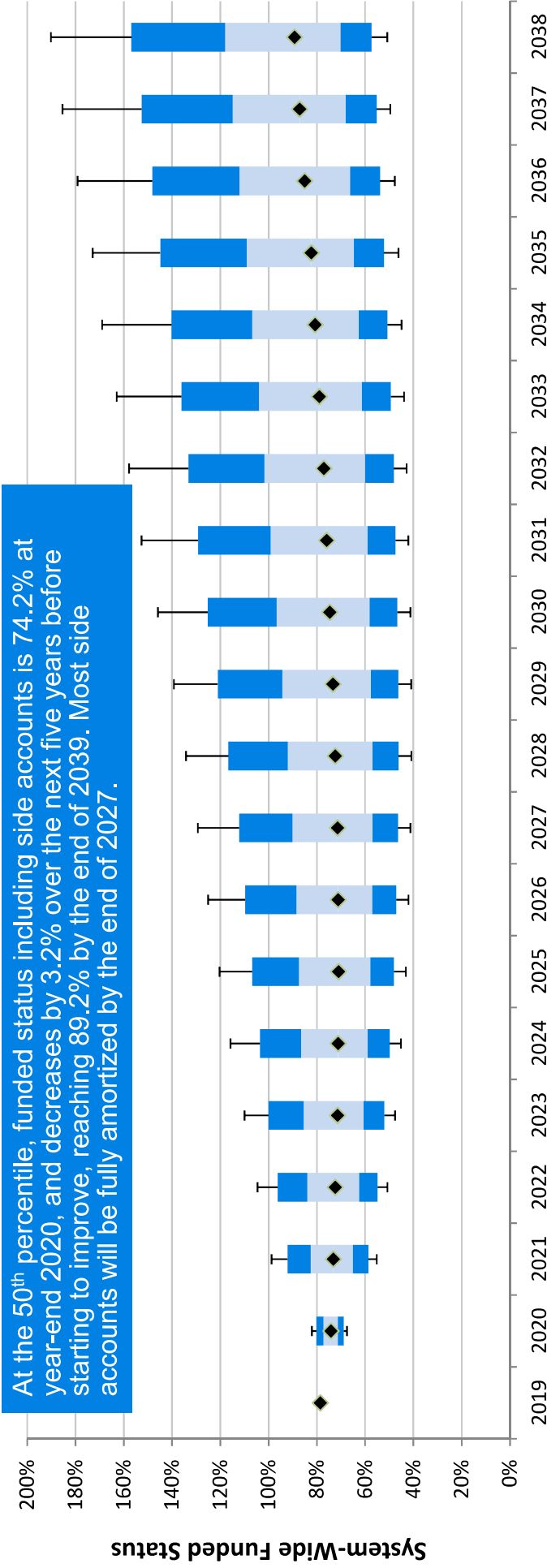
At the 50<sup>th</sup> percentile, funded status is 69.0% at year-end 2020, and decreases by 0.6% over the next three years before starting to improve, reaching 89.2% by the end of 2038. Median funded status fails to reach 100% by the end of the modeled period because the Tier 1/Tier 2 amortization period now extends beyond the projection period and the 50<sup>th</sup> percentile return in our model lags the current assumed return of 7.20%.



Year	95th	90th	75th	50th	25th	10th	5th
2019	72.5%	76.3%	82.5%	89.2%	95.5%	101.5%	108.0%
2020	72.5%	74.5%	77.3%	69.0%	81.5%	88.0%	94.5%
2021	92.5%	98.6%	104.5%	110.8%	116.1%	122.1%	128.3%
2022	86.2%	90.9%	95.1%	99.3%	103.2%	107.3%	111.3%
2023	77.3%	79.3%	81.5%	83.2%	84.8%	86.9%	89.5%
2024	68.7%	68.6%	68.4%	68.8%	69.3%	70.1%	71.0%
2025	61.2%	59.4%	58.2%	57.2%	56.7%	56.5%	56.7%
2026	55.2%	52.2%	50.1%	48.5%	47.3%	46.7%	46.1%
2027	51.9%	48.3%	45.9%	44.0%	42.6%	41.7%	41.0%
2028	62.8%	51.9%	48.3%	44.0%	42.6%	41.7%	41.0%
2029	64.1%	55.2%	50.1%	48.5%	47.3%	46.7%	45.9%
2030	66.4%	61.2%	58.2%	57.2%	56.7%	56.5%	56.7%
2031	68.7%	68.6%	68.4%	68.8%	69.3%	70.1%	71.0%
2032	69.0%	68.7%	68.4%	68.8%	69.3%	70.1%	71.0%
2033	71.9%	71.9%	71.9%	71.9%	71.9%	71.9%	71.9%
2034	72.5%	72.5%	72.5%	72.5%	72.5%	72.5%	72.5%
2035	72.5%	72.5%	72.5%	72.5%	72.5%	72.5%	72.5%
2036	72.5%	72.5%	72.5%	72.5%	72.5%	72.5%	72.5%
2037	72.5%	72.5%	72.5%	72.5%	72.5%	72.5%	72.5%
2038	72.5%	72.5%	72.5%	89.2%	95.5%	101.5%	108.0%

