PG&E HEARING EXHIBIT PGE-15

A.20-04-023

PG&E'S SECURITIZATION 2020

PACIFIC GAS AND ELECTRIC COMPANY

CHAPTER 6

CUSTOMER CREDIT MECHANISM AND INVESTMENT RETURNS – REBUTTAL

WITNESSES: D. THOMASON; G. ALLEN

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A. PG&E's Proposal Meets the Requirement of Rate Neutrality. [Issue 3] (David Thomason)

1. Commitment to Rate Neutrality

PG&E has committed to a rate-neutral securitization: "The Securitization structure is anticipated to yield a full (nominal) offset each year to securitized charges."[1] PG&E submits that this is the relevant standard for purposes of evaluating rate neutrality in this proceeding.

2. PG&E's Proposal Is Rate Neutral.

The proposed Securitization is rate neutral. Indeed, the Securitization is anticipated to yield significant customer benefits. The Fixed Recovery Charges (FRC) and the Customer Credit will appear on the same bill. This means that Customers will see a net impact of zero until the FRC cease unless there is a period in which the Customer Credit Trust balance falls below an amount necessary for the coming year's Customer Credit. Such a deficit is unlikely. As discussed in Greg Allen's testimony, there is an 84 percent probability that the Customer Credit Trust will have a positive balance when the securitized Bonds are fully paid, and if there is a deficit in the Customer Credit Trust, it is not expected to occur before 2047 (in 95 percent of the cases). In fact, Mr. Allen shows the expected value[2] of the Customer Credit Trust at the conclusion of the Bond term to be

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1 D.20-05-53, p. 75 (citing PG&E Motion for Official Notice, Attachment 2, p. 8.).

2 "Expected value" is a term used in finance to describe the most likely (weighted average) value of an investment when there is uncertainty regarding its outcome.

approximately $4.4 billion in nominal (2050) dollars and $525 million in Net Present Value (NPV) dollars.[3] Applying the 25 percent sharing of the surplus in the Customer Credit Trust, as proposed by PG&E, the customer expected value according to Mr. Allen's methodology is $990 million, with a NPV of $116 million.[4] In Chapter 10, Expert Rebuttal Regarding Customer Benefit (B. Cornell), Professor Cornell uses a slightly different methodology, which results in an expected value of the Securitization of $1,048 million (nominal), or $121 million net present value.[5] The Securitization also will result in additional benefits in the form of deleveraging and accelerating PG&E's path back to an investment-grade issuer credit rating. As set forth in Chapter 5, Stress Test Costs – Rebuttal (D. Thomason; J. Sauvage), accelerating the improvement in PG&E's credit profile is estimated to provide approximately $441 million (nominal) in cumulative interest savings.

The Utility Reform Network (TURN) witness Jennifer Dowdell[6] acknowledges that an improved credit rating would result in reduced borrowing costs, which she estimates at $63 million for customers with an NPV of $48 million.[7] For the reasons discussed in Chapter 5, that estimate is substantially understated. But even Dowdell's estimate is more than twice the size of the negative $20 million NPV of deficit cases in the Customer Credit Trust as set forth in Mr. Allen's testimony,[8] and more than 1.5 times

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3 Using a discount rate of 7.34 percent, PG&E's authorized return on rate base.

4 This result is calculated by taking 25 percent of the expected value of the positive outcomes ($1,142 million is 25 percent of $4,566 million) minus the expected value of the negative outcomes ($152 million).

5 Using the same calculation as shown in footnote 4, and a discount rate of 7.34 percent.

6 On the afternoon of November 10, 2020, the day before this testimony was due, TURN served errata testimony from Ms. Dowdell and revised testimony and workpapers from Mr. Ellis. There was not time to evaluate those changes, or to address them in rebuttal testimony before service on November 11, 2020. PG&E has revised this Chapter 6 – Rebuttal after reviewing those changes.

7 TURN-Dowdell, p. 21.

8 PG&E Prepared Testimony (Updated), Chapter 6, p. 6-29.

the value of the negative $30 million NPV of deficit cases as set forth in Professor Cornell's testimony.[9]

Finally, PG&E has already conferred a benefit on ratepayers through the proposed Securitization by agreeing to waive recovery of just and reasonable wildfire costs. Absent that waiver, PG&E could have sought recovery of such costs pursuant to Section 451. Had it prevailed, PG&E would have recovered such costs in rates without an offset. By agreeing to waive such claims, PG&E eliminated that potential cost to customers.

3. The Public Advocates Office (Cal Advocates) Confirms PG&E's Approach to Rate Neutrality.

Cal Advocates supports approval of securitization, although in a smaller amount. Cal Advocates acknowledges the benefits to PG&E's credit profile of securitization. Cal Advocates recommends that the Securitization be reduced from $7.5 billion to $6 billion, with a proportional reduction in the Initial and Additional Shareholder Contributions to the Customer Credit Trust. As a result, Cal Advocates' recommendation would result in a transaction that reflects the same risks as PG&E's proposal, i.e., the same 84 percent chance of surplus along with 25 percent surplus sharing, but would provide less overall benefit to customers because the contributions to the Trust are 20 percent less and the expected value to customers is also 20 percent less. For the reasons explained in Chapter 5, the Commission should approve a securitization of $7.5 billion to maximize the benefits of securitization.

4. The Proposed Securitization Maximizes the Value of NOLs for PG&E and Its Customers.

The proposed Securitization dedicates the monetized value of the NOLs resulting from the resolution of the 2017 and 2018 wildfire claims to funding

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9 Chapter 10, Expert Rebuttal Regarding Customer Benefit, Table 10-1.

the Customer Credit. This transaction structure is the most efficient way to realize the value of the NOLs. PG&E considered and rejected the alternative of a direct sale of the NOL cash flow because there is no liquid market for a transaction of this size and scale. This does not mean that PG&E has over-valued the NOLs, as TURN witness Dowdell suggests.[10] Instead, it means there is no "market value" for a sale of the NOLs, given IRS prohibitions on the sale of NOLs and the lack of active trading in synthetic NOL cash flow products. The only realistic alternative to the Securitization as a means of monetizing the value of the NOLs is to wait until PG&E has taxable income and use the cash flow at that time to pay down the Temporary Utility Debt. The proposed Securitization is a more efficient way of using the same cash flow as part of an immediate deleveraging of PG&E, with associated positive impacts for customers.

B. Intervenors Overstate the Risk Faced by Customers. (David Thomason)

As explained herein and in greater detail in Chapter 10, Expert Rebuttal Regarding Customer Benefit (B. Cornell), the risk to customers from the proposed Securitization is more than adequately compensated by the benefits. The risk faced by customers is a shortfall in the Customer Credit Trust. That single risk is driven by two variables: (1) timing of projected contributions to the Trust; and (2) Customer Credit Trust Returns. Intervenors' claims that PG&E has overstated each of these variables are incorrect.

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10 *See, e.g.*, TURN-Dowdell, p. 5, line 11 to p. 6, line 2.

1. Contributions to the Customer Credit Trust [Issues 3, 4] (David Thomason)

a. PG&E's Projection of Additional Shareholder Contributions Is Reasonable.

The Trust will be funded with $1.8 billion initially. No intervenor has suggested that contribution is at risk. With respect to the remaining $7.59 billion in Additional Shareholder Contributions, parties address risks associated with tax laws and achieving forecasted taxable income.

Certain parties note that contributions to the Trust could be affected by tax laws.[11] The corporate tax rate is presently at a historically low level. An increase in corporate tax rates, as has been proposed in President-Elect Biden's tax plan, seems more likely than a decrease. If tax rates increase, all else equal, the Customer Credit Trust will be funded with the $7.59 billion faster, increasing the likelihood of surplus. The other tax law related risk is a limitation on the use of Shareholder Deductions through a change in ownership under IRS Code Section 382. This is unlikely because transfers that increase a person's equity ownership to more than 4.75 percent require PG&E Board consent under the amended articles of incorporation.

TURN challenges PG&E's forecasted taxable income as set forth in Table 6-2. For this purpose, the key period is from 2021 through 2035, when the Cap of $7.59 billion is expected to be reached. For PG&E, the fundamental driver of taxable income is rate base, and as such PG&E anchored its forecast of taxable income on growth in rate base. PG&E's forecast starts with the Plan forecast of net income through 2024; PG&E then estimated growth in rate base of 7 percent from 2025 through 2030 and 5 percent thereafter; and applied these growth rates to projected 2024

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11 City and County of San Francisco (CCSF)-Meal, pp. 32-33; TURN-Dowdell, p. 6; Alliance for Nuclear Responsibility (A4NR)-Geesman, pp. 23, 28-29, 31; Cal Advocates, pp. 7-9, 13.

taxable income before interest.[12] That results in projected taxable income of approximately $5.4 billion for Federal and $3.9 billion for State by 2035.

These assumptions are reasonable, and likely conservative. First and foremost, PG&E needs to replace aging assets and to make substantial investments in fire risk mitigation and other projects to meet the State's ambitious policy goals. This will drive the projected growth in rate base, which drives earnings and taxable income. Despite the expanding scope of capital work, this projected increase in rate base is in fact below historical rate base growth for PG&E. Since 2006, the compound annual growth rate of PG&E's rate base was 7.6 percent. More recently, PG&E's rate base has grown at an even higher rate. Since 2015, the growth rate has been 8 percent. Likewise, in the Business Outlook prepared in connection with PG&E's Plan, PG&E forecast rate base growth of approximately 8 percent from 2019 through 2024.[13] Other California utilities have recorded even higher rates of growth of rate base in the past. Moreover, on October 28, 2020, SCE issued a Business Update in which it projected rate base growth

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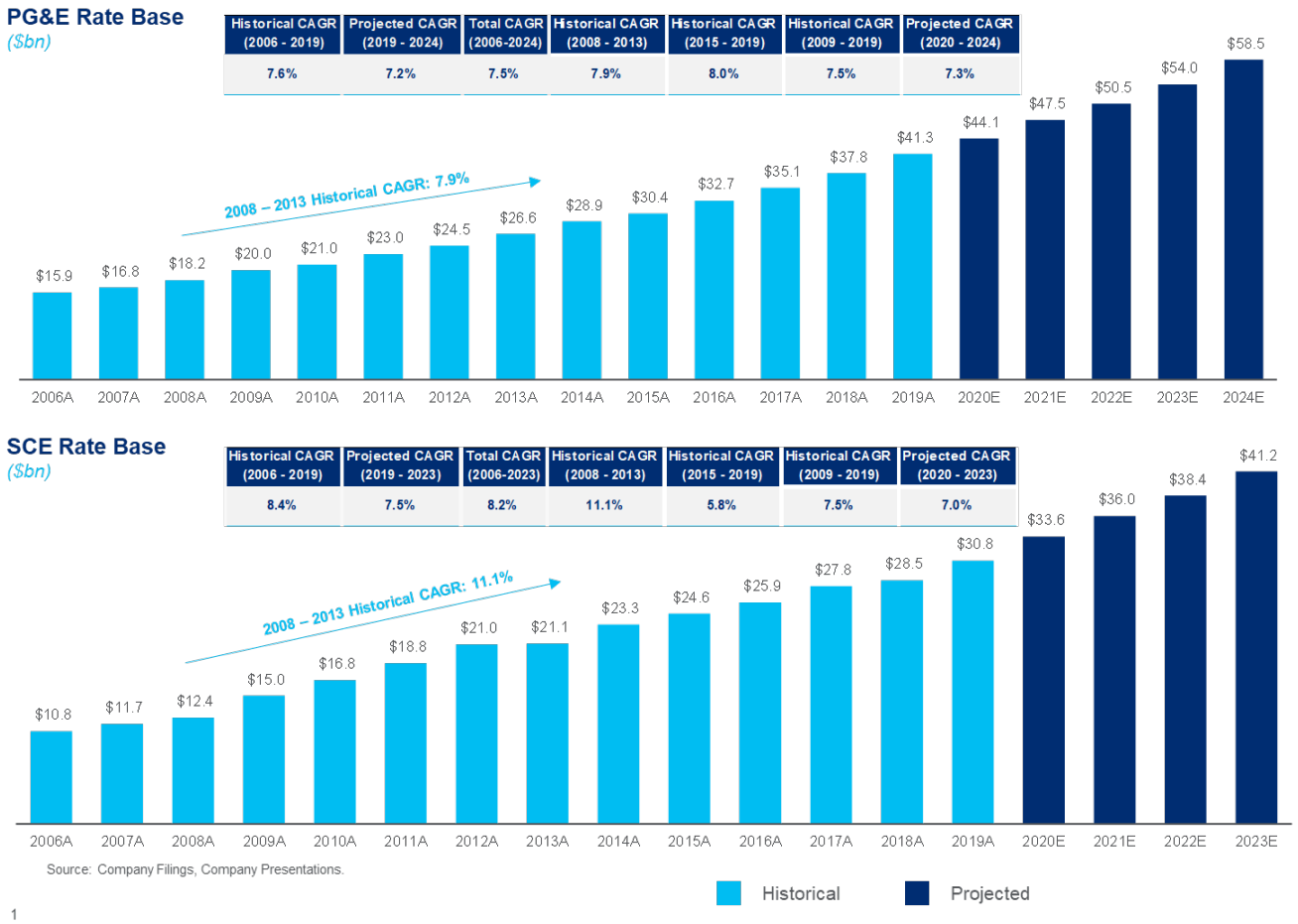
12 While PG&E escalated the interest expense associated with debt that finances rate base at the same rate as the growth in rate base, the interest expense associated with non-recoverable debt, including Holding Company debt, will be paid down over time. The interest expense forecast in PG&E's income projections reflects this expected pattern. Similarly, PG&E deducted expense associated with the Wildfire Fund based on a projected amortization schedule, which is not expected to escalate. PG&E's income forecast also reflects the impact of the Securitization: it deducts from taxable income the anticipated interest expense associated with the Securitized Bonds, and it adds to taxable income the assumed pre-tax returns on the Customer Credit Trust. The taxable income forecast also reflects various tax adjustments. While the forecast reflects rate base growth through 2050 as an illustration, for purposes of evaluating the probability of a surplus in the Customer Credit Trust, taxable income through 2035 is most relevant.

13 PG&E Business Outlook (Feb. 2020), available at http://s1.q4cdn.com/880135780/files/doc_financials/2019/q4/Business-Outlook-Presentation-Final-Feb-2020.pdf. This projection did not include the capital expenditures that, per AB 1054, are excluded from equity rate base. When such expenditures are included, PG&E estimated rate base growth of approximately 9 percent.

of 7.6 percent compounded annually from 2018 through 2023, which is comparable to PG&E's projection for the same period.[14]

FIGURE 6-2
CALIFORNIA UTILITIES HISTORICAL & PROJECTED RATE BASE



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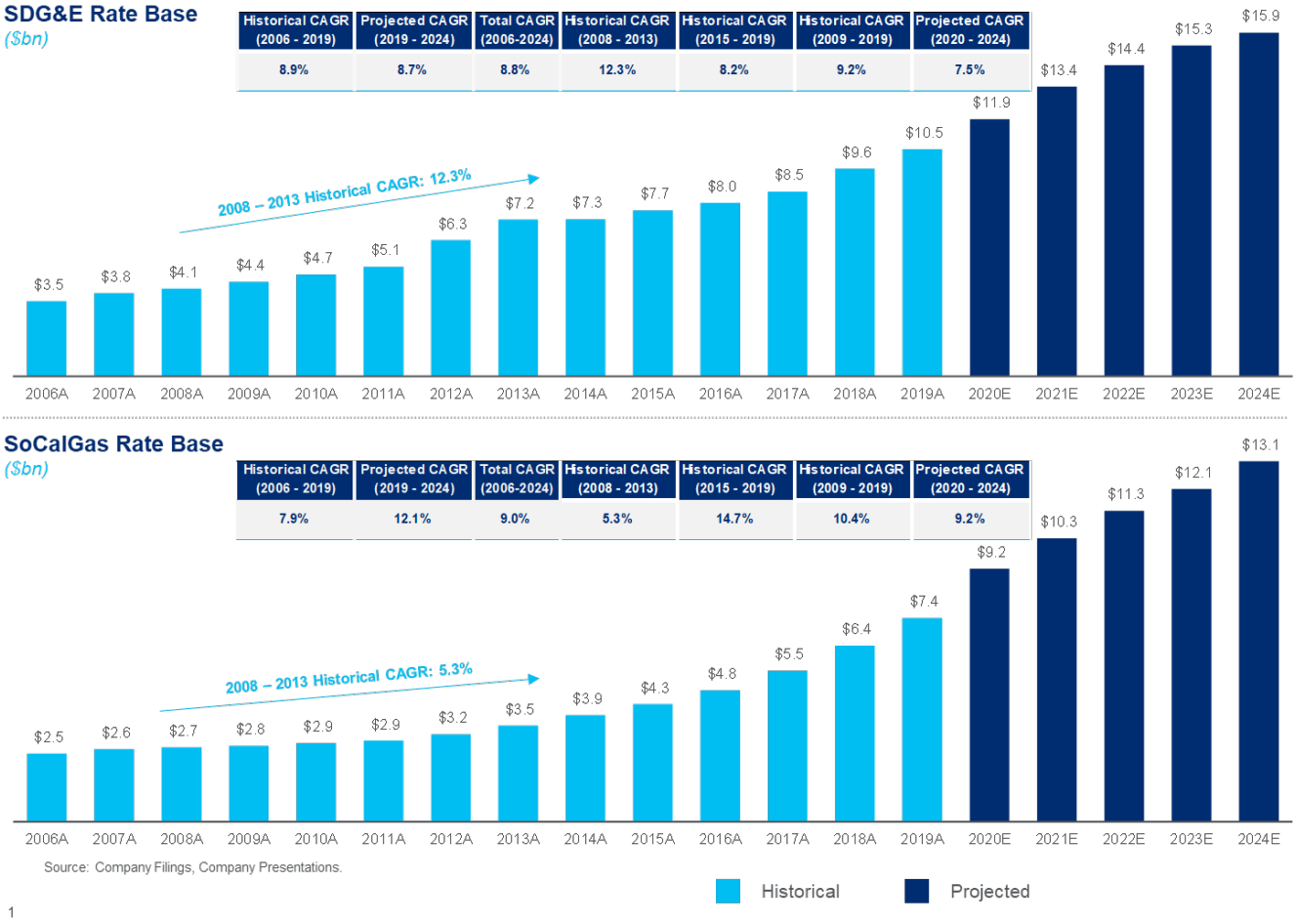
14 SCE Business Update (Oct. 28, 2020), available at https://www.sec.gov/Archives/edgar/data/92103/000082705220000140/eixoctober2020businessup.htm

FIGURE 6-2 (CONTINUED)



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CALIFORNIA UTILITES HISTORICAL & PROJECTED RATE BASE

b. TURN's Projection of Taxable Income and Rate Base Growth Is Flawed.

TURN witness Ellis attempts to question these projections and to prepare his own forecast. Importantly, Mr. Ellis accepts PG&E's projected rate base growth through 2024, which results in taxable income in 2023 of $1.6 billion federal and $1 billion state and in 2024 of $1.9 billion federal and $1.4 billion state (*see* Table 6-2 of Chapter 6). These projections were rigorously prepared and reviewed as part of the bankruptcy Plan of Reorganization process. As noted, Mr. Ellis agrees with these projections

for the next four years, but then after 2024, he assumes a sudden and precipitous drop to a 1.86 percent annual growth in rate base.

Mr. Ellis' alternative projections are unreliable for a number of reasons. Mr. Ellis assumes that rate base and earnings growth will be the product of three factors: load growth, inflation, and efficiency.[15] Before addressing the specific flaws in each of these factors, it is important to emphasize that Mr. Ellis' fundamental assumption that rate base growth and earnings will be a function of these three factors is contrary to historical data and inconsistent with cost of service ratemaking principles. For PG&E, and other California utilities, investments in rate base are driven by the need to provide safe and reliable service, as well as to meet California's clean energy policy objectives. Those investments will increase rate base and earnings, even if consumption of energy were to remain flat. And the cost of additions to rate base will reflect inflation specific to those assets, which has historically grown at a far higher rate than economy-wide rates of inflation.

Mr. Ellis' assumption that rate base growth is a function of load growth is particularly flawed. PG&E has a plan to harden 7,100 electric line miles over the next ten years as a means of mitigating the risk of wildfires. These investments, along with regular course investments in assets used to provide service, will drive significant rate base growth for the foreseeable future. Over the longer term, achievement of other public policy objectives, such as transportation and building electrification, are likely to increase the rate of growth in rate base even further.

