

May 2015



# Asset/Liability Study

## KERS Hazardous Pension Plan





## Memorandum

To	Kentucky Employees Retirement System
From	RVK, Inc.
Subject	KERS-HPP Asset/Liability Study – Executive Summary
Date	May 5, 2015

### Introduction

The purpose of this memorandum is to summarize the key inferences we draw from the Asset/Liability (“A/L”) study of the KERS Hazardous Pension Plan (“KERS-HPP” or the “Plan”). While this memorandum refers directly to points raised within the study, we emphasize that a full understanding of the A/L study and its implications requires a close review of the study in its entirety.

### Background and Key Conclusions

As of the fiscal year beginning June 30, 2014, the date of the most recent actuarial valuation and the start date of the projections in this study, the Plan was 68% funded (on a market value basis) meaning that assets were available to cover 68% of Plan liabilities as currently estimated by the Plan’s actuary. This equates to a shortfall of approximately \$257 million. This is a significant concern for the future of the Plan’s financial health, however, this study shows that the Plan remains solvent and while the Plan’s funding ratio will fluctuate during this period, the study suggests the potential for reducing the funding gap over the next 20 years.

As highlighted below, this study suggests that continued diversification in the investment of Plan assets is desirable. The study, however, suggests caution in assuming that increased pursuit of higher expected returns, through even more aggressive (and hence even more volatile) asset allocations, is always beneficial. High expected return and high expected risk approaches bring with them increased risk of large declines in the value of the Plan and increased volatility in required contributions.

### The Purpose of an Asset Liability Study

The central purpose of an A/L study is to examine the probable future consequences, over extended periods of time, of applying alternative asset allocation strategies to the Plan’s investment assets in order to fund the liabilities created by the benefit provisions of the Plan. A/L studies are unique in their ability to combine in a single analysis the three critical factors that drive the financial health of the Plan—benefit policy (liabilities), contribution policy, and investment strategy (asset allocation). Certainly this type of forward looking study—nor any others we are aware of—cannot indicate with any reliability what will happen in any given year over this extended period of time and its insights are dependent on the assumptions used. However, we have high conviction that the study’s results paint a highly reliable view of the core long-term trends in the Plan’s financial health. Best practice, in our judgment, is to take the

general direction suggested as most appropriate by this study with its unique consideration of liabilities, contribution policy and trending liquidity needs and refine it in an asset allocation study where implementing the Plan's structure can reflect the pragmatic considerations of investing in the capital markets present at any given point in time.

### **Deterministic versus Stochastic**

In this study, we examined a series of related questions associated with this central purpose, projecting future outcomes under two distinctly different methodologies:

1. a **deterministic** basis (all underlying assumptions, liabilities, contributions and most critically investment returns, are achieved precisely and without variance in each and every year); and
2. a **stochastic** basis (outcomes for investment returns vary each year according to estimated volatility with contribution *requirements* following suit while *actual* contribution policy and liabilities remains in their current form).

### **Key Results**

Below you will find a series of important findings, forecasts, and conclusions drawn from the body of the study. While the remarks are presented here to allow a quick assessment of some of the key findings, they represent only a sampling of the fundamental elements of the study. We emphasize that a solid understanding of each element requires that they be reviewed as they are presented in the study itself within their surrounding context (please note the frequent page references to the full study). This is especially important to understanding the findings which represent *probable, but not certain*, outcomes as analyzed in the stochastic section of the study.

#### *At the Outset:*

- As of June 30, 2014 (the date of the actuarial valuation used to model liabilities), the Plan's market value funded ratio (available assets to fund benefit obligations) was 68% (page 6).
- The number of active members is currently approximately equal to the number of inactive members. Over time, the inactive population is projected to grow and begin to quickly outnumber the active member population (page 8). The maturing demographics of the Plan is an important factor when considering the findings on Plan risk/return options and the projected status of Plan liquidity below.

*Deterministic Analysis: A deterministic analysis assumes full certainty about the future, in particular, certainty of investment returns. Its virtues are that it is simple and that the findings reflect what will happen if the future turns out to be precisely as forecasted—no better, but also no worse.*

- Benefit payments to Plan participants are expected to increase by about 73% over the next 20 years (page 9). Annual increases are projected to range between 1% and 4%.
- Total annual dollar contributions (employer and employee) based on actuarially required rates are expected to more than double over the next 20 years; from \$31 million in 2014 to \$70 million in 2034 (page 10). *Please note however*, that precise actuarially required rates as they unfold are the purview of the Plan's actuary and are affected by factors other than investment returns and resulting asset values of the Plan.
- Beginning in 2016, contributions expressed as a weighted average percentage of salary are projected to gradually decline (page 11).
- Aggregate benefit payments are expected to increase by about 73% over the next 20 years but actually slightly decrease as a percentage of Plan assets over this same time period (pages 9 and 12). Not only do benefit payments as a percentage of Plan assets decline, they are also healthy and sustainable on an absolute basis during this period. This is an important and positive indication, because increased payout ratios, if they rise sufficiently high, can potentially impose liquidity constraints on the management of the portfolio (inhibiting the ability of the Plan to invest with a long-term horizon) therefore limiting the opportunity to invest in less liquid asset classes regardless of the return or risk reducing diversification benefits they offer. The payout ratio is projected to decline from current levels near 10% to about 9% at the end of the projection period. These levels do not, in our opinion, materially inhibit investment opportunities for the Plan (page 12).
- As assets grow each and every year without exception at the assumed rate of return (7.50%), the funding ratio on a market value basis is expected to gradually increase to approximately 81% by 2034 from the current value of 68% (page 17).
- Assuming the current contribution policy remains unchanged, the Plan would need to experience annual returns in excess of 11% over the next 10 years or 9% over the next 20 years *without exception in each and every year* in order to reach full funding (page 18). Achieving such lofty returns on such a sustained basis is extremely unlikely in our judgment and underscores our conclusion that investment returns alone cannot move the Plan to full funding.
- Experiencing a return of 100 basis points below the Plan's current assumed rate of return of 7.50% (i.e., 6.50%) each year for the 20 year projection period would result in a moderate decline in the projected funding ratio to 71% in year 20 versus 81% at the current assumed rate of return (page 19). Additionally, under this scenario cumulative employer contributions would be \$104 million higher over the 20 year period. Given the widely shared concerns about the prospects for a low return environment in the capital markets over the foreseeable future, this is a conclusion that should be thoroughly understood and appreciated. In the event that capital markets do not support returns



commensurate with the assumed rate of return, reliance on contributions to complete the payout of the Plan’s liabilities effectively increases, especially in later years.

*Stochastic Analysis: Unlike a deterministic analysis, a stochastic analysis does not assume an unvarying stream of expected investment returns year after year. Instead, it reflects the realistic view that pension plan investment returns are—like the investment markets themselves—volatile and always uncertain. This means that there are a range of possible outcomes for KERS-HPP; some are more likely, others less likely, but still possible.*

*The deterministic approach is useful for gauging the general direction of change and associated consequences, but adding the element of uncertainty—more specifically year to year variability in the performance of the capital markets and the value of the Plan’s assets over time—can offer additional insights, albeit along with considerable complexity.*

Uncertainty in future investment returns is taken into account via a stochastic analysis of six different investment approaches (in the table below and on page 25) ranging from highly conservative (low risk, asset protective) to highly aggressive (high return seeking with substantial associated risk), including the Current Target allocation KERS-HPP. The reason for testing such a broad range of approaches is that at the heart of the KERS-HPP situation is a simple question that is difficult to answer: whether the Plan is better off following a strategy that:

- (A) Falls in the general category of higher prospective return with greater risk (i.e. potential for more widely varying outcomes – good or bad), or
- (B) Falls in the general category of lower prospective return with concomitantly lower risk (i.e. a tighter band of likely outcomes).

	Min	Max	1	2	3	4	5	6	7	8	9	10	Current Target	Conservative Portfolio	Potential Portfolio 1	Potential Portfolio 2	Potential Portfolio 3	Aggressive Portfolio
Global Equity	30	70	30	30	30	30	30	30	32	40	51	66	43	0	30	53	67	75
Int. Duration Fixed Income	0	30	30	30	30	27	18	9	2	0	0	0	10	100	20	6	2	0
Custom KRS Fixed Income	0	30	0	3	0	0	8	17	23	16	5	0	10	0	8	6	2	0
Core Real Estate	5	10	10	10	10	10	10	10	10	10	10	5	5	0	10	5	5	0
Diversified Hedge Funds	10	15	15	15	15	15	15	15	15	15	15	10	10	0	10	10	5	0
Private Equity	5	15	5	7	11	14	15	15	15	15	15	15	10	0	10	10	15	25
Diversified Inf. Strategies	2	15	5	3	2	2	2	2	2	2	2	2	10	0	10	8	2	0
Cash Equivalents	2	5	5	2	2	2	2	2	2	2	2	2	2	0	2	2	2	0
Total			100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Capital Appreciation			35	37	41	44	45	45	47	55	66	81	53	0	40	63	82	100
Capital Preservation			35	35	32	29	28	28	26	18	7	2	22	100	30	14	6	0
Alpha			15	15	15	15	15	15	15	15	15	10	10	0	10	10	5	0
Inflation			15	13	12	12	12	12	12	12	12	7	15	0	20	13	7	0
<b>Expected Return</b>			<b>5.96</b>	<b>6.17</b>	<b>6.38</b>	<b>6.60</b>	<b>6.81</b>	<b>7.02</b>	<b>7.23</b>	<b>7.44</b>	<b>7.66</b>	<b>7.87</b>	<b>6.93</b>	<b>3.50</b>	<b>6.49</b>	<b>7.23</b>	<b>7.81</b>	<b>8.47</b>
<b>Risk (Standard Deviation)</b>			<b>8.80</b>	<b>9.35</b>	<b>9.94</b>	<b>10.62</b>	<b>11.42</b>	<b>12.26</b>	<b>13.11</b>	<b>13.99</b>	<b>14.91</b>	<b>16.48</b>	<b>12.83</b>	<b>6.00</b>	<b>10.67</b>	<b>14.06</b>	<b>16.48</b>	<b>19.27</b>
Return (Compound)			5.60	5.76	5.92	6.07	6.20	6.32	6.44	6.54	6.64	6.63	6.17	3.33	5.96	6.32	6.57	6.80
Return/Risk Ratio			0.68	0.66	0.64	0.62	0.60	0.57	0.55	0.53	0.51	0.48	0.54	0.58	0.61	0.51	0.47	0.44
RVK Expected Equity Beta			0.43	0.46	0.49	0.52	0.56	0.59	0.63	0.68	0.74	0.84	0.65	0.06	0.52	0.71	0.84	0.99
RVK Liquidity Metric			70	67	64	62	59	56	53	56	61	69	69	85	66	70	71	69

Essential to answering this question is to ask precisely how KERS-HPP and the Plan’s broader constituencies define what “better off” means. The metrics we use for each to determine whether the Plan is “better off” under one approach versus another are as follows:

- (1) The effect on funding ratio (and thus on contribution rates which decline with higher funding ratios).
- (2) The effect on Plan liquidity (i.e. the Plan’s ability to pay annual benefits without major disruption of its strategic asset allocation, the driver of its investment strategy).
- (3) The effect on the trend line and stability of annual contributions.
- (4) The risk of large, sudden, and highly disruptive short-term declines in the Plan’s assets over the course of time and the associated effects on contributions and potentially investment decisions.

The results of this analysis are displayed on pages 26 through 46 of the accompanying A/L study. For purposes of this summary, the consequences of choosing A versus B, as described above, is summarized most clearly in the tables on pages 32 and 46 of the study (copied below followed by explanatory comments).

20 Years	Probability of Full Funding in 2034	Probability of < 68% (Current) Funding in 2034	Probability of < 40% (Current) Funding in 2034	Maximum 1 Year Investment Loss	Maximum 1 Year Employer Contribution
Current Target	17%	54%	14%	-38%	47%
Conservative Portfolio	0%	95%	24%	-22%	50%
Potential Portfolio 1	11%	59%	13%	-32%	47%
Potential Portfolio 2	21%	51%	14%	-41%	47%
Potential Portfolio 3	27%	48%	15%	-46%	47%
Aggressive Portfolio	33%	45%	16%	-51%	48%

20 Years	Actuarial Funded Ratio in Year 20			Market Funded Ratio in Year 20			Cumulative Employer Contributions in Year 20 (Millions)			Payout Ratios		
	50th	5th	95th	50th	5th	95th	50th	5th	95th	Year 20 Median	2014-2034	
											Peak	Trough
Current Target	67%	36%	140%	65%	32%	144%	\$868	\$1,221	\$290	11%	29%	5%
Conservative Portfolio	51%	36%	70%	47%	31%	67%	\$1,072	\$1,219	\$877	15%	28%	10%
Potential Portfolio 1	65%	38%	117%	62%	33%	118%	\$895	\$1,196	\$392	11%	27%	6%
Potential Portfolio 2	69%	36%	157%	67%	31%	162%	\$848	\$1,236	\$247	10%	30%	4%
Potential Portfolio 3	71%	35%	199%	70%	30%	200%	\$817	\$1,258	\$205	10%	32%	3%
Aggressive Portfolio	75%	33%	255%	74%	28%	267%	\$772	\$1,286	\$165	9%	35%	3%

- The median expected funding ratio at the end of the 20 year study period is lower than the current funding level all but Potential Portfolio 3 and the Aggressive Portfolio (pages 31, 32, and 46). The Current Target and Potential Portfolio 1 result in expected funding ratios that are substantially similar to the current level. This is supportive of the continued utilization of diversified investment approach.
- With the exception of the Conservative Portfolio all portfolios analyzed show a moderate (from 10% to 33%) probability of full funding in 20 years (page 32). The Conservative Portfolio shows a no probability of full funding in 20 years.

- None of the portfolios show significant probability of extreme payout ratios over the next 20 years (pages 33-38 and 46). However, the peak value for all portfolios is above 20%, a level that does begin to moderately inhibit asset allocation decisions as they relate to illiquid asset classes.
- As you incrementally increase the expected risk and return of the fund (from Potential Portfolio 1 to Potential Portfolio 3), the outcomes do appear to gradually improve at the cost of slightly reduced worst-case outcomes.
- The cumulative cost of providing the Plan's benefits is met through a combination of contributions and the investment returns on those contributions. The Conservative Portfolio requires the largest increase in cumulative contributions (i.e., the direct funding of benefits) (pages 40, 45, and 46). Even under the very unlikely best-case scenario the Plan would have a funded ratio of about 47%, far lower than any of the other portfolios (page 46). The only redeeming virtue of such an ultra-conservative approach is that the potential for large declines in the value of the fund is significantly mitigated albeit at much higher ongoing costs (contributions) and chronic poor Plan financial health.
- The Aggressive Portfolio does appear to have the highest *probability* of producing full funding by 2034 at 33% (page 32). *However*, it also has a maximum theoretical one-year portfolio decline of 51%—a loss of almost one half of the Plan's assets, significant we believe by any standard. This likelihood of notably larger one year declines within the study period gives pause to the desirability of a far more aggressive approach simply from a quantitative viewpoint. It also suggests it may be a strategy that is extremely difficult for decision makers to sustain over a long period of time. Declines in the total fund market value of this magnitude are a disruptive event from all aspects of Plan management. Yet, the benefit of such an aggressive approach that makes it superficially attractive can only be realized with any probability if the aggressive and highly volatile approach is maintained for several decades through good times, bad times, and unnerving times. Furthermore, this type of strategy could prove difficult to maintain in future years should demographic (early retirement incentives for example) or financial events create higher liquidity demands on the Plan. For all these reasons, it is not an approach that should be seriously considered without full recognition of the significant risks.
- While RVK supports the conclusions of the study using our current capital market assumptions, we also model for extreme market scenarios to stress test the results of the study. The summary of this analysis can be found in Appendices 1 and 2 (beginning on pages 47 and 50 respectively). The first test models the case of extreme market volatility by doubling the assumed standard deviations of all asset classes. The second test models converging market returns by assuming all assets are perfectly correlated (i.e. correlations equal +1.00). The results of these additional analyses show that the *relative* portfolio outcomes do not change, but that the range of potential results widens, indicating higher risk for all asset mixes given the increased systemic volatility and the

reduced dampening effects of total fund diversification we assume under these stress scenarios.

### **Final Comments**

This A/L study shows that KERS-HPP is currently underfunded but significant improvements in financial health are possible. The Plan can best meet its objectives through the continued use of a well-diversified investment portfolio. However, positive outcomes are extremely dependent on the contribution policy. The study is not supportive of a long-term, ultra-conservative approach. The increasing potential for large one-year declines suggests that there is likely a limit to the net benefits of adding increased risk in pursuit of additional return. Progress should be monitored periodically through studies such as these, particularly if the Plan encounters a sustained period of lower returns in the capital markets (and thus for the Plan's assets) as well as material changes in contribution policy or benefit levels.

Additionally, this study assumes no further changes are made to the benefit policy at any point during the 20 year projection period. Such changes would fall outside the reach of an Asset/Liability study. However, we do note that even small changes to the benefit policy can have a meaningful long-term impact on the likely future outcomes of the Plan.

# Table of Contents

---

**ACKNOWLEDGEMENTS ..... PAGE 2**

**INTRODUCTION..... PAGE 3**

**CURRENT STATUS ..... PAGE 6**

**DETERMINISTIC ANALYSIS..... PAGE 7**

**DETERMINISTIC SCENARIO ANALYSIS ..... PAGE 18**

**STOCHASTIC ANALYSIS..... PAGE 20**

**APPENDIX 1: SENSITIVITY ANALYSIS: VOLATILITY ..... PAGE 47**

**APPENDIX 2: SENSITIVITY ANALYSIS: CORRELATIONS..... PAGE 50**

**APPENDIX 3: ASSUMPTIONS AND METHODS..... PAGE 53**

## Acknowledgements

---

### PREPARED BY:

**TONY JOHNSON**, SENIOR CONSULTANT, RVK, INC.

**JAMES VOYTKO**, SENIOR CONSULTANT, RVK, INC.

**RYAN SULLIVAN**, CONSULTANT, RVK, INC.

**MATTHIAS BAUER**, CONSULTANT, RVK, INC.

### WITH THE COOPERATION OF:

**DAVID DOUGHERTY, LLC** (RVK CONSULTING ACTUARY)

**CAVANAUGH MACDONALD CONSULTING, LLC** (SYSTEM ACTUARY)

## Introduction

---

RVK, Inc. (RVK) has prepared this report for the Kentucky Employees Retirement System Hazardous Pension Plan (KERS) to:

- Present projected valuation results with respect to the funded status of the Plan.
- Present projected benefit payments of the Plan.
- Investigate asset mixes to determine those which best serve to protect and increase funding levels, while providing adequate liquidity for benefit payments.

The valuation projections are shown using both a deterministic and stochastic process.

The deterministic process provides an open group analysis of projected valuation results based on a fixed set of future assumptions (see summary in the Assumptions and Methods section of this report).

The stochastic process provides an open group analysis of projected valuation results under many capital market environments based on expected asset returns and inflation, and their expected volatility. Using a Monte Carlo simulation technique, both assets and liabilities are assumed to vary stochastically, linked together by changes in inflation. Expected values, variances of the returns and inflation, and correlations are used to generate 2,000 trials to produce a distribution of potential outcomes. A stochastic analysis can answer questions about the best/worst case outcomes along with the probability of such outcomes.

## Introduction (continued)

### What is an Asset/Liability Study?

- Investment programs and the strategy they seek to implement (Investment Policy) do not exist in a vacuum. They seek to satisfy one or more investment objectives and operate within a plan framework that includes the investment objectives (Benefit Policy) and plan funding (Contribution Policy).
- The purpose of an Asset/Liability Study is to examine how well alternative investment strategies (i.e., differing asset allocations) address the objectives served by the Plan—the Plan’s “liabilities” in the context of the Plan’s funding streams—the Plan’s Contribution Policy. It is the only standard analysis that fully links all three aspects of the Plan’s key financial drivers.
- In doing so, it creates an important “guidepost” for the actual asset allocation for the Plan; the asset allocation chosen by the Plan’s fiduciaries will likely reflect the nature of the liabilities but also numerous other factors including risk preferences, liquidity, implementation constraints, etc.
- For the KERS Asset/Liability Study, we assume the objectives are:
  1. Fund all participants’ benefits over time.
  2. Assure sufficient liquidity to pay benefits at all times.
  3. Foster a stable contribution stream consistent with objectives 1 and 2.
  4. Achieve adequate returns without accepting unnecessary or imprudent levels of risk.



### An Asset/Liability Study is NOT . . .

- An actuarial study of the KERS liabilities—that is the purview of the Plan’s actuary.
- A prescription for Plan benefits—that is the purview of the elected representatives.
- An assessment of the affordability of contribution levels—that is the purview of the elected officials and their constituents.
- The sole determinant of the final asset allocation adopted for the Plan—there are a number of factors, including insights from an Asset/Liability Study, which will bear on the optimal asset allocation.

## Introduction (continued)

---

### Asset/Liability Studies in Practice . . .

- Begin with a forecast of the financial liabilities (i.e., benefit obligations).
- Include a baseline estimation of the financial contributions to the Plan over time.
- Compare alternative investment strategies (i.e., total fund asset allocations to the Plan's financial needs).
- Draw conclusions regarding how well various investment strategies satisfy the Plan's financial needs.

### This Asset/Liability Study . . .

- Uses data from the June 30, 2014 KERS Actuarial Valuation to project pension liabilities.
- Uses the Actuarial Cost Method described in the June 30, 2014 KERS Actuarial Valuation, and the actuarial assumptions from the KRS Experience Study July 1, 2008 to June 30, 2013 (“the 2013 Experience Study”) performed by Cavanaugh Macdonald Consulting, LLC (Cavanaugh).
- Compares these specific investment strategies—(A) the Current Target, (B) a conservative illustrative portfolio (Conservative Portfolio), (C) a diversified lower risk portfolio (Potential Portfolio 1), (D) a diversified moderate risk portfolio (Potential Portfolio 2), (E) a diversified higher risk portfolio (Potential Portfolio 3), and (F) an aggressive illustrative portfolio (Aggressive Portfolio).
- Assumes the Plan's current benefit policy throughout the entire projection period—changes to the benefit policy are the purview of the elected representatives.
- Note: Does not assume any actuarial adjustments that may take place in future years.