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# Funded Status (Including Side Accounts)

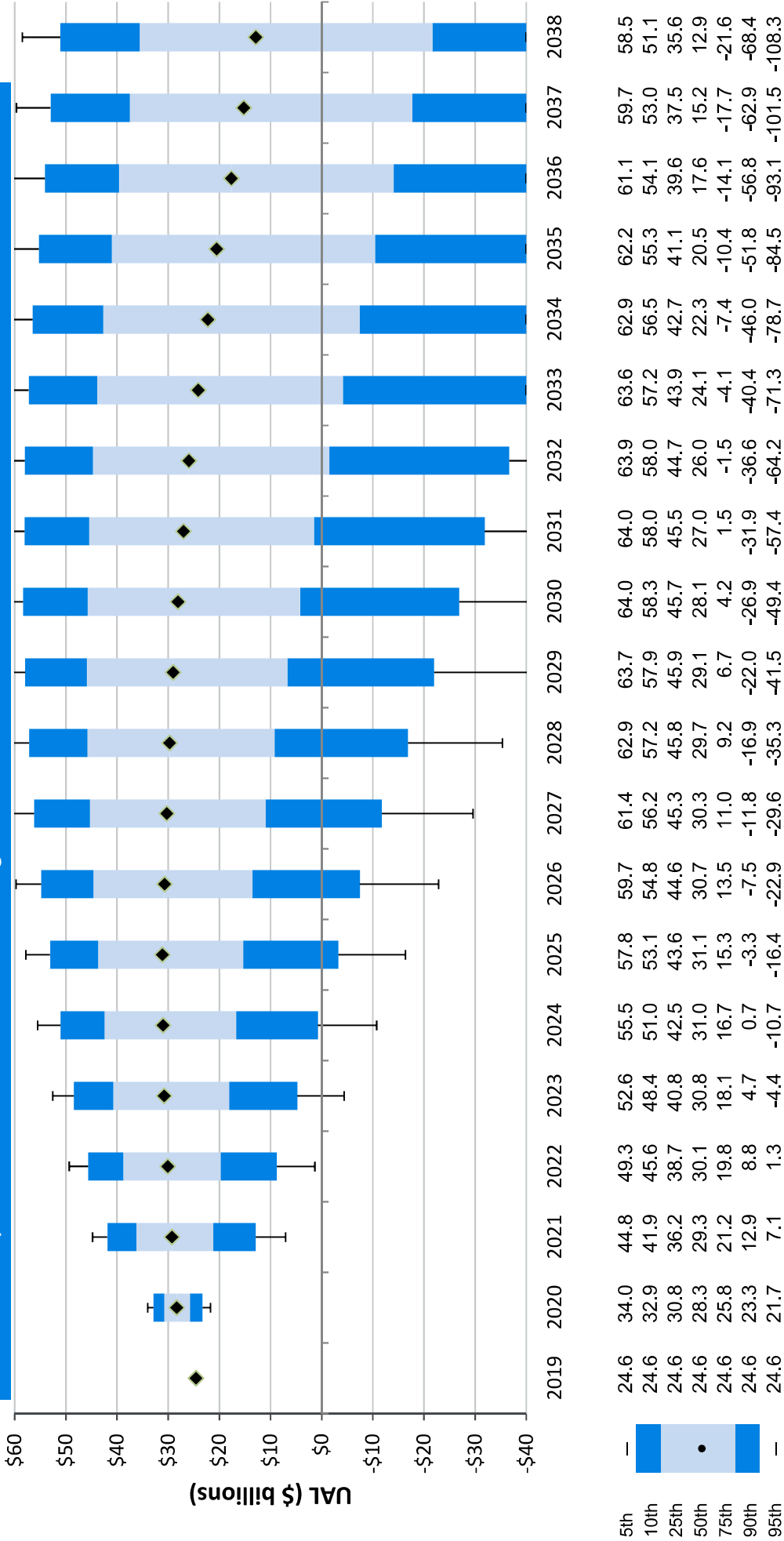


	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038
95th	78.6%	82.1%	98.8%	104.6%	110.0%	115.8%	120.3%	125.1%	129.3%	134.2%	139.3%	145.9%	152.7%	157.8%	162.9%	169.0%	172.9%	179.1%	185.3%	190.1%
90th	78.6%	80.2%	92.1%	96.3%	100.0%	103.5%	106.8%	109.7%	112.1%	116.6%	121.1%	125.2%	129.2%	133.2%	136.1%	140.2%	144.8%	148.1%	152.6%	156.8%
75th	78.6%	77.3%	82.5%	83.9%	85.5%	86.5%	87.3%	88.5%	90.1%	92.0%	94.4%	96.6%	99.1%	101.8%	104.0%	106.8%	109.1%	112.1%	114.8%	118.0%
50th	78.6%	74.2%	73.2%	72.4%	71.5%	71.2%	71.0%	71.2%	71.5%	72.4%	73.4%	74.7%	75.9%	77.1%	79.0%	80.8%	82.3%	85.1%	87.1%	89.2%
25th	78.6%	71.3%	65.2%	62.6%	60.7%	59.0%	57.9%	57.2%	57.0%	57.0%	57.6%	58.2%	59.0%	60.1%	61.4%	62.8%	64.7%	66.3%	68.2%	70.3%
10th	78.6%	68.9%	58.7%	54.9%	52.1%	49.9%	48.1%	47.0%	46.4%	46.2%	46.3%	46.7%	47.4%	48.1%	49.4%	50.8%	52.3%	53.8%	55.3%	57.3%
5th	78.6%	67.5%	55.2%	50.7%	47.6%	45.2%	43.2%	42.0%	41.3%	40.9%	41.0%	41.3%	42.1%	42.8%	43.8%	44.9%	46.2%	47.7%	49.6%	50.8%

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# UAL (Excluding Side Accounts)

At the 50<sup>th</sup> percentile, the UAL excluding side accounts is \$28.3 billion at year-end 2020, grows to \$31.1 billion at the end of 2025, then declines to \$12.9 billion by the end of 2039. Median UAL fails to reach \$0 by the end of the modeled period because the Tier 1/Tier 2 amortization period now extends beyond the projection period and the 50<sup>th</sup> percentile return in our model lags the current assumed return of 7.20%.

