Application of Discount Rates for Assessing Cost-effectiveness of Utility Risk Related Investments

A background on the use and applications of discount rates and recommendations for utility risk analyses

Synapse, on behalf of The Utility Reform Network

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1. INTRODUCTION AND OVERVIEW

This white paper provides a brief introduction into the role of discount rates in economic and benefit-cost analysis (BCA) for the Safety Model Assessment Proceeding (SMAP) at the California Public Utilities Commission (CPUC).

The current use and application of discount rates in utility cost-effectiveness calculations for risk-related investments is inconsistent and, in some cases, flawed, introducing biases that should be corrected in this phase of the SMAP proceeding. Our primary recommendations to rectify the most fundamental issues, discussed further in Section 6, are as follows:

1. The effect of inflation is distinct from the real discount rate. Utilities should calculate cost-benefit ratios (CBRs) by first removing the effect of inflation from the benefit and costs and then applying the real discount rate.

2. Utilities' presentation and calculation of present value costs (and benefits) affects the choice of discount rate; the Commission must establish a common framework for calculation of program costs, which currently differ significantly across utilities. We recommend costs of programs be calculated as the present value of revenue requirement for the full depreciation life of assets (for capital investments) as this is the most accurate representation of costs.

3. Only one discount rate should be selected for both the numerator (benefits) and denominator (costs) in order not to bias the calculation.

4. Utilities should conduct a sensitivity analysis for application of real discount rates using a societal discount rate (relatively low, around 3 percent), and the utilities' weighted average cost of capital (WACC, relatively high around 7 to 8 percent). These book-ends represent reasonable regulatory perspectives about the time value of money, and allows stakeholders and the Commission to examine the difference in results based solely on discount rate.

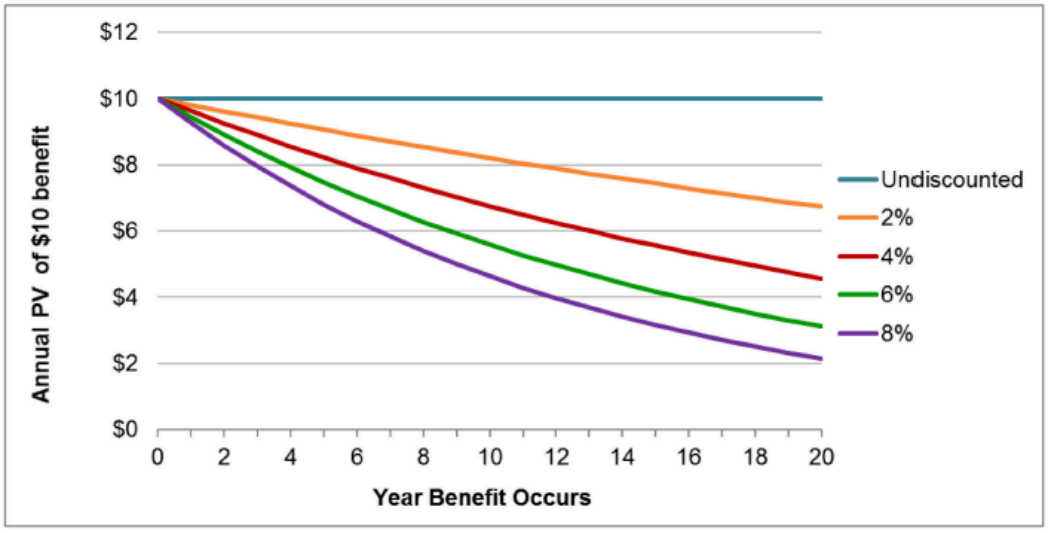
First, we present foundational information about discount rates and their application, and then discuss our recommendations in more detail in Section 6.

2. THE ROLE OF DISCOUNT RATES IN ECONOMIC ANALYSIS

A discount rate is a percentage factor applied to convert future monetary values or units into equivalent present value ones. Generally, the discount rate is a conversion factor that facilitates comparison of values across time (e.g., costs incurred now vs. costs incurred in ten years) by adjusting for the time

value of money.[1] This adjustment is called *discounting.* Since discount rates are expressed in percentage terms and are applied sequentially in a compound fashion, the further into the future the value is, the greater will be the effect of discounting in converting this value into present value terms. The choice of a discount rate plays a critical role in the results of a benefit-cost analysis (BCA) when costs and/or benefits are distributed over time.

Table 1. Impact of discount rates on future value streams[2]



The discount rate helps compare short- and long-term impacts of multi-year investments. As seen above, a higher discount rate gives more weight to short-term benefits and costs relative to the long-term, while a lower discount rate weighs short-term and long-term impacts more equally. The choice of discount rate should reflect the ultimate objective of the cost-effectiveness analysis and should be informed by the jurisdiction's applicable policy goals.