## Current Status

A summary of the Plan follows:

**Valuation Date** June 30, 2014

**Market Value of Assets (MVA)** \$560 million

**Actuarial Value of Assets (AVA)** \$528 million

**Actuarial Accrued Liability (AAL)** \$817 million

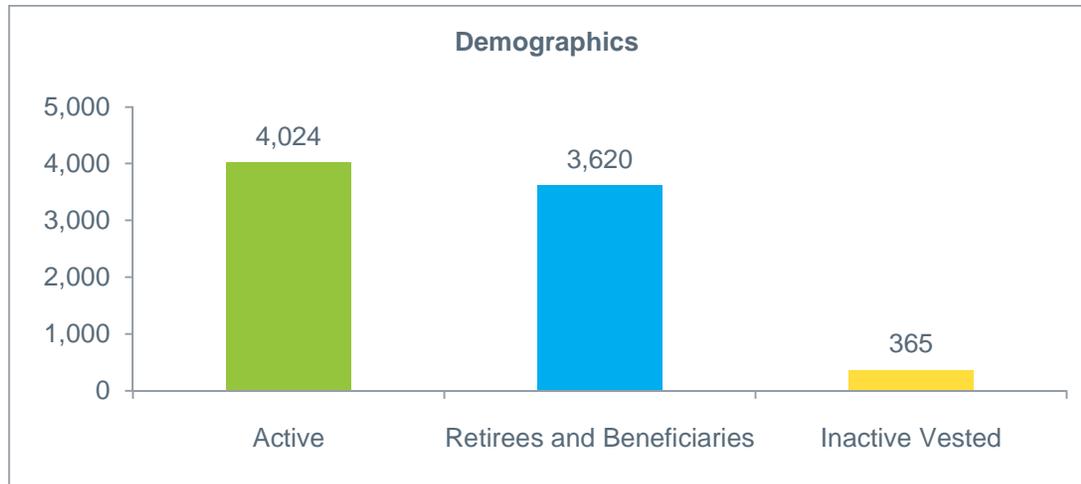
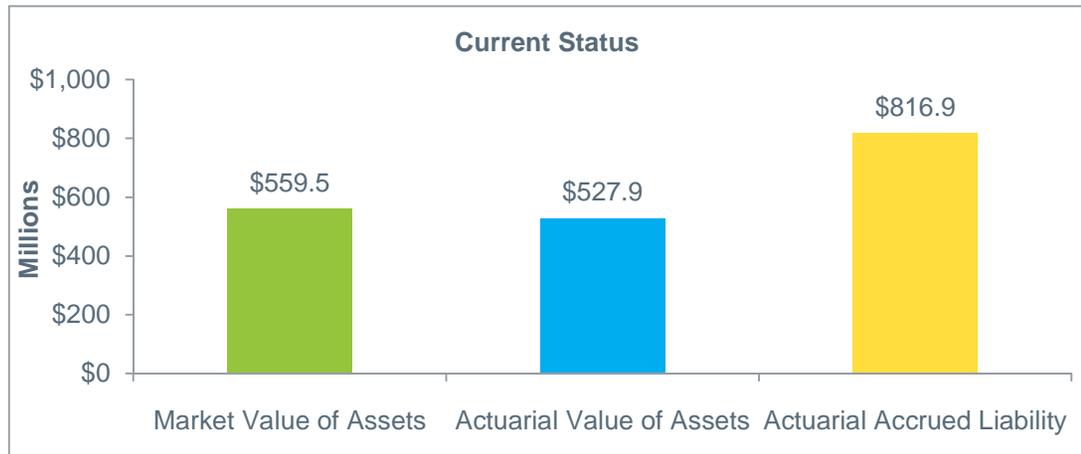
**Market Value Funded Ratio (MVA/AAL)** 68%

**Actuarial Value Funded Ratio (AVA/AAL)** 65%

**Active** 4,024

**Retirees and Beneficiaries** 3,620

**Inactive Vested** 365



## Deterministic Analysis

---

This section provides an analysis of the Plan's assets, liabilities, funded status, and benefit payments based on a fixed set of future assumptions. Each analysis that follows in this deterministic section rests on the critical assumptions below and must be read and interpreted with them in mind—particularly assumptions #2, #3 and #4.

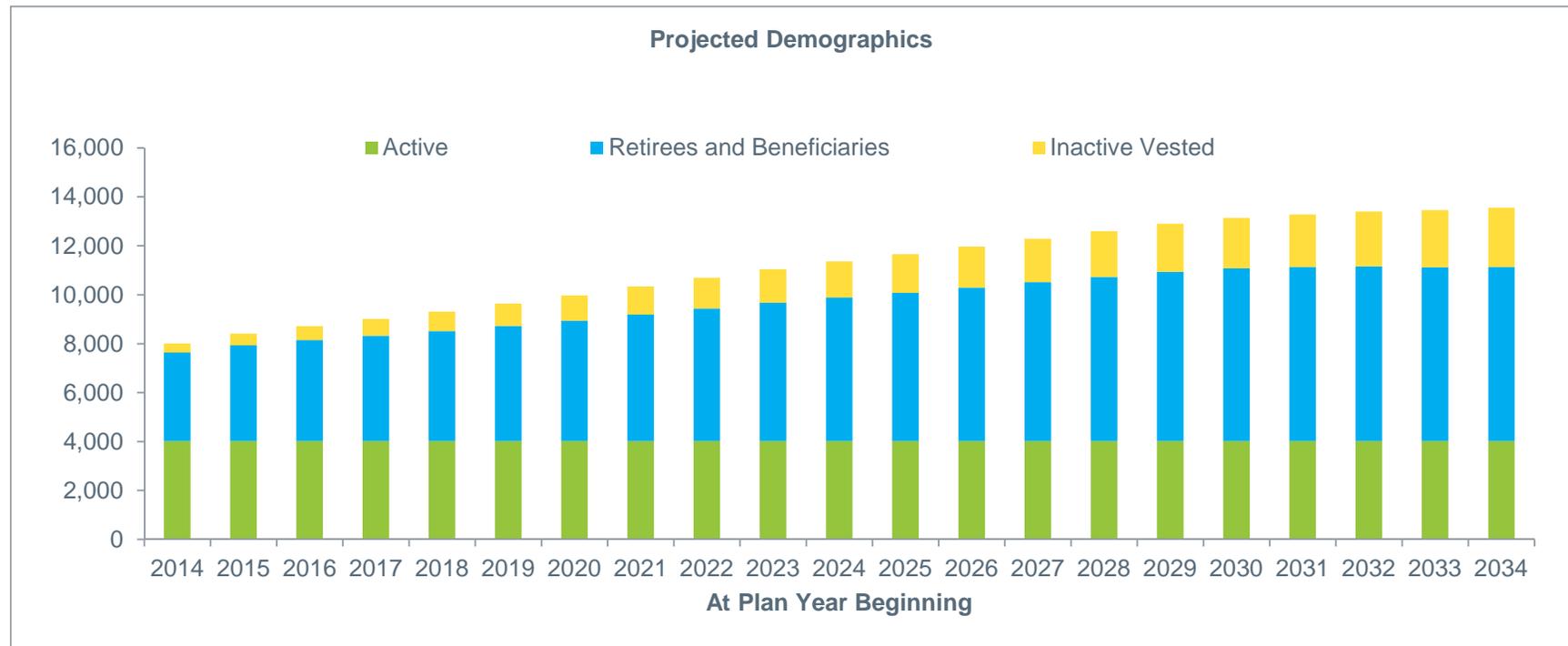
The deterministic assumptions are as follows:

1. Current Plan provisions (see Summary of Main Benefit and Contribution Provisions beginning on page 38 of the KERS June 30, 2014 actuarial valuation report prepared by Cavanaugh).
2. The participant data used by Cavanaugh in its June 30, 2014 actuarial valuation.
3. Actuarially assumed rate of return on Plan assets for all projection years: 7.50%.
4. For the fiscal years ending 2015 and 2016, assumes total employer contributions equal to the full actuarially required contributions as set forth in the actuarial valuation as of June 30, 2013 (16.37% of payroll). Thereafter, assumes employer contributions for each fiscal year are determined as of the prior year's valuation date in accordance with the actuarial funding policy and the assumptions from the 2013 Experience Study.
5. Assumes demographic experience projected in accordance with the actuarial assumptions proposed in the 2013 Experience Study.
6. Open group analysis: level active population. New active participants entering the Plan are assumed to have similar characteristics to recently hired participants.

## Deterministic Analysis (continued)

### Demographics

Following are the projected number of active and inactive participants at the beginning of each Plan year from 2014 through 2034 (2014 is actual). These projections are based on an open group analysis. Using the actuary’s assumptions for death, termination, retirement, and disability, current participants are assumed to leave the Plan in the future. The number of total inactive participants (Retirees and Beneficiaries and Vested Inactive) increases by approximately 139% during the 20-year projection period shown.

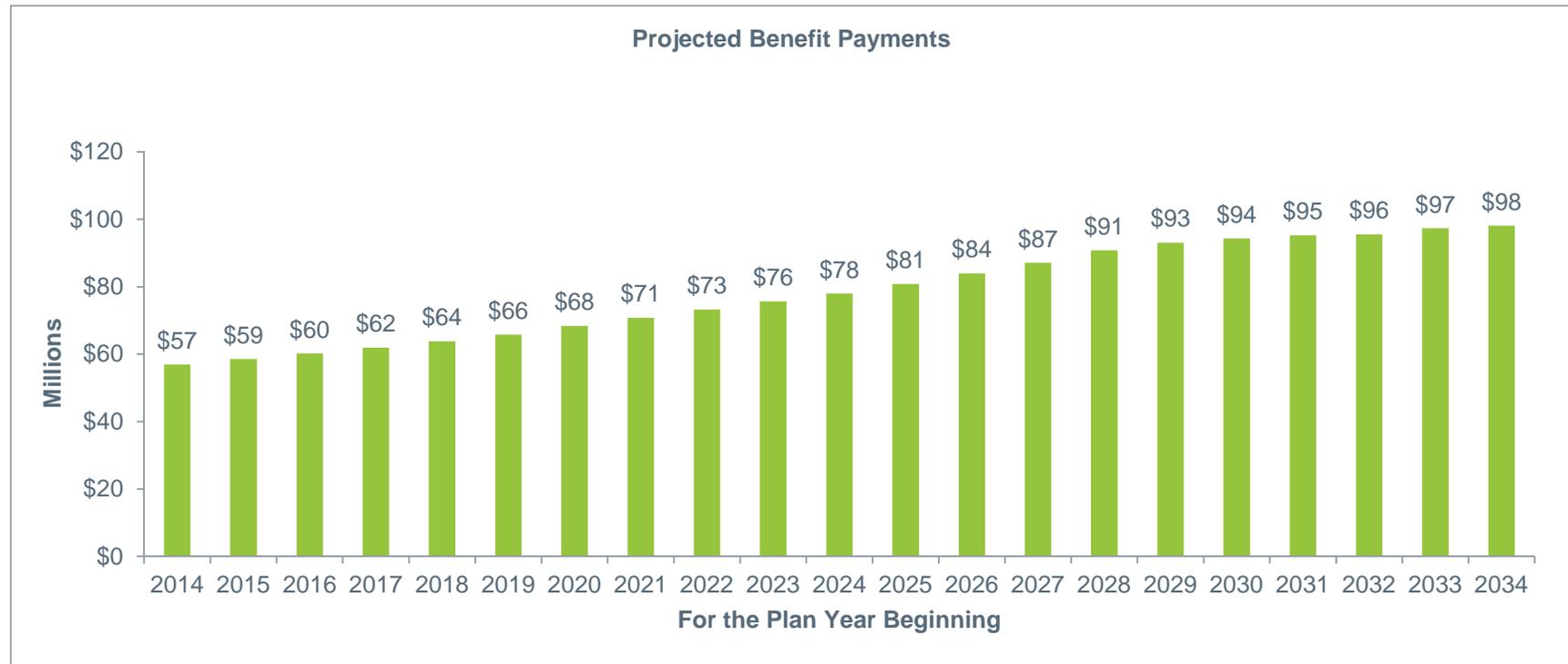


Total Population	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Annual Percent Change	N/A	5.0%	3.7%	3.3%	3.3%	3.6%	3.4%	3.6%	3.5%	3.2%	2.9%	2.6%	2.7%	2.6%	2.5%	2.4%	1.8%	1.1%	0.8%	0.5%	0.7%

## Deterministic Analysis (continued)

### Benefit Payments

The Plan’s projected annual benefit payments are shown in the chart below. The projected benefit payments are expected to increase by about 73% over the next 20 years. As a percentage of the market value of Plan assets, benefit payments are expected to gradually decline through approximately through the projection period (see page 12).

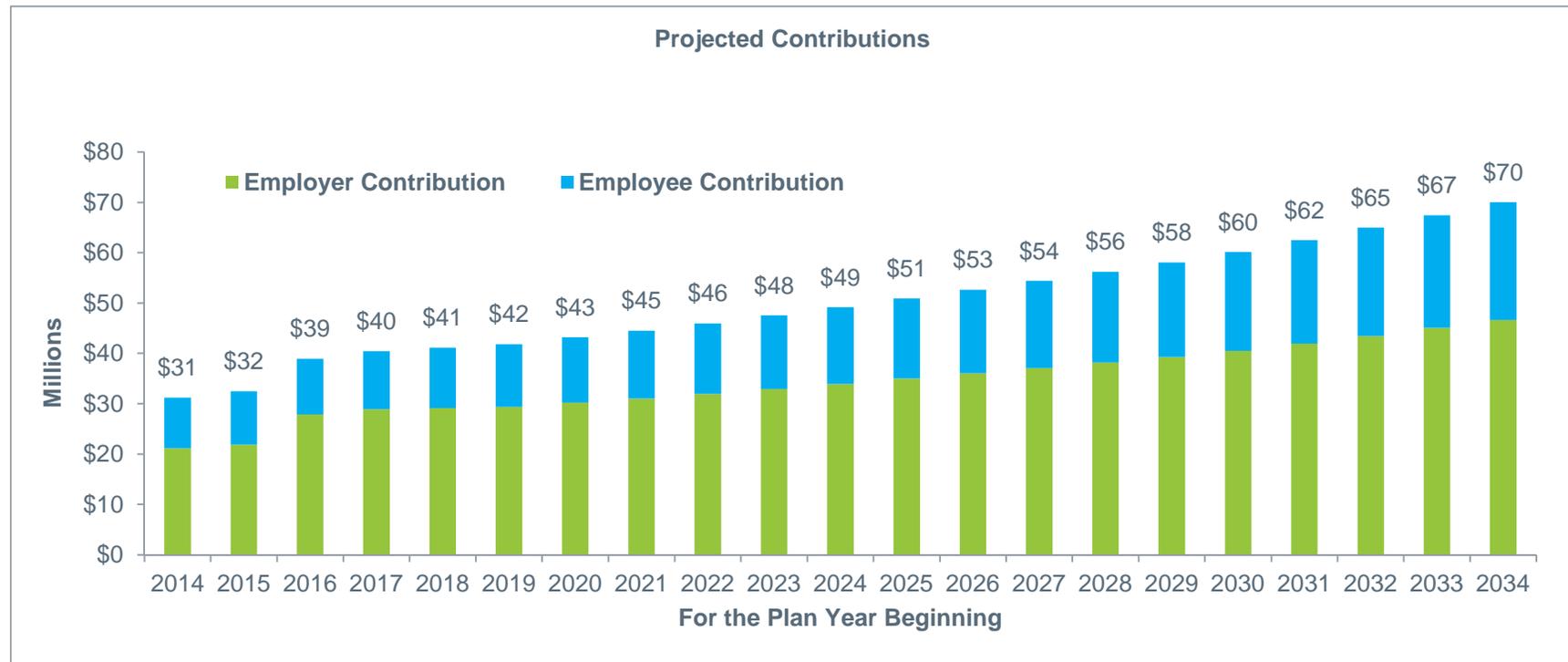


	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Annual Percent Change	N/A	2.9%	2.8%	2.8%	3.1%	3.1%	3.8%	3.5%	3.6%	3.3%	3.0%	3.7%	3.8%	3.7%	4.3%	2.5%	1.4%	0.9%	0.3%	1.9%	0.8%

## Deterministic Analysis (continued)

### Contributions

The Plan’s projected contributions, expressed as total dollar contributions, are shown in the chart below. The results assume the contribution policy remains unchanged, and that the Plan’s assets return precisely the actuarially assumed rate each year without exception for all projection years.

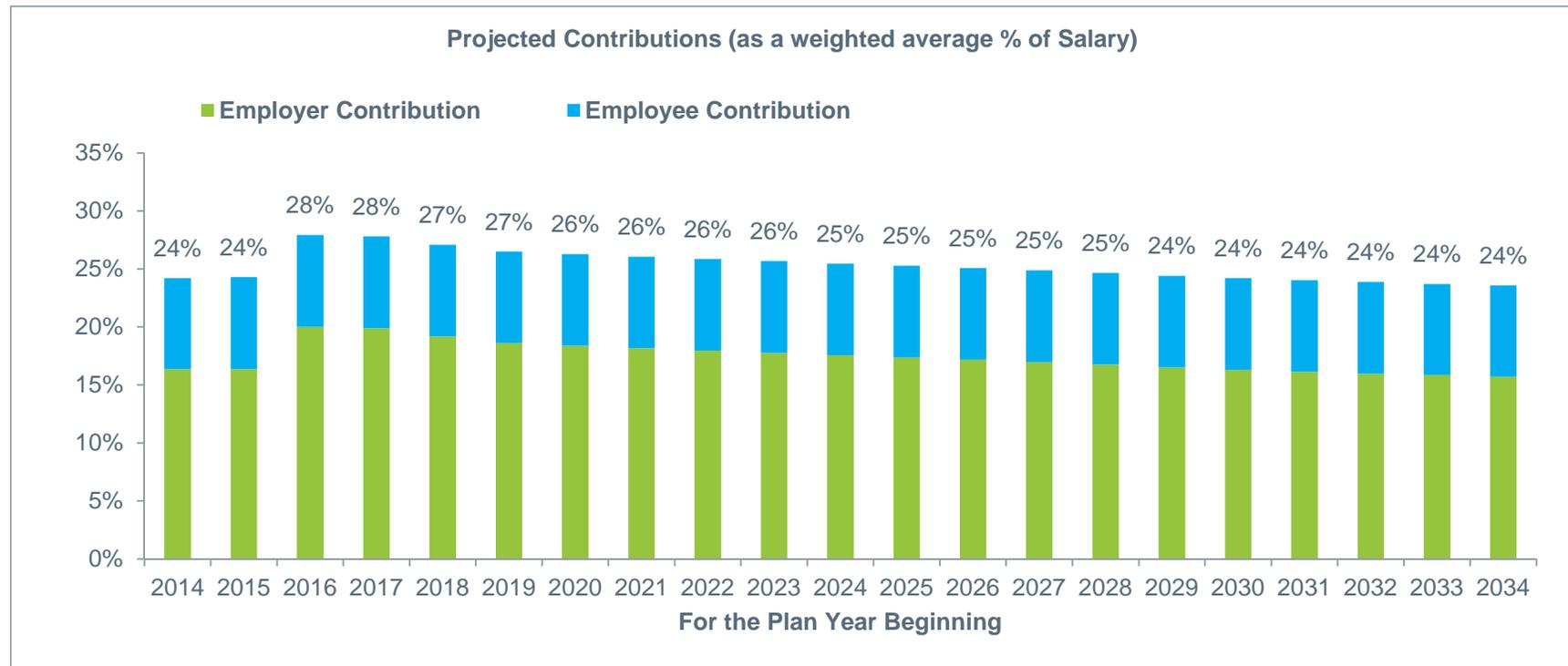


	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Annual Percent Change	N/A	4.0%	19.8%	3.9%	1.6%	1.8%	3.3%	3.1%	3.3%	3.4%	3.4%	3.5%	3.4%	3.3%	3.3%	3.2%	3.6%	3.9%	4.0%	3.8%	3.8%

## Deterministic Analysis (continued)

### Contributions

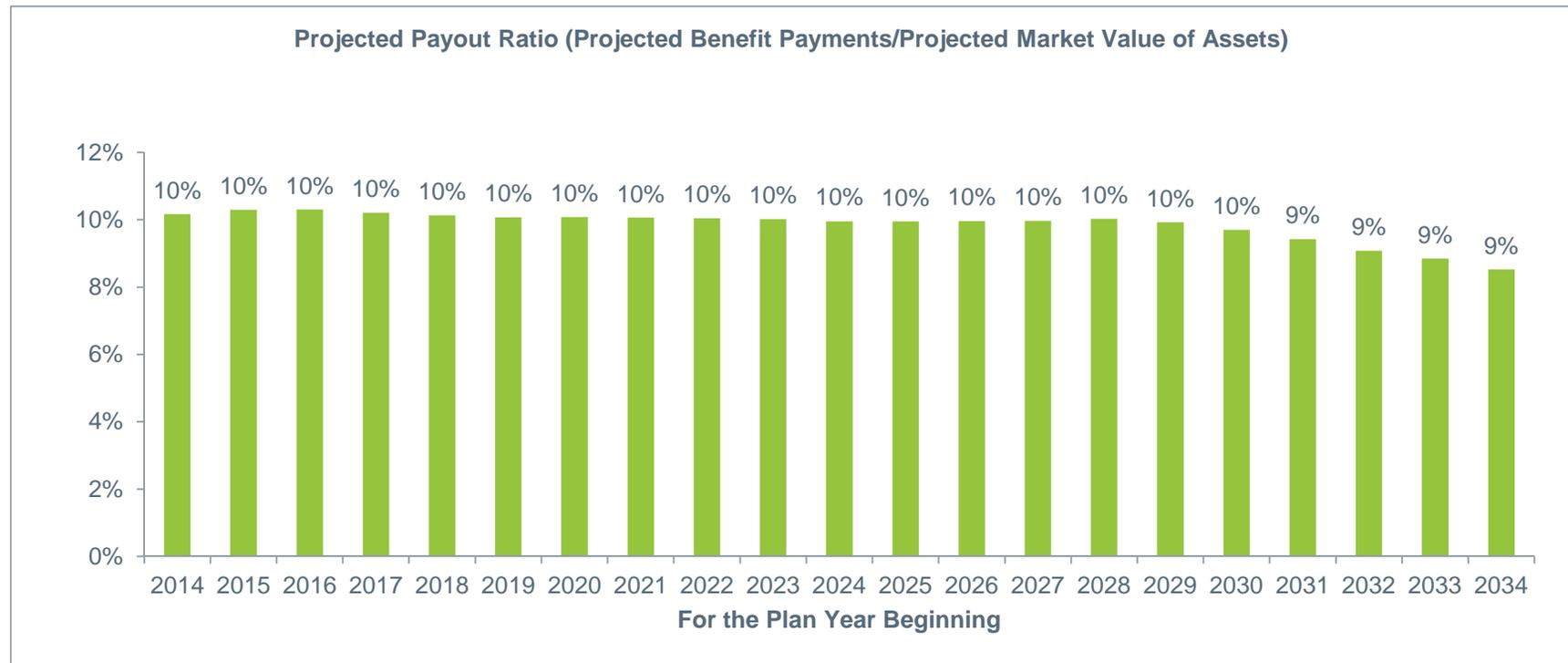
The Plan’s projected contributions, expressed as a weighted average percentage of salary, are shown in the chart below. The results assume the contribution policy remains unchanged, and that the Plan’s assets return precisely the actuarially assumed rate each year without exception for all projection years.



