Cost-Effectiveness Adjustments: How Effective Have States Been At Recreating the PAC?

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ABSTRACT

Since at least1990, states have been adopting adjustments to the total resource cost test (TRC). The driver of these efforts has been the recognition that a number of important benefits are not captured in the standard TRC test. These missing benefits may include societal benefits such as an improved environment and public health, as well as benefits accruing to program participants such as improved comfort and productivity. As a result, adders and lower discount rates have been adopted to account for some of these benefits, as quantifying them is frequently seen as too difficult. While these adjustments have addressed the deficiencies in the standard TRC test it is not clear that these approaches have been any better than simply shifting from the standard TRC test, to the PAC test as the primary cost-effectiveness screen.

This paper takes previous work in this area a step further by quantifying the impact of these adjustments. We find that these adjustments can have an enormous impact on cost-effectiveness, in some cases producing net benefits that are many multiples greater than what would have been estimated under the standard TRC test. We then consider how the results from the adjusted TRC tests compare to the standard PAC test results and ask whether it would be simpler and produce fewer distorted results to eliminate TRC adjustments and adopt the PAC or some hybrid as the primary cost-effectiveness screen.

Introduction

This project grew out of research PG&E did on cost-effectiveness policies in order to inform discussions that have been underway over the last few years on potential changes to the existing cost-effectiveness assumptions used by the California Public Utilities Commission (CPUC), which is the regulatory body that oversees the California IOU energy efficiency programs. More recently, cost-effectiveness policy has become even more topical in California with the 2013 launch of an all-source procurement request for offer (RFO) in Southern California in response to the closure of the San Onofre Nuclear Generating Station (SONGS). The rules for evaluating energy efficiency projects in this RFO are still under discussion, but one possibility is that energy efficiency projects will be assessed using a different cost-effectiveness test, which is more generous than that used in the current energy efficiency programs.

This paper builds on previous work by using cost-effectiveness rules from a number of states to show that differences in cost-effectiveness screening can lead to major differences in overall portfolio results. Previous studies have shown that major differences exist among states and that assumptions have large impacts at the individual program level (Woolf, 2012). Our findings indicate that as results are aggregated up to the portfolio level, the difference in net benefits among the different tests can be very large. This paper details these efforts, lists four approaches to adjusting the TRC, and examines whether current approaches to account for shortcomings of the most widely used test have resulted in materially different portfolios than would have been adopted using more parsimonious screening methods.

Why Cost-effectiveness Tests Are an Issue

Cost-effectiveness tests determine whether a portfolio, program, or product produces benefits that are greater than the costs. To provide a simple example, if a particular offering costs the administrator $100,000 to run, but provides $150,000 in benefits, the offering would be considered to be cost-effective and would be likely included in the administrator's portfolio. However, the benefits and costs can vary widely depending on the test and assumptions used, and the underlying inputs can require significant efforts to estimate. For example, should the test include the costs incurred by the customer? Should the benefits include operational and maintenance (O&M) savings? Or water savings? Should the discount rate used to value the benefits accruing in future years be the utility's discount rate or a societal discount rate? Should health and air quality benefits be included? Should risk reduction benefits be included? And across all of these questions, if the answer is yes, another question is raised – how should these benefits then be estimated, valued, and included?

As a result of the sheer number of variations that can be included, cost-effectiveness tests vary by every state and sometimes even within states.[1] The impacts of these different policy choices can have a dramatic impact on the amount and the types of energy efficiency efforts that are pursued in each state. For instance, if a test is very inclusive of what are termed "non-energy benefits," benefits like water, health, air quality, and comfort, among others, the net benefits of a given portfolio will likely be much higher than a portfolio that does not include these, thus enabling the program administrator to pursue additional energy efficiency savings for projects that would not be cost-effective under a more stringent test.

Supporters of more inclusive cost-effectiveness tests argue that cost-effectiveness tests, as structured in many states, don't include benefits associated with some costs included in those tests, resulting in less energy efficiency investment than there would be if all of the benefits were captured. Detractors of more inclusive cost-effectiveness tests argue that the primary purpose of energy efficiency programs is to lower costs for customers. They argue that including benefits that accrue to society or to individuals results in one set of customers shouldering the bill for another set of customers' comfort, aesthetic appeal, or other individual benefit.