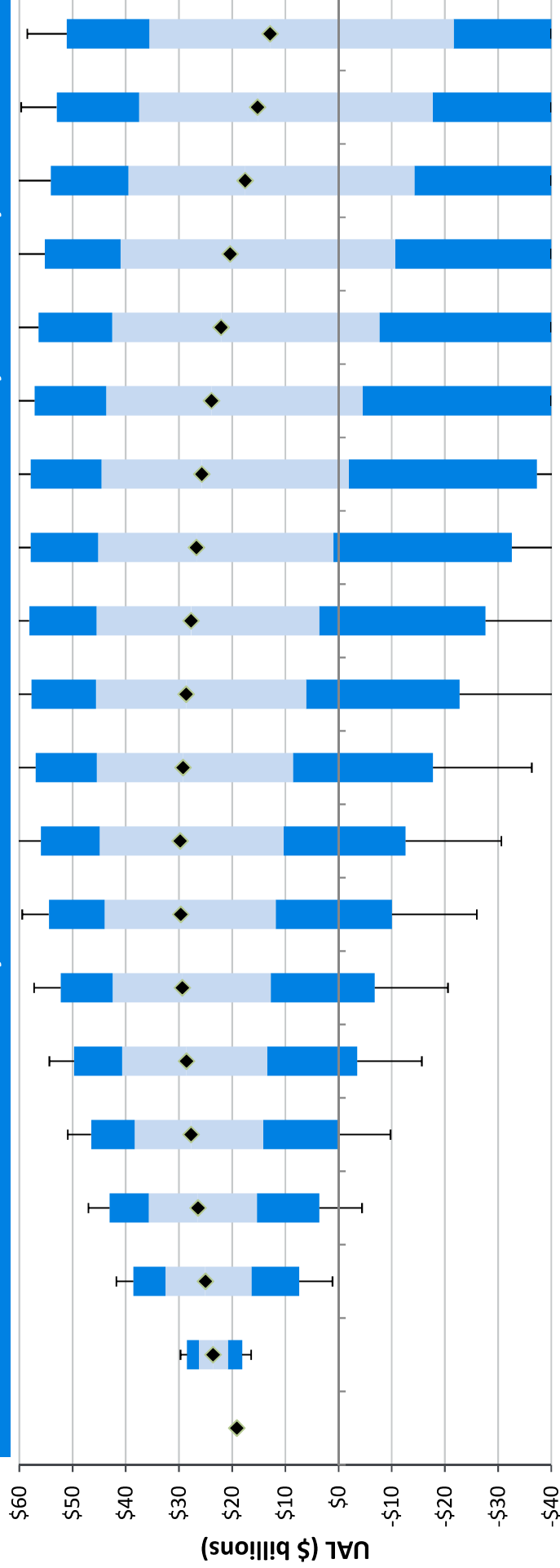


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# UAL (Including Side Accounts)

At the 50<sup>th</sup> percentile, the UAL including side accounts is \$23.6 billion at year-end 2020, grows to \$29.8 billion at the end of 2027, then declines to \$12.9 billion by the end of 2038. Most side accounts will be fully amortized by the end of 2027.



Year	5th	10th	25th	50th	75th	90th	95th
2019	19.1	19.1	19.1	19.1	19.1	19.1	19.1
2020	29.7	28.5	26.2	23.6	20.8	18.1	16.4
2021	41.7	38.6	32.5	25.0	16.4	7.4	1.1
2022	47.0	43.1	35.7	26.4	15.4	3.6	-4.4
2023	50.9	46.5	38.3	27.7	14.2	0.0	-9.8
2024	54.4	49.7	40.7	28.6	13.4	-3.5	-15.7
2025	57.2	52.2	42.4	29.3	12.8	-6.8	-20.5
2026	59.5	54.4	44.0	29.6	11.8	-10.0	-26.0
2027	61.2	55.9	44.9	29.8	10.3	-12.6	-30.6
2028	62.7	56.9	45.4	29.2	8.6	-17.7	-36.3
2029	63.5	57.7	45.6	28.6	6.1	-22.8	-42.5
2030	63.8	58.1	45.5	27.7	3.6	-27.6	-50.3
2031	63.9	57.9	45.2	26.7	1.0	-32.6	-58.3
2032	63.8	57.9	44.5	25.7	-1.9	-37.3	-65.0
2033	63.5	57.1	43.7	23.9	-4.5	-41.0	-72.0
2034	62.8	56.4	42.6	22.1	-7.7	-46.4	-79.4
2035	62.2	55.2	41.0	20.4	-10.7	-52.1	-85.0
2036	61.1	54.1	39.5	17.6	-14.3	-56.9	-93.3
2037	59.7	53.0	37.5	15.2	-17.7	-62.9	-101.5
2038	58.5	51.1	35.6	12.9	-21.6	-68.4	-108.3

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# Variable Return Model Stress Test

## Current Rate Setting Structure

- As in recent years, we also used the variable return model to do a “stress test” of the likelihood of certain events in the 10,000 scenarios modeled
- Before any changes to assumptions or methods adopted after the upcoming Experience Study, median funded status excluding side accounts at year-end 2020 is 69.0%
- The likelihood of specified events occurring at some point during the 20-year projection period is shown below

Likelihood of Event Occurring at Some Point in Next 20 Years	
Funded Status (Excluding Side Accounts) > 100%	57%
Funded Status (Excluding Side Accounts) < 60%	64%
Funded Status (Excluding Side Accounts) < 40%	12%

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# Variable Return Model Stress Test

## Current Rate Setting Structure

- The likelihood of specified events occurring at some point during the 20 year projection period is shown below

Likelihood of Event Occurring at Some Point in Next 20 Years	
Base Rate (Excluding Retiree Healthcare) < 10% of Pay	33%
Base Rate (Excluding Retiree Healthcare) > 30% of Pay	69%
Base Rate (Excluding Retiree Healthcare) > 40% of Pay	33%

- The system-average employer base rate for the 2021-2023 biennium is about 24.5%, per the December 31, 2019 valuation

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# Variable Return Model Stress Test