## Deterministic Analysis (continued)

### Payout Ratio (benefit payments/market value of assets)

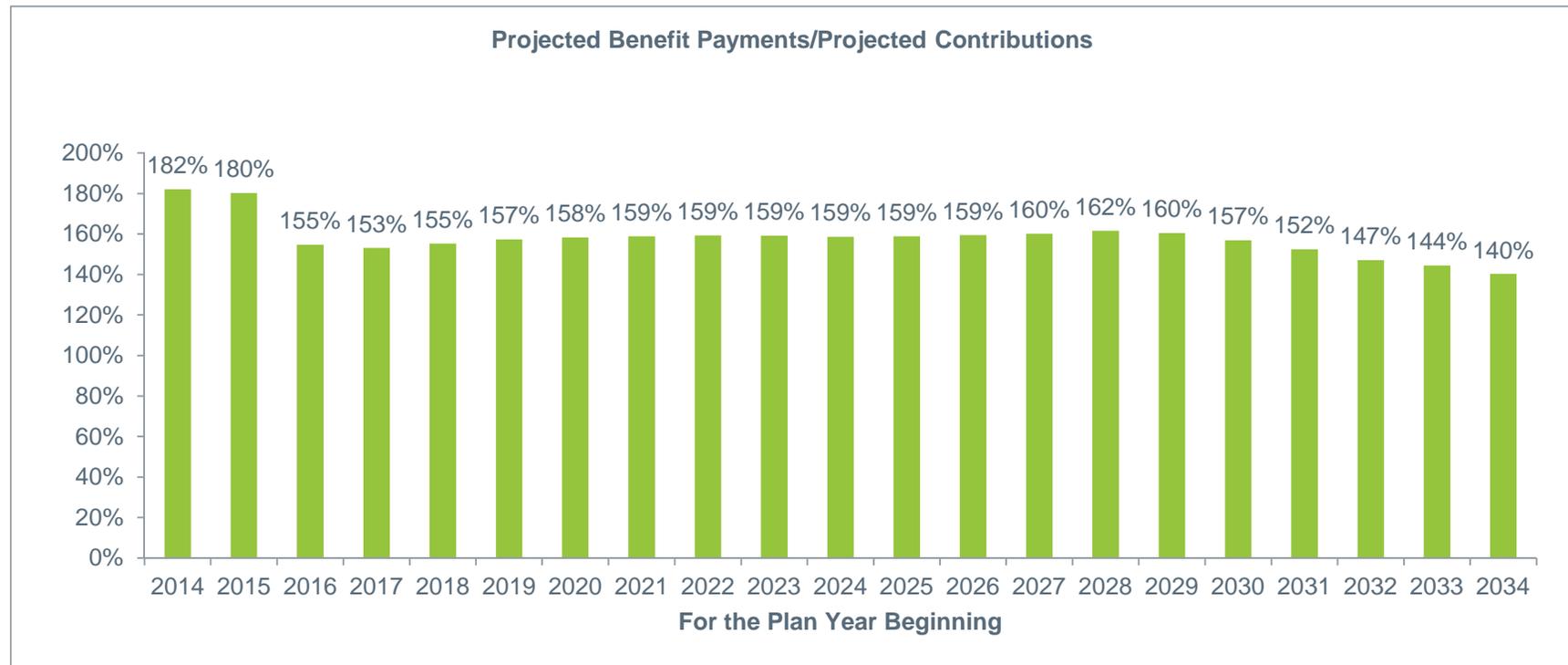
The Plan's projected payout ratios are shown in the chart below. The payout ratios are expected to gradually decline through the end of the projection period. The results assume the current contribution policy remains unchanged and that the Plan's assets return precisely the actuarially assumed rate each year without exception for all projection years.



## Deterministic Analysis (continued)

### Benefit Payments/Contributions

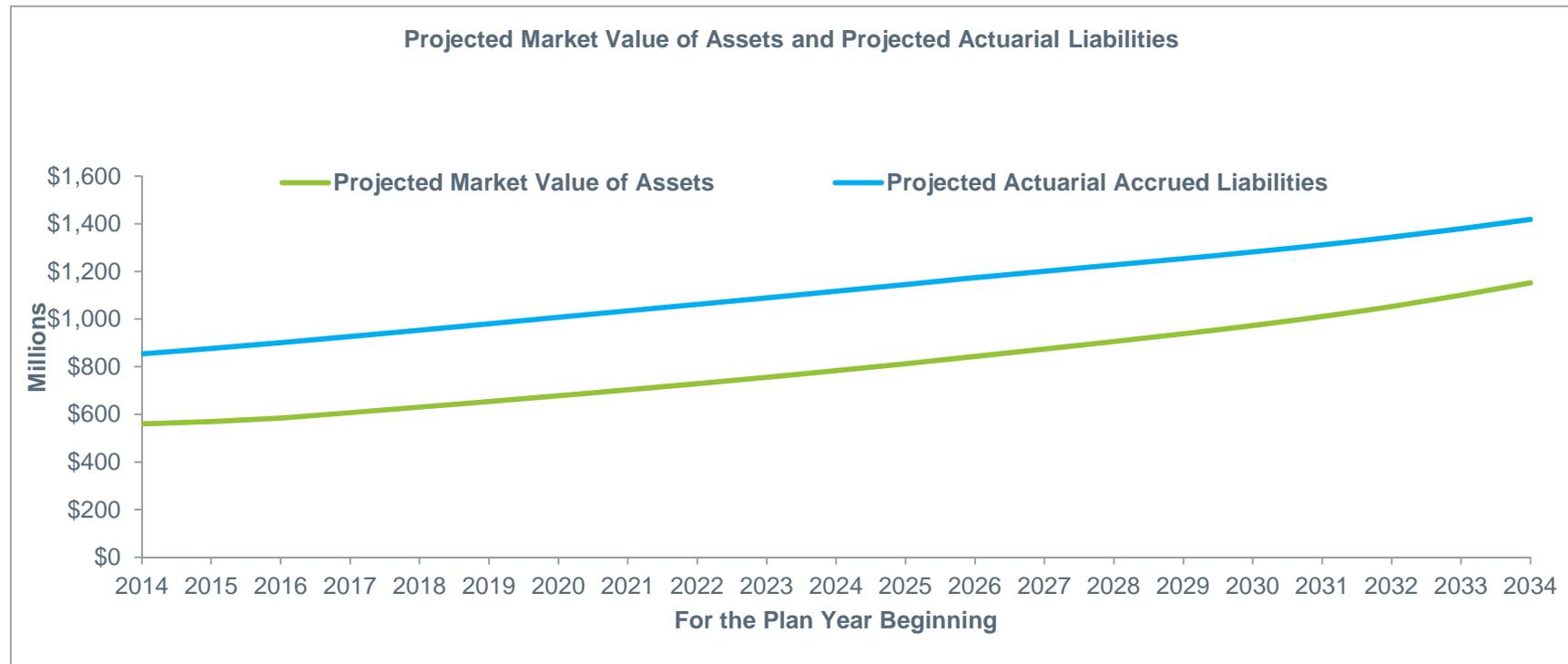
The Plan’s projected benefit payments divided by projected contributions are shown in the chart below. The results assume the contribution policy remains unchanged, and that the Plan’s assets return precisely the actuarially assumed rate each year without exception for all projection years.



## Deterministic Analysis (continued)

### Actuarial Accrued Liabilities and Market Value of Assets

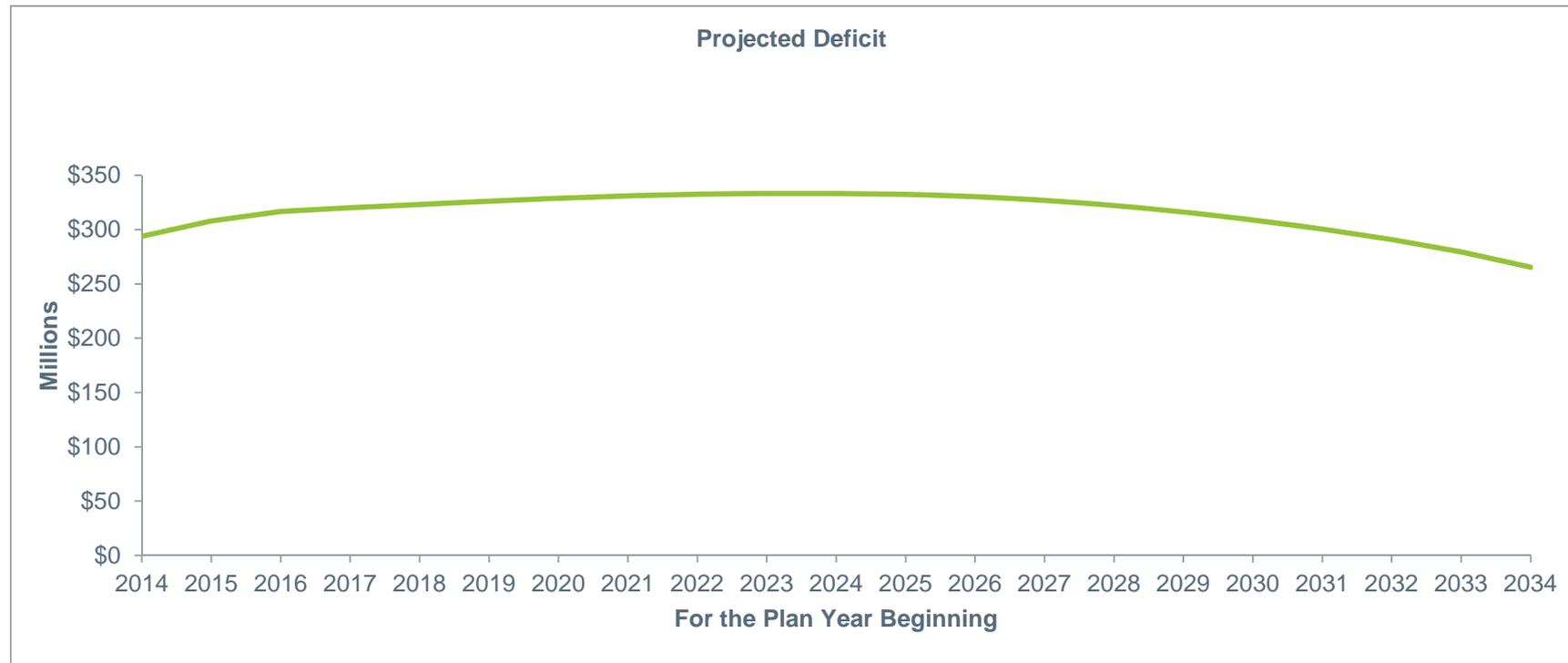
The Plan’s projected actuarial accrued liabilities and market value of assets are shown in the chart below. The results assume the contribution policy remains unchanged, and that the Plan’s assets return precisely the actuarially assumed rate each year without exception for all projection years. The relative disparity between the market value of assets and Plan liabilities is expected to decrease by 10% through the end of the projection period. The funded ratio (based on market value of assets) is expected to increase to approximately 81% by the end of the projection period. This is shown more clearly on the following pages.



## Deterministic Analysis (continued)

### Deficit (market value of assets – actuarial accrued liabilities)

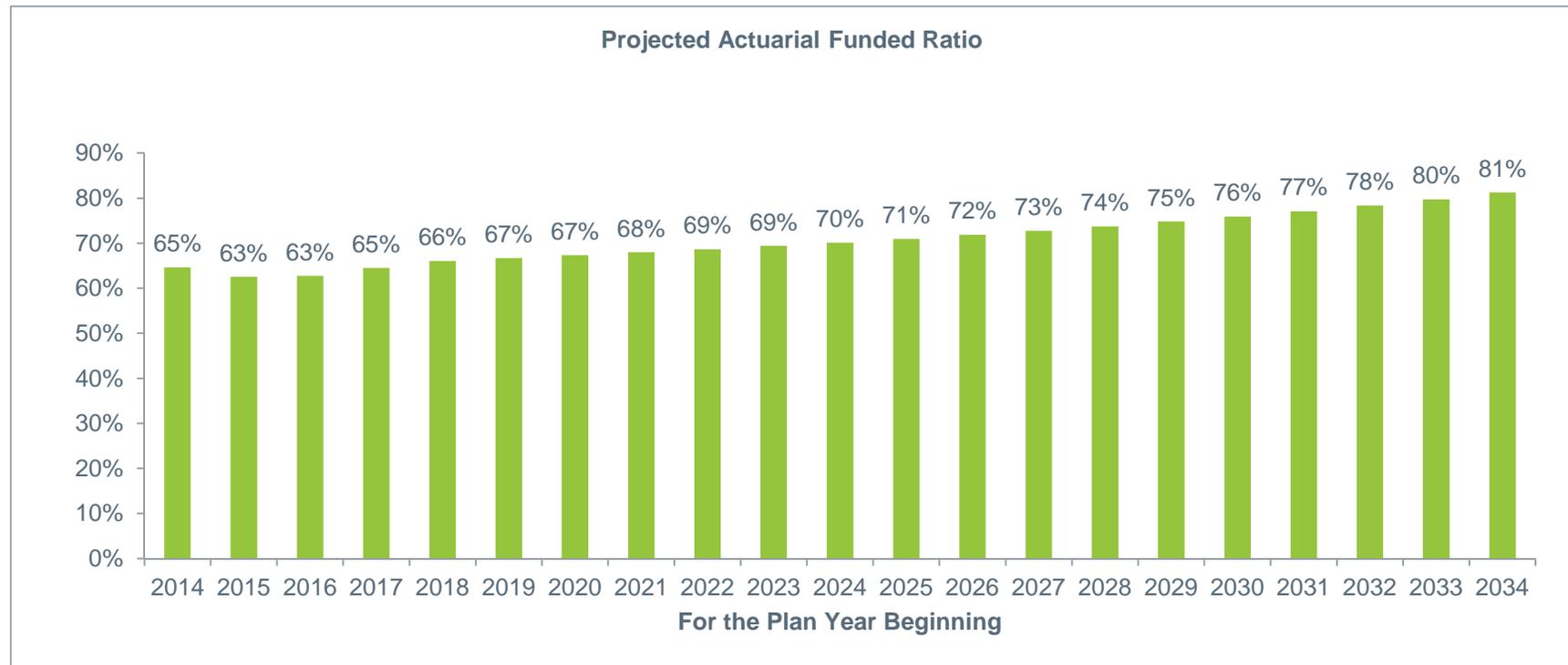
The Plan’s projected deficit of assets is shown in the chart below. The results assume the contribution policy remains unchanged, and that the Plan’s assets return precisely the actuarially assumed rate each year without exception for all projection years. The disparity between the market value of assets and Plan liabilities is expected to decrease by the end of the projection period by 10%.



## Deterministic Analysis (continued)

### Actuarial Funded Ratio (actuarial value of assets/actuarial accrued liability)

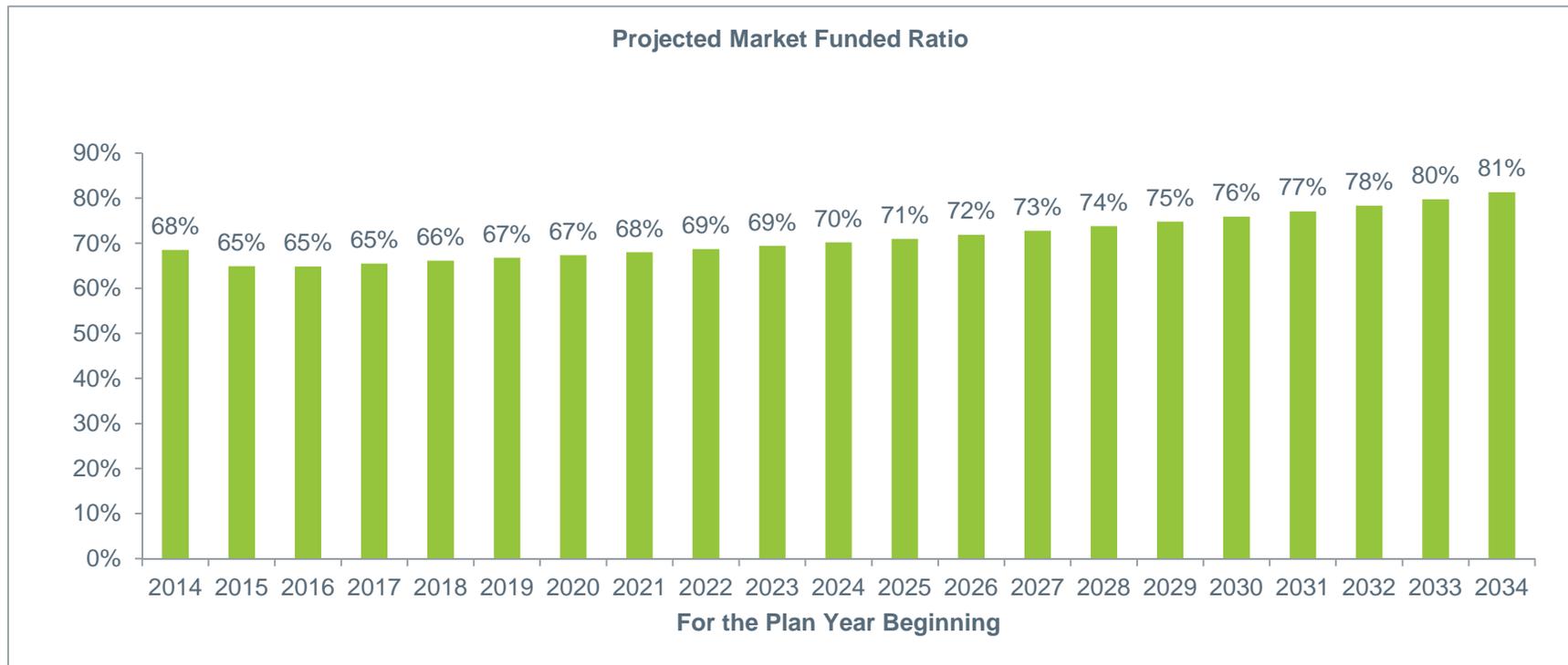
The Plan’s projected actuarial funded ratio is shown in the chart below. The Plan is expected to end the projection period at approximately 81% funded. The results assume the contribution policy remains unchanged, and that the Plan’s assets return precisely the actuarially assumed rate each year without exception for all projection years.



## Deterministic Analysis (continued)

### Market Funded Ratio (market value of assets/actuarial accrued liability)

The Plan's projected market funded ratio is shown in the chart below. The Plan is expected to end the projection period at approximately 81% funded. The results assume the contribution policy remains unchanged, and that the Plan's assets return precisely the actuarially assumed rate each year without exception for all projection years.

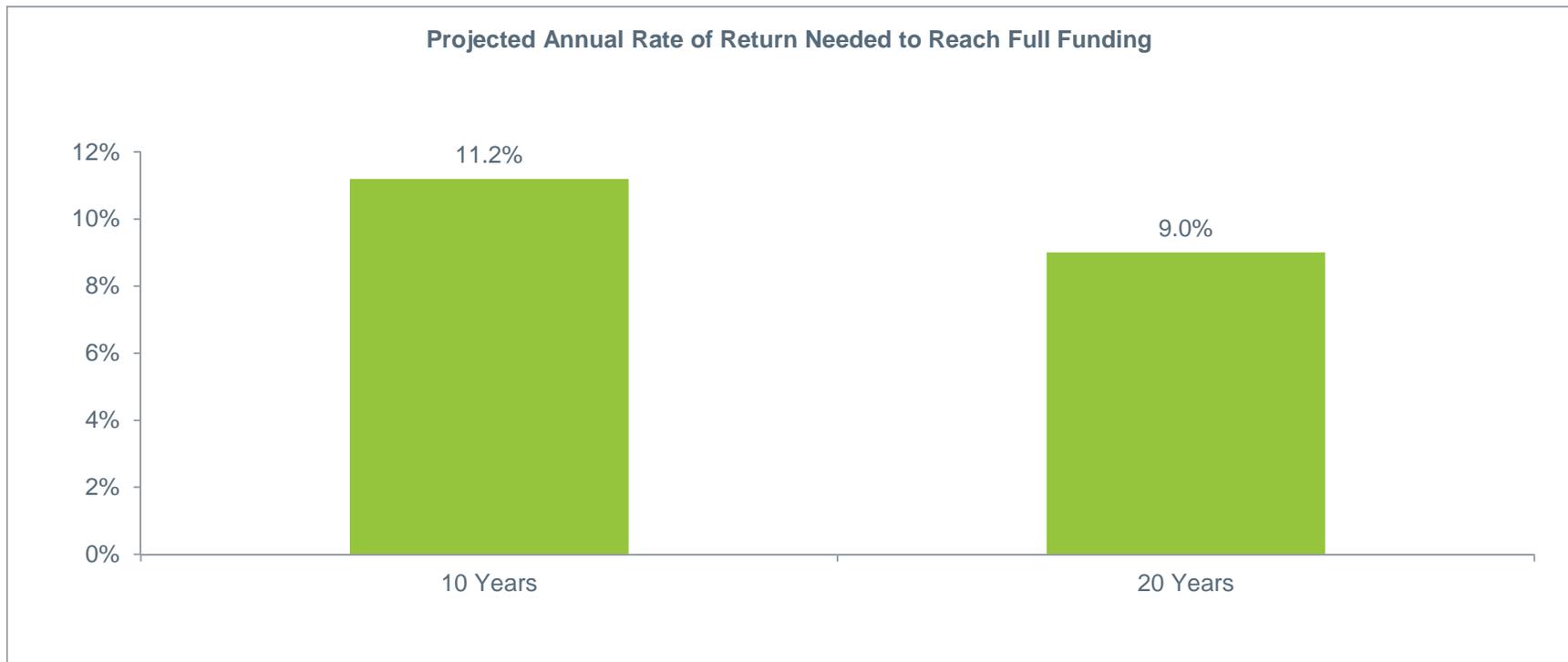


## Deterministic Scenario Analysis

### Full Funding Implied Returns

The figure below shows the projected investment return for the total fund needed to bring the Plan to 100% funding (on a market value basis) in 10 and 20 years, respectively. The results assume all other actuarial assumptions are precisely met over the time periods shown and that these returns are earned for every year, without variance.

Actuarially assumed rate of return – **7.50%**



## Deterministic Scenario Analysis (continued)

### Sensitivity Analysis – Decreased Return

Under the deterministic analysis presented in the preceding pages, the Plan is projected to have a market funded ratio of 81% in 20 years. The table below summarizes the projected funded ratio and other key statistics in 2034 assuming the Plan experiences an annualized investment return of 100 basis points lower (6.50%) than the current actuarially assumed rate of return (7.50%). The values assume all other actuarial assumptions are exactly met. The original values are also presented in the table for comparison.