Mr. Ellis' premise that rate base growth depends on load growth is refuted by historical data, which shows that rate base has increased steadily

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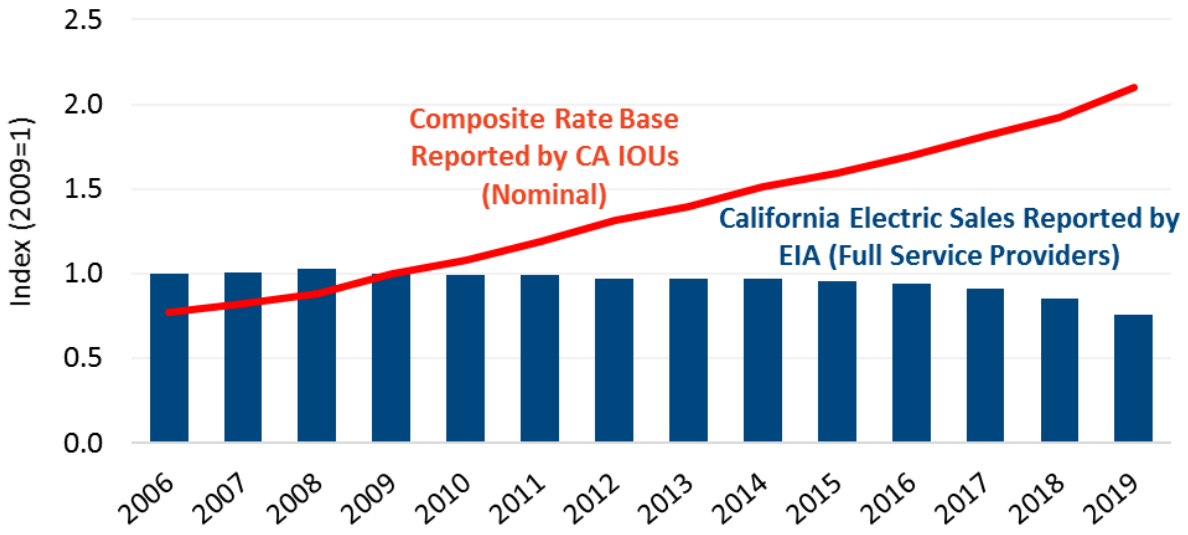
15 Revised TURN-Ellis, p. 8. In addition to annual inflation of 1.86 percent – reflecting general inflation similar to that captured by the Consumer Price Index ("CPI") – Mr. Ellis assumes 0.15 percent load growth minus 0.16 percent assumed cost efficiencies.

in California for more than a decade, even though load has been flat or declining over that period. Mr. Ellis provides no reason to expect that this relationship will change in the future.

FIGURE 6-3
CALIFORNIA LOAD, RATE BASE, AND RATES
(2009 = 1.00)

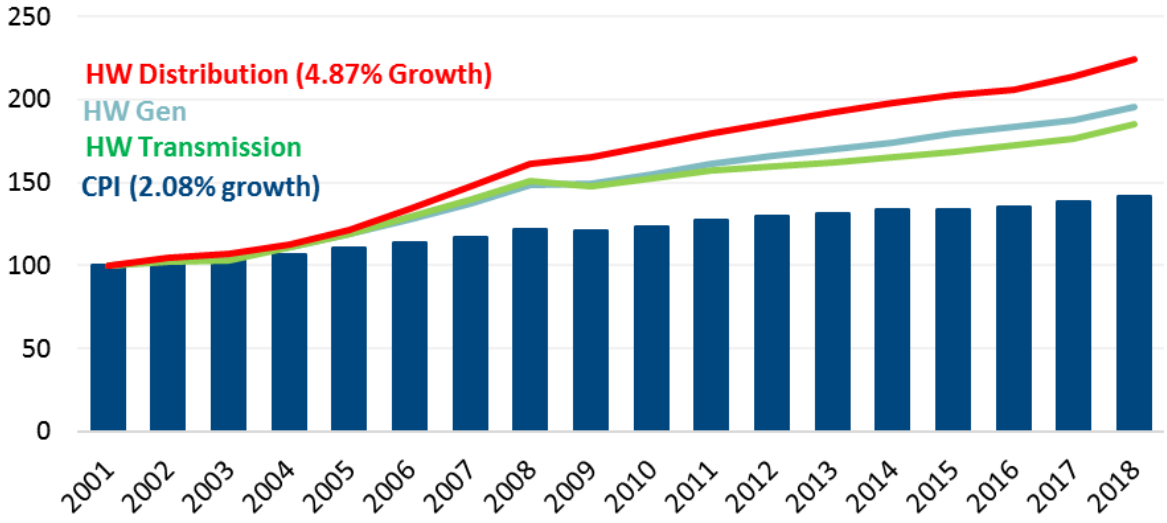


Furthermore, Chapter 11, Rebuttal Regarding Load Growth (J. Berman), refutes Mr. Ellis' claim that load growth will remain nearly flat through 2050.

After erroneously assuming that rate base growth is a function of load growth, Ellis next assumes that rate base, and taxable income, will grow at the rate of general inflation, minus the "efficiency" projected for the electric utility industry. Again, this methodology is an unreliable way to predict rate base growth or earnings. As I have noted, rate base investment is primarily a function of system needs, not inflation. While the cost of assets added to rate base also has an impact on rate base growth, Mr. Ellis fails to address a proper measure of inflation in the cost of rate base assets. Mr. Ellis cites a

"market-based inflation expectation[]" of 1.86 percent,[16] but the general rate of inflation is not representative of the rate of inflation in the cost of assets used to provide electric and gas service. Instead, as the Commission has recognized,[17] a more reliable index for estimating relative growth in utility plant replacement costs is the Handy-Whitman Index of Public Utility Construction Costs. From 2003 through 2018, the Handy-Whitman index has risen at approximately twice the rate of general inflation.

FIGURE 6-4
COST ESCALATION INDICES
HANDY WHITMAN "PACIFIC REGION" UTILITY INDICES VS. CPI
(2001 = 1.00)



Hence, the cost of replacing existing rate base assets can be expected to increase at a substantially higher rate than Mr. Ellis asserts. This asset-specific inflation rate, combined with the need to expand rate base by putting into service new assets beyond replacing existing assets, supports PG&E's rate base growth projections.

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16 Revised TURN-Ellis, p. 6 n.7.

17 *See, e.g.*, D.14-11-040, p. 101 ("The Handy-Whitman Index is an appropriate measure of inflation for utility construction projects . . . ."); D.15-11-021, pp. 382-383; D.10-12-058; D.05-12-042.

For similar reasons, Mr. Ellis's efficiency adjustment is not a valid means of predicting rate base or earnings. "Efficiency" connotes a reduction in the cost to produce the same unit of output. In the context of rate base, efficiency refers to the cost of replacing an existing asset. Again, the Handy-Whitman index demonstrates that this unit cost is increasing, i.e., there is a dis-efficiency in the unit cost of rate base.

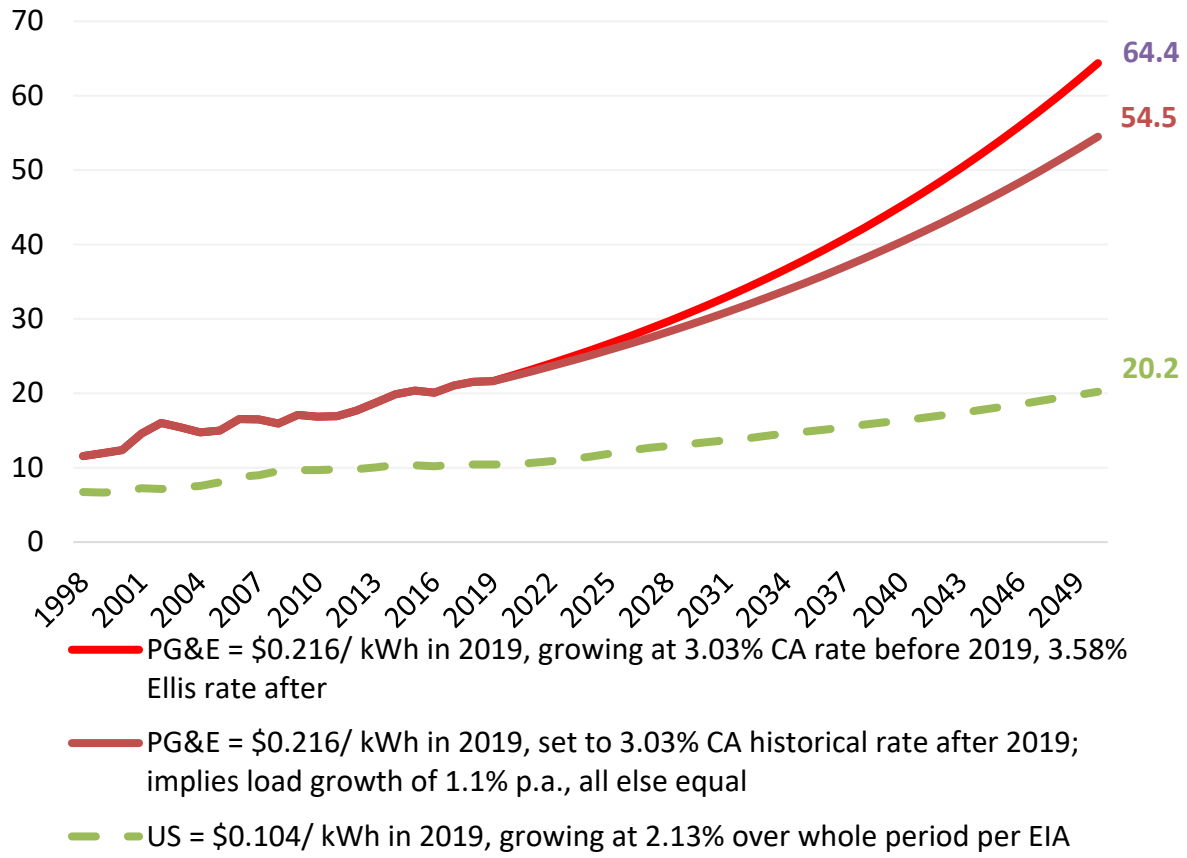
Mr. Ellis, however, does not address efficiency in the cost of replacing rate base assets, but instead looks to a broader, and inapplicable, measure of efficiency. Mr. Ellis references a real electricity price growth forecast by the Energy Information Administration (EIA) for the period 2019 to 2050 of negative 0.16 percent. EIA's forecast is for an "all-in" system-average rate, which includes commodity cost (particularly for fuel, with natural gas frequently a major driver). Given technological advances in natural gas extraction and renewable resources, these commodity costs may decrease, but that does not address the future cost of rate base investments. In addition, EIA's national average is not necessarily representative of costs of California utilities. For example, EIA's forecast for real electricity prices for the Pacific region is positive 0.25 percent annually.

Mr. Ellis further challenges PG&E's showing on the grounds that PG&E's projections would yield rates that are higher than the national average.[18] Once again, Mr. Ellis does not support his premise that California rates track national rates. On the contrary, the rates of California utilities have long been higher, and have been rising more quickly, than the national average. This reflects California's policy choices. Again, Mr. Ellis provides no reason to expect that this will change in the future. Figure 6-4 shows the historical rates for U.S. utilities, compared to PGE's rates, from

[18] Revised TURN-Ellis, pp. 5-6.

1998 through 2019. Escalating PG&E's rates at the historical average rate of increase in California utilities' rates (3.03 percent), as shown in the blue line, yields a rate of approximately 55 cents per kWh in 2050. The rate trajectory assumed by Mr. Ellis is shown in the red line, which yields a rate of approximately 64 cents in 2050. If, as discussed in Chapter 11, electric load grows after 2030, the rate will be lower than projected by Mr. Ellis. It bears emphasis, however, that even Mr. Ellis' erroneous load growth assumptions yield a rate that is in line with the rate that would be produced using the historical average rate of increase in California rates. In fact, in 2035, which is the forecasted end date for the Additional Shareholder Contributions, the rate at the historical trajectory is quite close to the rate assumed by Mr. Ellis.

FIGURE 6-5
CENTS PER KWH



In sum, PG&E's rate base forecast is based on reasonable assumptions about future capital needs and is consistent with historical trends. By contrast, Mr. Ellis' projections are based on a methodology that assumes a relationship between rate base, load, and inflation that is inconsistent with cost of service ratemaking principles and unsupported by historical data. In addition, the measure of inflation (and efficiency) Ellis uses is not representative of the cost of rate base assets.

c. PG&E's Historical Earnings Support PG&E's Projection of Additional Shareholder Contributions

Mr. Ellis also claims that PG&E's income forecast is "unrealistic" considering PG&E's historical growth rate of earnings before interest and

taxes (EBIT).[19] PG&E's historical EBIT is not predictive of future earnings because EBIT is directly proportional to the product of rate base and the adopted return on rate base (assuming PG&E earns the adopted return on equity). Therefore, EBIT declines as the adopted return declines. Over time, adopted returns have declined substantially due to falling interest rates. In 1988, the pre-tax authorized return on rate base was 15.6 percent. Today, the pre-tax authorized return on rate base is 9.4 percent. This alone results in about a 40 percent decline in EBIT over that period.

Moreover, historical PG&E EBIT reflects a number of extraordinary events that are not likely to recur. PG&E's recorded EBIT was affected by the following major non-recurring events:

- The energy crisis of 2000-2001, which led to substantial accounting charges relating to power procurement costs. These charges were subsequently reversed. The California legislature enacted a series of measures to prevent a recurrence of this event, including the AB 57 procurement framework.
- Gains and losses from the operation of National Energy Group, a non-regulated affiliate that was divested in 2004.
- Accounting charges taken in 2010-2016 associated with penalties and disallowances assessed in connection with the San Bruno gas explosion. PG&E has instituted a number of operational changes to prevent a recurrence of such an incident.
- Accounting charges associated with claims arising from the 2017-2018 wildfires. PG&E has adopted numerous governance and operational changes to mitigate the risk of a future catastrophic wildfire. In addition, the Go-Forward Wildfire Fund enacted by AB

[19] Revised TURN-Ellis, p. 4.

1054 limits PG&E's financial exposure to any future catastrophic wildfires, as further discussed below.

For related reasons, historical taxable income does not provide a reliable basis to predict future taxable income, as asserted by CCSF witness Meal. Historical taxable income was affected by a number of the same factors mentioned above, as well as balancing account overcollections and undercollections that affect taxable income in a given year but are unwound over time, as well as accelerated tax depreciation rules, e.g. bonus depreciation and super-bonus depreciation, that are not expected to be available in the future.

To provide a more comparable historical trend, PG&E removed from recorded EBIT and taxable income non-recurring charges associated with San Bruno and the 2017-2018 wildfires. PG&E also removed balancing accounts from taxable income. Finally, PG&E normalized the results for changes in authorized return on rate base. Because accurate adjustments are difficult to implement for time periods that are distant, PG&E looked to approximately the last 10 years as the most relevant time period. The compound annual growth rates are shown below.

TABLE 6-10
COMPOUND ANNUAL GROWTH RATES

Start Year	End Year	Scaled EBIT	Scaled TI	Ratebase
2009	2018	6.5%	11.4%	7.3%

Once adjusted to provide a historical trend that is comparable for evaluating future growth, PG&E has an earnings and taxable income history that is in line with PG&E's forecast, as would be expected for a regulated, investor-owned utility.

d. Intervenor Alternative Forecasts of Additional Shareholder Contributions Are Not Reasonable and Do Not Defeat Rate Neutrality.

CCSF witness Ms. Meal prepared modified cash flows that assume taxable income is reduced by 20, 30, and 40 percent for each period for 30 years.[20] No rationale or analysis is provided for these arbitrary reductions for even a single year, let alone for every year for a 30-year period. There is no reason to expect such reductions. In addition to the rate base and earnings trends above, tax policy makes it more likely that Additional Shareholder Contributions will be as projected or higher. There is a higher likelihood of a tax rate increase in the future than a tax rate decrease. And although historical taxable income was reduced by Federal tax rules permitting accelerated depreciation and other extraordinary deductions, those policies have been phased out and are no longer expected to depress taxable income. Finally, projected taxable income will increase more quickly in the future because of the unusual amount of debt incurred by PG&E Corporation as part of the Chapter 11 Plan. The interest on that debt is depressing taxable income in the early years of the forecast as compared to historical results, and that impact will decrease as the amount of debt is paid down and returns to levels consistent with authorized debt.

TURN witness Ellis' projection of taxable income is also not reasonable. As discussed above, his starting assumption is flawed – in particular the inappropriate tethering of expected rate base growth to forecast load growth, which infects his entire analysis and creates an artificial and inaccurate downward bias. Mr. Ellis then purports to vary and model his forecast of taxable income by varying the growth rate based on his assumptions for rate base growth, PG&E's historic EBIT growth rate, and various "shocks" and

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20 CCSF-Meal, p. 36, line 7 to p. 38, line 27.

random variations. As none of those assumptions is correct, the variations he purports to show are also incorrect. In fact, in a data response, TURN states that the probability of a surplus in the Customer Credit Trust is 76 percent using *TURN's* model of the schedule of Additional Shareholder Contributions and the investment returns in Greg Allen's Monte Carlo simulation model.[21] Thus, even using the flawed base assumptions of Mr. Ellis with respect to future taxable income, the proposed Securitization is rate neutral by a substantial margin.

In addition, as a check on the robustness of the modeling results, notwithstanding PG&E's governance and operational changes that will reduce the risk of a future catastrophic wildfire, PG&E evaluated the impact on the Customer Credit Trust of a catastrophic wildfire. PG&E assumed 2029 taxable income would be eliminated entirely by a reimbursement payment to the Wildfire Fund arising out of a fire. PG&E used this approach because any loss in excess of taxable income in that year would result in additional NOLs generated in that year, but those new NOLs would not delay the use of Shareholder Deductions in the following or subsequent tax years. As a result, the Additional Shareholder Contribution would be made in the following and subsequent years. In the testimony of Greg Allen below, the impact of the elimination of taxable income in 2029 reduces the probability of surplus by only 2 percent and increases the NPV of deficit cases by only $3 million, still leaving a 25 percent share of surplus of approximately $1 billion. In Table 10-3 of Chapter 10 – Expert Rebuttal Regarding Customer Credit, Professor Cornell shows similar results.

Finally, PG&E has conducted additional analysis regarding the rate-neutrality of the proposed Securitization, including analysis of the alternative

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21 Revised TURN-Ellis, p. 22, Figure 12; TURN's Response to Data Request PGE_TURN002, Question 7(b), dated October 27, 2020.

forecasts discussed above in this section. As explained in more detail by Professor Brad Cornell in Chapter 10, Expert Rebuttal Regarding Customer Benefit, risks to customers of a shortfall in the proposed Securitization can be quantified by calculating the probability that the Customer Credit is less than the FRC for some period of time and the amount that may actually be paid by customers if that occurs. Professor Cornell's analysis of the Monte Carlo simulation outcomes for Additional Shareholder Contributions shows that the risk to customers is approximately $30 million on an NPV basis using a discount rate of 7.34 percent. Stated differently, the compensation an investor would require to provide a guarantee of payment in the event the Customer Credit is insufficient would be approximately $30 million. Professor Cornell prepared a similar analysis with respect to the CCSF 20 percent decrease in taxable income for 30 years, TURN's assumptions regarding the timing of the Additional Shareholder Contributions, and the possibility of a catastrophic wildfire event in 2029. In all cases, the benefits of surplus sharing, reduced interest costs, and the waiver of recovery of wildfire claims render the proposed Securitization not just rate-neutral, but rate positive by a significant margin.

2. Customer Credit Trust Investment Returns [Issue 6] (Greg Allen)

PG&E's long-term projected investment return assumptions used in the Monte Carlo model are both reasonable and conservative relative to those used by both investment advisors and actuarial firms when building long-term financial models. Furthermore, they are consistent with the long-term projected investment returns used by the Commission for all three of the California utilities for their nuclear decommissioning trusts (NDTs) in triennial cost allocation proceedings.

When compared to return assumptions used by practitioners who build models specifically designed to simulate financial behavior over long-term

(e.g. 30-year) time horizons, PG&E's assumptions are below the median. As Tables 6-2, 6-3, and 6-4 below illustrate, PG&E's 6.93 percent composite long-term median return assumptions for the 80/20 mix used in the Monte Carlo simulation analysis are below the median of the relevant comparable long-term peer groups of 39 investment firms, 130 public pension plans, and the returns authorized for the NDTs.