## Current Rate Setting Structure

- As shown earlier, half of modeled scenarios show an increase in the collared rate above 2.4% of payroll at July 2023
- Table shows likelihood in the model of a collared rate increase exceeding a selected threshold at the July 2023 rate change

Likelihood of the July 2023 Collared Rate Increase Exceeding Threshold		
<u>Threshold Increase</u>	<u>Base Rate</u>	<u>Net Rate</u>
3% of Pay	47%	47%
4% of Pay	40%	40%
5% of Pay	34%	34%
6% of Pay	28%	28%

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# Alternative Collar Policies

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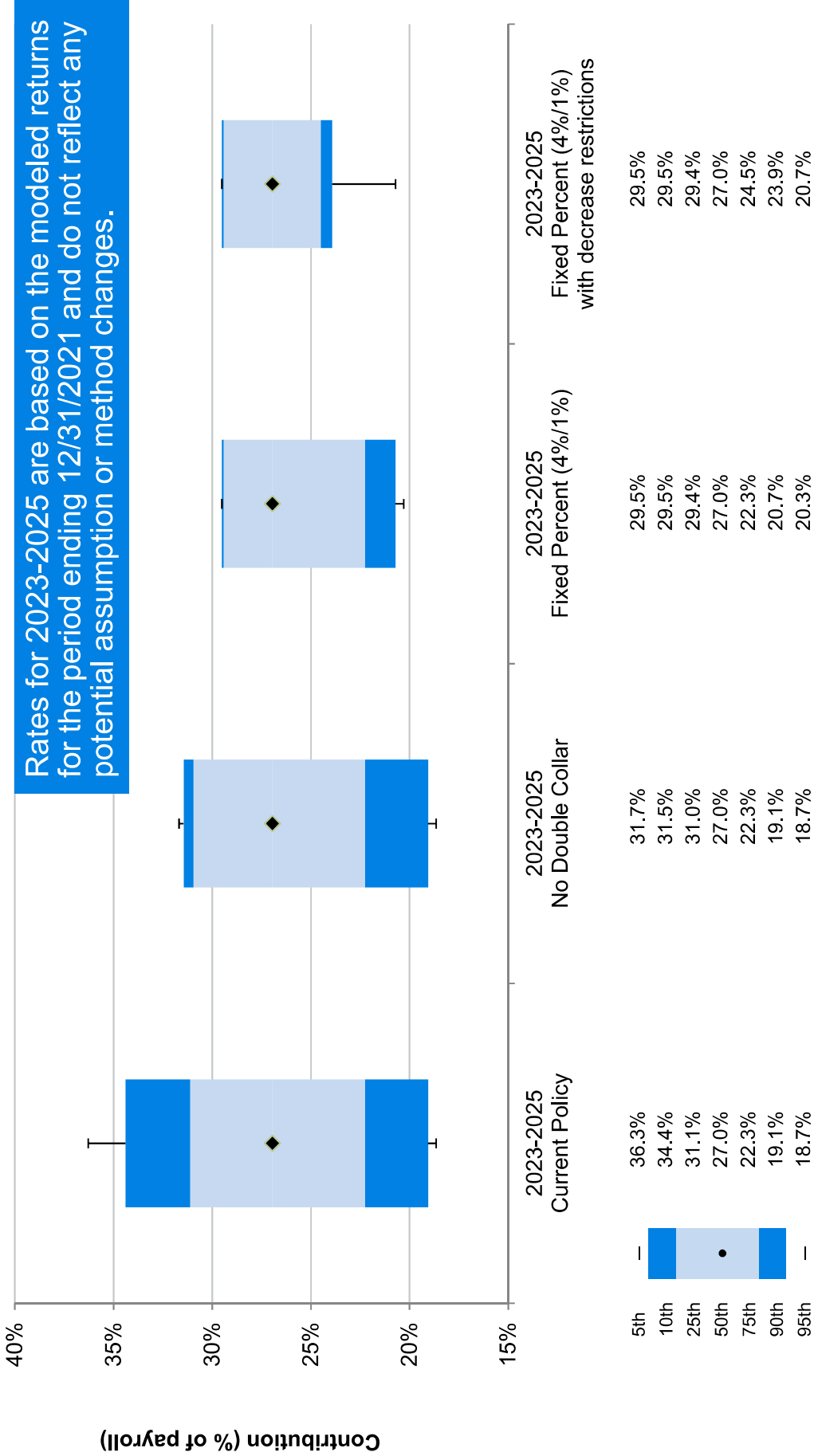
## Collar Alternatives Modeled