	Value in 2034			
	Actuarially Assumed Rate of Return	Reduced Return (100 bps)	Impact of Reduced Return	
Projected Payout Ratio	9%	10%	1%	▲
Projected Employer Contributions (millions)	\$47	\$62	\$15	▲
Projected Benefit Payments/Projected Total Contributions	140%	115%	-25%	▼
Projected Actuarial Accrued Liabilities (millions)	\$1,418	\$1,412	(\$6)	▼
Projected Market Value of Assets (millions)	\$1,152	\$996	(\$156)	▼
Projected Deficit (millions)	\$265	\$416	\$150	▲
Projected Market Funded Ratio	81%	71%	-11%	▼
	20 Year Cumulative Total			
Projected Cumulative Employer Contributions (millions)	\$722	\$825	\$104	▲

Values in impact column may not be additive to due rounding.

## Stochastic Analysis

---

In the previous section of this report, we assumed the Plan operated going forward with certain knowledge of the future investment returns earned by the Plan's assets. This section introduces the element of uncertainty in those future investment returns. This part of the analysis examines Plan assets and liabilities under many capital market environments based on expected future asset returns and inflation, and their expected volatility. Using a Monte Carlo simulation technique, both assets and liabilities are assumed to vary stochastically, linked together by changes in inflation.

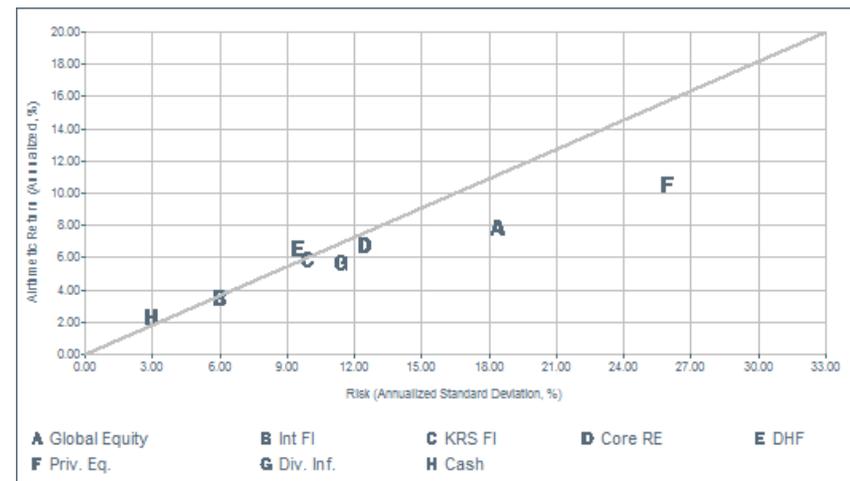
Using the current expected values and variances of the returns and inflation, along with their correlations, 2,000 trials are generated to produce a distribution of results. A stochastic analysis can answer questions about the best/worst case outcomes along with the probability of such outcomes. This is contrasted with the deterministic analysis that provides an expected value if all current Plan assumptions are exactly met.

## Stochastic Analysis (continued)

### Long-Term Return and Risk Assumptions

In order to perform a stochastic analysis and create asset allocation alternatives, it is necessary to estimate, for each asset class, its probable return and risk. The expected returns are our best estimates of the average annual percentage increases in values of each asset class over a prospective long period of time, and assumed to be normally distributed. The risk of an asset class is measured by its standard deviation, or volatility. If asset returns are normally distributed, two-thirds (67%) of all returns are expected to lie within one standard deviation on either side of the mean. For example, we expect Global Equity to return, annually on average, 7.80% with a standard deviation of 18.35%, meaning that two-thirds of the time we expect its return to lie between -10.55% (= 7.80 – 18.35) and 26.15% (= 7.80 + 18.35). Moreover, we expect 95% of all return outcomes to lie within two standard deviations of the mean return, implying only a one-in-twenty chance that the return on Global Equity will either fall below -28.90% or rise above 44.50%. The risk and return assumptions used in this study are outlined in the below table and chart:

Asset Class	Arithmetic Return Assumption	Standard Deviation Assumption
Global Equity	7.80	18.35
Int. Duration Fixed Income	3.50	6.00
Custom KRS Fixed Income	5.83	10.79
Core Real Estate	6.75	12.50
Diversified Hedge Funds	6.50	9.50
Private Equity	10.50	26.00
Diversified Inflation Strategies	5.65	11.45
Cash Equivalents	2.25	3.00



## Stochastic Analysis (continued)

### Correlation Between Asset Classes

Creating a diversified portfolio of asset classes enables the investor to achieve a high rate of return while minimizing volatility of the portfolio. As defined on the previous page, volatility is “risk” or standard deviation. By minimizing the volatility of a portfolio, we produce asset returns that vary less from year to year. Diversification exists because the returns of different asset classes do not always move in the same direction, at the same time, or with the same magnitude. Correlation values are between 1.00 and –1.00. If returns of two asset classes rise or fall at the same time and in the same magnitude, they have a correlation value of 1.00. Conversely, two asset classes that simultaneously move in opposite directions, and in the same magnitude, have a correlation value of –1.00. A correlation of zero indicates no relationship between returns. The assumed correlations are largely based on historical index data, with some qualitative analysis applied. For instance, where appropriate, we have weighted current history more heavily. The correlation matrix used in this study is shown below:

	Global Equity	Int. Duration Fixed Income	Custom KRS Fixed Income	Core Real Estate	Diversified Hedge Funds	Private Equity	Diversified Inflation Strategies	Cash Equivalents
Global Equity	1.00	-0.02	0.84	0.32	0.70	0.78	0.72	-0.05
Int. Duration Fixed Income	-0.02	1.00	0.28	-0.06	0.12	-0.26	0.22	0.24
Custom KRS Fixed Income	0.84	0.28	1.00	0.27	0.69	0.66	0.82	-0.07
Core Real Estate	0.32	-0.06	0.27	1.00	0.24	0.60	0.37	0.14
Diversified Hedge Funds	0.70	0.12	0.69	0.24	1.00	0.69	0.59	0.22
Private Equity	0.78	-0.26	0.66	0.60	0.69	1.00	0.62	0.07
Diversified Inflation Strategies	0.72	0.22	0.82	0.37	0.59	0.62	1.00	-0.03
Cash Equivalents	-0.05	0.24	-0.07	0.14	0.22	0.07	-0.03	1.00

The fact that the correlations shown in the table are nearly all positive does not imply that these asset classes do not diversify one another. Their correlations are significantly less than 1.00, meaning we expect a measurable number of instances when the underperformance of one or more of the asset classes will be offset by the outperformance of others. This point is demonstrated on the following pages, which illustrate that diversification into less correlated asset classes can decrease the expected overall volatility of a portfolio.

## Stochastic Analysis (continued)

### Efficient Portfolios

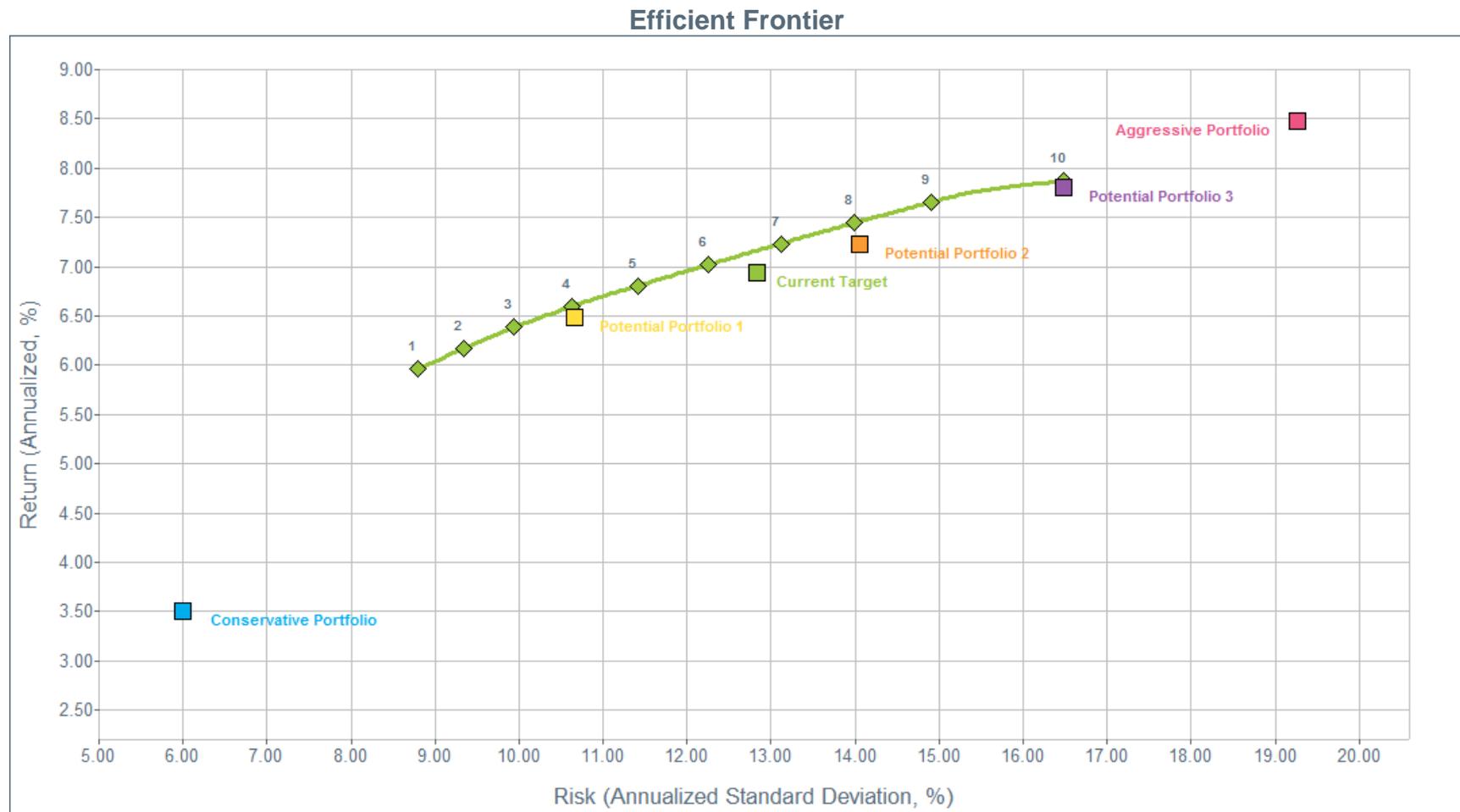
Each frontier portfolio (optimal allocation) is created using target rates of return both above and below the projected rate of return for the current allocation. This range illustrates the trade-off between return and risk; additional return can only be achieved by undertaking additional risk. The table below shows the possible optimal allocations given the selected asset classes and their constraints listed under “Min” and “Max.” The table shows the Current Target allocation and highlights three potential targets (Potential Portfolios 1, 2, and 3) for consideration throughout this study. Two illustrative portfolios (Conservative and Aggressive Portfolios) are also shown for demonstrative purposes.

	Min	Max	1	2	3	4	5	6	7	8	9	10	Current Target	Conservative Portfolio	Potential Portfolio 1	Potential Portfolio 2	Potential Portfolio 3	Aggressive Portfolio
Global Equity	30	70	30	30	30	30	30	30	32	40	51	66	43	0	30	53	67	75
Int. Duration Fixed Income	0	30	30	30	30	27	18	9	2	0	0	0	10	100	20	6	2	0
Custom KRS Fixed Income	0	30	0	3	0	0	8	17	23	16	5	0	10	0	8	6	2	0
Core Real Estate	5	10	10	10	10	10	10	10	10	10	10	5	5	0	10	5	5	0
Diversified Hedge Funds	10	15	15	15	15	15	15	15	15	15	15	10	10	0	10	10	5	0
Private Equity	5	15	5	7	11	14	15	15	15	15	15	15	10	0	10	10	15	25
Diversified Inf. Strategies	2	15	5	3	2	2	2	2	2	2	2	2	10	0	10	8	2	0
Cash Equivalents	2	5	5	2	2	2	2	2	2	2	2	2	2	0	2	2	2	0
<b>Total</b>			100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Capital Appreciation			35	37	41	44	45	45	47	55	66	81	53	0	40	63	82	100
Capital Preservation			35	35	32	29	28	28	26	18	7	2	22	100	30	14	6	0
Alpha			15	15	15	15	15	15	15	15	15	10	10	0	10	10	5	0
Inflation			15	13	12	12	12	12	12	12	12	7	15	0	20	13	7	0
<b>Expected Return</b>			<b>5.96</b>	<b>6.17</b>	<b>6.38</b>	<b>6.60</b>	<b>6.81</b>	<b>7.02</b>	<b>7.23</b>	<b>7.44</b>	<b>7.66</b>	<b>7.87</b>	<b>6.93</b>	<b>3.50</b>	<b>6.49</b>	<b>7.23</b>	<b>7.81</b>	<b>8.47</b>
<b>Risk (Standard Deviation)</b>			<b>8.80</b>	<b>9.35</b>	<b>9.94</b>	<b>10.62</b>	<b>11.42</b>	<b>12.26</b>	<b>13.11</b>	<b>13.99</b>	<b>14.91</b>	<b>16.48</b>	<b>12.83</b>	<b>6.00</b>	<b>10.67</b>	<b>14.06</b>	<b>16.48</b>	<b>19.27</b>
Return (Compound)			5.60	5.76	5.92	6.07	6.20	6.32	6.44	6.54	6.64	6.63	6.17	3.33	5.96	6.32	6.57	6.80
Return/Risk Ratio			0.68	0.66	0.64	0.62	0.60	0.57	0.55	0.53	0.51	0.48	0.54	0.58	0.61	0.51	0.47	0.44
RVK Expected Equity Beta			0.43	0.46	0.49	0.52	0.56	0.59	0.63	0.68	0.74	0.84	0.65	0.06	0.52	0.71	0.84	0.99
RVK Liquidity Metric			70	67	64	62	59	56	53	56	61	69	69	85	66	70	71	69

## Stochastic Analysis (continued)

### Efficient Frontier

The risk of each alternative allocation is plotted against the horizontal axis, while the return is measured on the vertical axis. The line connecting the points represents all the optimal portfolios subject to the given constraints and is known as the “efficient frontier.” The upward slope of the efficient frontier indicates the direct relationship between return and risk.



## Stochastic Analysis (continued)

### Asset Mixes

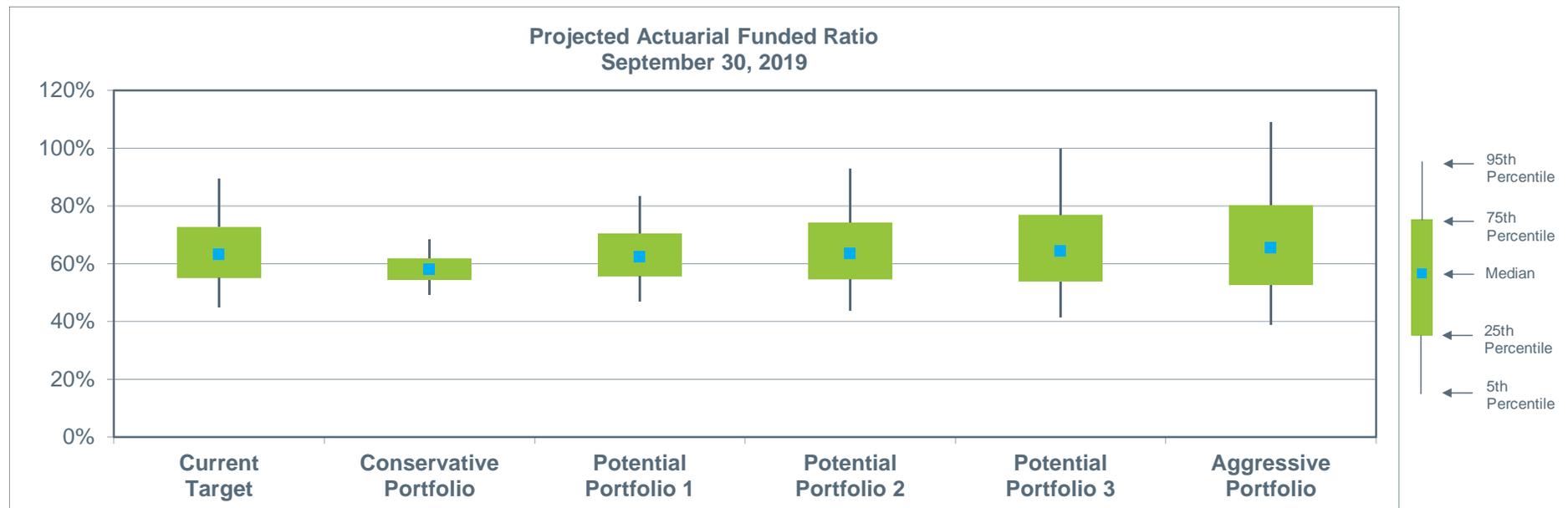
Outlined below are the Current Target allocation and five other mixes to be examined in this stochastic analysis. The expected return, expected risk (as measured by standard deviation), and RVK Liquidity Metric, for each is also shown.

Asset Class	Current Target	Conservative Portfolio	Potential Portfolio 1	Potential Portfolio 2	Potential Portfolio 3	Aggressive Portfolio
Global Equity	43%	0%	30%	53%	67%	75%
Int. Duration Fixed Income	10%	100%	20%	6%	2%	0%
Custom KRS Fixed Income	10%	0%	8%	6%	2%	0%
Core Real Estate	5%	0%	10%	5%	5%	0%
Diversified Hedge Funds	10%	0%	10%	10%	5%	0%
Private Equity	10%	0%	10%	10%	15%	25%
Diversified Inflation Strategies	10%	0%	10%	8%	2%	0%
Cash Equivalents	2%	0%	2%	2%	2%	0%
<b>Total Equity</b>	<b>53%</b>	<b>0%</b>	<b>40%</b>	<b>63%</b>	<b>82%</b>	<b>100%</b>
Expected Return	6.93%	3.50%	6.49%	7.23%	7.81%	8.47%
Expected Risk	12.83%	6.00%	10.67%	14.06%	16.48%	19.27%
RVK Liquidity Metric	69	85	66	70	71	69

## Stochastic Analysis (continued)

### Projected Actuarial Funded Ratio (actuarial value of assets/actuarial accrued liability); 5 Years

The graph below shows the distribution of possible actuarial funded ratios five years from now, assuming the six different asset mixes highlighted on the prior pages. The results assume the current contribution policy remains unchanged for all projection years.

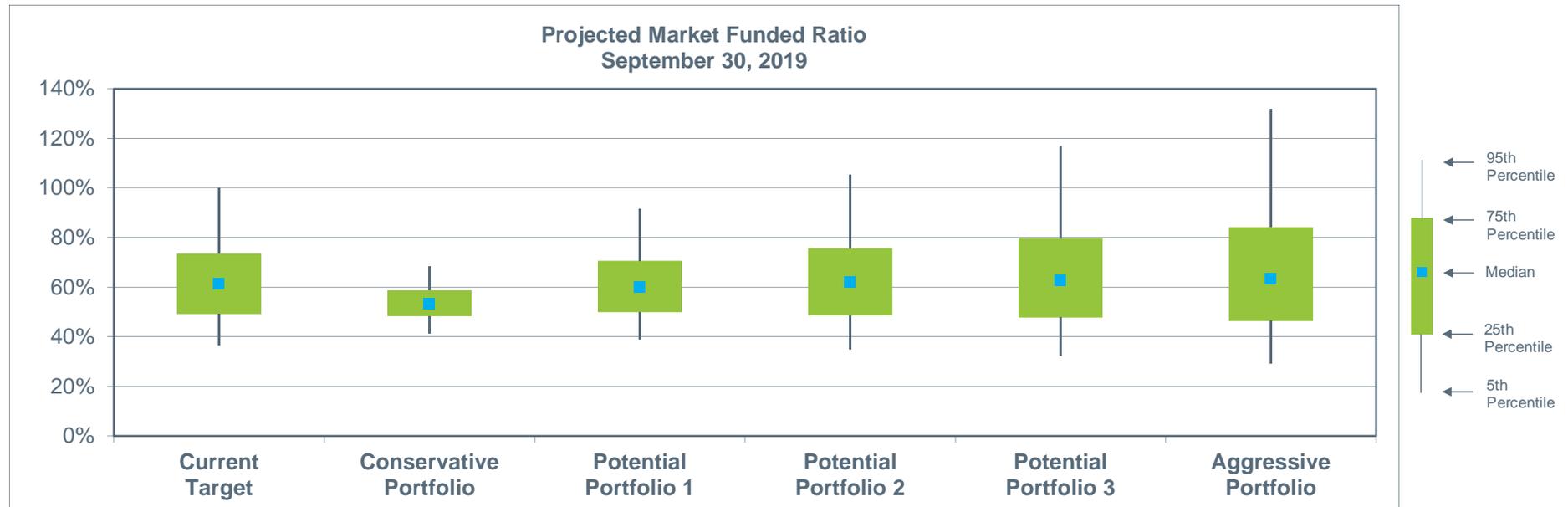


	Current Target		Conservative Portfolio		Potential Portfolio 1		Potential Portfolio 2		Potential Portfolio 3		Aggressive Portfolio	
	Unfunded Liability (Mil)	Funded Ratio	Unfunded Liability	Funded Ratio	Unfunded Liability (Mil)	Funded Ratio						
5th Percentile	\$535	45%	\$493	49%	\$513	47%	\$546	44%	\$568	41%	\$593	39%
25th Percentile	\$439	55%	\$444	54%	\$435	56%	\$443	55%	\$453	54%	\$463	53%
Median	\$361	63%	\$411	58%	\$368	62%	\$356	64%	\$350	65%	\$341	66%
75th Percentile	\$268	73%	\$375	62%	\$292	70%	\$254	74%	\$228	77%	\$195	80%
95th Percentile	\$107	89%	\$320	68%	\$165	83%	\$71	93%	\$1	100%	(\$88)	109%

## Stochastic Analysis (continued)

### Projected Market Funded Ratio (market value of assets/actuarial accrued liability); 5 Years

The graph below shows the distribution of possible market funded ratios five years from now, assuming the six different asset mixes highlighted on the prior pages. The results assume the current contribution policy remains unchanged for all projection years.