Broadly, there are three types of discount rates used in utility benefit-cost analyses: the weighted average cost of capital (WACC) reflecting the utility's cost of capital, a discount rate reflecting an individual customer's risk or time preference, and a "societal" discount rate.

[1] In simple terms, the "time value of money" denotes the concept that it is preferable to receive a given sum of money sooner rather than later. The reason for this preferencing of near-term value over future value is opportunity costs – money received now may be invested to earn returns or otherwise put to productive ends, whereas money deferred to the future cannot be invested or otherwise used and may in fact never be delivered (reflecting uncertainty in these outcomes).

[2] National Standard Practice Manual. 2020. National Energy Screening Project ("NSPM"): G-2.

Table 2. Types of Discount Rates and Typical Values[3]

Type of Discount Rate	Potential Indicator of Time Preference	Typical Values	Notes and Sources
Societal	Societal cost of capital, adjusted to consider intergenerational equity or other societal values	<0% to 3%	In addition to low-risk financing, government agencies have a responsibility to consider intergenerational equity, which suggests a lower discount rate (US OMB 2003). Society's values regarding environmental impacts might warrant the use of a negative discount rate (Dasgupta, Maler, and Barrett 2000).
Low-Risk	Interest rate on 10-year U.S. Treasury Bonds	-1.0% to 3%	Over the past 20 years the real interest rate on 10-year U.S. Treasury Bonds ranged between roughly -1.0% and 3.0% percent (multpl.com).
Utility Customers on Average	Customers' opportunity cost of money	varies	Customers' opportunity costs can be represented by either the cost of borrowing or the opportunity costs of alternative investments (Pindyck and Rubinfeld 2001, 550). The real rate on long-term government debt may provide a fair approximation of a discount rates for private consumption (US OMB 2003).
Publicly Owned Utility	Publicly owned utility's cost of borrowing	3% to 5%	Publicly owned utility costs of capital are available from the Federal Energy Regulatory Commission Form 1, Securities Exchange Commission 10k reports, and utility annual reports.
Investor-Owned Utility	Investor-owned utility's weighted average cost of capital	5% to 8%	Investor-owned utility costs of capital are available from the Federal Energy Regulatory Commission Form 1, Securities Exchange Commission 10k reports, and utility Annual Reports.

Note: Typical values of discount rates are in real terms, as opposed to nominal. Real interest rates take into account the effects of inflation whereas nominal rates have not been adjusted for inflation. Real discount rates should always be applied to real cash flows, and nominal discount rates should always be applied to nominal cash flows. The utility cost of capital should be after-tax.

3. NOMINAL VS. REAL DISCOUNT RATES

Discounting to adjust for the time value of money and other factors should be distinguished from adjustments to account for inflation. Inflation is an ever-present effect in the modern economy, and is measured in various ways.[4] As prices across the economy rise, the value (purchasing power) of a dollar of expenditure falls. In a sense, inflation can be conceptualized as similar in effect to the reduction in the value of money over time, discussed in the previous section. Unlike discounting in a benefit-cost analysis

[3] NSPM: G-4.

[4] Policymakers in the United States often follow the consumer price index (CPI) or personal consumption expenditures price index (PCE) from the Bureau of Economic Analysis. Synapse often considers changes in gross domestic product, as this considers a broad range of price changes over time. However, CPI may be preferable if the analysis seeks to quantify impacts on individual households and consumers. See St. Louis Fed, *President's Message: CPI vs. PCE Inflation: Choosing a Standard Measure,* July 2013, https://www.stlouisfed.org/publications/regional-economist/july-2013/cpi-vs-pce-inflation--choosing-a-standard-measure#:~:text=Two%20different%20price%20indexes%20are,the%20Bureau%20of%20Economic%20Analysis..

(discussed below), inflation is a relatively objective phenomenon for which there are common calculation methods to estimate effects. To distinguish between these two types of present value calculations, adjustments for inflation are not generally referred to as "discounting."

It is helpful to think about adjustments for inflation and the time value of money as occurring in a two-step sequence. When seeking to convert a future value into an equivalent present value, it is first necessary to adjust for inflation by converting *nominal (current) dollar* values into *real (constant) dollar* values.[5] Next, the real values can be *discounted* to adjust for the time value of money, opportunity costs, uncertainty, and other aspects not captured by inflation but that can be capture in a discount rate.