Finally, the returns used in the Monte Carlo simulation model were substantially more conservative than those realized for any 30-year period over the last 95 years. The median simulated 30-year return for the 80/20 mix used in the analysis was 6.93 percent, roughly 3.25 percent lower than the median return for a 30-year period for an 80/20 portfolio observed historically. Together, the 2,000 trials represent a conservative estimate of the full range of potential capital market outcomes for the anticipated investment portfolio of the Customer Credit Trust. The Coalition of California Utility Employees (CUE) agrees that "the Monte Carlo results using simulated returns are conservative and show that the risk to customers is small."[22]

a. Intervenors' Mistaken Criticisms of the Customer Credit Trust Investment Returns

Intervenor criticisms of the expected Customer Credit Trust investment returns are incorrect. A4NR argues that the 30-year Bond term is an inappropriate timeframe to evaluate Customer Credit Trust investment returns where "the weighted average length of time the Initial Shareholder Contribution, and the returns thereon, remains invested may be 8.3 years[, and a] similar calculation for the Additional Shareholder Contributions yields a weighted average of 15.3 years."[23] A4NR also contends that holding the

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22 CUE-Earle, p. 4, lines 17-18.

23 A4NR-Geesman, p. 34, lines 3-6.

80 percent equities and 20 percent fixed income asset allocation constant over the 30-year Bond term "may overweight equities and, consequently, overstate return[s]."[24] Neither concern is valid.

The first criticism makes little sense given a proper understanding of how the PG&E Monte Carlo simulation model actually works. The model was in fact designed to explicitly take into account the weighted average life of the Initial and Additional Shareholder Contributions to which A4NR refers. It does this by modelling the projected quarterly cash-flows associated with the Customer Credit Trust over the entire 30-year horizon (from inception through the final bond payment). This was done across 2,000 separate trials, each of which represents a series of 120 quarterly returns for the portfolio that reflect the quarter-to-quarter and year-to-year volatility of the assumed 80/20 mix. Importantly, the model did not assume that the portfolio achieved the same 30-year annualized return each year of the simulation as the A4NR criticism seems to suggest. The entire point of the model was to stress-test the Customer Credit Trust by modelling its projected cash-flows in the context of quarter-to-quarter and year-to-year investment return volatility, and from those simulations estimate the probability of success (surplus) or failure (deficit). This could not have been done properly without taking into account the weighted average life of the contributions to which A4NR refers. This exact same approach was taken when modelling the Customer Credit Trust in the context of historical 30-year periods. Each of the periods used in the historical simulation reflected the actual volatility of returns experienced over that period.

The second criticism also seems to reflect a misunderstanding of the model. The model simulates 2,000 different trials, each representing a

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24 *Id.*, p. 34, lines 12-13.

series of quarterly returns for the asset classes assumed to be employed in the Customer Credit Trust portfolio – US equities, non-US equities, and fixed income. The assumed asset allocation for the Customer Credit Trust is overlaid on these asset class return simulations to generate the simulated behavior of the Customer Credit Trust 80/20 portfolio. The model then calculates the probability of success (surplus) or failure (deficit) across those trials based on the volatility of an 80/20 mix. A4NR seems to be suggesting that in practice the Trust would not pursue an 80/20 mix over its entire life and therefore a lower return should be used. This is an oversimplified view. In the context of the model, what they are suggesting would be accomplished by reducing the assumed equity exposure in the portfolio at some point in the life of the Trust (not by simply reducing the return across all trials). Reducing the assumed equity exposure for the Customer Credit Trust would reduce expected return, but it would also reduce the expected volatility of return. This, in turn, would reduce the magnitude of the worst-case outcomes (they would be less negative). It would not make sense in the context of the model to simply reduce return without reducing the associated volatility. Reducing assumed equity exposure at some point in the life of the Trust would likely reduce the size of the surplus in the expected case, but that does not mean that it would reduce the probability of success given the corresponding reduction in the volatility of return.

TURN insists that "PG&E's return assumptions for the Trust's three asset classes are aggressive – 104 bps (18%) higher than the average of eighteen recent public forecasts from leading investment managers and consultants."[25] TURN states that "the average of the investor forecasts

[25] Revised TURN-Ellis, p. 12, lines 10-12.

represents a more realistic and appropriate set of base case return and risk (standard deviation) assumptions."[26]

Before specifically addressing TURN's critique of the long-term return assumptions used in the PG&E simulation analysis, it is important to understand the difference between short-term and long-term capital market assumptions, and how they are used in the industry. Short-term assumptions are generally driven primarily by current market conditions (current interest rates, current valuation metrics, short-term inflation outlook, political outlook, etc.). They are typically employed by investment firms to inform short-term tactical decisions to overweight (or underweight) relatively attractive (or unattractive) parts of the market. By their nature they tend to change frequently, and there is a wide distribution of assumptions across practitioners. Long-term assumptions are weighted more toward the long-term average behavior of markets over full market cycles. They tend to be geared toward equilibrium relationships between asset classes, they generally assume "mean reversion," they are more stable over time, and there is generally a much narrower distribution across practitioners. In general, in the investment management industry it is considered best practice to employ capital market assumptions that are specifically developed to match the time horizon of the modelling exercise or investment decision.

Within the institutional investment industry, actuaries and investment consultants tend to employ long-term assumptions in their work while asset managers tend to employ shorter-term assumptions. Callan's numbers represent 30-year projections, specifically designed to support long-term financial modelling (of pension plans, nuclear decommissioning trusts,

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26 *Id.*, p. 15, lines 7-8.

endowments, foundations, etc.) using Monte Carlo simulation analysis. Callan has developed and used these types of projections to support hundreds of long-term financial modelling projects on behalf of many of the largest institutional investors in the country. Callan has been doing this for over four decades and believes the assumptions used in the PG&E Monte Carlo simulation model are reasonable and well suited to the exercise.

With respect to TURN's specific critique of the PG&E capital market assumptions, TURN undertook a survey of investment firms to create a purported peer comparison of capital market assumptions to compare against the return forecast used in the PG&E Monte Carlo simulation. Based on the results of this survey, which TURN originally said included 25 comparable firms but then revised down to 18 to correct some of the errors in its approach, TURN argues that the return assumptions used in the analysis were roughly 1.04 percent (104 basis points) too high. While the methodology that TURN uses is theoretically defensible, their execution is not robust. This results in a small sample size that is plagued by inconsistencies and dominated by short-term projections. These problems have the effect of biasing their distribution of projected returns downward, away from long-term projections and towards short-term projections (which are more easily attainable).

Many of the large actuarial firms employ a survey approach to develop (or at least inform) their capital market projections that is similar in design to the approach used by TURN. Because these firms' businesses depend on the generation (and defense) of reasonable long-term capital market assumptions (and because actuaries by their nature are careful) many have developed very robust approaches to their surveys which they have been able to refine over decades.

One of the most well-respected surveys of this nature is conducted annually by Horizon Actuarial Services LLC, which is attached hereto as Exhibit 6.2. Horizon has been conducting this survey on an annual basis since 2008 to help inform the development of their own long-term investment return assumptions to be used in their long-term actuarial financial modelling work. Horizon's survey employs a very similar methodology to the one used by TURN. In 2020 Horizon surveyed 39 different investment firms asking for their long-term capital market assumptions for various asset classes (this contrasts with only 18 firms surveyed by TURN – less than half). Because Horizon has been doing this for over a decade they have been able to refine their process and the constituents of the survey. They have made a careful effort to include firms in their survey that are known for making long-term capital market assumptions, and exclude firms whose assumptions represent shorter time horizons and are used for more near-term, tactical purposes. TURN's survey, by contrast, is dominated by shorter-term projections. For example, of the 18 firms now used by TURN, only two state that the time horizon for their projections is 30 years. These two are Callan, whose projected returns are used by PG&E, and BlackRock, whose equity returns (comprising 80% of the portfolio), are higher than Callan's.[27]

Horizon also delves into the methodology (and the implied time horizons) employed by the respondents in their survey and has developed a robust approach to translating all of the responses into long-term (20-year) projections. The adjustments that they make, for example, to translate a 10-year projection into a 20-year projection for Investment Firm A are tailored to their understanding of the process employed by Investment Firm A.

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27 TURN's Response to Data Request PGE_TURN002, Question 4, Table DR2-Q4-1, dated October 27, 2020.

In contrast, TURN's original testimony simply applied a blanket conversion to all projections in their survey which was based entirely on the difference between Callan's standard 10-year projections and the 30-year projections used in the PG&E model. Unfortunately, this adjustment technique suffered from both a misunderstanding of the relationship between Callan's 10-year assumptions and those used in the PG&E simulation model, as well as an oversimplified approach of applying the same adjustment factor to all of the investment firms regardless of their underlying methodology.[28] These two factors undermined the robustness of the conversion process used in the TURN survey and generally biased the results downward (towards the short-term projections).

In response to data requests, TURN acknowledged that their use of the difference between Callan's standard 10-year projections and the 30-year projections used in the PG&E model as a scaling factor to be applied across the board to other investment firms' projections was not correct.[29] TURN's revised testimony indicates that they have refined their conversion technique in an attempt to make it more similar to the technique employed by Horizon – that is adjusting the technique to their understanding of the specific projection methodology employed by each of the investment firms.[30] While TURN's approach moves in the right direction (and consequently increases TURN's projected returns), their sample size remains small relative to that of the Horizon survey, and is overwhelmingly biased to firms with shorter-term projections. To that point, there were only two firms, Callan and BlackRock, in TURN's sample that explicitly made 20+ year projections and there were

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29 TURN's Response to Data Request PGE_TURN002, Question 4, dated October 27, 2020.

30 *Id.*

only nine firms for which TURN was able to develop explicit projections for all three of the asset classes employed in the PG&E analysis. By contrast, the Horizon study surveyed 39 firms and developed asset class projections for those three asset classes for all of them.

Based on these observations regarding the execution of the TURN survey, I would suggest that the Horizon survey represents a more robust (and objective) approach that accomplishes exactly what TURN was trying to achieve in their testimony. To that end, Table 6-11 (data extracted from the Horizon survey) contrasts the long-term assumptions used in the PG&E Monte Carlo simulation model (the last column) relative to the distribution of long-term assumptions for the Horizon survey respondents. The bottom row of the table shows the long-term median return that would result from applying the asset class assumptions above in the table to the 80/20 mix assumed in the PG&E analysis. As the table illustrates, using the median long-term return assumptions for the respondents in this survey would result in a median projected return for the 80/20 portfolio that is 10 basis points above what was used in the analysis for PG&E. In other words, the accurate peer comparison analysis does not suggest that the PG&E assumed returns are too high, but just right or slightly low.

TABLE 6-11
HORIZON ACTUARIAL SERVICES, LLC 2020
SURVEY OF CAPITAL MARKET ASSUMPTIONS
DISTRIBUTION OF LONG-TERM EXPECTED RETURNS

Asset Class	Minimum	25th Percentile	50th Percentile	75th Percentile	Maximum	PG&E
Broad US Equity*	5.58%	6.65%	**7.25%**	7.73%	8.68%	**7.15%**
Broad Non-US Equity**	6.38%	7.43%	**7.68%**	8.23%	9.43%	**7.15%**
US Fixed Income***	2.20%	3.00%	**3.20%**	4.40%	5.40%	**3.60%**
56/24/20 Mix - Median Return	5.59%	6.60%	**7.03%**	7.68%	8.70%	**6.93%**

* Assumes 85/15 mix of US large cap and US small/mid Cap (consistent with Russell 3000 weights).

** Assumes 75/25 mix of developed and emerging markets equities (Consistent with average MSCI ACWI ex-US weights).

*** US Corporate Bonds - Core

As a further check on this set of peer returns, I also consulted the annual National Association of State Retirement Administrators (NASRA) Survey of Public Pension Plans, attached hereto as Exhibit 6.3. These assumptions represent, collectively, the best thinking of all of the major actuarial firms in the industry. The 2020 survey included 130 different public pension plans (representing trillions of dollars) that collectively employ effectively all of the actuaries operating in the United States. *Id*. The survey details the assumed long-term investment return employed by each of these pension plans for their long-term financial modelling exercises (actuarial valuations). For convenience, these values are shown in Table 6-12.

TABLE 6-12
LONG TERM ASSUMED INVESTMENT RETURN FOR PUBLIC PENSION PLANS
2020 NASRA SURVEY

Percent Above 6.93%:	**85%**
Median:	**7.25%**
Average:	**7.21%**

Retirement System	Assumed Investment Return
Alabama ERS	7.70%
Alabama Teachers	7.70%
Alaska PERS	7.38%
Alaska Teachers	7.38%
Arizona Public Safety Personnel	7.30%
Arizona SRS	7.50%
Arkansas PERS	7.15%
Arkansas State Highway ERS	8.00%
Arkansas Teachers	7.50%
California PERF1	7.00%
California Teachers	7.00%
Chicago Teachers	7.00%
City of Austin ERS	7.00%
Colorado Affiliated Local	7.00%
Colorado Fire & Police Statewide	7.00%
Colorado Municipal	7.25%
Colorado School	7.25%
Colorado State	7.25%
Connecticut SERS	6.90%
Connecticut Teachers	6.90%
Contra Costa County	7.00%
DC Police & Fire	6.50%
DC Teachers	6.50%
Delaware State Employees	7.00%
Denver Employees	7.50%
Denver Public Schools	7.25%
Fairfax County Schools	7.25%
Florida RS	7.20%
Georgia ERS2	7.30%
Georgia Teachers	7.25%
Hawaii ERS	7.00%
Houston Firefighters	7.00%
Idaho PERS	7.00%
Illinois Municipal	7.25%
Illinois SERS	7.00%
Illinois Teachers	7.00%
Illinois Universities	6.75%
Indiana PERF	6.75%
Indiana Teachers	6.75%
Iowa PERS	7.00%
Missouri Teachers	7.50%
Montana PERS	7.65%
Montana Teachers	7.50%
Nebraska Schools	7.50%
Nevada Police Officer and Firefighter	7.50%
Nevada Regular Employees	7.50%
New Hampshire Retirement System	7.25%
New Jersey PERS8	7.50%
New Jersey Police & Fire8	7.50%
New Jersey Teachers8	7.50%
New Mexico PERA	7.25%
New Mexico Teachers	7.25%
New York City ERS	7.00%
New York City Teachers	7.00%
New York State Teachers	7.25%
North Carolina Local Government	7.00%
North Carolina Teachers and State Employees	7.00%
North Dakota PERS	7.75%
North Dakota Teachers	7.75%
NY State & Local ERS9	6.80%
NY State & Local Police & Fire9	6.80%
Ohio PERS	7.20%
Ohio Police & Fire	8.00%
Ohio School Employees	7.50%
Ohio Teachers	7.45%
Oklahoma PERS	7.00%
Oklahoma Teachers	7.50%
Orange County ERS	7.00%
Oregon PERS	7.20%
Pennsylvania School Employees	7.25%
Pennsylvania State ERS	7.13%
Phoenix ERS	7.25%
Rhode Island ERS	7.00%
Rhode Island Municipal	7.00%
Richmond Retirement System	7.00%
San Diego County	7.00%
San Francisco City & County	7.40%
South Carolina Police	7.25%
South Carolina RS	7.25%
South Dakota RS	6.50%

TABLE 6-12 (CONTINUED)
LONG TERM ASSUMED INVESTMENT RETURN FOR PUBLIC PENSION PLANS
2020 NASRA SURVEY

Retirement System	Assumed Investment Return	Retirement System	Assumed Investment Return
Kansas PERS	7.75%	St. Louis School Employees	7.50%
Kentucky County	6.25%	St. Paul Teachers	7.50%
Kentucky ERS3	5.25%	Tennessee Political Subdivisions	7.25%
Kentucky Teachers	7.50%	Tennessee State and Teachers	7.25%
Los Angeles County ERS	7.25%	Texas County & District	8.00%
Louisiana Parochial Employees	6.50%	Texas ERS	7.50%
Louisiana SERS4	7.60%	Texas LECOS	7.50%
Louisiana Teachers5	7.55%	Texas Municipal	6.75%
Maine Local	6.75%	Texas Teachers	7.25%
Maine State and Teacher	6.75%	University of California	6.75%
Maryland PERS	7.40%	Utah Noncontributory	6.95%
Maryland Teachers	7.40%	Vermont State Employees	7.50%
Massachusetts SERS	7.25%	Vermont Teachers	7.50%
Massachusetts Teachers	7.25%	Virginia Retirement System	6.75%
Michigan Municipal	7.35%	Washington LEOFF Plan 1	7.50%
Michigan Public Schools6,7	6.80%	Washington LEOFF Plan 2	7.40%
Michigan SERS7	6.70%	Washington PERS 1	7.50%
Minnesota PERF	7.50%	Washington PERS 2/3	7.50%
Minnesota State Employees	7.50%	Washington School Employees Plan 2/3	7.50%
Minnesota Teachers	7.50%	Washington Teachers Plan 1	7.50%
Mississippi PERS	7.75%	Washington Teachers Plan 2/3	7.50%
Missouri DOT and Highway Patrol	7.00%	West Virginia PERS	7.50%
Missouri Local	7.25%	West Virginia Teachers	7.50%
Missouri PEERS	7.50%	Wisconsin Retirement System	7.00%
Missouri State Employees	6.95%	Wyoming Public Employees	7.00%

As Table 6-12 illustrates, the median long-term return assumption of 6.93 percent used in the PG&E analysis is below the long-term return assumptions used by 85 percent of the plans in this large sample. This is in spite of the fact that the 80/20 asset allocation assumed in the PG&E analysis has a higher assumed equity exposure than most of the plans in this sample. These results suggest that, relative to other professionals that are also explicitly in the business of generating long-term return assumptions to support long-term financial modelling of large complex financial institutions, the long-term return assumptions employed in the PG&E analysis were reasonable, and reducing them by 104 basis points, as suggested by TURN, is unsupportable.

Finally, it is worth noting that PG&E (and the other California utilities) regularly employ long-term return assumptions in their triennial cost allocation proceedings with the Commission. Most notably these assumptions are used in developing the costs associated with funding NDTs. During the course of these proceedings, the Commission has evaluated and authorized these long-term assumptions and generally deemed them reasonable. Table 6-13 shows the equity and fixed income investment returns set in these proceedings going back to 2002, and in nearly every case, the returns exceed those used by Callan (the only exception being PG&E's 2.9 percent fixed income returns in 2012, which was then increased to 3.6 percent in 2015).

TABLE 6-13
INVESTMENT RETURNS IN TRIENNIAL COST ALLOCATION PROCEEDINGS

NDT Triennial Proceeding Decision	Return on Equities	Return on Fixed Income
D.03-10-014 [(a)]	PG&E: 10.5% SDG&E: 10.5% SCE: 10.5%	PG&E: 6.0% SDG&E: 6.0% SCE: 6.0%
D.07-01-003 (Settlement) [(b)]	PG&E: 8.5%	PG&E: 5.8%
D.10-07-047 (Settlement) [(c)]	PG&E: 8.5% SDG&E: 8.75% SCE: 8.75%	PG&E: 4.1%
D.14-12-082 [(d)]	PG&E: 7.5% SDG&E: 7.48% SCE: 7.79%	PG&E: 2.9% SDG&E: 4.25% SCE: 4.27%
D.17-05-020 [(e)]	PG&E: 7.7%	PG&E: 3.6%

(a) D.03-10-014, p. 14.
(b) D.07-01-003, p.18. Pursuant to CPUC Rule 12.5, Commission adoption of a settlement "does not constitute approval of, or precedent regarding, any principle or issue in the proceeding or in any future proceeding," unless the Commission expressly states otherwise.
(c) D.10-07-047, pp. 32-33.
(d) D.14-12-082, pp. 123, 127.
(e) D.17-05-020, p. 60.