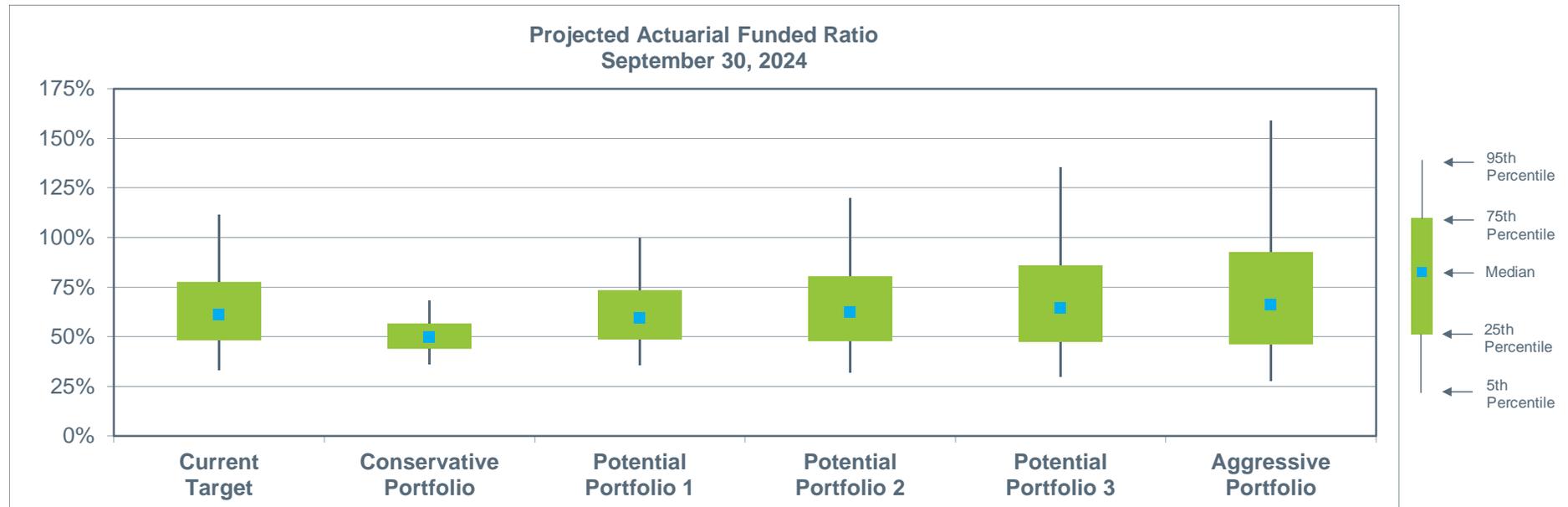


	Current Target		Conservative Portfolio		Potential Portfolio 1		Potential Portfolio 2		Potential Portfolio 3		Aggressive Portfolio	
	Unfunded Liability (Mil)	Funded Ratio	Unfunded Liability	Funded Ratio	Unfunded Liability (Mil)	Funded Ratio						
5th Percentile	\$613	36%	\$562	42%	\$587	39%	\$626	35%	\$654	32%	\$682	29%
25th Percentile	\$494	49%	\$501	48%	\$484	50%	\$499	49%	\$510	48%	\$520	46%
50th Percentile	\$379	61%	\$454	53%	\$390	60%	\$372	62%	\$366	63%	\$360	64%
75th Percentile	\$261	74%	\$408	59%	\$291	71%	\$241	76%	\$200	80%	\$155	84%
95th Percentile	\$1	100%	\$322	68%	\$84	91%	(\$55)	105%	(\$172)	117%	(\$308)	132%

## Stochastic Analysis (continued)

### Projected Actuarial Funded Ratio (actuarial value of assets/actuarial accrued liability); 10 Years

The graph below shows the distribution of possible actuarial funded ratios ten years from now, assuming the six different asset mixes highlighted on the prior pages. The results assume the current contribution policy remains unchanged for all projection years.

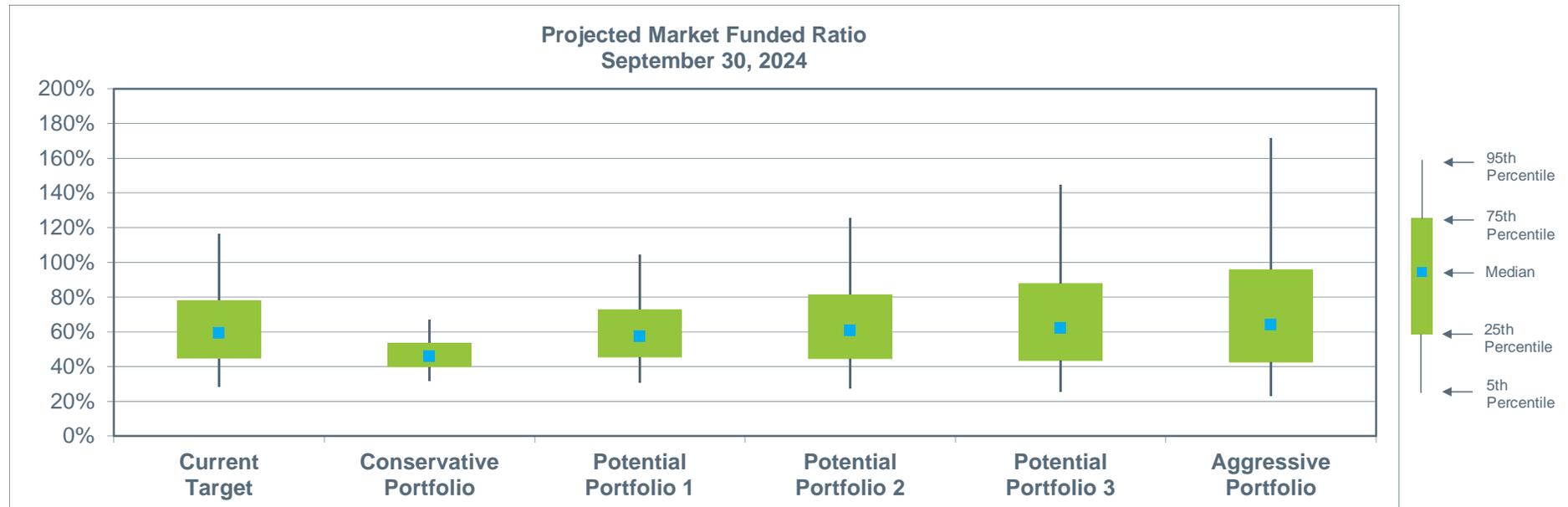


	Current Target		Conservative Portfolio		Potential Portfolio 1		Potential Portfolio 2		Potential Portfolio 3		Aggressive Portfolio	
	Unfunded Liability (Mil)	Funded Ratio	Unfunded Liability	Funded Ratio	Unfunded Liability (Mil)	Funded Ratio						
5th Percentile	\$722	33%	\$686	36%	\$699	36%	\$737	32%	\$765	30%	\$790	28%
25th Percentile	\$569	48%	\$615	44%	\$565	49%	\$570	48%	\$578	47%	\$590	46%
Median	\$431	61%	\$556	50%	\$451	60%	\$421	63%	\$401	64%	\$378	66%
75th Percentile	\$254	78%	\$495	57%	\$301	74%	\$222	80%	\$164	86%	\$81	93%
95th Percentile	(\$134)	111%	\$372	68%	\$4	100%	(\$222)	120%	(\$411)	135%	(\$650)	159%

## Stochastic Analysis (continued)

### Projected Market Funded Ratio (market value of assets/actuarial accrued liability); 10 Years

The graph below shows the distribution of possible market funded ratios ten years from now, assuming the six different asset mixes highlighted on the prior pages. The results assume the current contribution policy remains unchanged for all projection years.

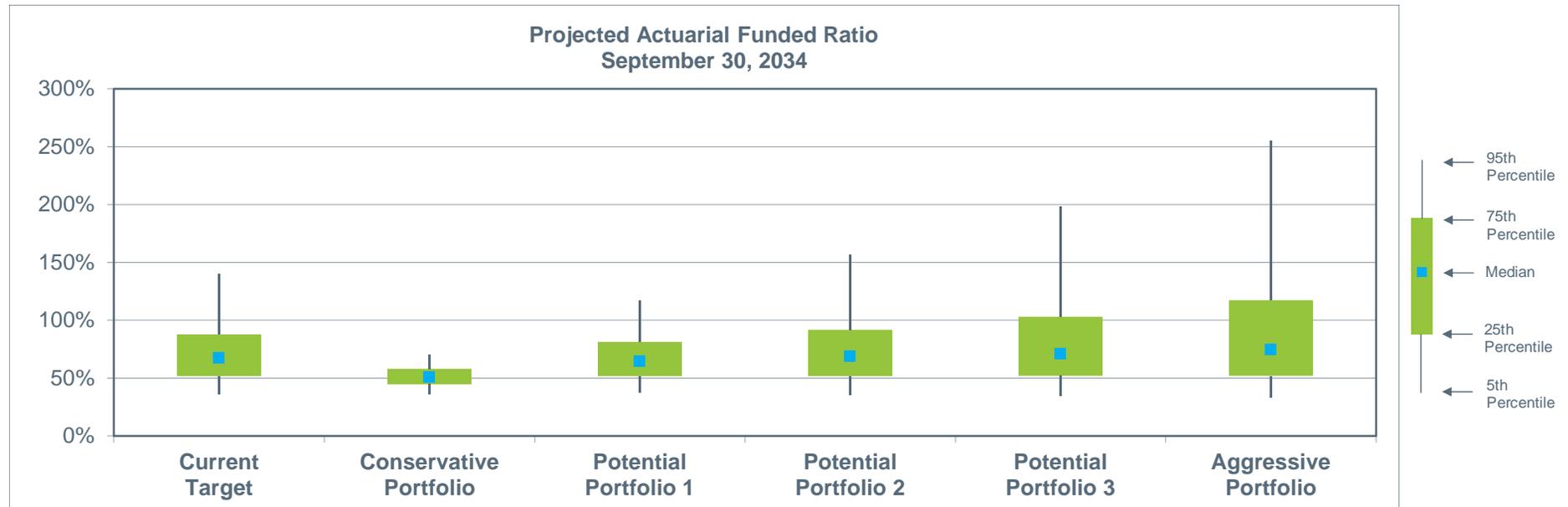


	Current Target		Conservative Portfolio		Potential Portfolio 1		Potential Portfolio 2		Potential Portfolio 3		Aggressive Portfolio	
	Unfunded Liability (Mil)	Funded Ratio	Unfunded Liability	Funded Ratio	Unfunded Liability (Mil)	Funded Ratio						
5th Percentile	\$767	28%	\$731	31%	\$741	31%	\$785	27%	\$808	25%	\$835	23%
25th Percentile	\$611	45%	\$663	40%	\$602	45%	\$614	44%	\$627	43%	\$635	42%
50th Percentile	\$454	59%	\$602	46%	\$473	58%	\$443	61%	\$422	62%	\$400	64%
75th Percentile	\$250	78%	\$530	54%	\$311	73%	\$211	82%	\$136	88%	\$46	96%
95th Percentile	(\$191)	116%	\$396	67%	(\$52)	105%	(\$297)	125%	(\$528)	145%	(\$824)	172%

## Stochastic Analysis (continued)

### Projected Actuarial Funded Ratio (actuarial value of assets/actuarial accrued liability); 20 Years

The graph below shows the distribution of possible actuarial funded ratios twenty years from now, assuming the six different asset mixes highlighted on the prior pages. The results assume the current contribution policy remains unchanged for all projection years.

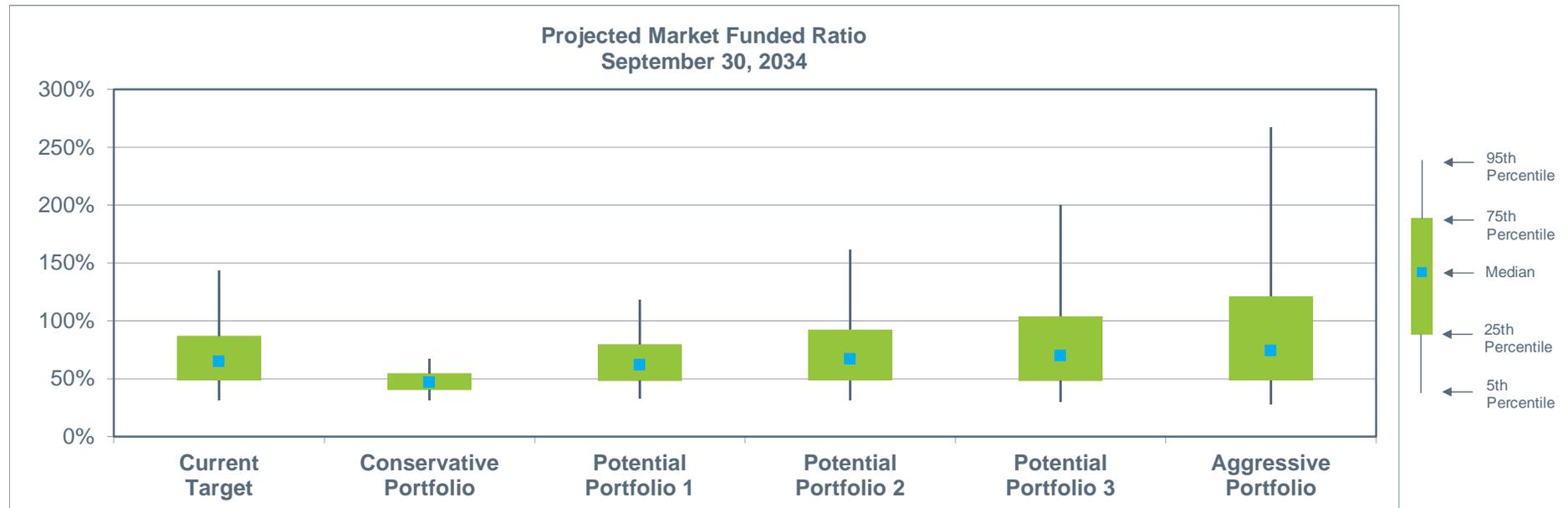


	Current Target		Conservative Portfolio		Potential Portfolio 1		Potential Portfolio 2		Potential Portfolio 3		Aggressive Portfolio	
	Unfunded Liability (Mil)	Funded Ratio	Unfunded Liability	Funded Ratio	Unfunded Liability (Mil)	Funded Ratio						
5th Percentile	\$808	36%	\$810	36%	\$785	38%	\$816	36%	\$835	35%	\$860	33%
25th Percentile	\$641	52%	\$735	45%	\$640	52%	\$638	52%	\$642	52%	\$643	52%
Median	\$454	67%	\$675	51%	\$487	65%	\$434	69%	\$402	71%	\$359	75%
75th Percentile	\$179	88%	\$604	58%	\$271	81%	\$116	92%	(\$43)	103%	(\$257)	117%
95th Percentile	(\$638)	140%	\$466	70%	(\$271)	117%	(\$850)	157%	(\$1,483)	199%	(\$2,403)	255%

## Stochastic Analysis (continued)

### Projected Market Funded Ratio (market value of assets/actuarial accrued liability); 20 Years

The graph below shows the distribution of possible market funded ratios twenty years from now, assuming the six different asset mixes highlighted on the prior pages. The results assume the current contribution policy remains unchanged for all projection years.



	Current Target		Conservative Portfolio		Potential Portfolio 1		Potential Portfolio 2		Potential Portfolio 3		Aggressive Portfolio	
	Unfunded Liability (Mil)	Funded Ratio	Unfunded Liability	Funded Ratio	Unfunded Liability (Mil)	Funded Ratio						
5th Percentile	\$862	32%	\$866	31%	\$836	33%	\$876	31%	\$904	30%	\$930	28%
25th Percentile	\$688	49%	\$788	40%	\$686	48%	\$687	48%	\$685	48%	\$686	49%
50th Percentile	\$476	65%	\$729	47%	\$516	62%	\$451	67%	\$406	70%	\$351	74%
75th Percentile	\$189	87%	\$655	55%	\$296	80%	\$111	92%	(\$58)	104%	(\$299)	121%
95th Percentile	(\$685)	144%	\$506	67%	(\$297)	118%	(\$948)	162%	(\$1,574)	200%	(\$2,482)	267%

## Stochastic Analysis (continued)

### Projected Market Funded Ratio and Maximum 1 Year Investment Loss (market value of assets/actuarial accrued liability)

The tables below show the probability that the Plan will be at various funding levels for each of the six different asset mixes highlighted on the prior pages. The tables also illustrate the maximum 1 year investment loss each portfolio is expected to experience during the given time period as well as the maximum one year employer contribution (shown as a weighted average percentage of salary). The results assume the current contribution policy remains unchanged for all projection years.

5 Years	Probability of Full Funding in 2019	Probability of < 68% (Current) Funding in 2019	Probability of < 40% (Current) Funding in 2019	Maximum 1 Year Investment Loss	Maximum 1 Year Employer Contribution
Current Target	5%	65%	9%	-37%	26%
Conservative Portfolio	0%	94%	4%	-22%	25%
Potential Portfolio 1	2%	69%	6%	-32%	25%
Potential Portfolio 2	7%	63%	11%	-39%	26%
Potential Portfolio 3	11%	59%	14%	-44%	27%
Aggressive Portfolio	15%	56%	16%	-48%	28%

10 Years	Probability of Full Funding in 2024	Probability of < 68% (Current) Funding in 2024	Probability of < 40% (Current) Funding in 2024	Maximum 1 Year Investment Loss	Maximum 1 Year Employer Contribution
Current Target	10%	64%	18%	-37%	34%
Conservative Portfolio	0%	96%	27%	-22%	34%
Potential Portfolio 1	6%	68%	16%	-32%	33%
Potential Portfolio 2	13%	61%	19%	-39%	35%
Potential Portfolio 3	18%	57%	21%	-45%	36%
Aggressive Portfolio	23%	54%	23%	-50%	37%

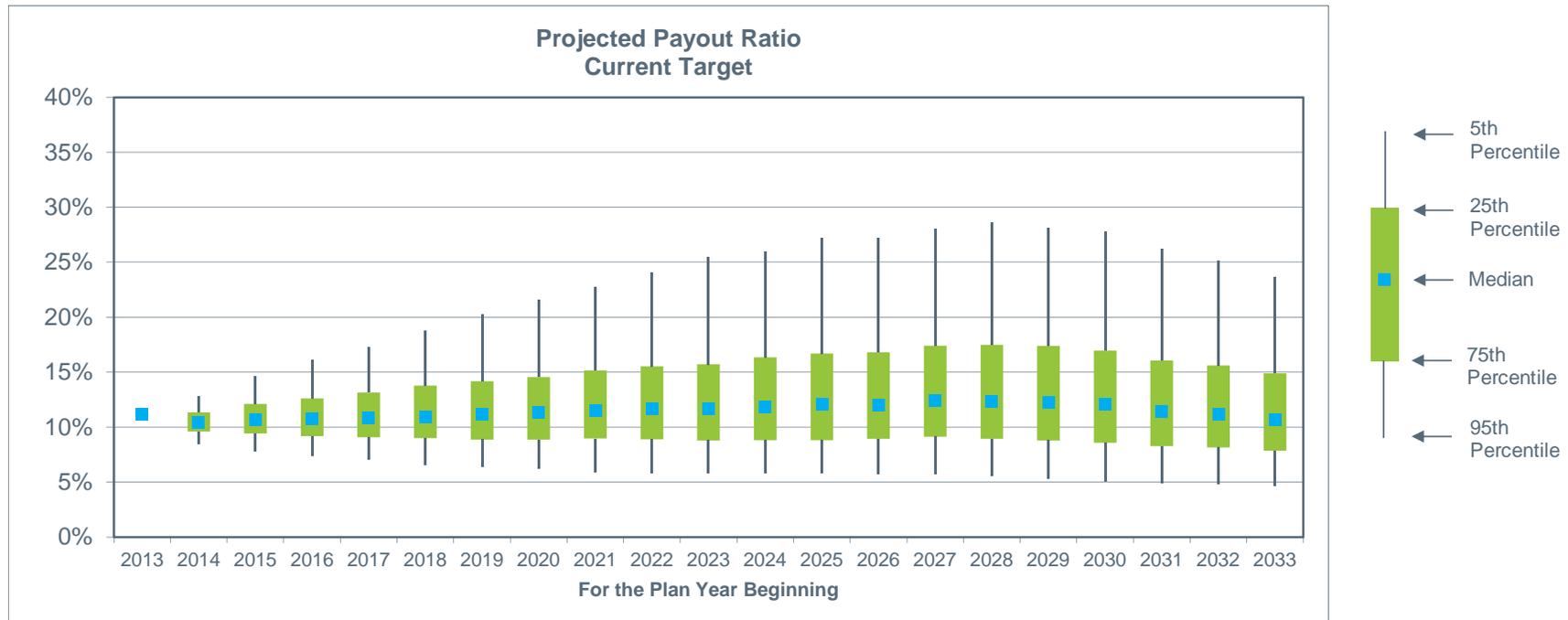
20 Years	Probability of Full Funding in 2034	Probability of < 68% (Current) Funding in 2034	Probability of < 40% (Current) Funding in 2034	Maximum 1 Year Investment Loss	Maximum 1 Year Employer Contribution
Current Target	17%	54%	14%	-38%	47%
Conservative Portfolio	0%	95%	24%	-22%	50%
Potential Portfolio 1	11%	59%	13%	-32%	47%
Potential Portfolio 2	21%	51%	14%	-41%	47%
Potential Portfolio 3	27%	48%	15%	-46%	47%
Aggressive Portfolio	33%	45%	16%	-51%	48%

## Stochastic Analysis (continued)

### Projected Payout Ratio (expected benefit payments/market value of assets); **Current Target**

The graph below displays the range of possible payout ratios over the next twenty years, assuming the Plan’s assets are allocated according to the **Current Target**. The results assume the current contribution policy remains unchanged for all projection years.

The median annual benefit payment as percentage of the market value of assets is expected to range between 10% and 12%. The worst-case scenario could reach 29% or higher.