- Current Policy
  - Single collar is greater of 3% of pay or 20% of current rate
  - Rate collar widens gradually to double collar based on funded status thresholds
- No double collar
  - Same as current policy, except only “single collar” is used
- Fixed percent (4%/1%)
  - Rate collar defined as a fixed percent of payroll (4% for Tier 1/Tier 2, 1% for OPSRP), rather than as a percentage of the current rate
- Fixed percent (4%/1%) with decrease restrictions
  - Rate collar defined as a fixed percent of payroll (4% for Tier 1/Tier 2, 1% for OPSRP), AND rates are not allowed to decrease unless funded status (excluding side accounts) is greater than 90%

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# Employer Collared Base Pension Rates (System Average)

## 2023-2025 Biennium under different collar policies

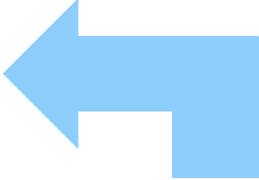


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# 12/31/2038 Funded Status (Excluding Side Accounts)

Under different collar policies, at end of modeled period

12/31/2038 Funded Status (excluding side accounts)			
	Collar Method:	Current	Fixed Percent (4%/1%) w/ decrease restrictions
75 <sup>th</sup> Percentile	No Double Collar	118%	127%
50 <sup>th</sup> Percentile		89%	93%
25 <sup>th</sup> Percentile		70%	70%



*In scenarios near the 50<sup>th</sup> and 75<sup>th</sup> percentiles, biennial investment returns frequently are near or above assumption. In some of those scenarios, the first three policies allow a decrease in the subsequent contribution rate while the fourth policy does not allow a decrease until the funded status threshold is satisfied.*

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# Variable Return Model Stress Test

- Can use the “stress test” results to illustrate the effect of alternative collar policies:

Likelihood of Event Occurring at Some Point in Next 20 Years			
Collar Method:	Current	No Double Collar	Fixed Percent (4%/1%) w/ decrease restrictions
Funded Status (Excluding Side Accounts) > 100%	57%	56%	58%
Funded Status (Excluding Side Accounts) < 60%	64%	64%	61%
Funded Status (Excluding Side Accounts) < 40%	12%	13%	14%

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# Variable Return Model Stress Test

- Can use the “stress test” results to illustrate the effect of alternative collar policies:

Likelihood of Event Occurring at Some Point in Next 20 Years				
	Collar Method:	Current	No Double Collar	Fixed Percent (4%/1%) w/ decrease restrictions
Base Rate (Excluding Retiree Healthcare) < 10% of Pay		33%	32%	30%
Base Rate (Excluding Retiree Healthcare) > 30% of Pay		69%	67%	60%
Base Rate (Excluding Retiree Healthcare) > 40% of Pay		33%	32%	25%

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## Wrap Up / Next Steps

- At the February 1, 2021 meeting, preliminary year-end 2020 investment results will be available
  - We can then comment as warranted on estimated impact on the 12/31/2020 actuarial valuation results, which will develop advisory 2023 – 2025 contribution rates
- The biennial experience study review of actuarial methods and assumptions will occur next year, with Board decisions anticipated at the July 23, 2021 meeting



# Appendix

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# Certification

This presentation summarizes deterministic and stochastic modeling for the Oregon Public Employees Retirement System (“PERS” or “the System”) over a 20 year period beginning December 31, 2019 under a wide range of potential economic scenarios. The results are based upon the same assumptions, methods, and plan provisions as described in the December 31, 2019 System-Wide Actuarial Valuation Report, except where noted otherwise.

In preparing this report, we relied, without audit, on information (some oral and some in writing) supplied by the System’s staff. 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 valuation 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.

All costs, liabilities, rates of interest, and other factors for the System have been determined on the basis of actuarial assumptions and methods which are individually reasonable (taking into account the experience of the System and reasonable expectations); and which, in combination, offer our best 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. The PERS Board has the final decision regarding the appropriateness of the assumptions.

Actuarial computations presented in this report are for purposes of determining the recommended funding amounts for the System. The computations prepared for other purposes may differ as disclosed in our report. The calculations in the enclosed report have been made on a basis consistent with our understanding of the System’s funding requirements and goals.

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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 this 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

## Actuarial Basis

### Data

We have based our calculation of the liabilities on the data supplied by the Oregon Public Employees Retirement System and summarized in the Valuation Report.