Cost-effectiveness Primer

Energy efficiency program cost-effectiveness dates to the California Standard Practice Manual (Manual), first published in the 1980s and most recently updated in 2001. The Manual includes five cost-effectiveness tests: the ratepayer impact measure test, the participant cost test (PCT), the total resource cost test (TRC), the societal test, and the program administrator cost test (PAC), also known as the utility cost test. The last four tests are the focus of this paper.

The TRC is the most widely used of the tests and seeks to balance the costs and benefits of participants and non-participants by including the total cost of a measure or project (i.e. the costs incurred by the administrator and the costs incurred by the participant). The PAC closely

[1] At a minimum, many IOUs have utility-specific avoided costs and discount rates.

resembles the TRC, with the primary difference being that it does not include the costs of the participant (e.g. the cost the participant would pay that is incremental to the base efficiency product minus the incentive – think of the difference in cost between a basic clothes washer and an efficient clothes washer less whatever incentive is paid). The PAC is frequently viewed as the test that most closely approximates the decision rule that is used for supply-side investments, as those investments are made from the utility's perspective and don't include any costs the participant may incur.[2] The societal cost test is a variation of the TRC that includes externalities like emissions (if not already included in the TRC) and frequently uses a lower, "societal" discount rate. This lower discount rate results in more cost-effective long-lived projects, as benefits accruing many years in the future would be discounted less. The last test, the participant cost test, includes the benefits the participant would receive (bill savings, incentives, and any tax credits) and the costs they would incur (the incremental amount of the measure that isn't covered by incentives).[3]

Common Issues with the TRC and Approaches to Correcting for Them

Non-energy Benefits and Costs

While the TRC includes all project costs, it often does not include all project benefits – common exclusions being non-energy benefits that accrue to participants and society like water, operations and maintenance (O&M), health, and air quality. This discrepancy between the inclusion of costs, but exclusion of benefits has been a common complaint with the test (Woolf, 2012; Neme 2010). As a result, many states have pursued benefit adders to account for these differences. Adders increase the benefits of an energy efficiency program above what they otherwise would be by a specific amount, typically between 5 and 15%. Some examples include Iowa and Oregon, which both use a broad 10% non-energy benefit adder to account for these benefits that most people agree exist, but aren't easy to quantify. See Table 1 for additional adder examples.

In addition to adders, some states have sought to quantify these non-energy benefits and then use these quantified results as additional benefit streams. One example is avoided or reduced operations and maintenance costs – essentially the savings that a participant would experience from not having to change a light bulb as frequently, for instance; Massachusetts is one state that includes O&M benefits.[4] Embedded energy in water is another example. Transporting, pumping, and treating water involves significant amounts of energy. By saving water, energy that would otherwise be required for these purposes is no longer needed. California is currently in the midst of a multiyear project to quantify these benefits, while Connecticut includes water benefits in the amount of $0.01 per gallon saved.[5] Other states, the Northeast in

[2] Other differences between the TRC and PAC can be the inclusion of avoided emissions and other environmental benefits. This is not universal, however, as California includes these benefits in both the TRC and PAC.
[3] Several papers (Woolf, 2012; Neme 2010) include tables delineating the benefits and costs included in each test. Because this paper is focused on the TRC, societal test, PAC, and participant test we have summarized the differences between these tests. Interested readers should review these other sources for a fuller explanation of differences, including the ratepayer impact measure test.
[4] 2013-15 Massachusetts EE Plan
[5] 2011 Electric and Natural Gas Conservation and Load Management Plan, October 2010

particular, have also estimated the "demand-reduction-induced price effects" (DRIPE), which is the price reduction observed in the wholesale energy and capacity markets as a result of the reduction in demand produced by energy efficiency savings (Synapse, 2013).