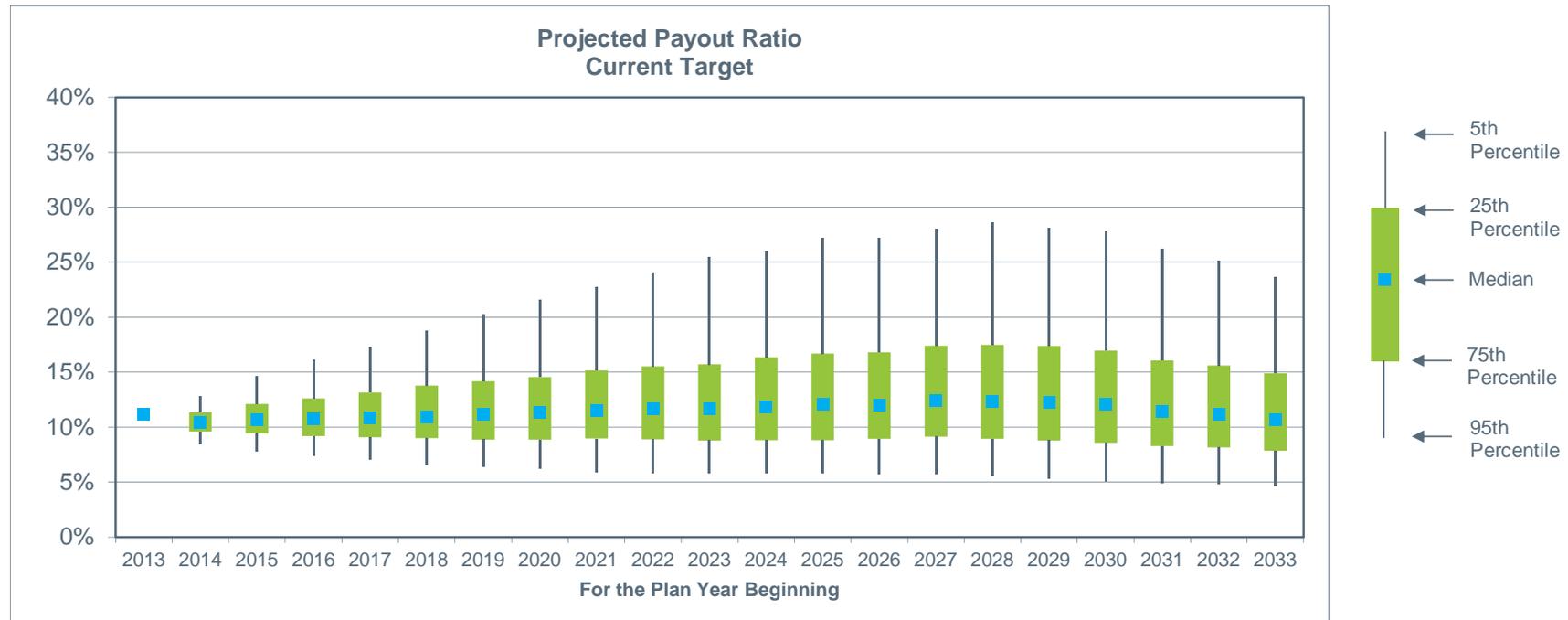
	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	
<b>Median</b>	11%	10%	11%	11%	11%	11%	11%	11%	11%	12%	12%	12%	12%	12%	12%	12%	12%	12%	12%	11%	11%	11%

## Stochastic Analysis (continued)

### Projected Payout Ratio (expected benefit payments/market value of assets); **Conservative Portfolio**

The graph below displays the range of possible payout ratios over the next twenty years, assuming the Plan’s assets are allocated according to the **Conservative Portfolio**. The results assume the current contribution policy remains unchanged for all projection years.

The median annual benefit payment as percentage of the market value of assets is expected to range between 11% and 17%. The worst-case scenario could reach 28% or higher.



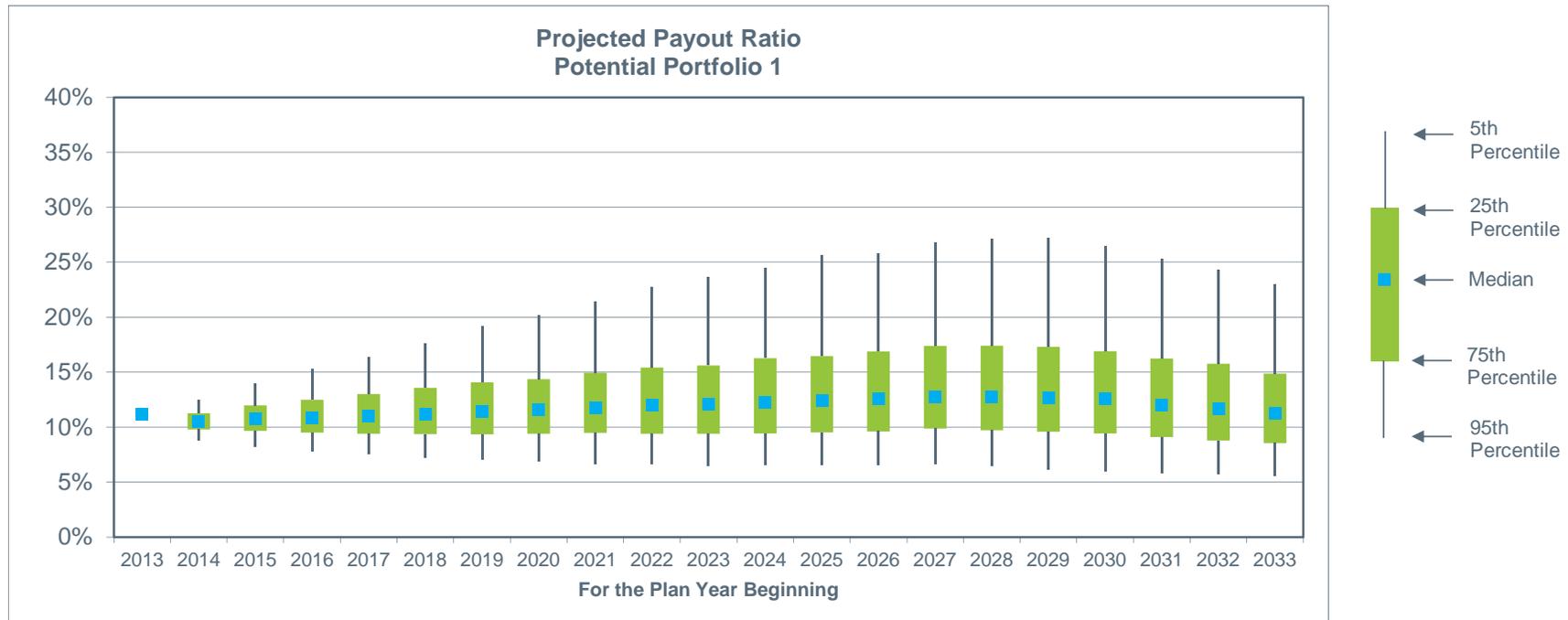
	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
<b>Median</b>	11%	11%	11%	12%	12%	13%	13%	14%	14%	15%	15%	16%	16%	17%	17%	17%	17%	17%	16%	16%	15%

## Stochastic Analysis (continued)

### Projected Payout Ratio (expected benefit payments/market value of assets); **Potential Portfolio 1**

The graph below displays the range of possible payout ratios over the next twenty years, assuming the Plan’s assets are allocated according to **Potential Portfolio 1**. The results assume the current contribution policy remains unchanged for all projection years.

The median annual benefit payment as percentage of the market value of assets is expected to range between 11% and 13%. The worst-case scenario could reach 27% or higher.



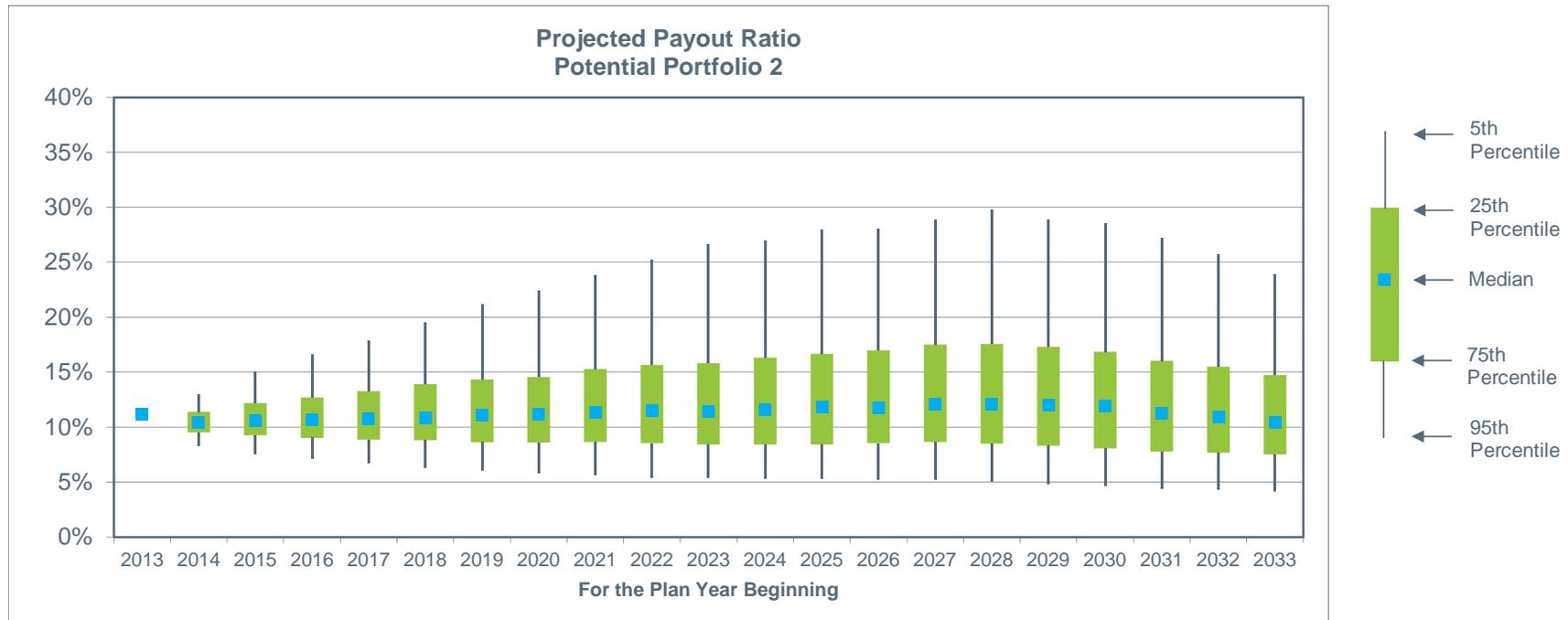
	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
<b>Median</b>	11%	11%	11%	11%	11%	11%	11%	12%	12%	12%	12%	12%	12%	13%	13%	13%	13%	13%	12%	12%	11%

## Stochastic Analysis (continued)

### Projected Payout Ratio (expected benefit payments/market value of assets); **Potential Portfolio 2**

The graph below displays the range of possible payout ratios over the next twenty years, assuming the Plan’s assets are allocated according to **Potential Portfolio 2**. The results assume the current contribution policy remains unchanged for all projection years.

The median annual benefit payment as percentage of the market value of assets is expected to range between 10% and 12%. The worst-case scenario could reach 30% or higher.



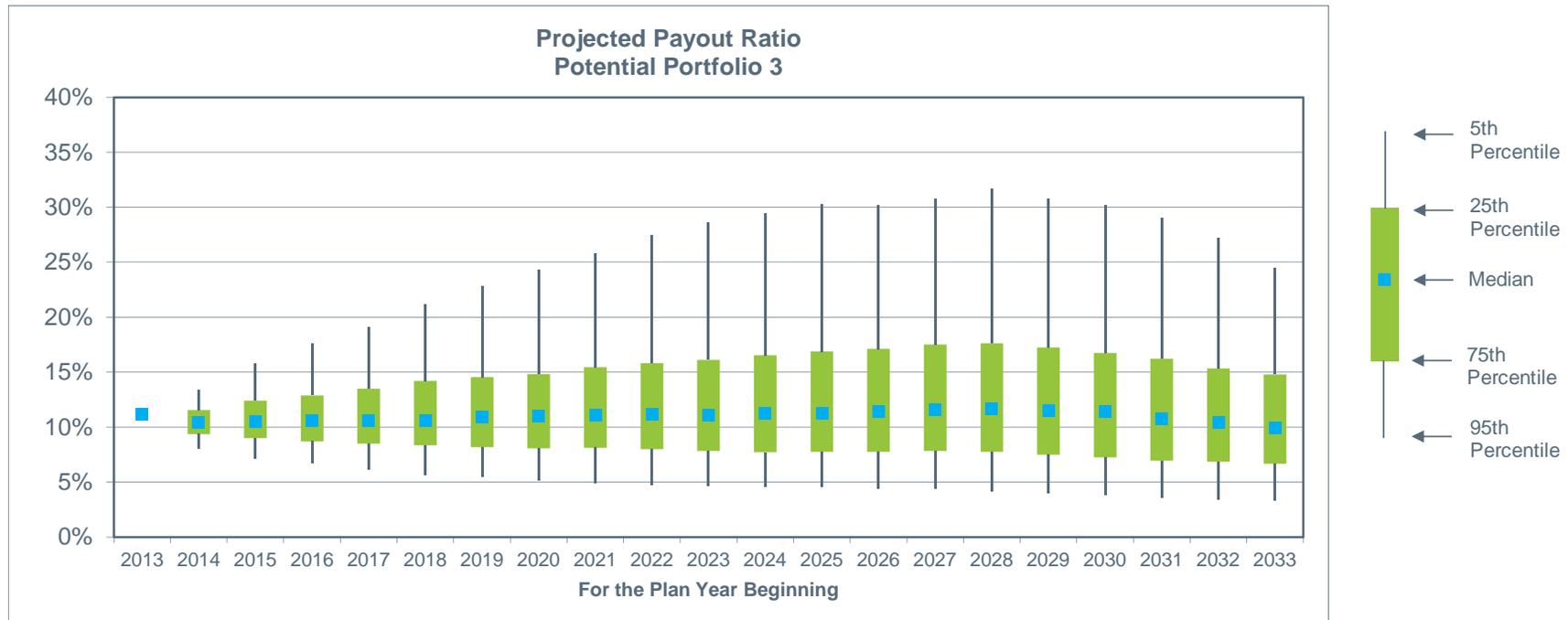
	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
<b>Median</b>	11%	10%	11%	11%	11%	11%	11%	11%	11%	11%	11%	12%	12%	12%	12%	12%	12%	12%	11%	11%	10%

## Stochastic Analysis (continued)

### Projected Payout Ratio (expected benefit payments/market value of assets); **Potential Portfolio 3**

The graph below displays the range of possible payout ratios over the next twenty years, assuming the Plan’s assets are allocated according to **Potential Portfolio 3**. The results assume the current contribution policy remains unchanged for all projection years.

The median annual benefit payment as percentage of the market value of assets is expected to range between 10% and 12%. The worst-case scenario could reach 32% or higher.



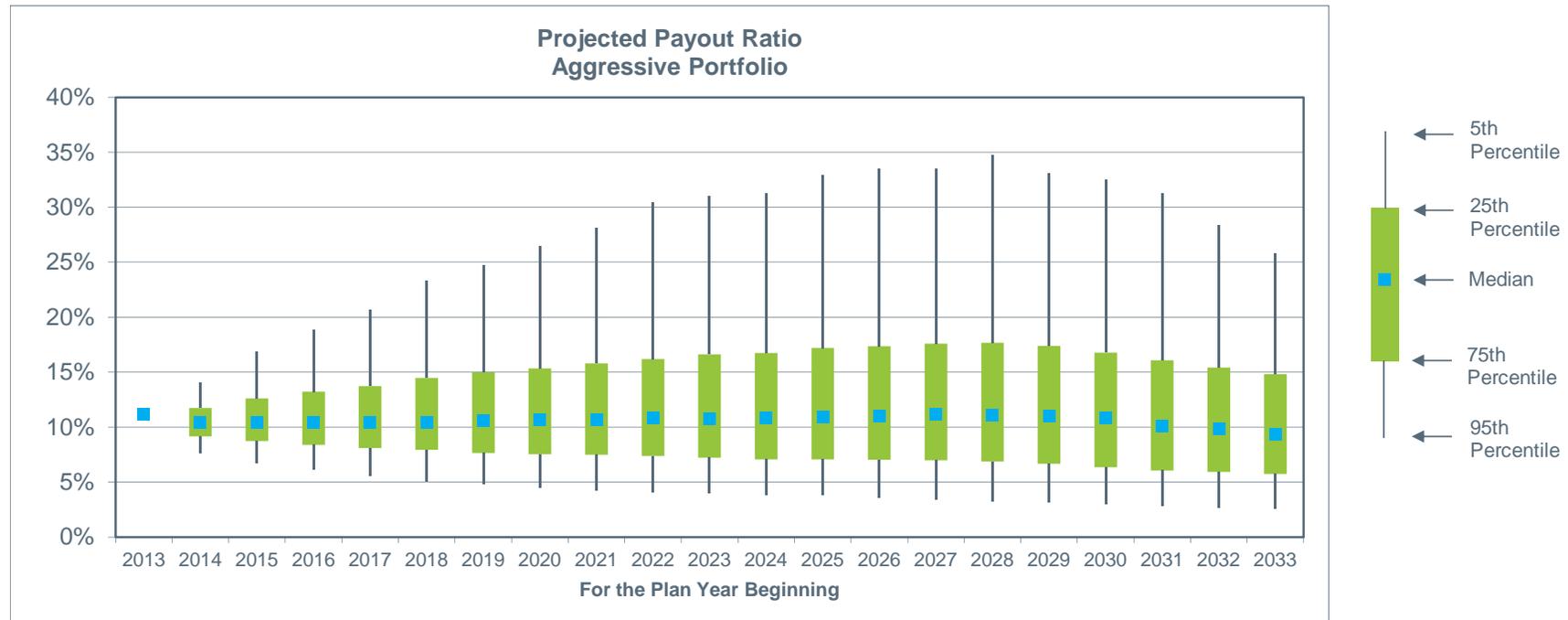
	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
<b>Median</b>	11%	10%	11%	11%	11%	11%	11%	11%	11%	11%	11%	11%	11%	11%	12%	12%	11%	11%	11%	10%	10%

## Stochastic Analysis (continued)

### Projected Payout Ratio (expected benefit payments/market value of assets); **Aggressive Portfolio**

The graph below displays the range of possible payout ratios over the next twenty years, assuming the Plan’s assets are allocated according to the **Aggressive Portfolio**. The results assume the current contribution policy remains unchanged for all projection years.

The median annual benefit payment as percentage of the market value of assets is expected to range between 9% and 11%. The worst-case scenario could reach 35% or higher.

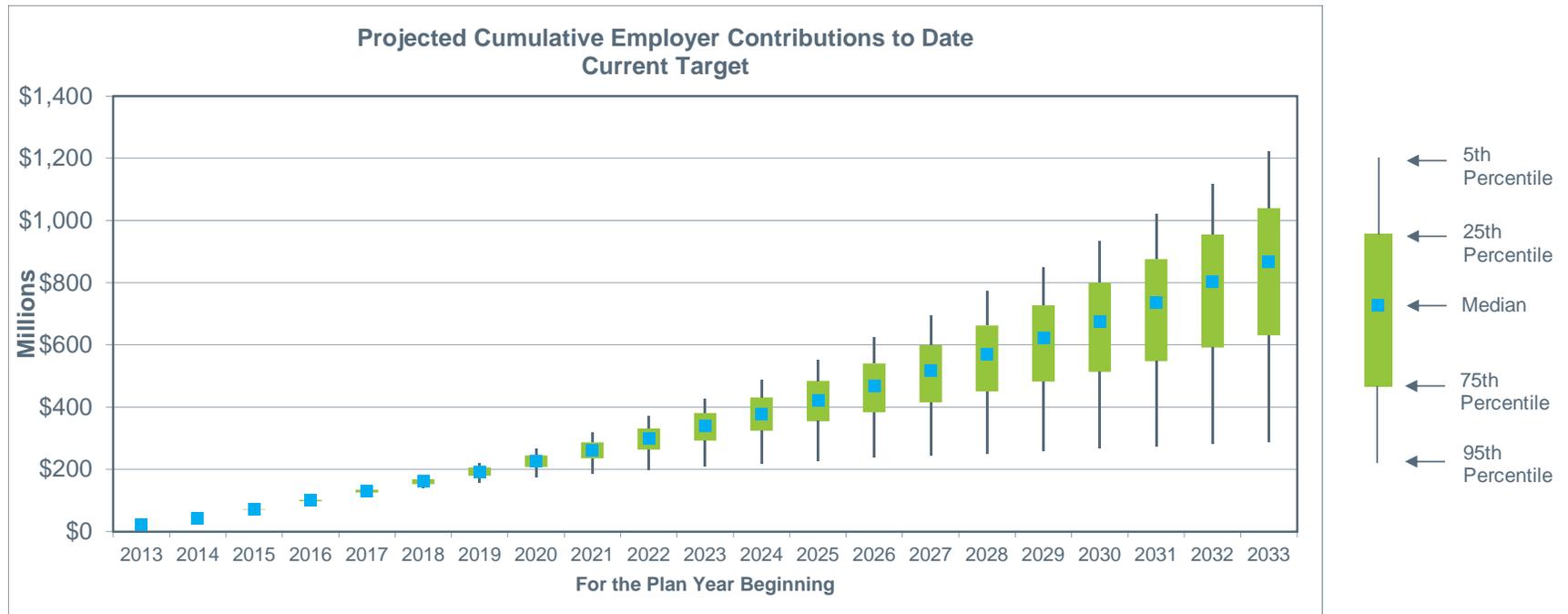


	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
<b>Median</b>	11%	10%	10%	10%	10%	10%	11%	11%	11%	11%	11%	11%	11%	11%	11%	11%	11%	11%	10%	10%	9%

## Stochastic Analysis (continued)

### Cumulative Employer Contributions to Date; Current Target

The graph and table below show the range of projected cumulative employer contributions over the next twenty years, assuming the Plan’s assets are allocated according to the **Current Target** (highlighted on the prior pages). The results assume the current contribution policy remains unchanged for all projection years.