Assets as of December 31, 2019, were based on values provided by Oregon PERS reflecting the Board's earnings crediting decisions for 2019, as shown in the Valuation Report. Financial model projections reflect September 30, 2020 investment results for regular and variable accounts as published by Oregon State Treasury.

### Methods / Policies

*Actuarial Cost Method:* Entry Age Normal, adopted effective December 31, 2012.

*UAL Amortization:* The UAL for OPSRP and Retiree Health Care as of December 31, 2007 are amortized as a level percentage of combined valuation payroll over a closed 16 year period for OPSRP and a closed 10 year period for Retiree Health Care. For the Tier 1/Tier 2 UAL, the amortization period was reset at 20 years as of December 31, 2013, and was reset at 22 years as of December 31, 2019, as required by Senate Bill 1049. Gains and losses between subsequent odd-year valuations are amortized as a level percentage of combined valuation payroll over the amortization period (20 years for Tier/Tier 1, 16 years for OPSRP, 10 years for Retiree Health Care) from the odd-year valuation in which they are first recognized.

*Contribution rate stabilization method:* Contribution rates for a rate pool (e.g. Tier 1/Tier 2 SLGRP, Tier 1/Tier 2 School Districts, OPSRP) are confined to a collar based on the prior contribution rate (prior to application of side accounts, pre-SLGRP liabilities, and 6 percent Independent Employer minimum). The new contribution rate will generally not increase or decrease from the prior contribution rate by more than the greater of 3 percentage points or 20 percent of the prior contribution rate. If the funded percentage excluding side accounts drops below 60% or increases above 140%, the size of the collar doubles. If the funded percentage excluding side accounts is between 60% and 70% or between 130% and 140%, the size of the rate collar is increased on a graded scale.

# Appendix

## Actuarial Basis

### Methods / Policies (cont'd)

*Expenses:* Annual administration expenses are assumed to be \$32.5M for Tier 1/Tier 2 and \$8.0M for OPSRP, as described in the 2018 Experience Study Report, and are added to the corresponding normal cost for the year in which they are incurred. Administration expenses for each year after 2020 are assumed to increase with inflation, which varies by scenario based on capital market assumptions.

*Actuarial Value of Assets:* Equal to Market Value of Assets excluding Contingency and Tier 1 Rate Guarantee Reserves. The Tier 1 Rate Guarantee Reserve is not excluded from assets if it is negative (i.e. in deficit status).

### Assumptions

Assumptions for valuation calculations are as described in the 2018 Experience Study Report.

### Provisions

Provisions valued are as detailed in the December 31, 2019 System-Wide Actuarial Valuation Report.

# Appendix

## Rate Projection Basis

### Assumptions

In general, all assumptions are as described in the 2018 Experience Study Report.

The major actuarial valuation assumptions used in our projections are shown below. They are aggregate average assumptions that apply to the whole population and were held constant throughout the projection period. The economic experience adjustments were allowed to vary in future years given the conditions defined in each economic scenario.

- Valuation interest rate – 7.20%
- Tier 1 Regular account growth – 7.20%
- Actual fund investment return – Varies by scenario according to capital market assumptions
- Variable account growth – Equal to investment return on public equity portion of the fund
- Inflation assumption – 2.50%
- Inflation experience – Varies by scenario according to capital market assumptions
- Wage growth assumption – 3.50%
- Wage growth experience – 1.00% greater than inflation experience
- Demographic experience – as described in 2018 Experience Study Report
- New entrant experience – New members are assumed to be hired at the rate necessary to keep the total number of members in each job class (General Service, School District, Police & Fire, and Judges) constant over the duration of the projection. All new entrants other than judges are assumed to join as OPSRP members. New entrant pay is assumed to grow at the rate necessary for overall system payroll to increase with wage growth experience, as described above.

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# Appendix

## Rate Projection Basis

### Reserve Projection

Contingency Reserve as of 12/31/2019 was \$50.0M. No future increases or decreases to this reserve were assumed.

The Tier 1 Rate Guarantee Reserve (“RGR”) was \$492.0 M as of 12/31/2019. The RGR was assumed to grow with excess returns above the 7.20% target growth on Tier 1 Member Accounts. When modeled aggregate returns were below 7.20%, applicable amounts from the RGR were assumed to transfer to Tier 1 Member Accounts to maintain the 7.20% target growth rate. The RGR is allowed to be negative, but the reserve is not excluded from valuation assets when it is negative. We did not include in rates any potential additional employer levy that could be required to eliminate a persistent negative RGR.