An alternative approach is to use a nominal discount rate that is a composite of the real discount rate and the inflation rate. This approach permits adjustment for both inflation and the time value of money in one step – i.e. with one value. Importantly, a *real* discount rate must be used with real dollars, while a nominal discount rate can only be used when applied to a future stream of nominal dollars.

4. CONSIDERATIONS WHEN DETERMINING THE REAL DISCOUNT RATE

The determination of an appropriate real discount rate – e.g. discounting beyond the effect of inflation – is a more subjective exercise than the direct measurement of inflation in the economy. One key consideration for real discount rates is the *opportunity cost* of an investment, or "the return to those resources in their most productive application elsewhere."[6] For example, the U.S. government has applied a 7 percent discount rate in its evaluation of government programs that displace private sector investment, an estimate of "average before-tax rate of return to private capital in the U.S. economy."[7]

[5] The nominal (current) dollar value is the price actually demanded or paid in any given time period, without any adjustment for changes in the purchasing power of the dollar. It is the term used to describe the value of something in the year that a person purchased it. The real (constant) dollar value is the price of something after accounting for inflation. This conversion, also known as deflation, adjusts for the effects of the changing purchasing power of the dollar and puts all costs in the same year's dollars. Adjusting for inflation helps understand the changes in purchasing power over time and is useful when comparing values/costs that occur at different points in time.

[6] Office of Management and Budget, *Circular A-94 Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs* ("OMB Circular"), p. 6, https://obamawhitehouse.archives.gov/sites/default/files/omb/assets/a94/a094.pdf.

[7] Council of Economic Advisers Issue Brief, January 2017, *Discounting for Public Policy: Theory and Recent Evidence on the Merits of Updating the Discount Rate (*"Economic Advisors Issue Brief"): 2. Online: https://obamawhitehouse.archives.gov/sites/default/files/page/files/201701_cea_discounting_issue_brief.pdf.

Of course, even these opportunity costs can be subjective depending on what one terms the best use of capital for an alternative investment.

Ethical considerations, particularly around the issue of intergenerational equity of costs and benefits, also come into play when selecting real discount rates. How should we compare the costs of programs today with the benefits that will accumulate to us in the future, or to future generations? As discussed by the U.S. Council of Economic Advisors:

> Special ethical considerations arise when comparing benefits and costs across generations. Although most people demonstrate time preference in their own consumption behavior, it may not be appropriate for society to demonstrate a similar preference when deciding between the well-being of current and future generations. Future citizens who are affected by such choices cannot take part in making them, and today's society must act with some consideration of their interest.[8]

Nevertheless, most analysts agree that a positive discount rate is necessary to discount future costs and benefits.

The NSPM provides several prompts for stakeholders as different jurisdictions consider the appropriate level of discount rate.

Table 3. Considerations for setting the appropriate real discount rate[9]

Consideration	If the answer is "yes"
Time Preference Considerations:	
Does the regulatory perspective suggest the same time preference as utility investors?	Choose a discount rate equal to the utility WACC.
Does the regulatory perspective suggest placing a higher value on long-term impacts than utility investors?	Choose a discount rate less than the utility WACC.
Does the regulatory perspective suggest the same time preference as that of all utility customers?	Choose a discount rate that is represents all utility customers on average.
Does the regulatory perspective suggest the same time preference as that of society?	Choose a societal discount rate.
Does the regulatory perspective suggest placing a lower value on long-term impacts than society does?	Choose a discount rate greater than a societal discount rate, or at the high end of the range of societal discount rates.

[8] Economic Advisors Issue Brief: 2.
[9] NSPM: 5-17.

5. DISCOUNT RATES AND BENEFIT-COST ANALYSIS

Benefit-Cost analysis (BCA) is an analytical approach to help understand the cost-effectiveness of investments by putting all costs and benefits into monetary values. It allows decision-makers to understand the implications of an investment. Often when valuing investments, analysts make intertemporal comparisons of benefits and costs.[10] The monetary values are often presented in terms of an annual stream of costs and benefits over the investment's lifespan, then discounted to determine the cumulative present value of costs and benefits.[11] Discounting future costs and benefits to calculate the present value ensures a common measure of benefits and costs for comparison purposes. The risk modeling results to determine relative and absolute cost-effectiveness at issue in this proceeding are no different.