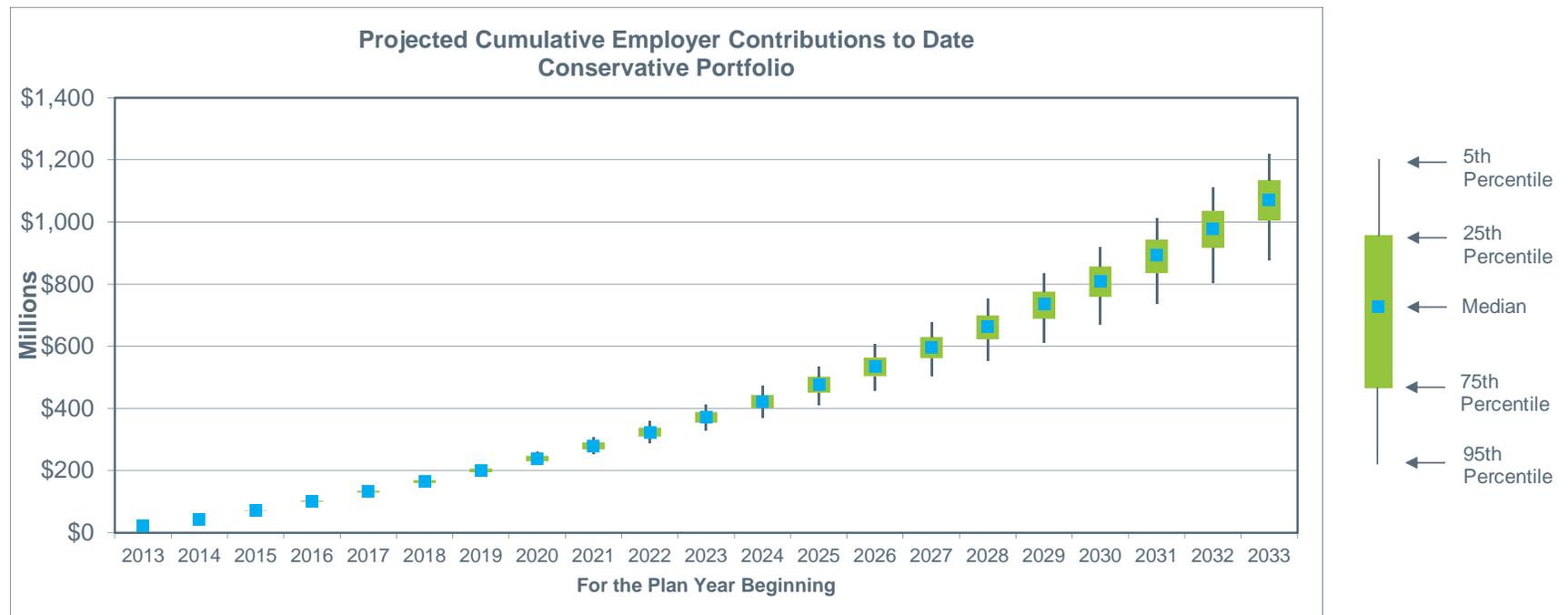


	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
<b>5th Percentile</b>	\$21	\$43	\$73	\$106	\$141	\$178	\$220	\$267	\$317	\$371	\$428	\$488	\$554	\$624	\$695	\$772	\$849	\$933	\$1,020	\$1,117	\$1,221
<b>25th Percentile</b>	\$21	\$43	\$72	\$102	\$135	\$168	\$205	\$245	\$287	\$332	\$380	\$431	\$484	\$541	\$599	\$663	\$728	\$800	\$876	\$955	\$1,039
<b>Median</b>	\$21	\$43	\$71	\$100	\$130	\$161	\$193	\$227	\$263	\$300	\$339	\$379	\$423	\$469	\$518	\$569	\$621	\$676	\$737	\$803	\$868
<b>75th Percentile</b>	\$21	\$43	\$70	\$98	\$125	\$152	\$180	\$207	\$235	\$264	\$293	\$324	\$355	\$384	\$416	\$450	\$482	\$513	\$548	\$591	\$630
<b>95th Percentile</b>	\$21	\$43	\$69	\$94	\$118	\$139	\$159	\$174	\$186	\$197	\$208	\$219	\$226	\$238	\$244	\$251	\$261	\$267	\$274	\$282	\$290

# Stochastic Analysis (continued)

## Cumulative Employer Contributions to Date; Conservative Portfolio

The graph and table below show the range of projected cumulative employer contributions over the next twenty years, assuming the Plan’s assets are allocated according to the **Conservative Portfolio** (highlighted on the prior pages). The results assume the current contribution policy remains unchanged for all projection years.

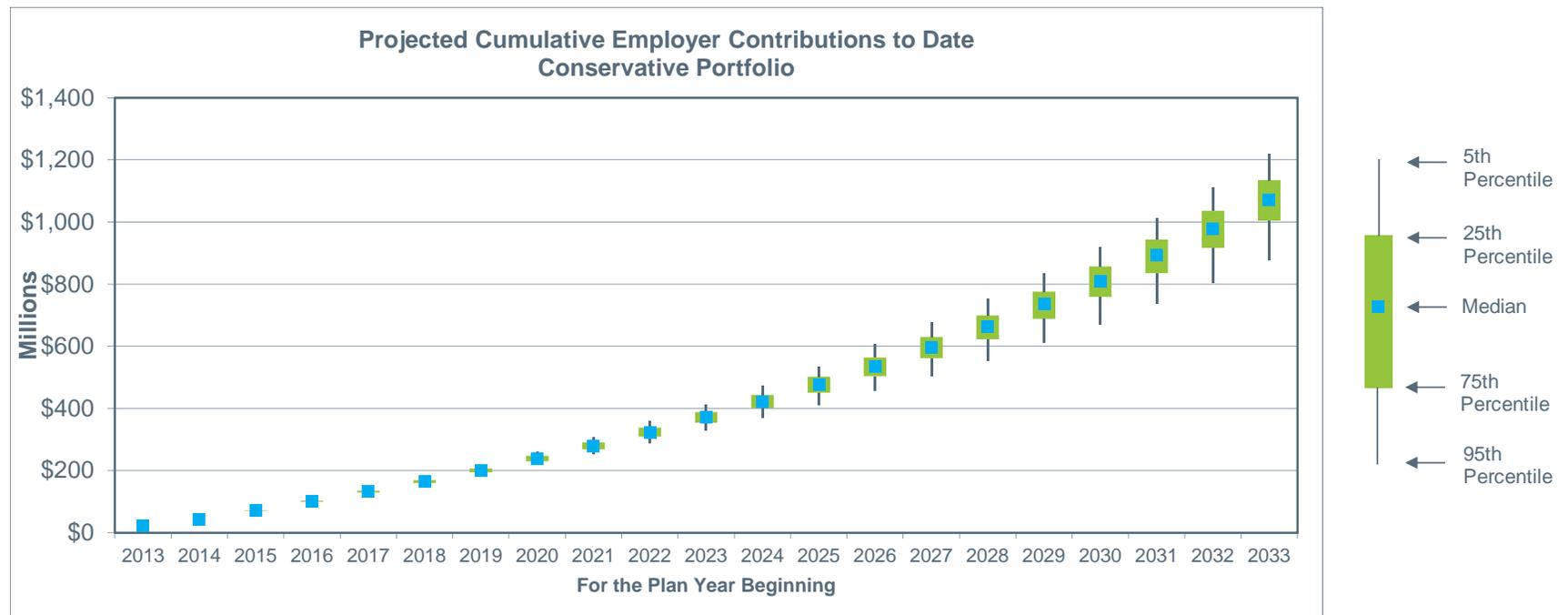


	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
<b>5th Percentile</b>	\$21	\$43	\$73	\$106	\$140	\$176	\$216	\$259	\$307	\$359	\$414	\$473	\$536	\$605	\$677	\$753	\$835	\$920	\$1,012	\$1,110	\$1,219
<b>25th Percentile</b>	\$21	\$43	\$72	\$103	\$135	\$169	\$207	\$247	\$290	\$338	\$389	\$443	\$502	\$563	\$630	\$699	\$776	\$857	\$944	\$1,036	\$1,135
<b>Median</b>	\$21	\$43	\$71	\$101	\$132	\$165	\$200	\$238	\$279	\$323	\$371	\$421	\$476	\$534	\$596	\$663	\$735	\$811	\$893	\$980	\$1,072
<b>75th Percentile</b>	\$21	\$43	\$70	\$99	\$129	\$160	\$194	\$230	\$268	\$309	\$354	\$401	\$451	\$504	\$562	\$622	\$688	\$759	\$836	\$917	\$1,004
<b>95th Percentile</b>	\$21	\$43	\$69	\$97	\$125	\$154	\$184	\$217	\$252	\$289	\$328	\$369	\$411	\$457	\$504	\$556	\$611	\$669	\$736	\$805	\$877

# Stochastic Analysis (continued)

## Cumulative Employer Contributions to Date; Potential Portfolio 1

The graph and table below show the range of projected cumulative employer contributions over the next twenty years, assuming the Plan’s assets are allocated according to **Potential Portfolio 1** (highlighted on the prior pages). The results assume the current contribution policy remains unchanged for all projection years.

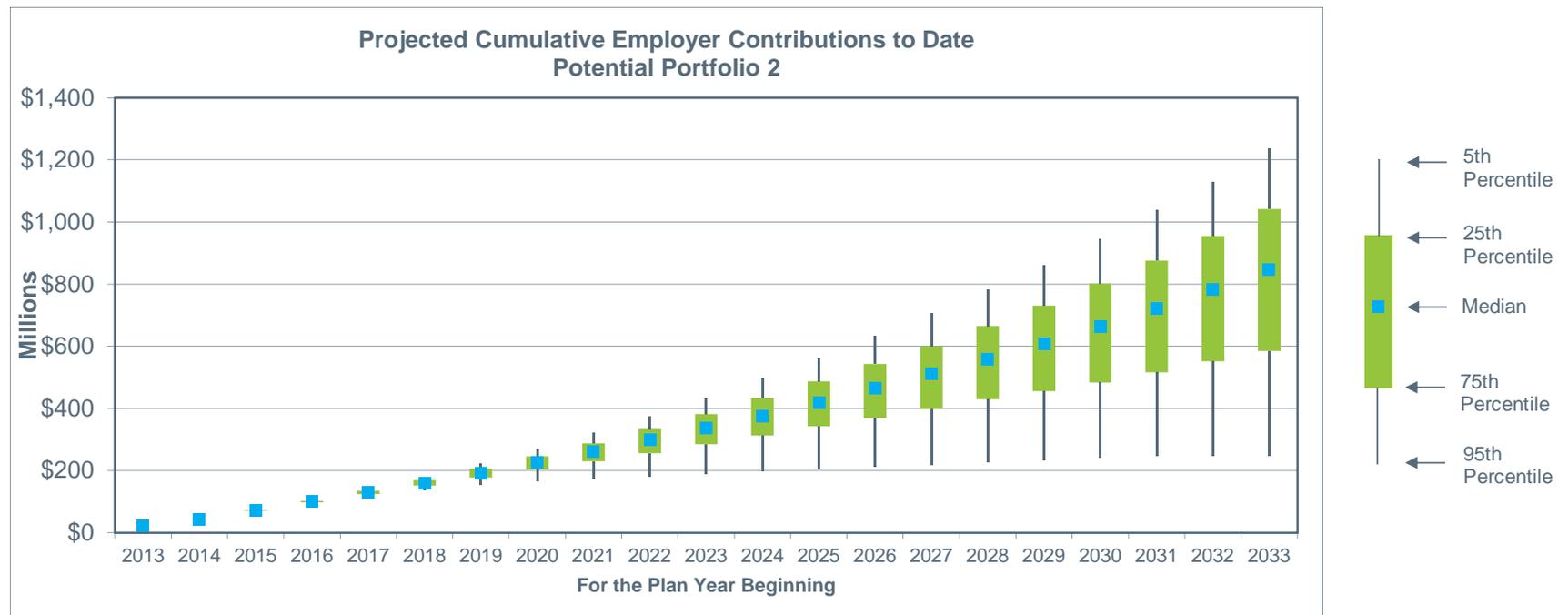


	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
<b>5th Percentile</b>	\$21	\$43	\$73	\$105	\$140	\$177	\$217	\$262	\$311	\$363	\$417	\$476	\$540	\$607	\$677	\$751	\$829	\$907	\$996	\$1,094	\$1,196
<b>25th Percentile</b>	\$21	\$43	\$72	\$102	\$134	\$168	\$204	\$243	\$285	\$329	\$377	\$428	\$481	\$537	\$596	\$658	\$725	\$797	\$874	\$953	\$1,039
<b>Median</b>	\$21	\$43	\$71	\$100	\$130	\$161	\$194	\$229	\$265	\$303	\$344	\$386	\$431	\$480	\$529	\$581	\$639	\$698	\$759	\$826	\$895
<b>75th Percentile</b>	\$21	\$43	\$70	\$98	\$126	\$154	\$183	\$212	\$243	\$274	\$306	\$340	\$374	\$407	\$447	\$487	\$527	\$568	\$607	\$660	\$711
<b>95th Percentile</b>	\$21	\$43	\$69	\$95	\$121	\$144	\$166	\$186	\$204	\$221	\$239	\$256	\$272	\$285	\$301	\$312	\$327	\$342	\$361	\$378	\$392

## Stochastic Analysis (continued)

### Cumulative Employer Contributions to Date; Potential Portfolio 2

The graph and table below show the range of projected cumulative employer contributions over the next twenty years, assuming the Plan’s assets are allocated according to **Potential Portfolio 2** (highlighted on the prior pages). The results assume the current contribution policy remains unchanged for all projection years.

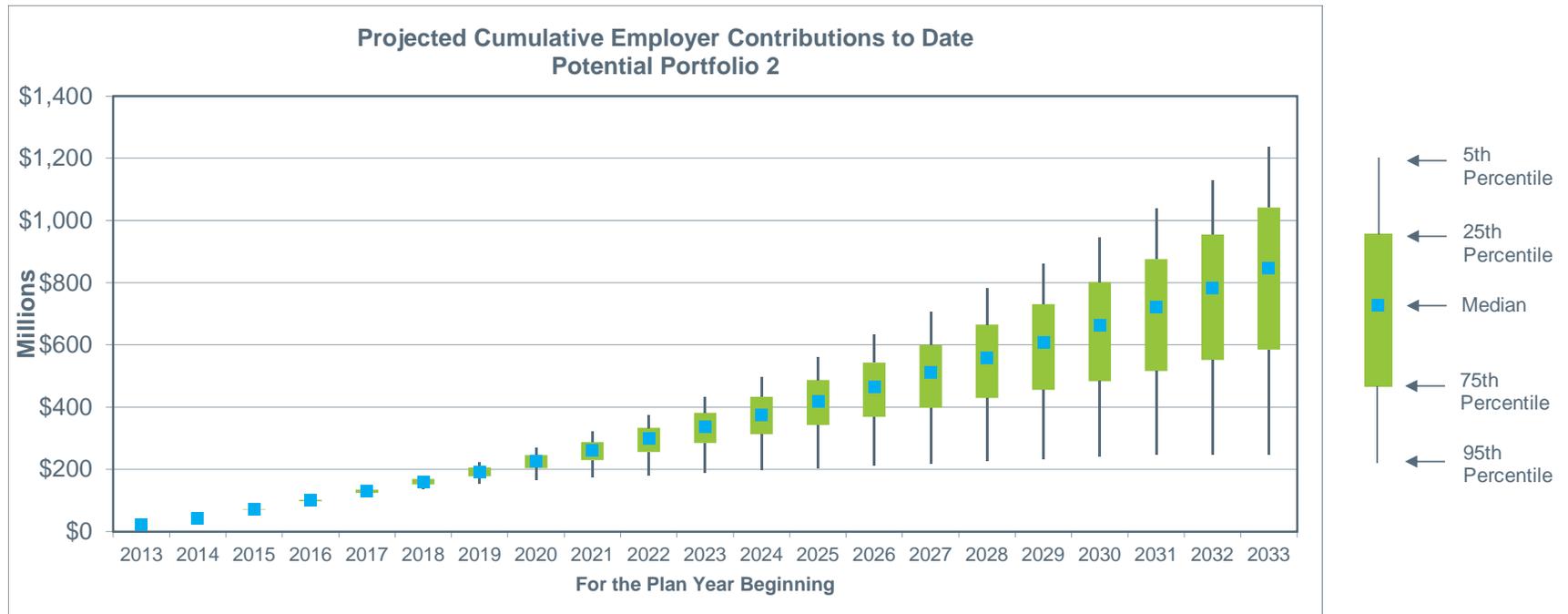


	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
<b>5th Percentile</b>	\$21	\$43	\$73	\$106	\$141	\$180	\$222	\$270	\$321	\$375	\$433	\$495	\$562	\$632	\$707	\$784	\$862	\$946	\$1,037	\$1,129	\$1,236
<b>25th Percentile</b>	\$21	\$43	\$72	\$103	\$135	\$169	\$206	\$246	\$288	\$333	\$381	\$433	\$487	\$543	\$600	\$665	\$732	\$802	\$875	\$955	\$1,041
<b>Median</b>	\$21	\$43	\$71	\$100	\$130	\$160	\$192	\$226	\$262	\$298	\$336	\$376	\$418	\$464	\$511	\$559	\$609	\$663	\$722	\$784	\$848
<b>75th Percentile</b>	\$21	\$43	\$70	\$98	\$125	\$151	\$178	\$204	\$230	\$256	\$285	\$313	\$343	\$368	\$398	\$429	\$456	\$483	\$516	\$551	\$585
<b>95th Percentile</b>	\$21	\$43	\$69	\$94	\$117	\$136	\$153	\$166	\$175	\$181	\$189	\$196	\$206	\$213	\$220	\$226	\$234	\$241	\$245	\$247	\$247

# Stochastic Analysis (continued)

## Cumulative Employer Contributions to Date; Potential Portfolio 3

The graph and table below show the range of projected cumulative employer contributions over the next twenty years, assuming the Plan’s assets are allocated according to **Potential Portfolio 3** (highlighted on the prior pages). The results assume the current contribution policy remains unchanged for all projection years.

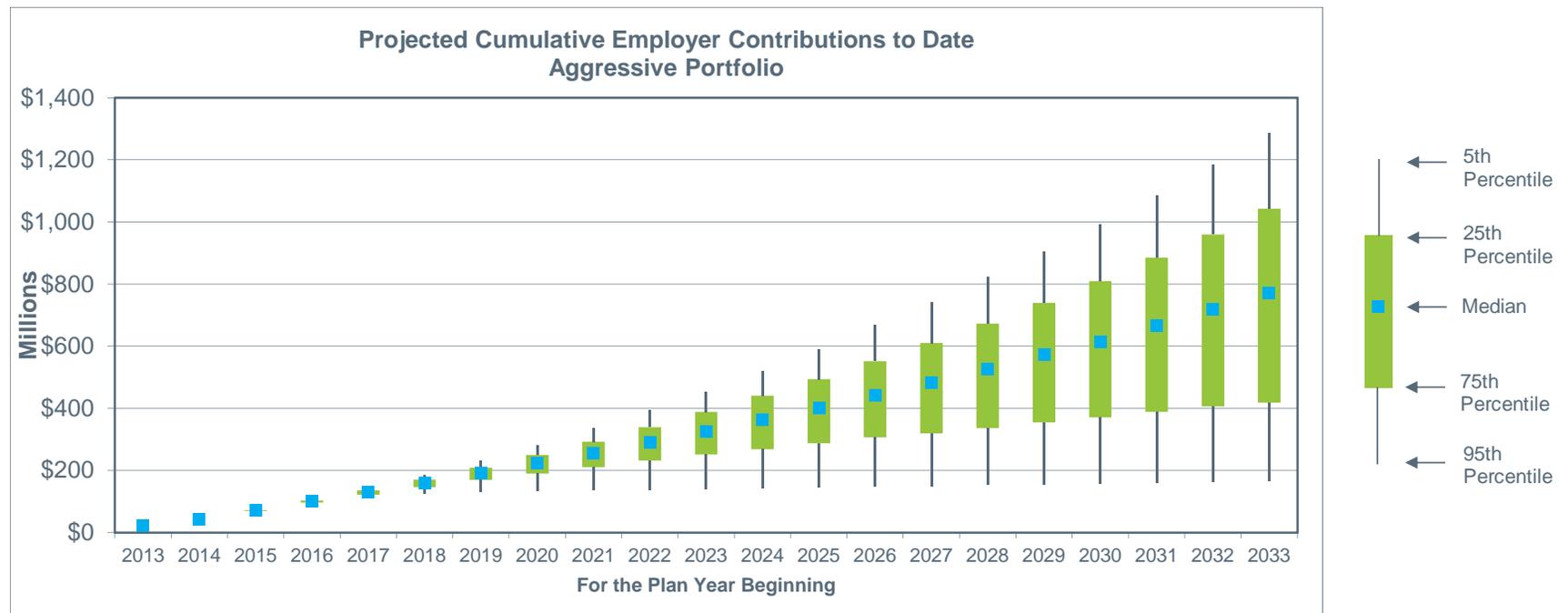


	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
<b>5th Percentile</b>	\$21	\$43	\$73	\$106	\$142	\$182	\$226	\$275	\$328	\$384	\$444	\$508	\$576	\$649	\$726	\$806	\$883	\$972	\$1,062	\$1,155	\$1,258
<b>25th Percentile</b>	\$21	\$43	\$72	\$103	\$135	\$170	\$207	\$247	\$290	\$336	\$384	\$436	\$491	\$546	\$604	\$668	\$735	\$804	\$880	\$957	\$1,043
<b>Median</b>	\$21	\$43	\$71	\$100	\$129	\$160	\$191	\$224	\$259	\$295	\$331	\$371	\$410	\$453	\$497	\$542	\$593	\$642	\$697	\$751	\$817
<b>75th Percentile</b>	\$21	\$43	\$70	\$97	\$123	\$149	\$174	\$197	\$221	\$246	\$268	\$293	\$316	\$341	\$359	\$385	\$407	\$427	\$446	\$475	\$498
<b>95th Percentile</b>	\$21	\$43	\$69	\$93	\$114	\$131	\$143	\$149	\$155	\$158	\$163	\$166	\$170	\$173	\$180	\$187	\$190	\$193	\$198	\$203	\$205

## Stochastic Analysis (continued)

### Cumulative Employer Contributions to Date; Aggressive Portfolio

The graph and table below show the range of projected cumulative employer contributions over the next twenty years, assuming the Plan’s assets are allocated according to the **Aggressive Portfolio** (highlighted on the prior pages). The results assume the current contribution policy remains unchanged for all projection years.



	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
<b>5th Percentile</b>	\$21	\$43	\$73	\$107	\$144	\$184	\$230	\$281	\$336	\$394	\$454	\$520	\$591	\$668	\$742	\$824	\$905	\$993	\$1,085	\$1,183	\$1,286
<b>25th Percentile</b>	\$21	\$43	\$72	\$103	\$136	\$171	\$209	\$249	\$293	\$339	\$388	\$441	\$494	\$551	\$610	\$672	\$740	\$809	\$885	\$959	\$1,043
<b>Median</b>	\$21	\$43	\$71	\$100	\$129	\$159	\$190	\$222	\$256	\$291	\$326	\$363	\$401	\$441	\$481	\$526	\$571	\$614	\$667	\$718	\$772
<b>75th Percentile</b>	\$21	\$43	\$70	\$97	\$122	\$146	\$169	\$190	\$210	\$231	\$251	\$268	\$288	\$306	\$319	\$336	\$355	\$370	\$388	\$406	\$418
<b>95th Percentile</b>	\$21	\$43	\$68	\$92	\$110	\$123	\$131	\$133	\$134	\$136	\$138	\$143	\$145	\$147	\$150	\$153	\$155	\$157	\$161	\$162	\$165

## Stochastic Analysis (continued)

### Employer Contributions (as a weighted average percentage of salary)

The tables below show the range of required employer contributions (as a weighted average percentage of salary) assuming the six different asset mixes highlighted on the prior pages. The results assume the current contribution policy remains unchanged for all projection years.