Other Issues With Cost-effectiveness Calculators and Efforts to Account for Them

In addition to non-energy benefits, states have sought to correct for other avoided cost deficiencies. The most popular change is to add avoided emissions. This change takes the form of an adder and is based on a $/ton calculation of avoided GHGs, generally CO2; values tend to range between the market prices of allowances on the RGGI market ($3/ton as of December 2013[6]), to those identified in a forecast of CO2 prices (e.g. Synapse's forecast, which California moved to in 2013; E3, 2012), to a flat $/ton value (e.g. $30/ton, which was used in California prior to 2013).

In some cases, states have sought to make corrections on the cost side of the equation as well. One example is the benefits energy efficiency may provide in reducing future energy price risk – the idea being that energy efficiency reduces the amount of electricity customers have to purchase, thus shielding them to a certain extent from any volatility that may occur in energy markets in the future. One example is Vermont, which includes a 10% cost reduction to account for this benefit.[7]

Lastly, some states have raised the question of what the appropriate discount rate is for energy efficiency. The discount rate is used to account for the time value of benefits that occur in the future, with a high rate reducing the value of those benefits. In most states, the discount rate is set as the utility's weighted average cost of capital for the TRC and PAC, the same rate that utilities would face when raising capital to build new generation sources. However, some entities have argued that this rate is too high – that there are societal benefits that are delivered through energy efficiency programs and that the rate should therefore be lower to account for these benefits. Massachusetts is one state where the discount rate has been lowered, boosting the benefits that accrue particularly from long-lived investments.[8]

Table 1. Cost-effectiveness variations

State	Cost-Effectiveness Screen	Discount Rate (nominal)*	Data Year	Non-Energy Benefits	Source
Massachusetts	TRC	2.35%	2013	RGGI Price for CO2	Department of Telecommunications and Energy, order D.T.E. 98-100, 2000.

[6] The December 2013 auction had a clearing price of $3/ton.
[7] Vermont Public Service Board Order, "Modifications to State Cost-Effectiveness Screening Tool," Feb 7, 2012.
[8] The discount rate in Massachusetts is based on the historical yield on the 10 year treasury note (DPU 08-50-A, p22); the 2013 average was 2.35% (Federal Reserve Historical Data).

Minnesota	SCT, primary; PCT, PAC, secondary	3.22%	2011		2011 Xcel Annual DSM Report
Wisconsin	Modified TRC	4.00%	2010	Carbon: $30 / ton	Quadrennial Planning Process; 5-GF-191
Maine	SCT	4.22%	2010	No value assigned to these at this time.	Efficiency Maine Trust, Triennial Plan 2011-2013, March 2010.
Iowa	SCT, primary; TRC, RIM, PAC, PCT, secondary	4.81% (SCT)	2012	10% adder for electric, 7.5% adder for gas.	MidAmerican 2012 Annual Report; IAC 199—35.8(2)
Vermont	SCT	5.00%	2012	15% non-energy benefit adder; 10% cost reduction for risk and flexibility advantages.	Vermont Public Service Board Order, "Modifications to State Cost-Effectiveness Screening Tool," Feb 7, 2012.
Connecticut	TRC, PAC	7.42% (electric)	2010	Non-embedded emissions, per Synapse avoided energy supply cost reports	2011 Electric and Natural Gas Conservation and Load Management Plan, October 2010
Oregon	SCT, primary; PAC, secondary	7.20%	2008	Carbon ($15/ton); Non-energy benefits: 10% adder.	Cadmus Consulting, "Picking a TRC Standard."
New York	TRC	7.50%	2008	None, although a TRC + C is also reported; "C" equals $15/ton carbon.	Cadmus Consulting, "Picking a TRC Standard."
Colorado	TRC, primary; PAC, RIM secondary	7.67%	2011	10% adder.	Black Hills Energy 2011 Annual Report

New Jersey	PCT	8.00%	2009	Consider emission reductions as ancillary benefits; CO2 price based on RGGI auctions.	Guidelines for calculating energy savings 2009.
Washington	TRC, primary; PAC, RIM, PCT, secondary	8.10%	2011	10% adder.	839a(4) (D) of NW Power Act; "Puget Sound Energy CE Methodology."
California[9]	TRC, primary; PAC, secondary	8.79%	2013	GHG ($30/ton).	E3 cost-effectiveness calculator and avoided costs model

Analysis, Methodology, and Results

Comparing Costs and Benefits Across States

This analysis aims to estimate the impact of these various changes to the cost-effectiveness results in terms of additional benefits beyond the TRC results. It uses data gathered on the changes mentioned above and publically available cost-effectiveness results from the latest available year of data from PG&E's energy efficiency programs, 2012. It then uses the other state assumptions and the cost-effectiveness results to model what the results would have been under these different state schemes. Finally, it compares the results to the amount of additional benefits that would have been required to equal the PAC results from that same PG&E portfolio year.