Of note, TURN, the only intervenor to propose alternative investment return forecasts in this proceeding, has argued in past NDT proceedings that the long-term return assumptions employed by the utilities are too low.[31] As shown above, the returns in those proceedings are in fact higher than PG&E's long-term return forecasts used for the proposed Securitization, making them more conservative than the NDT returns and substantially less than those advocated by TURN in those proceedings.

b. Revisions to Monte Carlo Model

In response to the testimony of TURN witness Ellis, I have made small adjustments to the Monte Carlo model, none of which materially affect the results. First, I adjusted the model so that if there is a shortfall in the Customer Credit Trust, customers are repaid as soon as additional funds are available from Additional Shareholder Contributions. Second, I revised the model to capture the gross-up for taxes on only the principal portion of the FRC. This provides customers the benefit of the interest deduction for tax purposes in a period in which the Customer Credit is less than the FRC and customers pay some portion of the FRC (in all other periods, Customers do not pay any cash for the FRC). Finally, I adjusted the discount rate calculation to include the first

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31 *See, e.g.*, D.14-12-082, p. 111 ("TURN recommended application of a higher (8.75%) return value as a reasonable pre-tax Return on Equity (ROE) for all the trust funds, and an increase from 2.90% to 4.25% for PG&E's estimated return on Fixed Income."); D.10-07-047, p. 31 ("SCE initially applied an 8.06% pre-tax return on equity, SDG&E applied 8.13%, PG&E used 8.5%, and TURN proposed 10.05% for all three utilities."); *id.* p. 33 ("For the fixed income portions of the trust fund portfolios, SCE originally assumed a 4.69% pre-tax return, SDG&E assumed 5.34%, PG&E applied 4.11%, and TURN agreed with SCE.").

quarter of the 30 year period. The revised output from the model is set forth below.[32]

TABLE 6-14
RANGE OF SURPLUS (DEFICIT) INCLUDING PRINCIPAL TAX GROSS-UP
(BASE CASE 80/20)

Percentiles	Nominal Surplus (Deficit) ($Millions)	NPV Surplus (Deficit) ($Millions)	First Shortfall Year
5%	$16,639	$1,987	NA
10%	$12,642	$1,510	NA
15%	$9,874	$1,179	NA
20%	$8,176	$977	NA
25%	$7,005	$837	NA
30%	$6,034	$721	NA
35%	$5,180	$619	NA
40%	$4,468	$534	NA
45%	$3,860	$461	NA
50%	$3,276	$391	NA
55%	$2,785	$333	NA
60%	$2,292	$274	NA
65%	$1,809	$216	NA
70%	$1,372	$164	NA
75%	$914	$109	NA
80%	$421	$50	NA
85%	($115)	($14)	2047
90%	($848)	($106)	2049
95%	($1,921)	($259)	2050
Expected Value (EV):	$4,414	$525	
EV Positive Outcomes:	$4,566	$545	
EV Negative Outcomes:	($152)	($20)	
Breakeven Pre-Tax Return:	4.06%	4.06%	
Probability of Surplus:	**84%**	**84%**	

32 The approach I use to calculate expected values differs from that used by Professor Brad Cornell in Rebuttal Chapter 10. Professor Cornell's approach considers the results of all 2,000 trials from the simulation. The approach I employ uses summary data from the 2,000 trials. Specifically, it equally weights the results at 5 percentile increments between the 5th and 95th percentile cases. This approximation technique is a convention that Callan has adopted to streamline the presentation of results to our clients. This approach eliminates the highly unlikely tail events (both positive and negative) from the presentation and from the calculation of the expected value. Generally speaking, the magnitude of positive tail events exceeds the magnitude of negative tail events when simulating the behavior of investment portfolios. As a result, the approximation approach that I used should generally result in lower expected values than the approach employed by Professor Cornell.

c. Alternative Scenario Case – Wildfire Loss in 2029

As discussed above, I prepared alternative scenarios requested by PG&E using the Monte Carlo model. Set forth below is the output based on a scenario in which all taxable income is eliminated in 2029.

TABLE 6-15
RANGE OF SURPLUS (DEFICIT) INCLUDING PRINCIPAL TAX GROSS-UP
(NO TAXABLE INCOME IN 2029 CASE 80/20)

Percentiles	Nominal Surplus (Deficit) ($Millions)	NPV Surplus (Deficit) ($Millions)	First Shortfall Year
5%	$14,583	$1,742	NA
10%	$10,956	$1,309	NA
15%	$8,613	$1,029	NA
20%	$7,021	$839	NA
25%	$6,040	$721	NA
30%	$5,158	$616	NA
35%	$4,375	$523	NA
40%	$3,676	$439	NA
45%	$3,152	$376	NA
50%	$2,648	$316	NA
55%	$2,189	$261	NA
60%	$1,794	$214	NA
65%	$1,444	$172	NA
70%	$1,013	$121	NA
75%	$607	$73	NA
80%	$194	$23	NA
85%	($347)	($42)	2047
90%	($1,041)	($132)	2049
95%	($1,895)	($255)	2050
Expected Value (EV):	$3,694	$439	
EV Positive Outcomes:	$3,866	$462	
EV Negative Outcomes:	($173)	($23)	
Breakeven Pre-Tax Return:	4.29%	4.29%	
Probability of Surplus:	**82%**	**82%**	

3. The Other Risks Identified by Intervenors Are Remote and Overstated [Issues 3, 4] (David Thomason)

Set forth below are additional items raised by intervenors and the reasons these are not material risks.

TABLE 6-16
ADDITIONAL RISKS IDENTIFIED BY INTERVENORS

Intervenor Position	PG&E Response
True-ups unpredictable [(a)]	True-ups are an essential feature of securitizations to achieve the highest rating possible. They have been a feature in prior securitizations, and PG&E is unaware of problems caused by true-ups. The impact of the true-up on a customer's bill is likely to be minimal, especially in light of the Customer Credit.
Bond interest rate [(b)]	Chapter 2 provided the most current estimate of the rate.
Higher servicing fees if PG&E not servicer [(c)]	There is no reason to believe that PG&E will be replaced as servicer. This would increase costs and difficulty of collection. In its Chapter 11 proceedings, PG&E was not replaced as the billing agent for third-party charges, such as DWR, or as the servicer for the Revenue Reduction Bonds.
Higher administration expenses of Bond SPE and Trust [(d)]	The estimates used are based on past experience with prior securitized bonds, input from market benchmarks, and the costs of the NDTs.
Delay consideration of the Stress Test Application [(e)]	There is no reason to delay consideration. The finance team's purpose is to provide advice on the Recovery Bonds, not the Stress Test Costs. PG&E and intervenors have invested substantial time and presented ample evidence to decide whether there at least $7.5 billion in Stress Test Costs eligible for securitization.
PG&E Model for Taxable Income Contains an Error [(f)]	PG&E explained in its data request response that there is no error in the model. It is based on certain assumptions and was not constructed to work with alternative assumptions. [(g)]

(a) AECA-Boccadoro, p. 5, lines 23-27.
(b) CCSF-MEAL, p. 31, lines 22-24; EPUC-Gorman, p. 11, lines 3-6.
(c) A4NR-Geesman, p. 25, lines 7-12.
(d) CCSF-Meal, p. 31, lines 22-24.
(e) Wild Tree-Rothschild, p. 12, line 19 to p.13, line 15.
(f) Revised TURN-Ellis, p. 10 n.13.
(g) *See* PG&E's Response to Data Request TURN_008-Q01-08, Questions 4-8, dated September 28, 2020.

C. The Proposed Structure of the Customer Credit Trust Is Reasonable. [Issue 7] (David Thomason)

PG&E proposes to structure the Customer Credit Trust to be similar to the NDTs that have operated successfully under the Commission's oversight for decades. Wild Tree Foundation (Wild Tree) suggests that all members of the Trust management committee be independent and that these managers, not the Commission, be empowered to distribute any surplus earlier than the end of the Trust. PG&E submits that these changes are neither necessary nor prudent.[33] As proposed by PG&E, the Customer Credit Trust would be managed by a majority-independent committee, with three independent members approved by the Commission. In addition, fundamental decisions will require Commission approval. Given PG&E's residual interest in the Trust surplus, a majority independent board, the same as for the NDTs, is appropriate. And given the impact on customers of an early distribution of Trust surplus, the Commission should make that decision, not the Trust's management committee. Finally, the Customer Credit Trust is structured so that its assets would be dedicated exclusively to funding the Customer Credit embodied in an irrevocable rate setting order of the Commission, and with restrictions to prevent it from being eligible to file for bankruptcy. In the prior PG&E bankruptcies, the NDTs continued to function in the normal course without interruption. There is no reason to think the Customer Credit Trust would be any different or that the concerns of intervenors are material risks.[34]

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33 Wild Tree-Rothschild, pp. 4-5.

34 A4NR-Geesman, p. 24, lines 1-3; CCSF-Meal, p. 30 n.91; CLECA-Yap, p. 8, lines 22-26, p. 10, lines 11-22; TURN-Dowdell, p. 4, line 22 to p. 5, line 1; Wild Tree-Rothschild, p. 9, lines 3-7, p. 11, lines 13-22.

PACIFIC GAS AND ELECTRIC COMPANY

CHAPTER 6

EXHIBIT 6.2

HORIZON ACTUARIAL SERVICES LLC

2020 SURVEY OF CAPITAL MARKET ASSUMPTIONS

Horizon Actuarial Services, LLC

Survey of Capital Market Assumptions

2020 Edition

Horizon Actuarial Services, LLC is proud to serve as the actuary to over 100 multiemployer defined benefit pension plans across the United States and across various industries. As actuary to these plans, we must develop assumptions regarding future investment returns on plan assets. We then use those assumptions as we determine the actuarial values of the benefits promised by these plans to their participants and beneficiaries, as well as to project plan funding and solvency levels years into the future.

At Horizon Actuarial, we are retirement and healthcare actuaries, not investment professionals. Therefore, when developing assumptions as to what returns a pension plan's assets might be expected to earn in the future, we seek input from our colleagues in the investment advisory community. Each year, as part of this survey, we ask different investment firms to provide their "capital market assumptions" – their expectations for future risk and returns for different asset classes in which pension plans commonly invest. The information gathered from this survey can help answer the common question: "Are my plan's investment return assumptions reasonable?"

There are many factors to consider when evaluating a plan's investment return assumptions, such as its asset allocation, the maturity of its participant population, and the purpose of the measurement. Any of these factors can make the expected return for one plan very different from others. Therefore, this report does not opine on the reasonableness of any one plan's investment return assumptions. Nevertheless, we hope this report will be a useful resource for trustees, actuaries, and investment professionals alike.

Horizon Actuarial sincerely thanks the 39 investment advisors who participated in this survey.

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Miami ▪ San Diego ▪ San Francisco ▪ Washington, D.C.

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Horizon Actuarial Services, LLC is an independent consulting firm specializing in providing actuarial and consulting services to multiemployer benefit plans. Horizon Actuarial does not provide investment, legal, or tax advice. Please consult with your investment advisor, legal counsel, or tax advisor for information specific to your plan's investment, legal, or tax implications.

Summary

Horizon Actuarial first conducted this survey in 2010, and it included 8 investment advisors. In 2012, we first published a report on the survey results, which included 17 advisors. The survey has expanded considerably over the past few years; this 2020 edition of the survey includes assumptions from 39 different investment firms.

Over the last 5 years, expected returns have declined for all but a few asset classes. The steepest declines have been for fixed income investments such as US corporate bonds and Treasuries, where return expectations fell by 70-100 basis points or more from 2019 to 2020 alone. These declines were driven by the Federal Reserve's intervention in the markets in response to the COVID-19 pandemic and may have significant implications for multiemployer pension plans. Other asset classes (including both developed market and US equities) have seen significant declines in recent years as well.

As we have seen in prior surveys, expected returns are noticeably lower over the short term than over the long term. This trend is apparent when we focus on the 18 advisors who provided assumptions for both the short term (up to 10 years) and long term (20 years or more).

For less mature ongoing pension plans without solvency issues, we believe a horizon of 20 years or more is appropriate for evaluating the reasonableness of the long-term investment return assumption. A shorter horizon, such as 10 years, may be more appropriate for evaluating the return assumption for a plan that is more mature or has solvency issues. Even for plans with long-term investment horizons, it is important to understand the potential impact of lower expected returns over the short term. Therefore, this survey shows return expectations over horizons of both 10 years and 20 years.

For illustration, this report also constructs an asset allocation for a hypothetical multiemployer pension plan and uses the results from the survey to develop a range of reasonably expected returns for the plan. When compared to the 2019 edition of the survey, the expected returns for this 2020 edition were 27 basis points lower over a 10-year horizon and 35 basis points lower over a 20-year horizon. These changes were primarily driven by declines in return expectations for fixed income securities (as noted above) for advisors who participated in both the 2019 and 2020 editions of the survey.

If you have questions about how the results of this survey relate to your multiemployer plan, please contact your consultant at Horizon Actuarial or visit the "contact us" page on our website, www.horizonactuarial.com.

For questions about the survey itself, please contact Ben Ablin at ben.ablin@horizonactuarial.com.

Survey Participants

Exhibit 1 below lists the 39 investment advisors whose capital market assumptions are included in the 2020 survey. This report does not attribute specific assumptions to individual firms, which is a precondition of the survey.

Originally, this survey was exclusive to the multiemployer plan community; it included only assumptions from investment advisors to multiemployer pension plans. The survey has expanded over the years, and it now includes assumptions from investment advisors outside of the multiemployer plan community.

A complete listing of the firms participating in the survey is provided below.

Exhibit 1

2020 Survey Participants	
AJ Gallagher	*Marquette Associates*
Alan Biller	*Meketa Investment Group*
AndCo Consulting	*Mercer*
Aon Hewitt	*Merrill Lynch Global Institutional Consulting*
The Atlanta Consulting Group	*Milliman*
*Bank of New York Mellon**	*Morgan Stanley Wealth Management*
*BlackRock**	*NEPC*
Callan Associates	*PFM Asset Management, LLC*
Cambridge Associates	*Research Affiliates, LLC**
CapTrust	*Royal Bank of Canada*
Ellwood Associates	*RVK*
Envestnet	*Segal Marco Advisors*
*Franklin Templeton**	*SEI*
Goldman Sachs Asset Management	*Sellwood Consulting*
Graystone Consulting	*SunTrust*
*Invesco**	*UBS*
Investment Performance Services, LLC (IPS)	*The Vanguard Group**
Janney Montgomery Scott, LLC	*Verus*
*J.P. Morgan Asset Management**	*Voya Investment Management**
	Willis Towers Watson

**Assumptions obtained from published white paper.*

Investment Horizons

When evaluating the expected return assumption for an active, ongoing multiemployer pension plan, actuaries usually consider investment returns over a long-term investment horizon of 20 years or more. A shorter time horizon, say over the next 10 years, may be more appropriate when evaluating the return assumption for a mature plan, a plan that has high negative cash flows, or a plan that is projected to become insolvent.

It is also important to understand the sensitivity of plan funding to changes in future investment returns. For example, the actuary for an active, ongoing pension plan will typically set the plan's investment return assumption based on expectations over a long-term horizon. However, evaluating the sensitivity of funding results to short-term investment returns that are expected to be higher or lower than the long-term assumption also plays an integral role in the decision-making process.

Advisors provided their most recent capital market assumptions: expected returns for different asset classes, standard deviations (i.e., volatilities) for those expected returns, and a correlation matrix. The advisors also indicated the investment horizon(s) to which their assumptions apply. If the advisor develops separate assumptions for different time horizons, they provided multiple sets of assumptions, one for each time horizon.

In the 2020 edition of the survey, 21 advisors provided one set of assumptions: of those, 20 specified a time horizon of 10 years and 1 specified a time horizon of 7 years. The remaining 18 advisors provided assumptions over both shorter-term (5 to 10 years) and longer-term (20 years or more) horizons. Note that two of the advisors rely on the same assumptions as other survey participants. Each assumption set was only counted once, even if it was provided by more than one advisor.

Exhibit 2 below summarizes the time horizons specified by each advisor, grouped by type.

Exhibit 2

Investment Time Horizons	
Time Horizon	**Total**
5 to 10 Years	21
Both Short- and Long-Term	18
Total	39

Short-Term vs. Long-Term

As noted in the previous section, survey participants provided expected returns over different time horizons. Given current market conditions, many investment advisors may expect returns for certain asset classes to be different in the short term versus over the long term.

For comparability, this survey groups expected returns into two time horizons: 10 years and 20 years. As pension plan actuaries, we often refer to the 10-year expected returns as "short-term" and the 20-year expected returns as "long-term." Note, however, that many investment firms consider 10-year expectations to be "long-term."

When comparing the expected returns for the 18 advisors who provided both short-term and long-term assumptions,[1] we see some interesting differences. See Exhibit 3 below. The expected returns shown below are annualized (geometric) over the indicated time horizons.

Exhibit 3

Average Expected Returns: Short-Term vs. Long-Term
Subset of 18 Survey Respondents

Asset Class	10-Year Horizon	20-Year Horizon	Difference
US Equity - Large Cap	6.44%	7.06%	0.62%
US Equity - Small/Mid Cap	7.14%	7.56%	0.42%
Non-US Equity - Developed	7.06%	7.48%	0.42%
Non-US Equity - Emerging	8.24%	8.42%	0.18%
US Corporate Bonds - Core	2.53%	3.56%	1.03%
US Corporate Bonds - Long Dur.	2.61%	3.56%	0.95%
US Corporate Bonds - High Yield	4.82%	5.62%	0.80%
Non-US Debt - Developed	1.41%	2.26%	0.84%
Non-US Debt - Emerging	5.27%	5.85%	0.58%
US Treasuries (Cash Equivalents)	1.53%	2.25%	0.71%
TIPS (Inflation-Protected)	2.03%	2.73%	0.70%
Real Estate	6.01%	6.59%	0.59%
Hedge Funds	5.05%	5.71%	0.66%
Commodities	3.34%	4.04%	0.70%
Infrastructure	7.15%	7.30%	0.15%
Private Equity	9.29%	9.87%	0.58%
Private Debt	7.81%	7.85%	0.05%
Inflation	2.11%	2.16%	0.05%

The 10-year and 20-year returns shown above are the averages for the 18 advisors who provided both short-term and long-term assumptions.
Expected returns are annualized (geometric).

The consensus among these 18 advisors was that returns are expected to be lower in the short term compared to the long term. In general, the difference between long-term and short-term returns is more pronounced for US equity and fixed income investments. The differences are also relatively large for alternative investments such as private equity, real estate, and hedge funds.

As noted earlier, the results shown in Exhibit 3 are based on a subset of 18 advisors. If we include all 39 survey advisors, the differences between short-term and long-term expected returns do not change dramatically for most asset classes. See Exhibit 4 below.

Exhibit 4

Average Expected Returns: Short-Term vs. Long-Term
All Survey Respondents

Asset Class	10-Year Horizon	20-Year Horizon	Difference
US Equity - Large Cap	6.16%	7.06%	0.91%
US Equity - Small/Mid Cap	6.85%	7.56%	0.71%
Non-US Equity - Developed	6.80%	7.48%	0.68%
Non-US Equity - Emerging	7.85%	8.42%	0.57%
US Corporate Bonds - Core	2.60%	3.56%	0.97%
US Corporate Bonds - Long Dur.	2.70%	3.56%	0.86%
US Corporate Bonds - High Yield	4.90%	5.62%	0.72%
Non-US Debt - Developed	1.39%	2.26%	0.87%
Non-US Debt - Emerging	5.16%	5.85%	0.69%
US Treasuries (Cash Equivalents)	1.56%	2.25%	0.68%
TIPS (Inflation-Protected)	1.98%	2.73%	0.76%
Real Estate	5.75%	6.59%	0.85%
Hedge Funds	4.74%	5.71%	0.97%
Commodities	3.19%	4.04%	0.85%
Infrastructure	6.94%	7.30%	0.36%
Private Equity	9.08%	9.87%	0.80%
Private Debt	7.75%	7.85%	0.10%
Inflation	1.97%	2.16%	0.19%

10-year horizon results include all 39 survey respondents.
20-year horizon results include a subset of 18 survey respondents.
Expected returns are annualized (geometric).

The 10-year expected returns shown above include assumptions from all 39 advisors, while the 20-year expected returns include assumptions from only the 18 advisors who provided longer-term assumptions.

Given the significant differences in expected returns over the short term and the long term, it remains important for actuaries to illustrate the effects of near-term underperformance on their clients' pension funds. Furthermore, it may be appropriate for actuaries to attribute more weight to nearer term expectations when setting the investment return assumption for mature plans whose liabilities have a shorter duration.

[1] In cases where an advisor indicated a time horizon shorter than 10 years, the shorter-term expected returns were combined with the longer-term expected returns to achieve a 10-year horizon. Similarly, if an advisor indicated a time horizon longer than 20 years, the longer-term expected returns were combined with the shorter-term expected returns to achieve a 20-year horizon.

Differing Opinions

Exhibit 5 below shows the distribution of expected returns and standard deviations (i.e., volatilities) for each asset class in the survey, as provided by the 39 individual advisors in the survey. The expected returns shown are geometric.

Note that the exhibit below focuses on a 10-year horizon in order to include assumptions from all 39 advisors. See Exhibits 16 and 17 in the appendix to this report for a more detailed look at the distribution of expected returns and standard deviations over both 10- and 20-year horizons. The ranges of expected returns by asset class can be found in the appendix as Exhibits 18 and 19.