5 Years	Required Employer Contribution for Plan Year Beginning 2019				
	5th	25th	50th	75th	95th
Current Target	26%	22%	20%	17%	13%
Conservative Portfolio	25%	23%	21%	20%	17%
Potential Portfolio 1	25%	22%	20%	17%	14%
Potential Portfolio 2	26%	22%	19%	16%	12%
Potential Portfolio 3	27%	23%	19%	16%	10%
Aggressive Portfolio	28%	23%	19%	15%	8%

10 Years	Required Employer Contribution for Plan Year Beginning 2024				
	5th	25th	50th	75th	95th
Current Target	34%	27%	21%	14%	2%
Conservative Portfolio	34%	28%	25%	22%	16%
Potential Portfolio 1	33%	27%	21%	16%	6%
Potential Portfolio 2	35%	27%	20%	13%	0%
Potential Portfolio 3	36%	27%	20%	11%	0%
Aggressive Portfolio	37%	27%	19%	9%	0%

20 Years	Required Employer Contribution for Plan Year Beginning 2034				
	5th	25th	50th	75th	95th
Current Target	47%	33%	23%	11%	0%
Conservative Portfolio	50%	38%	32%	26%	18%
Potential Portfolio 1	47%	33%	24%	15%	0%
Potential Portfolio 2	47%	33%	22%	9%	0%
Potential Portfolio 3	47%	33%	21%	4%	0%
Aggressive Portfolio	48%	33%	19%	0%	0%

## Stochastic Analysis (continued)

### Drawing Inferences

The tables below compare the projected actuarial and market funded ratios five, ten, and twenty years from now, under the median (50<sup>th</sup> percentile), worst-case (5<sup>th</sup> percentile), and best-case (95<sup>th</sup> percentile) scenarios, assuming the six different asset mixes highlighted on the prior pages. The table also displays for comparative purposes the median, peak, and trough projected payout ratios and cumulative employer contributions assuming the same six asset mixes being examined.

5 Years	Actuarial Funded Ratio in Year 5			Market Funded Ratio in Year 5			Cumulative Employer Contributions in Year 5 (Millions)			Payout Ratios		
	50th	5th	95th	50th	5th	95th	50th	5th	95th	Year 5 Median	2014-2019	
											Peak	Trough
Current Target	63%	45%	89%	61%	36%	100%	\$161	\$178	\$139	11%	19%	7%
Conservative Portfolio	58%	49%	68%	53%	42%	68%	\$165	\$176	\$154	13%	17%	10%
Potential Portfolio 1	62%	47%	83%	60%	39%	91%	\$161	\$177	\$144	11%	18%	7%
Potential Portfolio 2	64%	44%	93%	62%	35%	105%	\$160	\$180	\$136	11%	20%	6%
Potential Portfolio 3	65%	41%	100%	63%	32%	117%	\$160	\$182	\$131	11%	21%	6%
Aggressive Portfolio	66%	39%	109%	64%	29%	132%	\$159	\$184	\$123	10%	23%	5%

10 Years	Actuarial Funded Ratio in Year 10			Market Funded Ratio in Year 10			Cumulative Employer Contributions in Year 10 (Millions)			Payout Ratios		
	50th	5th	95th	50th	5th	95th	50th	5th	95th	Year 10 Median	2014-2024	
											Peak	Trough
Current Target	61%	33%	111%	59%	28%	116%	\$339	\$428	\$208	12%	25%	6%
Conservative Portfolio	50%	36%	68%	46%	31%	67%	\$371	\$414	\$328	15%	23%	10%
Potential Portfolio 1	60%	36%	100%	58%	31%	105%	\$344	\$417	\$239	12%	24%	6%
Potential Portfolio 2	63%	32%	120%	61%	27%	125%	\$336	\$433	\$189	11%	27%	5%
Potential Portfolio 3	64%	30%	135%	62%	25%	145%	\$331	\$444	\$163	11%	29%	5%
Aggressive Portfolio	66%	28%	159%	64%	23%	172%	\$326	\$454	\$138	11%	31%	4%

20 Years	Actuarial Funded Ratio in Year 20			Market Funded Ratio in Year 20			Cumulative Employer Contributions in Year 20 (Millions)			Payout Ratios		
	50th	5th	95th	50th	5th	95th	50th	5th	95th	Year 20 Median	2014-2034	
											Peak	Trough
Current Target	67%	36%	140%	65%	32%	144%	\$868	\$1,221	\$290	11%	29%	5%
Conservative Portfolio	51%	36%	70%	47%	31%	67%	\$1,072	\$1,219	\$877	15%	28%	10%
Potential Portfolio 1	65%	38%	117%	62%	33%	118%	\$895	\$1,196	\$392	11%	27%	6%
Potential Portfolio 2	69%	36%	157%	67%	31%	162%	\$848	\$1,236	\$247	10%	30%	4%
Potential Portfolio 3	71%	35%	199%	70%	30%	200%	\$817	\$1,258	\$205	10%	32%	3%
Aggressive Portfolio	75%	33%	255%	74%	28%	267%	\$772	\$1,286	\$165	9%	35%	3%

## Appendix 1: Sensitivity Analysis: “Effect of Higher Volatility”

This section provides a sensitivity analysis of the original stochastic projections by assuming the risk (as measured by standard deviation) of each asset class is doubled. These modified assumptions are outlined in the table below, compared to the original values:

Asset Class	Arithmetic Return Assumption	Standard Deviation Assumption	Standard Deviation Assumption Doubled
Global Equity	7.80	18.35	36.70
Int. Duration Fixed Income	3.50	6.00	12.00
Custom KRS Fixed Income	5.83	10.79	21.58
Core Real Estate	6.75	12.50	25.00
Diversified Hedge Funds	6.50	9.50	19.00
Private Equity	10.50	26.00	52.00
Diversified Inflation Strategies	5.65	11.45	22.90
Cash Equivalents	2.25	3.00	6.00

RVK supports the recommendations based on the original assumptions shown in the Stochastic Analysis section of this report. However, this stress-testing illustrates that potential increased capital market volatility does not change the asset allocation recommendations, based on the current status of the Plan. Instead it simply widens the range of potential results, exacerbating the potential best and worst-case scenarios.

## Appendix 1: Sensitivity Analysis: “Effect of Higher Volatility” (continued)

### Projected Market Funded Ratio and Maximum 1 Year Investment Loss (market value of assets/actuarial accrued liability)

The tables below show the probability that the Plan will be at various funding levels for each of the six different asset mixes highlighted on the prior pages. The tables also illustrate the maximum 1 year investment loss each portfolio is expected to experience during the given time period as well as the maximum one year employer contribution (shown as a weighted average percentage of salary). The results assume the current contribution policy remains unchanged for all projection years.

5 Years	Probability of Full Funding in 2019	Probability of < 68% (Current) Funding in 2019	Probability of < 40% (Current) Funding in 2019	Maximum 1 Year Investment Loss	Maximum 1 Year Employer Contribution
Current Target	19%	57%	26%	-62%	33%
Conservative Portfolio	1%	80%	18%	-41%	29%
Potential Portfolio 1	15%	59%	23%	-56%	32%
Potential Portfolio 2	22%	56%	26%	-65%	34%
Potential Portfolio 3	25%	54%	28%	-70%	35%
Aggressive Portfolio	29%	53%	30%	-74%	37%

10 Years	Probability of Full Funding in 2024	Probability of < 68% (Current) Funding in 2024	Probability of < 40% (Current) Funding in 2024	Maximum 1 Year Investment Loss	Maximum 1 Year Employer Contribution
Current Target	26%	57%	32%	-62%	46%
Conservative Portfolio	4%	81%	38%	-41%	44%
Potential Portfolio 1	21%	60%	30%	-56%	45%
Potential Portfolio 2	29%	55%	32%	-65%	46%
Potential Portfolio 3	32%	53%	33%	-71%	47%
Aggressive Portfolio	35%	51%	33%	-76%	49%

20 Years	Probability of Full Funding in 2034	Probability of < 68% (Current) Funding in 2034	Probability of < 40% (Current) Funding in 2034	Maximum 1 Year Investment Loss	Maximum 1 Year Employer Contribution
Current Target	34%	49%	27%	-63%	71%
Conservative Portfolio	4%	79%	35%	-41%	72%
Potential Portfolio 1	28%	53%	26%	-56%	71%
Potential Portfolio 2	38%	47%	26%	-67%	71%
Potential Portfolio 3	42%	45%	27%	-72%	70%
Aggressive Portfolio	45%	43%	27%	-77%	70%

## Appendix 1: Sensitivity Analysis: “Effect of Higher Volatility” (continued)

### Drawing Inferences

The tables below compare the projected actuarial and market funded ratios five, ten, and twenty years from now, under the median (50<sup>th</sup> percentile), worst-case (5<sup>th</sup> percentile), and best-case (95<sup>th</sup> percentile) scenarios, assuming the six different asset mixes highlighted on the prior pages. The table also displays for comparative purposes the median, peak, and trough projected payout ratios and cumulative employer contributions assuming the same six asset mixes being examined.

5 Years	Actuarial Funded Ratio in Year 5			Market Funded Ratio in Year 5			Cumulative Employer Contributions in Year 5 (Millions)			Payout Ratios		
	50th	5th	95th	50th	5th	95th	50th	5th	95th	Year 5 Median	2014-2019	
											Peak	Trough
Current Target	64%	30%	126%	62%	21%	160%	\$160	\$197	\$112	11%	32%	4%
Conservative Portfolio	58%	42%	79%	54%	32%	86%	\$165	\$188	\$144	13%	22%	7%
Potential Portfolio 1	63%	34%	111%	60%	25%	137%	\$161	\$193	\$123	11%	28%	5%
Potential Portfolio 2	64%	27%	135%	63%	20%	175%	\$160	\$201	\$106	11%	35%	4%
Potential Portfolio 3	65%	24%	154%	63%	16%	212%	\$159	\$206	\$96	11%	42%	3%
Aggressive Portfolio	66%	20%	183%	64%	13%	256%	\$158	\$213	\$84	10%	51%	3%

10 Years	Actuarial Funded Ratio in Year 10			Market Funded Ratio in Year 10			Cumulative Employer Contributions in Year 10 (Millions)			Payout Ratios		
	50th	5th	95th	50th	5th	95th	50th	5th	95th	Year 10 Median	2014-2024	
											Peak	Trough
Current Target	62%	18%	207%	60%	13%	225%	\$338	\$494	\$121	11%	55%	3%
Conservative Portfolio	50%	25%	92%	46%	21%	94%	\$370	\$456	\$276	15%	36%	7%
Potential Portfolio 1	60%	20%	166%	58%	16%	183%	\$341	\$475	\$140	12%	48%	3%
Potential Portfolio 2	63%	16%	232%	62%	12%	259%	\$333	\$505	\$112	11%	60%	3%
Potential Portfolio 3	66%	14%	291%	64%	11%	336%	\$328	\$522	\$99	11%	71%	2%
Aggressive Portfolio	67%	12%	388%	66%	9%	452%	\$321	\$538	\$90	10%	87%	1%

20 Years	Actuarial Funded Ratio in Year 20			Market Funded Ratio in Year 20			Cumulative Employer Contributions in Year 20 (Millions)			Payout Ratios		
	50th	5th	95th	50th	5th	95th	50th	5th	95th	Year 20 Median	2014-2034	
											Peak	Trough
Current Target	71%	23%	370%	70%	18%	391%	\$848	\$1,402	\$137	10%	65%	2%
Conservative Portfolio	52%	24%	97%	48%	20%	96%	\$1,066	\$1,344	\$567	15%	51%	6%
Potential Portfolio 1	67%	23%	266%	65%	19%	277%	\$875	\$1,350	\$180	11%	58%	2%
Potential Portfolio 2	73%	22%	448%	72%	17%	477%	\$829	\$1,423	\$125	9%	69%	1%
Potential Portfolio 3	76%	21%	649%	78%	16%	714%	\$800	\$1,471	\$107	9%	79%	1%
Aggressive Portfolio	82%	20%	961%	87%	15%	1079%	\$753	\$1,503	\$94	8%	90%	1%

## Appendix 2: Sensitivity Analysis: “Effect of Higher Correlations”

This section provides a sensitivity analysis of the original stochastic projections by assuming that all asset classes are perfectly positively correlated (i.e. correlation = 1.00). A correlation matrix reflecting these modified assumptions is provided below:

	Global Equity	Int. Duration Fixed Income	Custom KRS Fixed Income	Core Real Estate	Diversified Hedge Funds	Private Equity	Diversified Inflation Strategies	Cash Equivalents
Global Equity	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Int. Duration Fixed Income	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Custom KRS Fixed Income	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Core Real Estate	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Diversified Hedge Funds	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Private Equity	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Diversified Inflation Strategies	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Cash Equivalents	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

RVK supports the recommendations based on the original assumptions shown in the Stochastic Analysis section of this report. However, this stress-testing illustrates that converging correlations across capital markets does not change the asset allocation recommendations, based on the current status of the Plan. Instead it simply widens the range of potential results, indicating higher risk for all asset mixes given the dampened effects of total fund diversification.

## Appendix 2: Sensitivity Analysis: “Effect of Higher Correlations” (continued)

**Projected Market Funded Ratio and Maximum 1 Year Investment Loss** (market value of assets/actuarial accrued liability)

The tables below show the probability that the Plan will be at various funding levels for each of the six different asset mixes highlighted on the prior pages. The tables also illustrate the maximum 1 year investment loss each portfolio is expected to experience during the given time period as well as the maximum one year employer contribution (shown as a weighted average percentage of salary). The results assume the current contribution policy remains unchanged for all projection years.

5 Years	Probability of Full Funding in 2019	Probability of < 68% (Current) Funding in 2019	Probability of < 40% (Current) Funding in 2019	Maximum 1 Year Investment Loss	Maximum 1 Year Employer Contribution
Current Target	13%	61%	16%	-41%	29%
Conservative Portfolio	0%	85%	10%	-23%	27%
Potential Portfolio 1	10%	63%	15%	-38%	28%
Potential Portfolio 2	14%	59%	16%	-43%	29%
Potential Portfolio 3	17%	57%	18%	-47%	30%
Aggressive Portfolio	20%	55%	20%	-51%	31%

10 Years	Probability of Full Funding in 2024	Probability of < 68% (Current) Funding in 2024	Probability of < 40% (Current) Funding in 2024	Maximum 1 Year Investment Loss	Maximum 1 Year Employer Contribution
Current Target	19%	59%	26%	-41%	40%
Conservative Portfolio	1%	87%	33%	-23%	37%
Potential Portfolio 1	16%	61%	26%	-38%	39%
Potential Portfolio 2	21%	57%	26%	-43%	40%
Potential Portfolio 3	25%	55%	26%	-47%	41%
Aggressive Portfolio	29%	53%	26%	-51%	42%

20 Years	Probability of Full Funding in 2034	Probability of < 68% (Current) Funding in 2034	Probability of < 40% (Current) Funding in 2034	Maximum 1 Year Investment Loss	Maximum 1 Year Employer Contribution
Current Target	25%	54%	22%	-48%	56%
Conservative Portfolio	1%	86%	33%	-29%	55%
Potential Portfolio 1	21%	57%	23%	-46%	55%
Potential Portfolio 2	28%	52%	22%	-50%	56%
Potential Portfolio 3	33%	49%	22%	-54%	57%
Aggressive Portfolio	36%	46%	22%	-58%	57%

## Appendix 2: Sensitivity Analysis: “Effect of Higher Correlations” (continued)

### Drawing Inferences

The tables below compare the projected actuarial and market funded ratios five, ten, and twenty years from now, under the median (50<sup>th</sup> percentile), worst-case (5<sup>th</sup> percentile), and best-case (95<sup>th</sup> percentile) scenarios, assuming the six different asset mixes highlighted on the prior pages. The table also displays for comparative purposes the median, peak, and trough projected payout ratios and cumulative employer contributions assuming the same six asset mixes being examined.

5 Years	Actuarial Funded Ratio in Year 5			Market Funded Ratio in Year 5			Cumulative Employer Contributions in Year 5 (Millions)			Payout Ratios		
	50th	5th	95th	50th	5th	95th	50th	5th	95th	Year 5 Median	2014-2019	
											Peak	Trough
Current Target	64%	40%	102%	61%	30%	121%	\$160	\$175	\$136	11%	23%	5%
Conservative Portfolio	58%	46%	74%	53%	37%	78%	\$164	\$170	\$158	13%	19%	8%
Potential Portfolio 1	63%	41%	97%	60%	31%	114%	\$161	\$174	\$140	11%	22%	6%
Potential Portfolio 2	64%	39%	105%	62%	30%	127%	\$160	\$176	\$133	11%	24%	5%
Potential Portfolio 3	65%	37%	113%	63%	28%	139%	\$159	\$178	\$127	11%	25%	5%
Aggressive Portfolio	65%	34%	122%	64%	26%	154%	\$158	\$180	\$119	11%	27%	4%

10 Years	Actuarial Funded Ratio in Year 10			Market Funded Ratio in Year 10			Cumulative Employer Contributions in Year 10 (Millions)			Payout Ratios		
	50th	5th	95th	50th	5th	95th	50th	5th	95th	Year 10 Median	2014-2024	
											Peak	Trough
Current Target	62%	26%	143%	59%	22%	152%	\$339	\$426	\$159	12%	34%	4%
Conservative Portfolio	50%	31%	80%	46%	26%	78%	\$370	\$407	\$307	15%	29%	8%
Potential Portfolio 1	60%	27%	130%	57%	22%	137%	\$343	\$422	\$172	12%	33%	5%
Potential Portfolio 2	63%	25%	152%	60%	21%	163%	\$336	\$429	\$153	12%	35%	4%
Potential Portfolio 3	65%	24%	172%	62%	19%	187%	\$332	\$436	\$137	11%	38%	3%
Aggressive Portfolio	66%	23%	199%	64%	18%	219%	\$327	\$444	\$125	11%	42%	3%

20 Years	Actuarial Funded Ratio in Year 20			Market Funded Ratio in Year 20			Cumulative Employer Contributions in Year 20 (Millions)			Payout Ratios		
	50th	5th	95th	50th	5th	95th	50th	5th	95th	Year 20 Median	2014-2034	
											Peak	Trough
Current Target	67%	29%	216%	64%	24%	226%	\$863	\$1,225	\$185	11%	43%	3%
Conservative Portfolio	51%	31%	81%	47%	26%	81%	\$1,070	\$1,196	\$749	15%	38%	8%
Potential Portfolio 1	64%	30%	182%	62%	25%	189%	\$894	\$1,217	\$211	11%	42%	3%
Potential Portfolio 2	68%	29%	243%	66%	23%	257%	\$842	\$1,232	\$169	11%	45%	2%
Potential Portfolio 3	71%	28%	303%	70%	23%	323%	\$809	\$1,246	\$146	10%	49%	2%
Aggressive Portfolio	75%	27%	392%	74%	21%	419%	\$774	\$1,263	\$133	10%	53%	2%

## Appendix 3: Assumptions and Methods

---

**Actuarial Valuation Assumptions and Methods:** At the beginning of each projection year, an actuarial valuation is performed to determine employer contributions. The assumptions proposed in the 2013 Experience Study were used with actuarial valuations beginning in 2015 and beyond. These methods and assumptions are summarized below:

<b>Actuarial Cost Method</b>	Entry-Age Normal (level % of pay). Funding policies and methods are described in the June 30, 2014 actuarial valuation report prepared by Cavanaugh.
<b>Liability Discount Rate</b>	7.50% per year, compounded annually.
<b>Future Pay Increases</b>	Future pay increases as recommended in the 2013 Experience Study. Pay increases include a 4.00% base wage inflation rate.
<b>Retirement</b>	Rates of retirement as recommended in the 2013 Experience Study.
<b>Mortality</b>	Rates of mortality as recommended in the 2013 Experience Study.
<b>Disability</b>	Rates of disability as recommended in the 2013 Experience Study.
<b>Withdrawal</b>	Rates of withdrawal as recommended in the 2013 Experience Study.
<b>Asset Valuation Method</b>	5-Year smoothing of actual versus expected returns. The asset valuation method is described on page 36 of the June 30, 2014 actuarial valuation report prepared by Cavanaugh.
<b>Contribution Policy</b>	For fiscal years 2017 and beyond, employer contributions are assumed to equal the full actuarially required contribution consisting of: (1) gross normal cost, less (2) expected employee contributions, plus (3) administrative expenses (0.69% of 2014-15 payroll, growing at inflation each year), plus (4) an amortization of the unfunded actuarial liability over 29 years beginning in 2014, calculated as a level percentage of payroll assuming 4.00% payroll growth. The amortization period was not assumed to reset at any point in the future, and was not allowed to fall below 10 years.

## Appendix 3: Assumptions and Methods (continued)

---

**Projection Assumptions (used in the deterministic and stochastic asset/liability projections):** These projections begin with the Plan's participant population as of June 30, 2014, as provided by Cavanaugh. The Plan's population is projected forward and assumed to change as a result of employment separation, death, disability, and retirement, as predicted by the assumptions recommended in the 2013 Experience Study (and described on the prior pages). New members are assumed to enter the Plan such that the active population remains level throughout the projection. Employee compensation is projected into the future in accordance with the assumptions described on the prior pages. Investment returns are projected into the future in accordance with the assumptions described below.

<b>Employer Contributions</b>	For the fiscal years ending 2015 and 2016, assumes total employer contributions equal to the full actuarially required contributions as set forth in the actuarial valuation as of June 30, 2013 (16.37% of payroll). Thereafter, assumes employer contributions for each fiscal year are determined as of the prior year's valuation date in accordance with the actuarial funding policy and the assumptions from the 2013 Experience Study.
<b>Member Contributions</b>	Member contributions are determined based on current contribution rates, and projected pay.
<b>New Entrants</b>	New employees are assumed to join the Plan such that the active population remains level throughout the projection. New employees entering the Plan are assumed to have characteristics similar to recently hired participants.
<b>Rate of Return on Assets</b>	<u>Deterministic Analysis:</u> 7.50%, compounded annually.  <u>Stochastic Analysis:</u> Returns on the portfolio are based on the expected returns of each asset class and the correlations between each class which are detailed in the Stochastic Analysis section of this report.
<b>Cash Balance Interest Credit</b>	<u>Deterministic Analysis:</u> 7.00%, compounded annually.  <u>Stochastic Analysis:</u> Interest credits are based on the expected returns of a benchmark portfolio designed to mirror the overall portfolio return.

## Appendix 3: Assumptions and Methods (continued)

---

**Inflation**

2.50% per year with a standard deviation of 3.00%.

**Other**

All other projection assumptions are the same as those recommended in the 2013 Experience Study.

Our work was based partly on original work prepared by Cavanaugh using the ProVal valuation software. This included their coding of benefit provisions and the methodology to generate liabilities under the entry age normal actuarial cost method. Cavanaugh provided us with an actuarial valuation as of June 30, 2014, using assumptions from the 2013 Experience Study. We reviewed this work for reasonableness, but we did not perform a complete audit of this work.

We started with Cavanaugh's base year valuation work. Certain changes to the coding of benefit provisions were required in order to facilitate a 20-year projection of liabilities and costs. For example, we added employee contribution definitions in order to offset gross normal cost calculations by expected employee contributions. In some cases, scaling of liabilities was used to approximate liabilities not valued directly in the work provided by Cavanaugh.

The participant data provided by Cavanaugh was the same as that used in the actuarial valuation as of June 30, 2014, for KERS Hazardous funding purposes. This data was used without grouping or adjustment.

It is our understanding that Kentucky law does not allow employer contribution rates to change in the second year of a biennium for the KERS systems. This means that an actuarial valuation every other year provides the funding rates for the following two fiscal years. We were not able to model this feature. Instead, we modeled contribution rates based on annual valuations with a one-year lag period.