The benefit-cost ratio (BCR) is the ratio of the cumulative present value of benefits to the cumulative present value of costs. Within the BCA construct, an investment with a BCR that exceeds 1.0 indicates cost effectiveness, with benefits exceeding costs.[12]

$$Benefit\ Cost\ Ratio = \frac{\sum\ Present\ Value\ Benefits\ (dollars)}{\sum\ Present\ Value\ Costs\ (dollars)}$$

One must be careful not to confuse the issues of *cost-effectiveness* and *affordability.* This why the assessment of affordability must occur in parallel with BCA to have an informed perspective on a program. Put another way, it is not a contradiction that a program may be found to be *cost-effective* but *unaffordable.* The converse can also be true. As stated in the National Standard Practice Manual (NSPM):

> Cost-effectiveness analyses are intended to answer the key question of *which utility DER investments are expected to have benefits that exceed costs*. Rate impact analysis are intended to answer the question of *how much will utility DER investments impact rates for one group of customers compared to another*. Attempting to answer these two questions in a single analysis conflates the two questions and thus does not provide helpful information on either one.[13]

Typically, a single discount rate is applied to benefits and costs regardless of the type of costs and benefits:

[10] Boardman, A., D. Greenberg, A. Vining, D, Weimer. 2011. *Cost Benefit Analysis: Concepts and Practice.* Cambridge University Press*:* 133.
[11] Woolf, T., B. Havumaki, D. Bhandari, M. Whited, L. Shwartz. 2021. *Benefit-Cost Analysis for Utility-Facing Grid Modernization Investments: Trends, Challenges, and Considerations.* U.S Department of Energy: 17.
[12] NSPM: D-2.
[13] NSPM: A-2.

> […] a single discount rate is typically used for conducting a BCA. A single discount rate is typically applied to all the benefits and costs, even though the benefits and costs are associated with energy resources with different costs of capital [….] Similarly, a single discount rate is typically applied to a BCA, even though different parties affected by the resources in the BCA have different time preferences.[14]

The bias and inaccuracies introduced into BCAs with application of different discount rates in the numerator and denominator is discussed below.

6. SYNAPSE RECOMMENDATIONS REGARDING THE USE OF DISCOUNT RATES FOR RISK RELATED INVESTMENTS

The application of discount rates for the calculation of cost-benefit ratios (CBRs) related to the benefits and costs of safety investments should follow standard economic theory and best practices for benefit-cost analysis. While risk modeling involves a distinct set of modeling techniques and ultimately benefits that differ from standard utility BCAs, the goal of projecting a stream of benefits due to a certain investment is the same as traditional utility BCA. The recent emphasis on translating all benefits into dollar units further underscores these similarities.

6.1. Benefits and Costs Should be Presented in a Constant / Real Dollars to Remove the Effect of Inflation

As discussed above, the effects of inflation are distinct from the selection of a real discount rate. The first step of utility analyses should be to select a "dollar year," i.e. the present value of all future dollars removing the effect of inflation. If utilities have embedded inflation expectations in their calculation of benefits and costs, these should be removed to calculate constant dollars *for the test year of the general rate case.* This is the most applicable year to calculate constant dollar values because it is when costs and benefits of programs will begin to occur.

6.2. Program Costs Must be Presented Correctly before a Discount Rate is Applied

How costs are calculated in the BCA directly relates to the appropriate discount rate. For example, nominal dollar costs must use a nominal discount rate, real dollars a real rate. The major issue we wish to address here, which we view as indistinguishable from the discount rate issue, is that utilities have

[14] NSPM: 5-16 to 5-17.

not presented capital costs in a uniform manner in their RSE analyses.[15] For example, we have seen capital program costs presented in real (constant year) dollars, nominal dollars, and as the present value of revenue requirement (RRQ). Certain approaches are more accurate than others. Further, the Commission cannot determine the application of discount rates without also knowing a) how cost are presented by the utility and b) whether costs have been accurately depicted (also in relation to benefits). Some of these issues may also be relevant when calculation of dollar benefits are presented in cost-benefit ratios, and the Commission should be careful to ensure these calculations are also consistent and correctly calculated across utilities.

To accurately represent the costs of proposed programs, Synapse and TURN recommend that the Commission order utilities to present the costs of risk reducing programs *in terms of the present value of revenue requirement for the full life of the asset or investment* (for capital costs). The reason for this is simple: annual revenue requirement is the most accurate representation of a capital investment's annual rate impact, and the present value of this represents the cost of a program in present value dollars. We understand that this may be an estimate on behalf of the utility, rather than a requirement that the utility determine each program's RRQ through entering the cost into a Result of Operations (RO) model. This estimate could be accomplished using a technique employed by Pacific Gas and Electric in its TY 2023 GRC filing, in which a conversion factor to gross up direct costs to PV RRQ was used for each type of capital investment.[16]

We assume for the remainder of this discussion below that this issue will be resolved and utilities will present capital and O&M in terms of total present value revenue requirement, for capital investments reflecting the full depreciation life of the proposed asset.