The exhibit below shows that there are significant differences in expected returns and standard deviations among investment advisors. As the saying goes, "reasonable people may differ."

The differences in assumptions are more pronounced for alternative investments such as real estate, hedge funds, and private equity. A contributing factor may be differences in the underlying strategies different advisors apply to these alternative investments.

To contrast, the differences in expected returns and volatilities are smaller for more traditional investments, such as US equity and US fixed income.

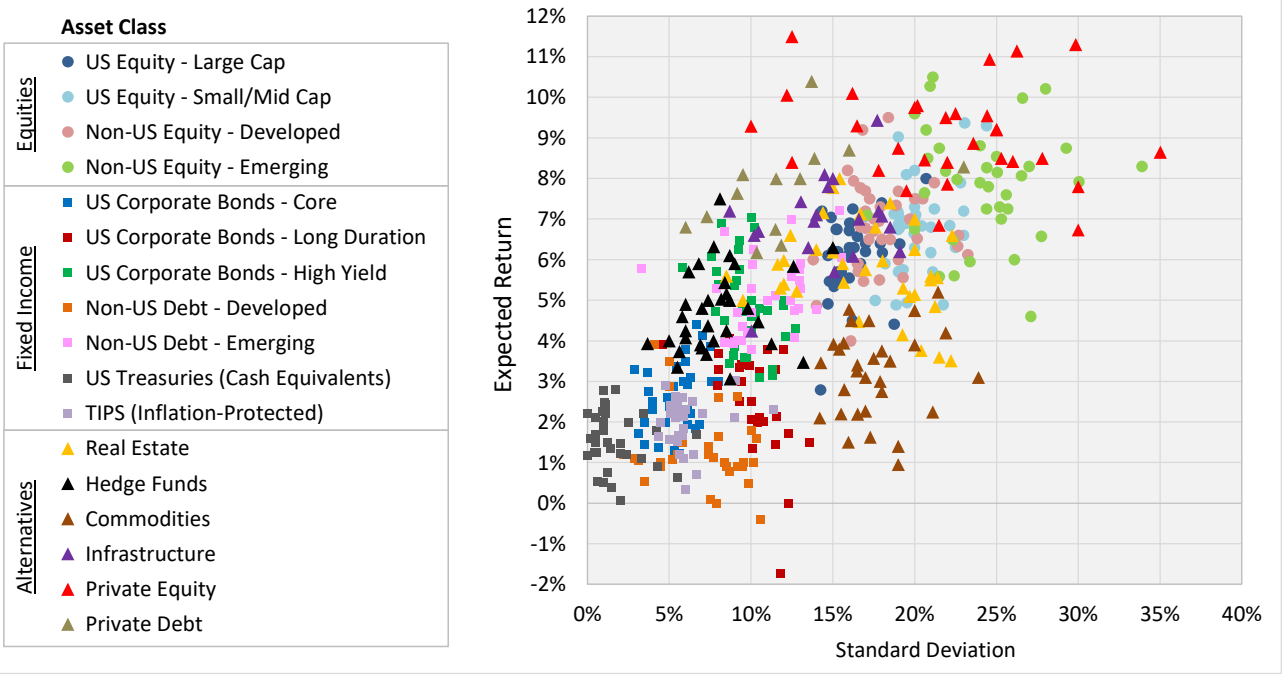
Another reason for the significant differences among investment advisors is the effective date of the assumptions. Some advisors update their assumptions annually, while others update their assumptions more frequently (e.g., quarterly). Since current price and yield information are two of the most important inputs in developing capital market assumptions, differing prices and yields at different effective dates can have a significant impact on future expectations.

For this 2020 edition of the survey, we felt it was important for as many advisors as possible to reflect changing expectations due to the COVID-19 pandemic and the Federal Reserve's response of reducing interest rates and providing significant liquidity to the markets. While the vast majority of responses take these updated market conditions into account, considerable uncertainty remains. For these reasons, it may be more important than ever for actuaries to apply professional judgment in applying the results of this survey to the evaluation and selection of an investment return assumption.

Exhibit 5

2020 Survey: Distribution of Expected Returns and Standard Deviations

10-Year Horizon | Geometric Returns



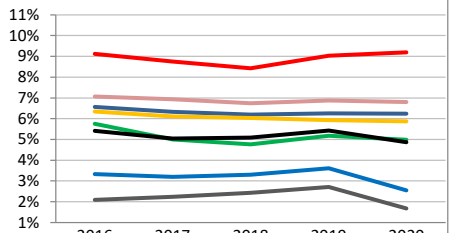
Changing Outlooks: 2016 to 2020

In recent years, there has been much discussion about whether it is reasonable to expect that future investment returns will be as high as they have been historically. Citing various reasons such as increased equity prices, tightening credit spreads, and the persistence of historically low interest rates, many advisors have lowered their expectations over the last five years.

Exhibit 6 below shows average expected returns over a 10-year horizon for selected asset classes each year from 2016 to 2020. For consistency, this exhibit includes only the 29 advisors who provided short-term assumptions in each of these years.

Exhibit 6

Average Expected Returns (10-Year Horizon)



	2016	2017	2018	2019	2020
Private Equity	9.1%	8.7%	8.4%	9.0%	9.2%
Non-US Eq. (Dev)	7.1%	6.9%	6.7%	6.9%	6.8%
US Eq. (Large Cap)	6.6%	6.3%	6.2%	6.3%	6.2%
Real Estate	6.3%	6.1%	6.0%	5.9%	5.9%
US Bonds (HY)	5.8%	5.0%	4.8%	5.2%	5.0%
Hedge Funds	5.4%	5.0%	5.1%	5.4%	4.9%
US Bonds (Core)	3.3%	3.2%	3.3%	3.6%	2.6%
US Treasuries	2.1%	2.2%	2.4%	2.7%	1.7%

Figures are average geometric returns for selected asset classes for the 29 advisors who provided short-term assumptions in each of the surveys from 2016 through 2020.

For this subset of advisors, average expected returns over a 10-year horizon have declined for most asset classes. The sharpest declines from 2016 to 2020 were for high-yield US Bonds (from 5.8% to 5.0%) and core US corporate bonds (from 3.3% to 2.6%).

While the steep decline for high-yield US bonds occurred between 2016 and 2017, the steep declines for lower-risk fixed income securities occurred from 2019 to 2020. For example, expectations for core US corporate bonds fell 100 basis points from 3.6% to 2.6% and expectations for US Treasuries also fell 100 basis points from 2.7% to 1.7% over the past year.

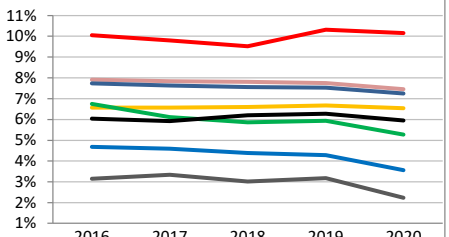
The declines for other asset classes, such as large cap US equities, real estate, and hedge funds have been more gradual, but significant nonetheless, over the 5-year period.

Exhibit 7 below shows how average expected returns have changed for the same asset classes for a subset of 9 advisors who provided assumptions each year from 2016 to 2020 over a 20-year horizon.

Note that the expected returns shown in Exhibits 6 and 7 are not directly comparable with those in other sections or previous surveys because we include only a subset of advisors who participated in each of the last 5 years.

Exhibit 7

Average Expected Returns (20-Year Horizon)



	2016	2017	2018	2019	2020
Private Equity	10.1%	9.8%	9.5%	10.3%	10.2%
Non-US Eq. (Dev)	7.9%	7.8%	7.8%	7.7%	7.4%
US Eq. (Large Cap)	7.7%	7.6%	7.6%	7.5%	7.3%
Real Estate	6.6%	6.6%	6.6%	6.7%	6.5%
US Bonds (HY)	6.7%	6.1%	5.9%	5.9%	5.3%
Hedge Funds	6.0%	5.9%	6.2%	6.3%	5.9%
US Bonds (Core)	4.7%	4.6%	4.4%	4.3%	3.6%
US Treasuries	3.1%	3.3%	3.0%	3.2%	2.2%

Figures are average geometric returns for selected asset classes for the 9 advisors who provided long-term assumptions in each of the surveys from 2016 through 2020.

Although the expected returns are generally higher over a 20-year horizon than a 10-year horizon, the trends over the 5-year period are very similar.

The steep declines in return expectations for fixed income investments over both 10-year and 20-year horizons reflect the impact of the Federal Reserve's response to the COVID-19 pandemic. These developments are troubling for defined benefit pension plans for two reasons. Not only will they lead to reduced returns on plan assets, but they may also lead to lower discount rates, resulting in higher present values of promised benefits (liabilities).

Even though multiemployer plans are not required to discount their liabilities using bond yields, they generally have significant allocations to fixed income securities. As a result of these allocations, portfolio level expected returns are likely to decline. For these reasons, the consequences of the Federal Reserve's actions on defined benefit pension plans of all types cannot be understated.

Evaluating the Return Assumption

Multiemployer pension plans are usually invested in a well-diversified mix of stocks, bonds, real estate, and alternative investments structured to meet the goals of the Trustees. This typically involves maximizing returns over the long term while minimizing return volatility.

The actuary of a multiemployer pension plan must consider the plan's asset allocation and, based on expectations of future returns, develop an assumption for what plan assets are projected to earn over the long term. This assumption is then used (along with others) to determine the actuarial present value of the benefits promised by the plan to its participants and beneficiaries.

The actuary will often seek input on future return expectations from the plan's investment advisor in developing the plan's investment return assumption. However, as noted earlier, different investment advisors often have widely differing opinions on what future returns will be. Therefore, it can be beneficial to keep in mind other advisors' expectations when setting the investment return assumption.

In the following exhibits, we will evaluate the investment return assumption for a hypothetical multiemployer pension plan. Exhibit 8 below shows the asset allocation for this hypothetical plan. The asset allocations are arbitrary, except for the fact that we made sure to include at least a small allocation to every asset class in the survey.

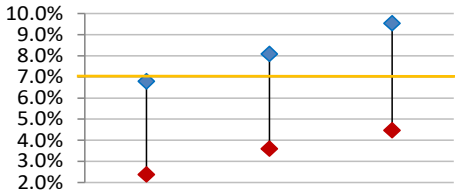
Exhibit 8

Asset Class - Hypothetical Plan	Weight
US Equity - Large Cap	20.0%
US Equity - Small/Mid Cap	10.0%
Non-US Equity - Developed	7.5%
Non-US Equity - Emerging	5.0%
US Corporate Bonds - Core	7.5%
US Corporate Bonds - Long Duration	2.5%
US Corporate Bonds - High Yield	5.0%
Non-US Debt - Developed	5.0%
Non-US Debt - Emerging	2.5%
US Treasuries (Cash Equivalents)	5.0%
TIPS (Inflation-Protected)	5.0%
Real Estate	7.5%
Hedge Funds	5.0%
Commodities	2.5%
Infrastructure	2.5%
Private Equity	5.0%
Private Debt	2.5%
TOTAL PORTFOLIO	**100.0%**

Exhibit 9 shows expected annualized (geometric) returns for the hypothetical plan over a 10-year horizon. These results may be appropriate for modeling sensitivities of future funding results to short-term investment returns, or for evaluating the return assumption for a plan with severely negative cash flows or solvency issues.

Exhibit 9

Annualized Expected Returns
Hypothetical Multiemployer Pension Fund
10-Year Horizon

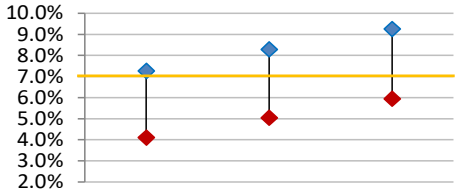


	Conservative Advisor	Survey Average	Optimistic Advisor
◆ 75th percentile	6.78%	8.08%	9.54%
◆ 25th percentile	2.37%	3.60%	4.47%
Probability of Meeting or Exceeding:			
7.50% per Year	18.6%	30.9%	44.7%
7.00% per Year	22.9%	36.4%	50.0%
6.50% per Year	27.8%	42.1%	55.3%

Exhibit 10 shows expected annualized (geometric) returns for the hypothetical plan over a 20-year horizon based on assumptions from the 18 advisors who provided longer-term assumptions. These results may be more appropriate for evaluating the return assumption for a less mature plan with no projected solvency issues.

Exhibit 10

Annualized Expected Returns
Hypothetical Multiemployer Pension Fund
20-Year Horizon



	Conservative Advisor	Survey Average	Optimistic Advisor
◆ 75th percentile	7.26%	8.29%	9.24%
◆ 25th percentile	4.10%	5.04%	5.93%
Probability of Meeting or Exceeding:			
7.50% per Year	21.9%	36.4%	51.4%
7.00% per Year	28.6%	44.5%	59.5%
6.50% per Year	36.3%	52.7%	67.1%

Evaluating the Return Assumption (cont.)

It is important to keep in mind that the expected returns shown in Exhibits 9 and 10 apply only to the hypothetical asset allocation shown in Exhibit 8. The expected returns will be different – perhaps significantly – for different asset allocations. The following are points to consider when reviewing the results in Exhibits 9 and 10:

Range of Reasonable Assumptions: When setting the investment return assumption for pension valuations, actuaries traditionally constructed a range of reasonable assumptions and then selected a best-estimate point within that range. Actuaries would often consider the reasonable range to be the middle 50 percent of possible results, bounded by the 25th and 75th percentiles.

The applicable actuarial standards of practice were updated in 2013, and the updated standards de-emphasize use of the reasonable range when setting the investment return assumption. Nevertheless, considering this range remains instructive; it may be difficult for an actuary to justify an assumption outside of this range.

Based on the average assumptions in this 2020 survey, the middle 50 percent range for this hypothetical pension plan is very wide: 5.04% to 8.29% over the next 20 years. Note that the range is even wider for a 10-year horizon: 3.60% to 8.08%. This is due to the fact that, while returns may be volatile from one year to the next, deviations will be lower when returns are annualized (in other words, smoothed out) over longer horizons.

Probability of Meeting/Exceeding the Benchmark: For example, say that the actuary for this hypothetical pension plan expects its investment returns to be 7.00% per year, represented by the gold lines in Exhibits 9 and 10. Based on the average assumptions in this 2020 survey, there is a 44.5% probability the plan will meet or beat its 7.00% benchmark on an annualized basis over a 20-year period. The probability is lower, 36.4%, that the plan will meet or beat its benchmark over the next 10 years.

Also note that over a 20-year period, the probability that the annualized investment return will exceed 7.50% (arbitrarily, 50 basis points above the benchmark return) is 36.4%. The probability that the annualized return will exceed 6.50% (50 basis points below the benchmark) is 52.7%. These probabilities are a bit lower when focusing on a 10-year horizon rather than a 20-year horizon.

Purpose of the Measurement: It is important to note that this survey focuses on the investment return assumption, which may (or may not) be the same as the assumption used to discount a plan's projected benefit payments to measure its liabilities. The applicable standards of practice emphasize that the actuary should consider the purpose of the measurement (e.g., contribution budgeting, defeasance or settlement, market measurements, pricing) as a primary factor in choosing a discount rate.

Optimistic and Conservative Assumptions: As previously noted, different investment advisors may have widely varying future capital market expectations. Therefore, it may also be interesting to consider the range of expected returns based on the assumptions provided by the most conservative and most optimistic advisors in the survey.

For this hypothetical asset allocation, the assumptions from the most conservative advisor indicate that the probability of beating the 7.00% benchmark assumption over the next 20 years is 28.6%. Using assumptions from the most optimistic advisor results in a probability of 59.5%. Again, reasonable people may differ.

Limitations: The following are some important limiting factors to keep in mind when reviewing these results.

- The asset classes in this survey do not always align perfectly with the asset classes provided by the investment advisors. Adjustments were made to standardize the different asset classes provided.
- Many of the advisors develop their future assumptions based on investment horizons of no more than 10 years, and returns are generally expected to be lower in the short term. The typical multiemployer pension plan will have an investment horizon that is much longer than 10 years.
- The return expectations are generally based on market returns. In other words, they do not reflect any additional returns that may be earned due to active asset managers outperforming the market ("alpha").
- The return expectations do not adjust for plan size. Specifically, they do not take into account the fact that certain investment opportunities are more readily available to larger plans, as well as the fact that larger plans may often receive more favorable investment fee arrangements than smaller plans.
- The ranges of expected annualized returns were constructed using basic, often simplified, formulas and methodologies. More sophisticated investment models – which may consider various economic scenarios, non-normal distributions, etc. – could produce significantly different results.

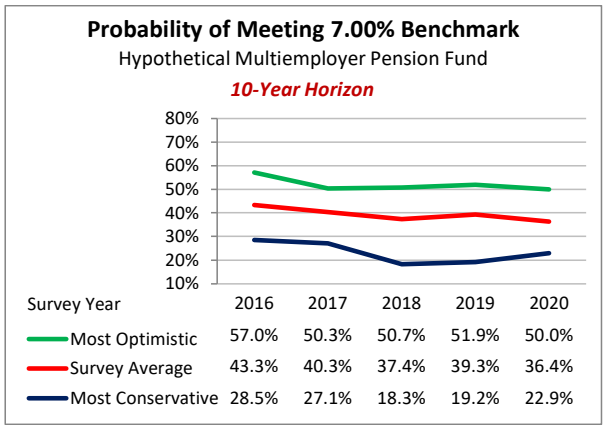
Use of the Survey: This survey is not intended to be a substitute for the expectations of individual portfolio managers, advisors, or actuaries performing their own independent analyses. The actuarial standards of practice provide for various methods of selecting and supporting the investment return assumption. This survey is intended to be used in conjunction with these methods, with appropriate weighting of various resources based on the plan actuary's professional judgment.

Comparison with Prior Surveys

Exhibits 6 and 7 showed how expected returns for certain asset classes have changed over the past few years. Similarly, Exhibits 11 and 12 below show how return expectations for the hypothetical multiemployer pension plan whose asset allocation is shown in Exhibit 8 have changed from 2016 to 2020. (Note that the allocation was changed slightly to include private debt for the first time in 2019.)

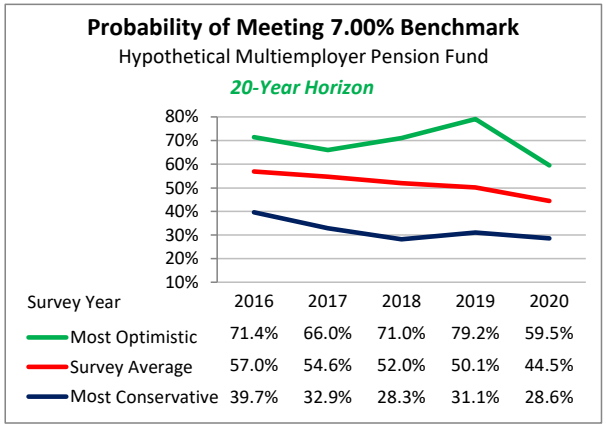
Both exhibits show the probabilities that the hypothetical pension plan will meet or exceed its 7.00% benchmark return on an annualized basis over the given time horizon. Exhibit 11 focuses on expected returns over a 10-year period, and Exhibit 12 focuses on expected returns over a 20-year period. Probabilities are shown for the survey average for each year from 2016 through 2020. For comparison, probabilities are also shown for the most conservative and optimistic advisors in each survey.

Exhibit 11



Survey Year	2016	2017	2018	2019	2020
Most Optimistic	57.0%	50.3%	50.7%	51.9%	50.0%
Survey Average	43.3%	40.3%	37.4%	39.3%	36.4%
Most Conservative	28.5%	27.1%	18.3%	19.2%	22.9%

Exhibit 12



Survey Year	2016	2017	2018	2019	2020
Most Optimistic	71.4%	66.0%	71.0%	79.2%	59.5%
Survey Average	57.0%	54.6%	52.0%	50.1%	44.5%
Most Conservative	39.7%	32.9%	28.3%	31.1%	28.6%

As shown in Exhibits 11 and 12, the probabilities that this hypothetical pension plan would meet or beat a benchmark return of 7.00% have generally decreased from 2016 to 2020.

For example:

- Based on the average assumptions from the 2020 survey, the probability of this hypothetical plan meeting or exceeding an annualized return of 7.00% over the next 10 years is 36.4%. The probability was considerably higher (43.3%) five years ago when the 2016 survey was conducted.

- Based on the average assumptions from the 2020 survey, the probability of this hypothetical plan meeting or exceeding an annualized return of 7.00% over the next 20 years is 44.5%. This represents a decline from 2019 when the probability was 50.1% and a precipitous decline from 2016 when the probability was 57.0%. The decrease in probably from 2019 to 2020 was driven primarily by lower expected returns for fixed income investments.