### Offset for Member Redirect Contributions

Under Senate Bill 1049, a portion of the 6% of pay member contribution previously made to the IAP was redirected to fund Tier 1/Tier 2 and OPSRP defined benefits beginning July 1, 2020. For Tier 1/Tier 2 members, the redirected amount will be 2.50% of pay, and for OPSRP it will be 0.75% of pay. Members with less than \$2,500 in monthly pay (indexed in future years) will be exempt from the redirection.

For the rate projection, member redirect contributions are assumed to offset the contribution rates paid by employers beginning with the July 2021 – June 2023 biennium. The offset is assumed to be 2.45% of total payroll for Tier 1/Tier 2 and 0.70% of total payroll for OPSRP.

Redirected member contributions are assumed to cease in a biennium following a rate-setting valuation where the funded status, including side accounts, is 90% or greater.

### Work After Retirement Contributions

Under Senate Bill 1049, starting in 2020 and ending December 31, 2024, employers are required to pay PERS contribution rates on rehired retiree payroll. For 2020, rehired retiree payroll was assumed to be approximately \$179.0 for Tier 1/Tier 2 members and \$4.3 million for OPSRP members. After 2020, rehired retiree payroll was assumed to increase with the wage growth assumption.

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# Appendix

## Rate Projection Basis

### Capital Market Model

For each 20-year projection, we ran 10,000 stochastic scenarios for inflation and asset class rates of return. The scenarios were calibrated to represent Milliman's capital market assumptions in terms of expected average real returns, the expected year-to-year volatility of the returns, and the expected correlation between the returns of different asset classes. Annual rates of return for each of the asset classes and inflation are generated from a multivariate lognormal probability distribution. Rates of return are independent from year to year.

The variable return model includes 10,000 projected scenarios for possible future year-by-year system investment returns and levels of inflation. In developing that model, per Actuarial Standards of Practice we disclose reliance upon a Milliman colleague who is a credentialed actuary and also a credentialed investment professional with expertise in preparing capital outlook modeling. We reviewed overall model results for reasonability while, as part of his work, our investment professional colleague reviewed the investment projections for internal consistency.

For this purpose, we considered the Oregon PERS Fund to be allocated among the model's asset classes as shown on the following slide. This allocation is based on the OIC's Statement of Investment Objectives and Policy Framework for the Oregon PERS Fund, as revised in April 2019.

# Appendix

## Rate Projection Basis

### Capital Market Model

Reflects Milliman's capital market assumptions as of July 1, 2020.

	Annual Arithmetic Mean	20-Year Annualized Geometric Mean	Annual Standard Deviation	Policy Allocation
US Large/Mid-Cap Equity	7.18%	5.99%	16.45%	16.17%
US Small Cap Equity	8.60%	6.69%	21.15%	1.35%
US Micro-Cap Equity	9.24%	6.89%	23.60%	1.35%
Non-US Developed Equity	8.80%	7.34%	18.45%	13.48%
Emerging Markets Equity	10.81%	8.14%	25.40%	4.24%
Non-US Small Cap Equity	9.44%	7.74%	20.00%	1.93%
Private Equity	11.92%	8.29%	30.00%	17.50%
US Core Fixed Income	3.05%	2.99%	3.85%	9.60%
US Short-Term Bonds	2.58%	2.56%	2.05%	9.60%
US Bank/Leveraged Loans	5.20%	4.95%	7.40%	3.60%
High Yield Bonds	6.20%	5.78%	9.70%	1.20%
Real Estate	6.33%	5.69%	12.00%	10.00%
Global REITs	8.52%	6.84%	19.75%	2.50%
Timber	6.54%	5.79%	13.00%	1.13%
Farmland	6.99%	6.24%	13.00%	1.13%
Infrastructure	7.77%	6.79%	15.00%	2.25%
Commodities	5.37%	3.79%	18.85%	1.13%
Hedge Fund of Funds - Diversified	4.42%	4.19%	7.10%	1.50%
Hedge Fund Event-Driven	5.98%	5.64%	8.70%	0.38%
US Inflation (CPI-U)	2.50%	2.49%	1.65%	N/A
<b>Fund Total (reflecting asset class correlations)</b>	<b>7.44%</b>	<b>6.74%*</b>	<b>12.64%</b>	<b>100.00%</b>

\* The model's 20-year annualized geometric median is **6.68%**.

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