6.3. One Discount Rate Should be Applied in the Numerator and Denominator of a BCA

While we understand that the CPUC has stated a preference for using different discount rates for the benefits and costs of the BCA,[17] this is not standard practice and is not based in sound economic theory. Use of two different discount rates in the numerator and denominator does not allow for the direct comparison of costs and benefits, a primary purposes of risk modeling and the cost-effectiveness metric results. Particularly for investments or programs that have multiple years of future benefits, the choice of discount rate may end up playing a larger role in the benefit-cost ratio than the absolute benefits examined, potentially leading to incorrect conclusions about the program.

[15] O&M expenditures are relatively straight-forward and are less subject to different approaches than capital programs.
[16] See PG&E wildfire risk modeling Excel workpapers, EO-WLDFR-3_RSE Input File, tab "Table PVRR."
[17] Safety Policy Division Staff Evaluation Report on the Southern California Edison Company's 2022 Risk Assessment and Mitigation Phase (RAMP) Application, November 10, 2022 ("SPD SCE RAMP Report"), p. 18.

Let us look at a hypothetical example of a 10 year program where the costs and benefits in each year *are exactly the same*. Clearly, the benefit-cost ratio of such a program should be 1.0, because benefits are equal to costs. However, application of different discount rates in the numerator or denominator of the cost-benefit ratio makes the result less than or greater than one.

Table 4.Hypothetical ten year program with equal costs and benefits in each year

	Numerator (Benefits)	Denominator (Costs)	Cost-Benefit Ratio
Discount Rate	7%	3%	0.82
	3%	7%	1.21
	3%	3%	1.00
	7%	7%	1.00

The disparity in choice of discount rate between numerator and denominator will have a large effect on the results of the analysis. Whichever side of the benefit-cost fraction uses the higher discount rate imposes undue influence on whether the program is deemed cost-effective. This will also be true for programs where benefits and costs are not exactly equal.

The notion that a program with exactly the same costs and benefits could have a benefit-cost ratio that is not equal to 1.0 is unreasonable and demonstrates the inappropriateness and bias introduced by using different discount rates for discounting costs and benefits. The same discount rate should be used in both the numerator and denominator, consistent with standard calculation of CBRs across the various types of BCAs.

6.4. Sensitivity Analyses Should be Used to Examine the Impact of the Real Discount Rate on Cost-effectiveness Results

Regarding the level of discount rate to be used, we discuss the appropriateness of two book-ends: a societal (low) discount rate and the utility's weighted average cost of capital (WACC, relatively high).

Previously, TURN has stated a preference for WACC, as this is clearly the applicable discount rate for costs from the utility's perspective. It represents the time value of money for utility investors, including opportunity cost. This is a reasonable choice of discount rate for the risk modeling and resulting cost-effectiveness metrics at issue here.

However, we recognize that SPD has expressed a lack of comfort with the use of such a high discount rate when applied to future benefits. As noted by SPD in its comments on SCE's RAMP:

> It does not necessarily make sense to force the same discount rate to be used to discount both the numerator and the denominator unless the two types of outcomes in the numerator and the denominator have the same characteristics and the same built-in assumptions. Furthermore, on its surface, it does not seem appropriate that fatalities averted (or other

external benefits) one year from today should be worth less than fatalities averted today by an amount dependent on SCE's WACC.[18]

While we disagree with SPD's contention that this means multiple discount rates should be used (see above), we understand the hesitance to use WACC to discount the benefits of risk-related investments, some of which, particularly those related to health and safety, may be reasonably considered "societal." As discussed above, the time preference of the regulator is a key consideration in determining the appropriate discount rate.

Given that there may be legitimate reasons to adopt either a low or high discount rate in this case, we recommend utilities present the result of cost-effectiveness analyses using both a real societal discount rate (3 percent) and the utility's most recently approved WACC (7-8 percent). The use of sensitivity analysis for these issues is common. For example, guidance from the office of management and budget "requires using both a 7 percent and 3 percent real discount rate in regulatory benefit-cost analyses," as well as an additional sensitivity below the 3 percent rate.[19]

7. CONCLUSION

The use of discount rates in economic and benefit-cost analysis is worthy of due consideration; certain ground rules should be established in this phase of the SMAP proceeding to ensure consistency with best practices and accurate results of utility risk modeling analysis.

First, the effects of inflation should be distinguished from the effects of the time value of money expressed in a real discount rate. Second, utilities should express all costs as the present value of revenue requirement. Third, utilities should present sensitivity analyses using two real discount rates; a societal rate – 3 percent – and the utility perspective – WACC.

[18] SPD SCE RAMP Report, p. 18.
[19] Economic Advisors Issue Brief: 1 and 2.