Other points of note when comparing the results from the 2020 survey to those from prior years:

- The results for the most conservative advisor decreased significantly from 2016 to 2018 over both 10- and 20-year horizons. This trend reversed in 2019, where we saw a small increase in the probability of the hypothetical plan meeting its 7.00% benchmark over both 10- and 20-year horizons. The upward trend continued for the most conservative advisor over a 10-year horizon from 2019 to 2020, but reversed for the most conservative advisor over a 20-year horizon. For 2020, the most conservative advisor over a 10-year horizon projects slightly more than a 1 in 5 chance of meeting the benchmark. The prognostication is better for the most conservative advisor over a 20-year horizon, but remains less than 1 in 3.

- The results for the most optimistic advisor in each survey have also declined in recent years. Over a 10-year horizon, the probability of meeting the 7.00% benchmark reached an all-time low of 50.0% in 2020. Over a 20-year horizon, the results are more pronounced. After reaching a high of 79.2% in 2019, the most optimistic advisor in the 2020 survey projects a 3 in 5 chance of meeting the 7.00% benchmark over the long term.

- Note that the most conservative and most optimistic advisors are not necessarily the same from year to year or for different time horizons.

Glossary

The following are basic definitions of some of the investment terminology used in this report.

Expected Return

The *expected return* is the amount, as a percentage of assets, that an investment is expected to earn over a period of time. Expected returns in this survey are generally market returns that do not reflect value added or fees due to active management. Returns for asset classes where passive investments are not available (e.g., hedge funds and private equity) are generally net of fees.

Arithmetic vs. Geometric Returns

An *arithmetic* return is the average return in any one year. A *geometric* return is the annualized return over a multi-year period. In general, it is more appropriate to focus on geometric returns when evaluating expected returns over multi-year horizons. However, arithmetic returns are also important. For example, the expected return of a portfolio is calculated as the weighted average of arithmetic returns, not geometric returns.

This survey focuses on geometric returns. Many advisors provide both arithmetic and geometric expected returns. For advisors who provided expected returns only on an arithmetic basis, we converted them to geometric returns for consistency. The following formula was used to make this conversion.

$$E[R_G] = ((1 + E[R_A])^2 - VAR[R])^{1/2} - 1$$

In this formula, $E[R_G]$ is the expected geometric return, $E[R_A]$ is the expected arithmetic return, and VAR[R] is the variance of the expected annual (arithmetic) return.

Standard Deviation

The *standard deviation* is a measure of the expected volatility in the returns. Generally, the standard deviation expresses how much returns may vary in any one year. Assuming that returns are "normally distributed," there is about a 68% probability that the actual return for a given year will fall within one standard deviation (higher or lower) of the expected return. There is about a 95% probability that the actual return will fall within two standard deviations of the expected return.

Correlation

The degree to which the returns for two different asset classes move in tandem with one another is their *correlation*. For example, if two asset classes are perfectly correlated, their correlation coefficient will be 1.00; in other words, if one asset class has a return of X% in a given market environment, then the other asset class is expected to also have a return of X%. A portfolio becomes better diversified as its asset classes have lower (or even negative) correlations with each other.

Methodology

The following is a high-level description of the methodology used in compiling the survey results.

Standardized Asset Classes

Not all investment advisors use the same asset classes when developing their capital market assumptions. Some are very specific (more asset classes), while others keep things relatively simple (fewer asset classes).

We exercised judgment in classifying each advisor's capital market assumptions into a standard set of asset classes. In the event that an advisor did not provide assumptions for a given asset class, the average assumptions from the other advisors was used when developing expected returns for that advisor.

Investment Horizons

This survey considers "short-term" expected returns to apply to a 10-year investment horizon, and "long-term" expected returns to apply to a 20-year horizon.

In this 2020 edition of the survey, 21 of the 39 advisors provided only short-term assumptions, indicating a horizon of no more than 10 years. Included in this group is 1 advisor who provided assumptions over a horizon of 7 years.

All 18 advisors who provided long-term assumptions over horizons of 20 years or more also provided short-term assumptions. In cases where such an advisor indicated a horizon shorter than 10 years, the shorter-term expected returns were combined with the longer-term expected returns to achieve a 10-year horizon. If an advisor indicated a time horizon longer than 20 years, the longer-term expected returns were combined with the shorter-term expected returns to achieve a 20-year horizon.

No Adjustment for Alpha

No adjustment was made to reflect the possible value added by an active investment manager outperforming market returns (earning "alpha").

Normally-Distributed Returns

This survey assumes that investment returns will be normally distributed according to the capital market assumptions provided. The survey also assumes that the investment return in one year does not affect the investment return in the following year.

Equal Weighting

Each assumption set was given equal weight in developing the average assumptions for the survey, regardless of factors such as total assets under advisement, research methodology, etc.

Exhibit 13

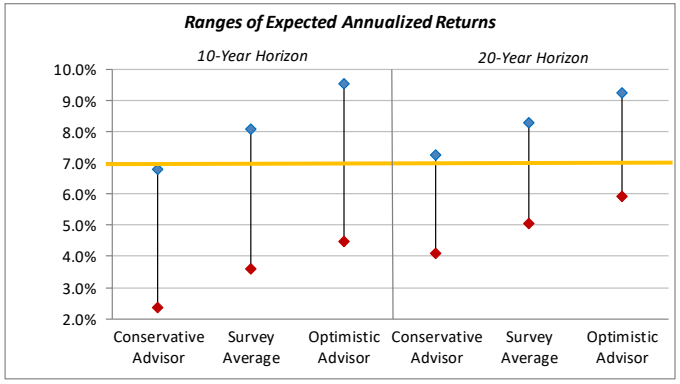
The following exhibit evaluates the investment return assumption for a hypothetical multiemployer pension plan. It reflects the same hypothetical asset allocation as shown in Exhibit 8, and it provides more detail than Exhibits 9 and 10. Note that the most conservative and optimistic advisors for the 10-year horizon are not necessarily the same as the most conservative and optimistic advisors for the 20-year horizon. This hypothetical pension plan has a benchmark return of 7.00% per year, which is indicated by the gold line in the exhibit below.

Hypothetical Multiemployer Plan

2020 Survey of Capital Market Assumptions

		Average Survey Assumptions		
Asset Class	Portfolio Weight	10-Year Horizon	20-Year Horizon	Standard Deviation
US Equity - Large Cap	20.0%	6.16%	7.06%	16.22%
US Equity - Small/Mid Cap	10.0%	6.85%	7.56%	20.22%
Non-US Equity - Developed	7.5%	6.80%	7.48%	18.05%
Non-US Equity - Emerging	5.0%	7.85%	8.42%	24.23%
US Corporate Bonds - Core	7.5%	2.60%	3.56%	5.47%
US Corporate Bonds - Long Duration	2.5%	2.70%	3.56%	10.16%
US Corporate Bonds - High Yield	5.0%	4.90%	5.62%	9.75%
Non-US Debt - Developed	5.0%	1.39%	2.26%	7.02%
Non-US Debt - Emerging	2.5%	5.16%	5.85%	10.97%
US Treasuries (Cash Equivalents)	5.0%	1.56%	2.25%	1.78%
TIPS (Inflation-Protected)	5.0%	1.98%	2.73%	6.05%
Real Estate	7.5%	5.75%	6.59%	16.84%
Hedge Funds	5.0%	4.74%	5.71%	8.00%
Commodities	2.5%	3.19%	4.04%	17.60%
Infrastructure	2.5%	6.94%	7.30%	14.58%
Private Equity	5.0%	9.08%	9.87%	21.99%
Private Debt	2.5%	7.75%	7.85%	12.06%
Inflation	N/A	1.97%	2.16%	1.70%
TOTAL PORTFOLIO	**100.0%**	*Expected returns are geometric.*		

	10-Year Horizon			*20-Year Horizon*		
	Conservative Advisor	**Survey Average**	**Optimistic Advisor**	**Conservative Advisor**	**Survey Average**	**Optimistic Advisor**
Expected Returns						
Average Annual Return (Arithmetic)	5.09%	6.36%	7.66%	6.20%	7.21%	8.15%
Annualized Return (Geometric)	4.57%	5.84%	7.00%	5.68%	6.66%	7.59%
Annual Volatility (Standard Deviation)	10.36%	10.52%	11.88%	10.48%	10.76%	10.97%
Range of Expected Annualized Returns						
75th Percentile	6.78%	8.08%	9.54%	7.26%	8.29%	9.24%
25th Percentile	2.37%	3.60%	4.47%	4.10%	5.04%	5.93%
Probabilities of Exceeding Certain Returns						
7.50% per Year, Annualized	18.6%	30.9%	44.7%	21.9%	36.4%	51.4%
7.00% per Year, Annualized	22.9%	36.4%	50.0%	28.6%	44.5%	59.5%
6.50% per Year, Annualized	27.8%	42.1%	55.3%	36.3%	52.7%	67.1%



Considerations and Limitations

- Allocations may be approximated if certain asset classes are not included in the survey.
- Many investment advisors provided only shorter-term assumptions (10 years or less).
- Assumptions are generally based on indexed returns and do not reflect anticipated alpha.
- Assumptions do not reflect investment opportunities or fee considerations available to larger funds.

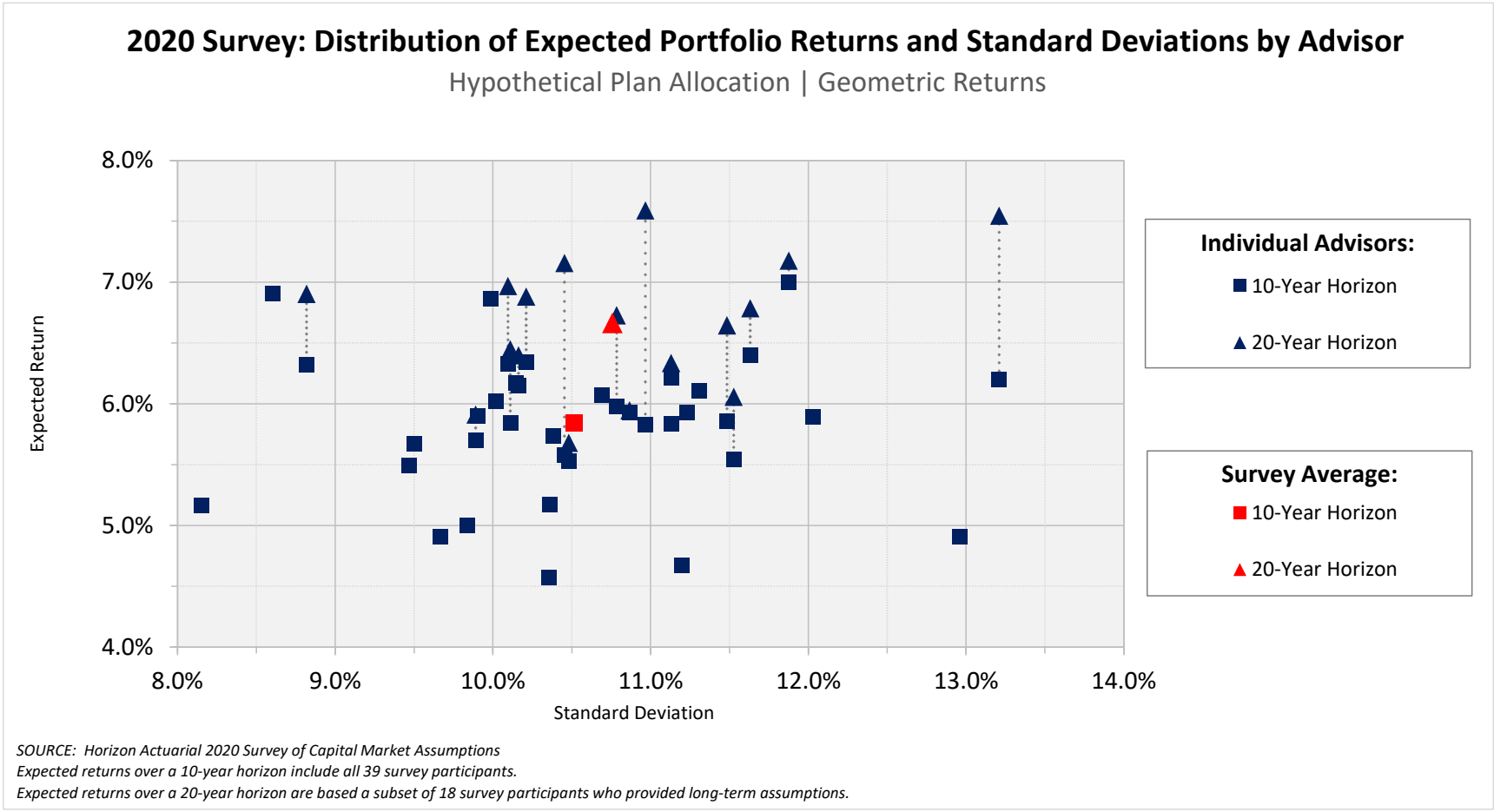
SOURCE: Horizon Actuarial 2020 Survey of Capital Market Assumptions

Expected returns over a 10-year horizon include all 39 survey participants.

Expected returns over a 20-year horizon are based a subset of 18 survey participants who provided long-term assumptions.

Exhibit 14

The following exhibit shows the distribution of expected annualized returns and annual standard deviations for the same hypothetical asset allocation that is shown in Exhibit 13. The expected annualized return and annual standard deviation of the hypothetical asset allocation are shown separately for each advisor who participated in the survey. Individual advisors are grouped by investment horizon, and the survey average assumptions are shown in red. The exhibit shows that there are a wide variety of investment return assumptions that could be considered to be reasonable for any given asset allocation.



SOURCE: Horizon Actuarial 2020 Survey of Capital Market Assumptions
Expected returns over a 10-year horizon include all 39 survey participants.
Expected returns over a 20-year horizon are based a subset of 18 survey participants who provided long-term assumptions.

Exhibit 15

The following exhibit provides the average capital market assumptions for all 39 investment advisors in the 2020 survey. Each of the 39 advisors was given equal weight in determining the average assumptions. For reference, expected returns are shown over 10-year and 20-year horizons. Expected returns are also provided on both an arithmetic basis (one-year average) and geometric basis (multi-year annualized). The standard deviations (volatilities) and correlations apply to both arithmetic and geometric expected returns.

Horizon Actuarial 2020 Survey of Capital Market Assumptions

Average Survey Assumptions

		Expected Returns					*Correlation Matrix*													
		10-Year Horizon		20-Year Horizon		Standard														
	Asset Class	Arith.	Geom.	Arith.	Geom.	Deviation	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1	US Equity - Large Cap	7.40%	6.16%	8.36%	7.06%	16.22%	1.00																
2	US Equity - Small/Mid Cap	8.76%	6.85%	9.54%	7.56%	20.22%	0.89	1.00															
3	Non-US Equity - Developed	8.33%	6.80%	9.09%	7.48%	18.05%	0.84	0.76	1.00														
4	Non-US Equity - Emerging	10.59%	7.85%	11.33%	8.42%	24.23%	0.73	0.69	0.80	1.00													
5	US Corporate Bonds - Core	2.75%	2.60%	3.74%	3.56%	5.47%	0.15	0.08	0.17	0.16	1.00												
6	US Corporate Bonds - Long Duration	3.13%	2.70%	4.11%	3.56%	10.16%	0.14	0.07	0.14	0.11	0.86	1.00											
7	US Corporate Bonds - High Yield	5.36%	4.90%	6.14%	5.62%	9.75%	0.63	0.62	0.62	0.62	0.38	0.32	1.00										
8	Non-US Debt - Developed	1.58%	1.39%	2.53%	2.26%	7.02%	0.12	0.06	0.28	0.23	0.53	0.49	0.24	1.00									
9	Non-US Debt - Emerging	5.76%	5.16%	6.54%	5.85%	10.97%	0.48	0.44	0.52	0.62	0.44	0.36	0.62	0.41	1.00								
10	US Treasuries (Cash Equivalents)	1.59%	1.56%	2.28%	2.25%	1.78%	(0.08)	(0.08)	(0.07)	(0.06)	0.23	0.17	(0.08)	0.21	0.06	1.00							
11	TIPS (Inflation-Protected)	2.16%	1.98%	2.94%	2.73%	6.05%	0.05	0.02	0.09	0.13	0.67	0.54	0.27	0.45	0.36	0.22	1.00						
12	Real Estate	7.15%	5.75%	7.91%	6.59%	16.84%	0.53	0.55	0.49	0.44	0.22	0.18	0.46	0.19	0.36	(0.01)	0.17	1.00					
13	Hedge Funds	5.08%	4.74%	6.10%	5.71%	8.00%	0.63	0.61	0.63	0.61	0.15	0.11	0.53	0.13	0.43	(0.06)	0.10	0.37	1.00				
14	Commodities	4.70%	3.19%	5.60%	4.04%	17.60%	0.31	0.30	0.39	0.42	0.08	0.01	0.35	0.21	0.30	0.03	0.22	0.23	0.37	1.00			
15	Infrastructure	7.97%	6.94%	8.45%	7.30%	14.58%	0.53	0.50	0.56	0.51	0.25	0.25	0.53	0.28	0.45	(0.02)	0.20	0.40	0.49	0.36	1.00		
16	Private Equity	11.42%	9.08%	12.54%	9.87%	21.99%	0.73	0.71	0.67	0.59	0.04	0.04	0.51	0.07	0.36	(0.06)	0.01	0.46	0.60	0.30	0.51	1.00	
17	Private Debt	8.50%	7.75%	8.63%	7.85%	12.06%	0.57	0.57	0.53	0.52	0.11	0.10	0.73	0.01	0.40	(0.09)	0.08	0.39	0.52	0.34	0.44	0.56	1.00
	Inflation	1.98%	1.97%	2.17%	2.16%	1.70%																	

Expected returns over a 10-year horizon include all 39 survey participants.

Expected returns over a 20-year horizon are based a subset of 18 survey participants who provided long-term assumptions.

Exhibit 16

Earlier in this report, Exhibit 5 showed the distribution of expected returns and standard deviations for all 39 advisors who provided short-term assumptions. The exhibit below shows the same distribution, broken out by asset type: equities, fixed income, and alternatives. Note that the average expected return and standard deviation from the 2020 survey are listed in brackets for each asset class. Also note that every advisor did not provide expectations for every asset class.

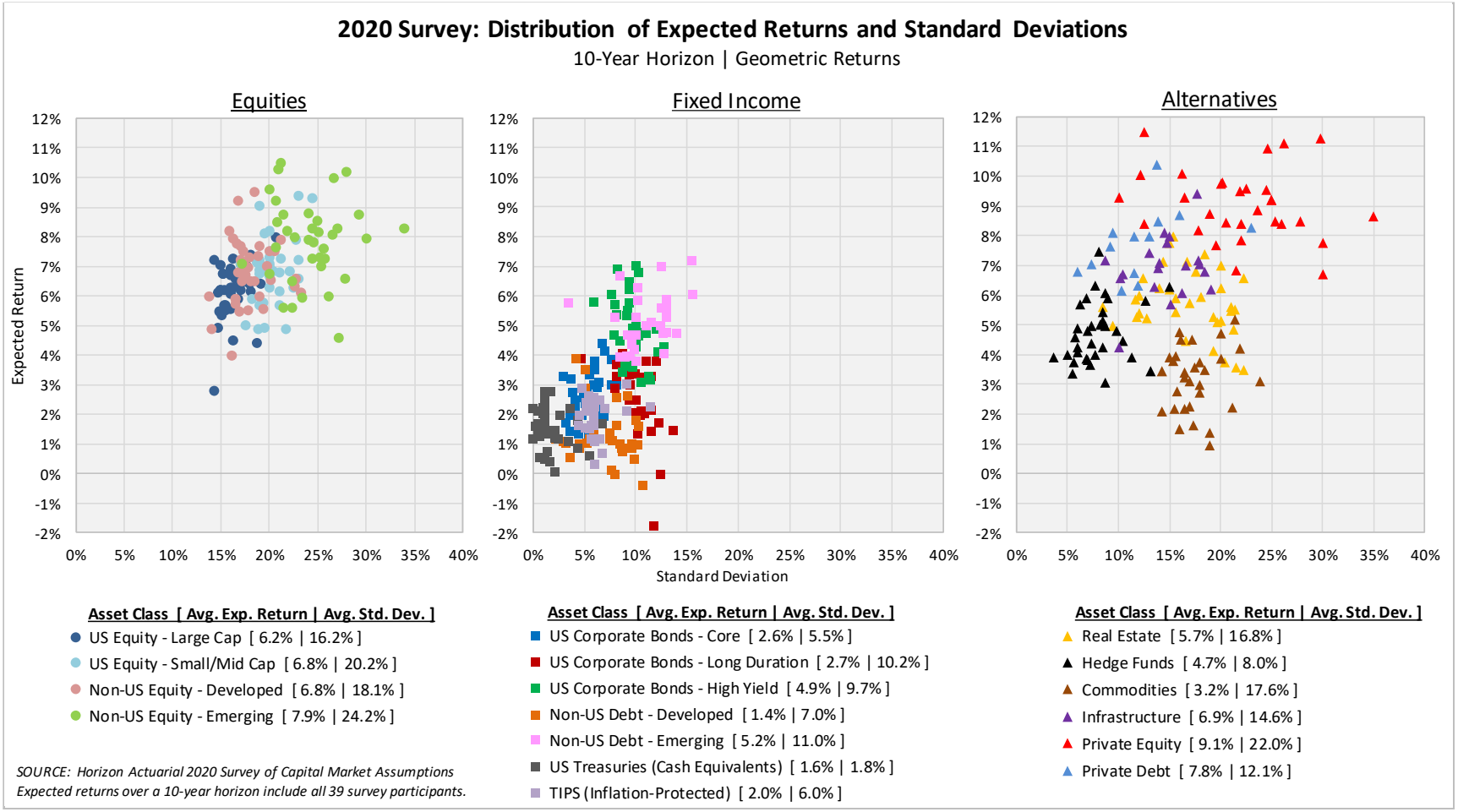


Exhibit 17

Exhibit 16 showed the distribution of expected returns and standard deviations over an investment horizon of 10 years. The exhibit below shows the same distribution, but for a horizon of 20 years. Note that while Exhibit 16 included all 39 advisors in the survey, the exhibit below only includes assumptions for the 18 advisors who provided longer-term assumptions (horizons of 20 years or more). Also note that every advisor did not provide expectations for every asset class.

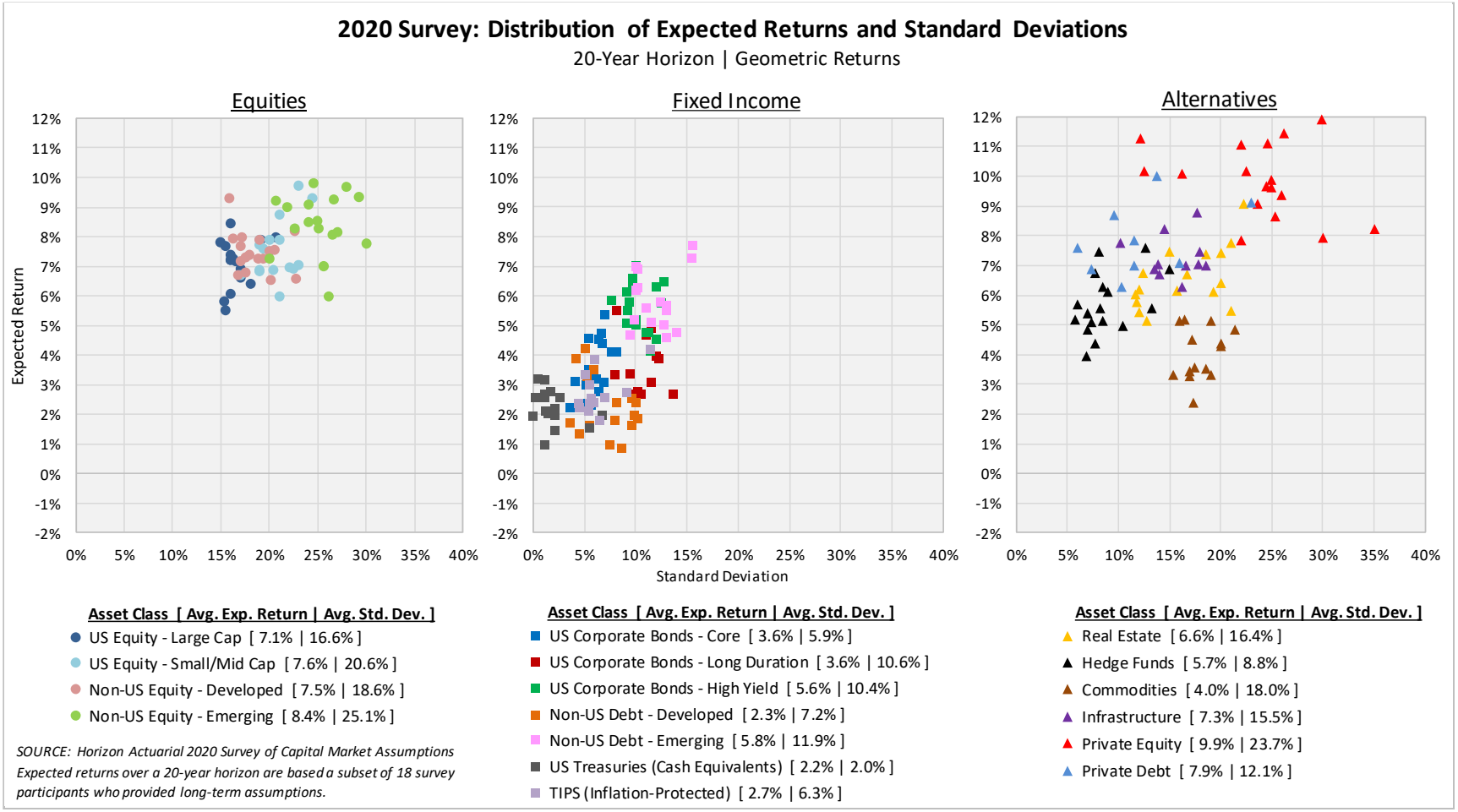
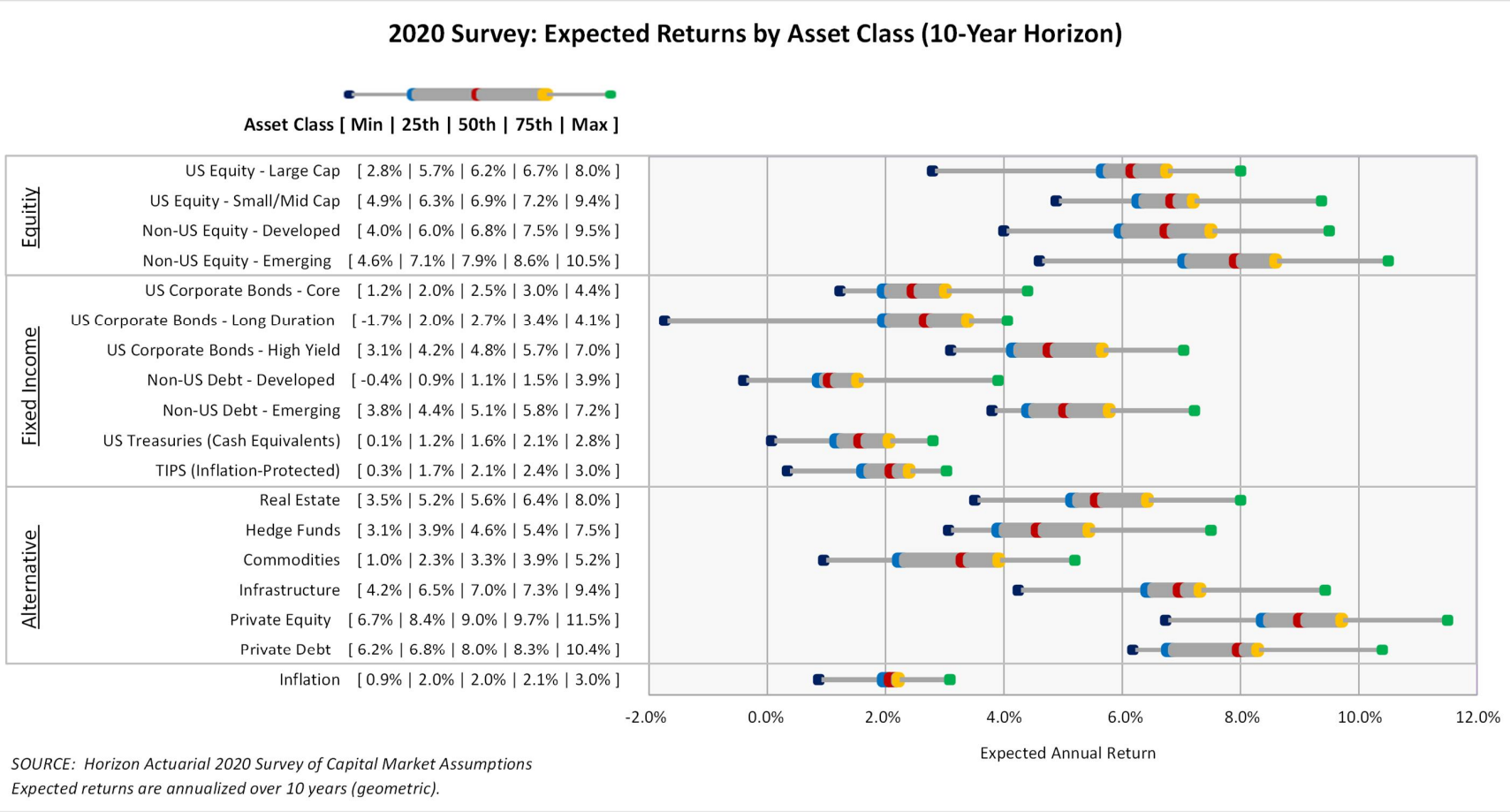


Exhibit 18

The exhibit below shows the ranges of expected annual returns for different asset classes over a 10-year investment horizon. The ranges shown below include assumptions for all the 39 advisors in the 2020 survey. Expected returns shown below are annualized (geometric).

To illustrate the distribution of expected returns, the exhibit shows the range of the middle 50 percent of results: the range between the 25th and 75th percentiles. It also shows the median expected return for each asset class: the 50th percentile. Note that the expected returns for the *median* advisor shown below are not the same as the *average* expected returns shown elsewhere in the report. In most cases, however, the differences between median and average expected returns are relatively small.

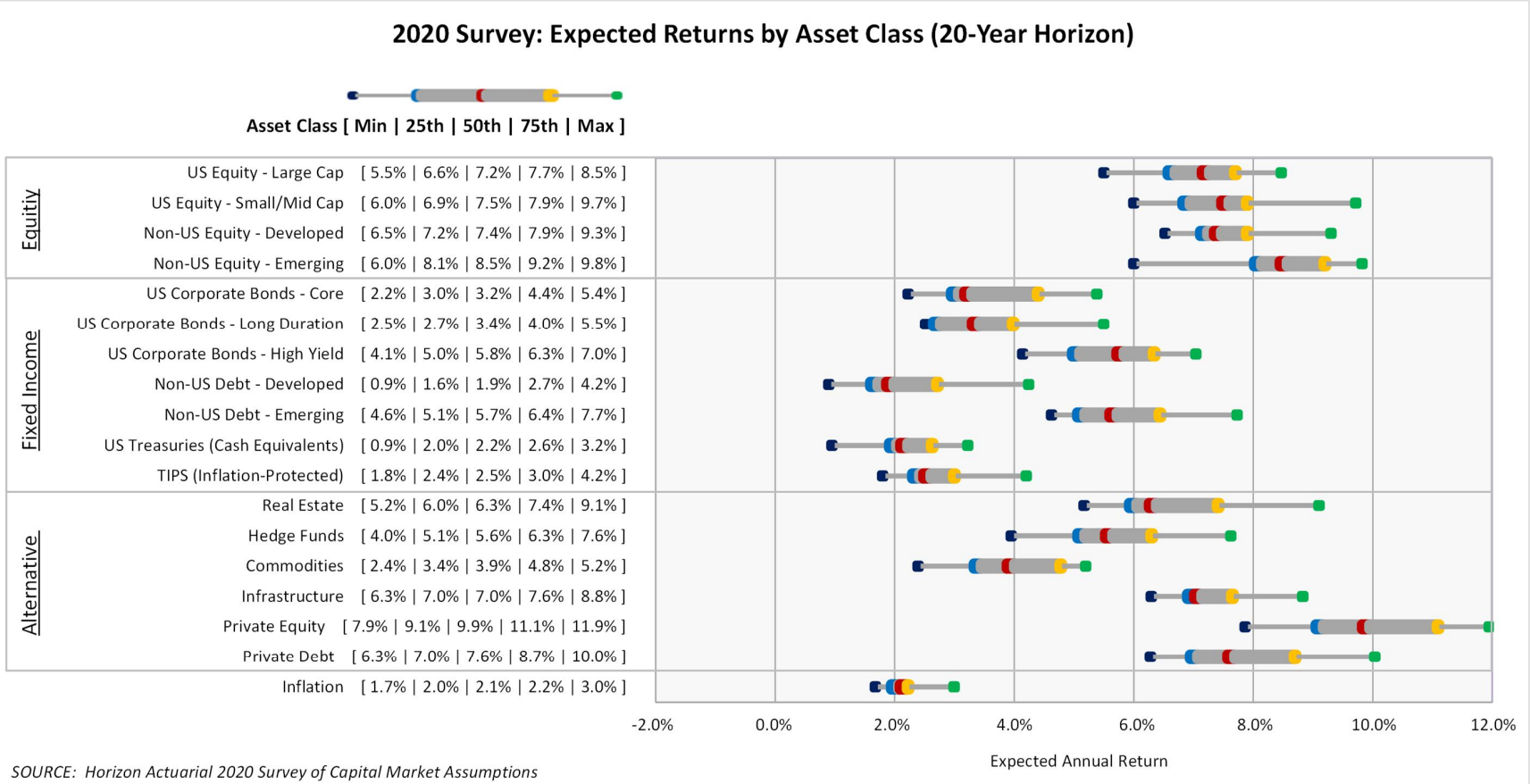


SOURCE: Horizon Actuarial 2020 Survey of Capital Market Assumptions
Expected returns are annualized over 10 years (geometric).

Exhibit 19

The exhibit below shows the ranges of expected annual returns for different asset classes over a 20-year investment horizon. The ranges shown below are based on the assumptions for 18 advisors who provided longer-term assumptions (horizons of 20 years or more). Expected returns shown below are annualized (geometric). Note that the ranges of expected returns are somewhat narrower when the investment horizon is longer.

To illustrate the distribution of expected returns, the exhibit shows the range of the middle 50 percent of results: the range between the 25th and 75th percentiles. It also shows the median expected return for each asset class: the 50th percentile. Note that the expected returns for the *median* advisor shown below are not the same as the *average* expected returns shown elsewhere in the report. In most cases, however, the differences between median and average expected returns are relatively small.



SOURCE: Horizon Actuarial 2020 Survey of Capital Market Assumptions

Expected returns are annualized over 20 years (geometric), based on a subset of 18 advisors who provided longer term assumptions.

PACIFIC GAS AND ELECTRIC COMPANY

CHAPTER 6

EXHIBIT 6.3

NATIONAL ASSOCIATION OF STATE RETIREMENT ADMINISTRATORS

SURVEY OF PUBLIC PENSION PLANS

NASRA Issue Brief:
Public Pension Plan Investment Return Assumptions

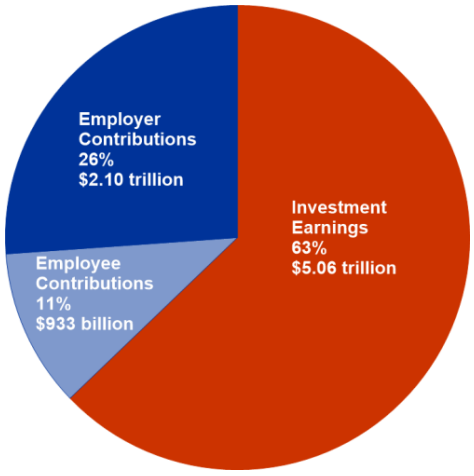
Updated February 2020

As of December 31, 2019, state and local government retirement systems held assets of approximately $4.8 trillion.[1] These assets are held in trust and invested to pre-fund the cost of pension benefits. The investment return on these assets matters, as investment earnings account for a majority of public pension financing. A shortfall in long-term expected investment earnings must be made up by higher contributions or reduced benefits.

Funding a pension benefit requires the use of projections, known as actuarial assumptions, about future events. Actuarial assumptions fall into one of two broad categories: demographic and economic. Demographic assumptions are those pertaining to a pension plan's membership, such as changes in the number of working and retired plan participants; when participants will retire, and how long they'll live after they retire. Economic assumptions pertain to such factors as the rate of wage growth and the future expected investment return on the fund's assets.

As with other actuarial assumptions, projecting public pension fund investment returns requires a focus on the long-term. This brief discusses how investment return assumptions are established and evaluated, compares these assumptions with public funds' actual investment experience, and the challenging investment environment public retirement systems currently face.

Figure 1: Public Pension Sources of Revenue, 1989-2018



Compiled by NASRA based on U.S. Census Bureau data

Because investment earnings account for a majority of revenue for a typical public pension fund, the accuracy of the return assumption has a major effect on a plan's finances and actuarial funding level. An investment return assumption that is set too low will overstate liabilities and costs, causing current taxpayers to be overcharged and future taxpayers to be undercharged. A rate set too high will understate liabilities, undercharging current taxpayers, at the expense of future taxpayers. An assumption that is significantly wrong in either direction will cause a misallocation of resources and unfairly distribute costs among generations of taxpayers.

As shown in Figure 1, for the 30-year period ended in 2018, public pension funds accrued approximately $8.1 trillion in revenue, of which $5.1 trillion, or 63 percent, is from investment earnings. Employer contributions account for $2.1 trillion, or 26 percent of the total, and employee contributions total over $900 billion, or 11 percent.[2] The large portion of revenues from investment earnings reflect the important role they play in funding public pension benefits.

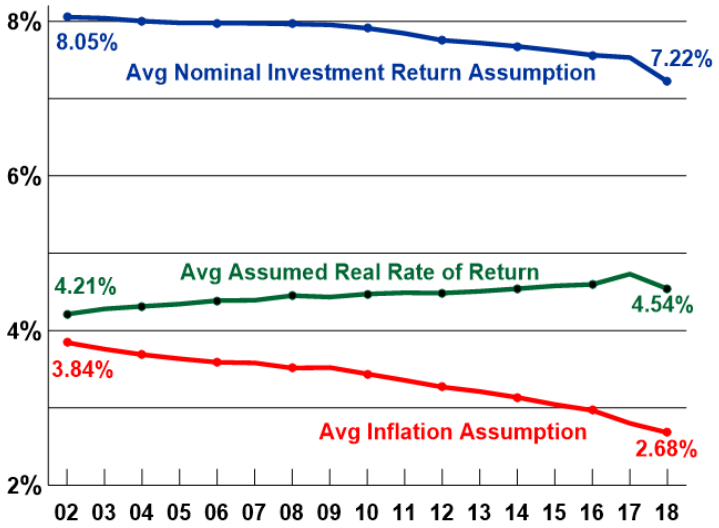
Most public retirement systems review their actuarial assumptions regularly, pursuant to state or local statute or system policy. The entity (or entities) responsible for setting the return assumption, as identified in Appendix B, typically works with one or more professional actuaries, who follow guidelines set forth by the Actuarial Standards Board in Actuarial Standards of Practice No. 27: Selection of Economic Assumptions for Measuring Pension Obligations (ASOP 27). ASOP 27 prescribes the factors actuaries should consider in setting economic actuarial assumptions, and recommends that actuaries consider the context of the measurement they are making, as defined by such factors as the purpose of the

[1] Federal Reserve, *Flow of Funds Accounts of the United States: Flows and Outstandings, Third Quarter 2019*, Table L.120

[2] US Census Bureau, Annual Survey of Public Pensions, State & Local Data

measurement, the length of time the measurement period is intended to cover, and the projected pattern of the plan's cash flows.

Figure 2: Average nominal and real rate of return, and average assumed inflation rate, FY 02 – FY 18



ASOP 27 also advises that actuarial assumptions be reasonable, defined in subsection 3.6 as being consistent with five specified characteristics; and requires that actuaries consider relevant data, such as current and projected interest rates and rates of inflation; historic and projected returns for individual asset classes; and historic returns of the fund itself. For plans that remain open to new members – which includes most public plans – actuaries focus chiefly on a long investment horizon, i.e., 20 to 30 years, which is the length of a typical public pension plan's funding period. One key purpose for relying on a long timeframe is to promote the key policy objectives of cost stability and predictability, and intergenerational equity among taxpayers.

The investment return assumption used by public pension plans typically contains two components: inflation and the real rate of return. The sum of these components is the nominal rate of return, which is the rate that is most often used and cited. The system's inflation assumption typically is also applied to other actuarial assumptions, such as the level of wage growth and, where relevant, assumed rates of cost-of-living adjustments (COLAs). Achieving an investment return approximately commensurate with the inflation rate normally is attainable by investing in securities, such as US Treasuries.

The second component of the investment return assumption is the real rate of return, which is the return on investment after adjusting for inflation. The real rate of return is intended to reflect the return produced as a result of the risk taken by investing the assets. Achieving a return higher than the risk-free rate requires taking some investment risk; for public pension funds, this risk takes the form of investments in assets such as public and private equities and real estate, which contain more risk than Treasury bonds.

Figure 2 illustrates the changes in the average nominal (non-inflation-adjusted) return, the inflation assumption, and the resulting real rate of return assumption. As the chart shows, although the average nominal public pension fund investment return has been declining, because the average rate of assumed inflation has been dropping more quickly, the average real rate of return has risen, from 4.21 percent in FY 02 to 4.54 percent in FY 18. One factor that may be contributing to the higher real rate of return is public pension funds' higher allocations to alternative assets, particularly to private equities, which usually have a higher expected return than other asset classes.

Figure 3 plots median public pension fund annualized investment returns for a range of periods ended December 31, 2019. As the figure shows, strong returns in 2019 helped raise annualized returns for the three- and five-year periods.

Figure 3: Median public pension annualized investment returns for period ended 12/31/2019

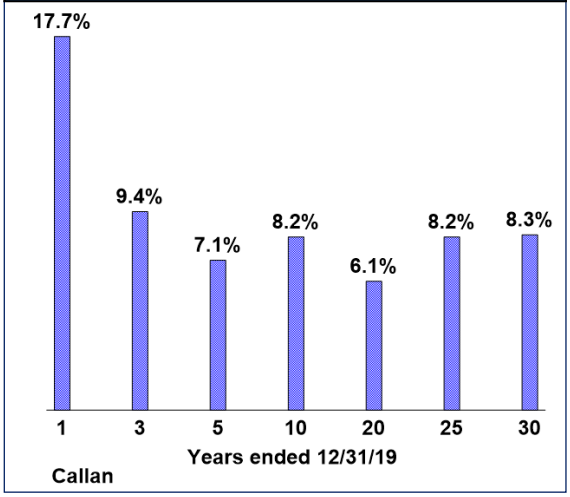
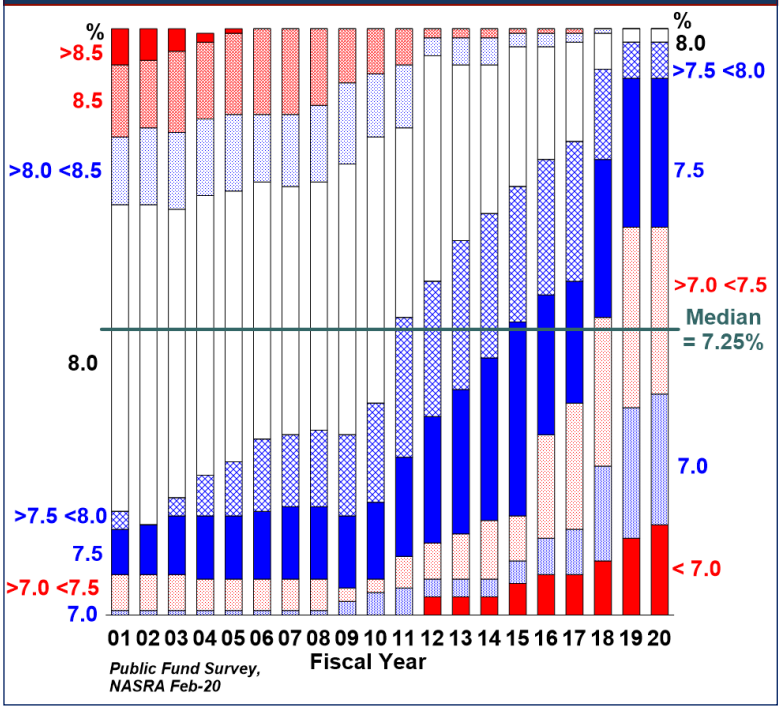


Figure 4: Change in Distribution of Public Pension Investment Return Assumptions, FY 01 to FY 20



In the wake of the 2008-09 capital market decline and Great Recession, global interest rates and inflation declined and have remained low by historic standards. These low interest rates have led to reductions in projected returns for most asset classes, which, in turn, has resulted in an unprecedented number of reductions in the investment return assumption used by public pension plans. This trend is illustrated by Figure 4, which plots the distribution of investment return assumptions among a representative group of plans since 2001. Among the 130 plans measured, 94, or over 70 percent, have reduced their assumed rate of return since fiscal year 2017, and all but five plans (96 percent) have done so since fiscal year 2010. These reductions have resulted in a decline in the average return assumption from 7.52 percent in FY 17 to 7.20 percent in FY 20. Appendix A lists the assumptions in use or adopted for future use by the 130 plans in this dataset, as of February 2020.

One challenging facet of setting the investment return assumption that has emerged more recently is a divergence between expected returns over the near term, i.e., the next five to 10 years, and over the longer term, i.e., 20 to 30 years[3]. Many investment return projections conclude that near-term returns will be lower than both historic norms as well as projected returns over longer timeframes. Because many near-term projections calculated recently are well below the long-term assumption most plans are using, some plans face the difficult choice of either maintaining a return assumption that is higher than near-term expectations, or lowering their return assumption to reflect near-term expectations.

If actual investment returns in the near-term prove to be lower than historic norms, plans that maintain their long-term return assumption risk experiencing a steady increase in unfunded pension liabilities and corresponding costs. Alternatively, plans that reduce their assumption in the face of diminished near-term projections will experience an immediate increase unfunded liabilities and required costs. As a rule of thumb, a 25 basis point reduction in the return assumption, such as from 7.5 percent to 7.25 percent, will increase the cost of a plan that has an automatic COLA, by three percent of pay (such as from 10 percent to 13 percent), and a plan that does not have a COLA, by two percent of pay.

Conclusion

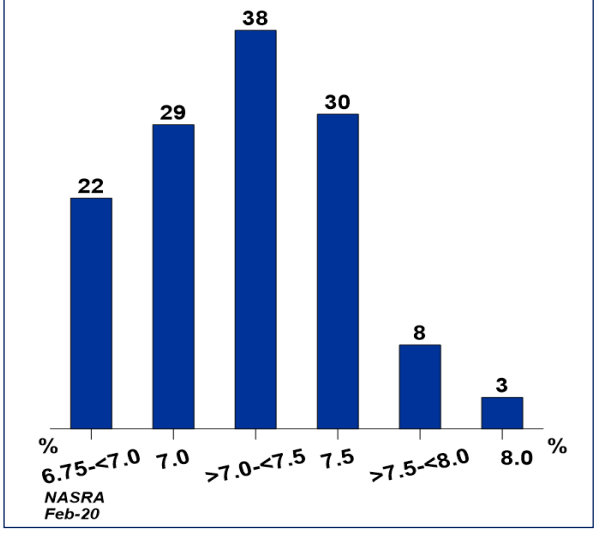
The investment return assumption is the single most consequential of all actuarial assumptions in terms of its effect on a pension plan's finances. The sustained period of low interest rates since 2009, combined with lower projected returns for most asset classes, has caused many public pension plans to reduce their long-term expected investment returns. Absent other changes, a lower investment return assumption increases both the plan's unfunded liabilities and cost. The process for evaluating a pension plan's investment return assumption should include abundant input and feedback from investment experts and actuarial professionals, and should reflect consideration of the factors prescribed in actuarial standards of practice.

[3] Horizon Actuarial Services, "Survey of Capital Market Assumptions, 2019 Edition (August 2019) p4

See Also:

- Actuarial Standards of Practice No. 27, Actuarial Standards Board
- The Liability Side of the Equation Revisited, Missouri SERS, September 2006

Figure 5: Distribution of investment return assumptions



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Appendix A: Investment Return Assumption by Plan

Figures reflect the nominal assumption in use, or announced for use, as of February 2020.
This list of nominal investment return assumptions is updated at www.nasra.org/latestreturnassumptions

Plan	Rate (%)
Alabama ERS	7.70
Alabama Teachers	7.70
Alaska PERS	7.38
Alaska Teachers	7.38
Arizona Public Safety Personnel	7.30
Arizona SRS	7.50
Arkansas PERS	7.15
Arkansas State Highway ERS	8.0
Arkansas Teachers	7.50
California PERF[1]	7.0
California Teachers	7.0
Chicago Teachers	7.0
City of Austin ERS	7.0
Colorado Affiliated Local	7.0
Colorado Fire & Police Statewide	7.0
Colorado Municipal	7.25
Colorado School	7.25
Colorado State	7.25
Connecticut SERS	6.90
Connecticut Teachers	6.9.0
Contra Costa County	7.0
DC Police & Fire	6.50
DC Teachers	6.50
Delaware State Employees	7.0
Denver Employees	7.50
Denver Public Schools	7.25
Fairfax County Schools	7.25
Florida RS	7.20
Georgia ERS[2]	7.30
Georgia Teachers	7.25
Hawaii ERS	7.0
Houston Firefighters	7.0
Idaho PERS	7.0
Illinois Municipal	7.25
Illinois SERS	7.0
Illinois Teachers	7.0
Illinois Universities	6.75
Indiana PERF	6.75
Indiana Teachers	6.75
Iowa PERS	7. 0
Kansas PERS	7.75
Kentucky County	6.25
Kentucky ERS[3]	5.25
Kentucky Teachers	7.50
Los Angeles County ERS	7.25
Louisiana Parochial Employees	6.50
Louisiana SERS[4]	7.60
Louisiana Teachers[5]	7.55
Maine Local	6.75
Maine State and Teacher	6.75
Maryland PERS	7.40
Maryland Teachers	7.40
Massachusetts SERS	7.25
Massachusetts Teachers	7.25
Michigan Municipal	7.35
Michigan Public Schools[6,7]	6.80
Michigan SERS[7]	6.70
Minnesota PERF	7.50
Minnesota State Employees	7.50
Minnesota Teachers	7.50
Mississippi PERS	7.75
Missouri DOT and Highway Patrol	7.0
Missouri Local	7.25
Missouri PEERS	7.50
Missouri State Employees	6.95
Missouri Teachers	7.50
Montana PERS	7.65
Montana Teachers	7.50
Nebraska Schools	7.50
Nevada Police Officer and Firefighter	7.50
Nevada Regular Employees	7.50
New Hampshire Retirement System	7.25
New Jersey PERS[8]	7.50
New Jersey Police & Fire[8]	7.50
New Jersey Teachers[8]	7.50
New Mexico PERA	7.25
New Mexico Teachers	7.25
New York City ERS	7.0
New York City Teachers	7.0
New York State Teachers	7.25
North Carolina Local Government	7.0
North Carolina Teachers and State Employees	7.0
North Dakota PERS	7.75
North Dakota Teachers	7.75
NY State & Local ERS[9]	6.80
NY State & Local Police & Fire[9]	6.80
Ohio PERS	7.20
Ohio Police & Fire	8.0
Ohio School Employees	7.50

Ohio Teachers	7.45
Oklahoma PERS	7.0
Oklahoma Teachers	7.50
Orange County ERS	7.0
Oregon PERS	7.20
Pennsylvania School Employees	7.25
Pennsylvania State ERS	7.125
Phoenix ERS	7.25
Rhode Island ERS	7.0
Rhode Island Municipal	7.0
Richmond Retirement System	7.0
San Diego County	7.0
San Francisco City & County	7.40
South Carolina Police	7.25
South Carolina RS	7.25
South Dakota RS	6.50
St. Louis School Employees	7.50
St. Paul Teachers	7.50
Texas County & District	8.0
Texas ERS	7.50
Texas LECOS	7.50
Texas Municipal	6.75

Texas Teachers	7.25
Tennessee Political Subdivisions	7.25
Tennessee State and Teachers	7.25
University of California	6.75
Utah Noncontributory	6.95
Vermont State Employees	7.50
Vermont Teachers	7.50
Virginia Retirement System	6.75
Washington LEOFF Plan 1	7.50
Washington LEOFF Plan 2	7.40
Washington PERS 1	7.50
Washington PERS 2/3	7.50
Washington School Employees Plan 2/3	7.50
Washington Teachers Plan 1	7.50
Washington Teachers Plan 2/3	7.50
West Virginia PERS	7.50
West Virginia Teachers	7.50
Wisconsin Retirement System	7.0
Wyoming Public Employees	7.0

1. In February 2017 the CalPERS Board adopted a risk mitigation policy, effective beginning FY 2021, that calls for a reduction in the system's investment return assumption commensurate with the pension fund achieving a specified level of investment return. Details are available online: https://www.calpers.ca.gov/docs/board-agendas/201702/financeadmin/item-9a-02.pdf.
2. For each year in which the actual rate of investment return exceeds the target rate of return, the Georgia ERS will reduce its investment return assumption by 0.1% (10 basis points) until a target rate of return assumption of 7.0% is reached.
3. The Kentucky ERS is composed of two plans: Hazardous and Non-Hazardous. The rate shown applies to the plan's Non-Hazardous plan, which accounts for more than 90 percent of the Kentucky ERS plan liabilities. The investment return assumption used for the Hazardous plan is 6.25 percent.
4. LASERS is reducing its discount rate from 7.75 % to 7.5% by 2021 in annual increments of 0.05%. The discount rate used to determine the FY 2019/2020 funding requirement is 7.60%, which is net of gain-sharing. The investment return assumption differs from the discount rate because of the effective cost of providing potential future ad hoc postretirement benefit increases, or gain-sharing. The investment return assumption, which includes gain-sharing, is reducing incrementally to 7.90% by 2021.
5. The TRS of Louisiana is reducing its discount rate from 7.55% to 7.45%, effective July 1, 2020. The investment return assumption differs from the discount rate because of the effective cost of providing potential future ad hoc postretirement benefit increases, or gain-sharing. The investment return assumption, which includes gain-sharing, will reduce to 7.85%.
6. The Michigan Public School Employees' Retirement System administers three plans: a defined benefit plan and two hybrid plans (Pension Plus and Pension Plus 2). The rate shown applies to the defined benefit plan and the Pension Plus Plan. The investment return assumption used for the Pension Plus 2 plan is 6.0 percent.
7. In August 2017 the Michigan SERS and PSERS adopted a dedicated investment gains policy that calls for a reduction in the assumed rate of return in years when investment earnings exceed the assumed rate of return. The size of the reduction depends on the level of investment return. More details are available here: https://www.nasra.org//Files/Topical%20Reports/Actuarial/MI%20Dedicated%20Gains%20policy.pdf
8. The assumed rate of return for the New Jersey PERS, Police & Fire, and Teachers plans is scheduled to decrease to 7.3 percent for FY 21 and FY 22, and to 7.0 percent effective FY 23.
9. Effective FY 21

Appendix B: Entity Responsible for Setting Investment Return Assumption for Selected State Plans

State	System	Investment Return Assumption Set By
AK	Alaska Public Employees Retirement System	Alaska Retirement Management Board
AK	Alaska Teachers Retirement System	Alaska Retirement Management Board
AL	Retirement Systems of Alabama	Retirement board
AR	Arkansas Public Employees Retirement System	Retirement board
AR	Arkansas State Highway Employees' Retirement System	Retirement board
AR	Arkansas Teachers Retirement System	Retirement board
AZ	Arizona Public Safety Personnel Retirement System	Retirement board
AZ	Arizona State Retirement System	Retirement board
CA	California Public Employees Retirement System	Retirement board
CA	California State Teachers Retirement System	Retirement board
CO	Colorado Public Employees Retirement Association	Retirement board
CO	Fire & Police Pension Association of Colorado	Retirement board
CT	Connecticut State Employees Retirement System	State Employees Retirement Commission
CT	Connecticut Teachers Retirement Board	Retirement board
DC	District of Columbia Retirement Board	Retirement board
DE	Delaware Public Employees Retirement System	Retirement board
FL	Florida Retirement System	FRS Actuarial Assumption Estimating Conference[1]
GA	Georgia Employees Retirement System	Retirement board
GA	Georgia Teachers Retirement System	Retirement board
HI	Hawaii Employees Retirement System	Retirement board
IA	Iowa Public Employees Retirement System	IPERS Investment Board
ID	Idaho Public Employees Retirement System	Retirement board
IL	Illinois State Universities Retirement System	Retirement board
IL	Illinois State Employees Retirement System	Retirement board
IL	Illinois Municipal Retirement Fund	Retirement board
IL	Illinois Teachers Retirement System	Retirement board
IN	Indiana Public Retirement System	Retirement board
KS	Kansas Public Employees Retirement System	Retirement board
KY	Kentucky Retirement Systems	Retirement board
KY	Kentucky Teachers Retirement System	Retirement board
LA	Louisiana State Employees Retirement System	Retirement board
LA	Louisiana Parochial Employees' Retirement System	Retirement board
LA	Louisiana Teachers Retirement System	Retirement board
MA	Massachusetts State Employees Retirement System	Collaborative between the legislature, state treasurer, governor, and the Massachusetts Public Employee Retirement Administration Commission
MA	Massachusetts Teachers Retirement Board	Collaborative between the legislature, state treasurer, governor, and the Massachusetts Public Employee Retirement Administration Commission
MD	Maryland State Retirement and Pension System	Retirement board
ME	Maine Public Employees Retirement System	Retirement board
MI	Michigan Public School Employees Retirement System	Retirement board
MI	Michigan State Employees Retirement System	Retirement board
MI	Municipal Employees' Retirement System of Michigan	Retirement board
MN	Minnesota Public Employees Retirement Association	Legislature
MN	Minnesota State Retirement System	Legislature
MN	Minnesota Teachers Retirement Association	Legislature

MO	Missouri Local Government Employees Retirement System	Retirement board
MO	Missouri Public Schools Retirement System	Retirement board
MO	Missouri State Employees Retirement System	Retirement board
MO	MoDOT & Patrol Employees' Retirement System	Retirement board
MS	Mississippi Public Employees Retirement System	Retirement board
MT	Montana Public Employees Retirement Board	Retirement board
MT	Montana Teachers Retirement System	Retirement board
NC	North Carolina Retirement Systems	Retirement board
ND	North Dakota Public Employees Retirement System	Retirement board
ND	North Dakota Teachers Fund for Retirement	Retirement board
NE	Nebraska Public Employees Retirement System	Retirement board
NH	New Hampshire Retirement System	Retirement board
NJ	New Jersey Division of Pension and Benefits	Retirement board and state treasurer
NM	New Mexico Educational Retirement Board	Retirement board
NM	New Mexico Public Employees Retirement Association	Retirement board
NV	Nevada Public Employees Retirement System	Retirement board
NY	New York State & Local Retirement Systems	State comptroller
NY	New York State Teachers Retirement System	Retirement board
OH	Ohio Police and Fire Pension Fund	Retirement board
OH	Ohio Public Employees Retirement System	Retirement board
OH	Ohio School Employees Retirement System	Retirement board
OH	Ohio State Teachers Retirement System	Retirement board
OK	Oklahoma Public Employees Retirement System	Retirement board
OK	Oklahoma Teachers Retirement System	Retirement board
OR	Oregon Public Employees Retirement System	Retirement board
PA	Pennsylvania Public School Employees Retirement System	Retirement board
PA	Pennsylvania State Employees Retirement System	Retirement board
RI	Rhode Island Employees Retirement System	Retirement board
SC	South Carolina Retirement Systems	Legislature
SD	South Dakota Retirement System	Retirement board
TN	Tennessee Consolidated Retirement System	Retirement board
TX	Teacher Retirement System of Texas	Retirement board
TX	Texas County & District Retirement System	Retirement board
TX	Texas Employees Retirement System	Retirement board
TX	Texas Municipal Retirement System	Retirement board
UT	Utah Retirement Systems	Retirement board
VA	Virginia Retirement System	Retirement board
VT	Vermont State Employees Retirement System	Retirement board
VT	Vermont Teachers Retirement System	Retirement board
WA	Washington Department of Retirement Systems	Legislature
WI	Wisconsin Retirement System	Retirement board
WV	West Virginia Consolidated Public Retirement Board	Retirement board
WY	Wyoming Retirement System	Retirement board

1. The Conference consists of staff from the Florida House, Senate, and Governor's office