It should be noted that not every state uses the same set of items as part of their core set of avoided costs. For example, in California the avoided costs include: energy, capacity, T&D, ancillary services, emissions, losses, and avoided renewable portfolio standard costs. The avoided renewable portfolio standard benefits comes from a California law that requires all investor owned utilities to procure 33% of their electricity from renewable sources by 2020. Because renewable sources are typically more expensive than conventional sources, saving energy through energy efficiency programs not only avoids costs from energy, capacity, T&D, ancillary services, emissions, and losses, it also avoids the incremental cost of procuring additional renewables.

[9] The California methodology was updated for the 2013 program year to reflect an after tax weighted average cost of capital (7.66%) and a GHG adder that is based on the Synapse forecast. The values reflected in the table are the previous values, which applied to 2012, the most recent full year of data available for the analysis performed in subsequent sections.

Every state faces a different set of circumstances and costs associated with procuring electricity, building conventional power plants, and building new transmission and distribution lines. For instance, in the Pacific Northwest, where much of the power mix is hydropower-based, the avoided energy costs will be much lower than parts of the country that rely on more expensive natural gas. This exercise did not seek to account for these core avoided cost variations between states, as the point of this exercise was to estimate the impact of adders and discount rates, not to produce an exhaustive study of the differing valuations assigned to energy efficiency across states.

Analysis and Methodology

We started with the cost-effectiveness results from PG&E in the latest year of available data, 2012. We then backed out the impact of the CO2 adder that was in place in California for the 2010-12 program cycle, or $30/ton (this modification allowed us to include the impact of the different CO2 policies across states; thus, the base set of benefits used in this analysis does not include carbon). We then adjusted the impact of the discount rate on the program results using a constant portfolio average measure life (~10 years) and varying the discount rate (using rates in effect in other states) to estimate a new benefit stream that reflected the impact of each state's discount rate. This resulted in a set of different benefit streams that could be compared across the set of discount rates in question.

We did have to make some broad assumptions that should be noted. For instance, energy efficiency costs often occur within the year in which projects are developed, but that isn't always the case. Because we weren't able to determine the impact of discounted costs in the PG&E portfolio, the analysis does not include an adjustment for any cost discounting present in the 2012 portfolio results. While not completely accurate; we felt that the impact would be minimal compared to the much larger impact that is experienced by savings occurring many years in the future.

Lastly, this analysis was focused on the easily quantifiable adders and discount rate differences listed in Table 1. As mentioned above, some states, like Massachusetts, have quantified non-energy benefits like O&M and increased health, safety, and comfort. These benefits have been incorporated into its technical reference manual at the measure level rather than in aggregate at the portfolio level. This means that measures that produce significant non-energy benefits in Massachusetts will be assigned greater benefits at the measure level and that the portfolio would in turn also have greater net benefits once the measure level benefits are aggregated. Capturing this impact would be possible, if the portfolio were to be run through the cost-effectiveness calculator used in each of these states. However, the significant amount of work involved in such a detailed analysis was beyond the scope of this effort. For now, the Massachusetts changes in benefits due to adders (Figure 1) should be viewed as a low, and the actual amount of benefits would likely be much larger if the analysis were conducted at the measure level.

Results

Figure 1 shows the results of the analysis, as detailed above, with input assumptions as detailed in table 1. The graph illustrates the significant impact adders and discount rates can have on benefits. On the low end of the graph, Connecticut and New Jersey assumptions would have resulted in ~$30 million in additional benefits. On the high end, Wisconsin and Vermont assumptions would have resulted in over $250 million of additional benefits, with the remaining states falling somewhere in between, either as a result of a lower discount rate or different adder / cost reduction policies.

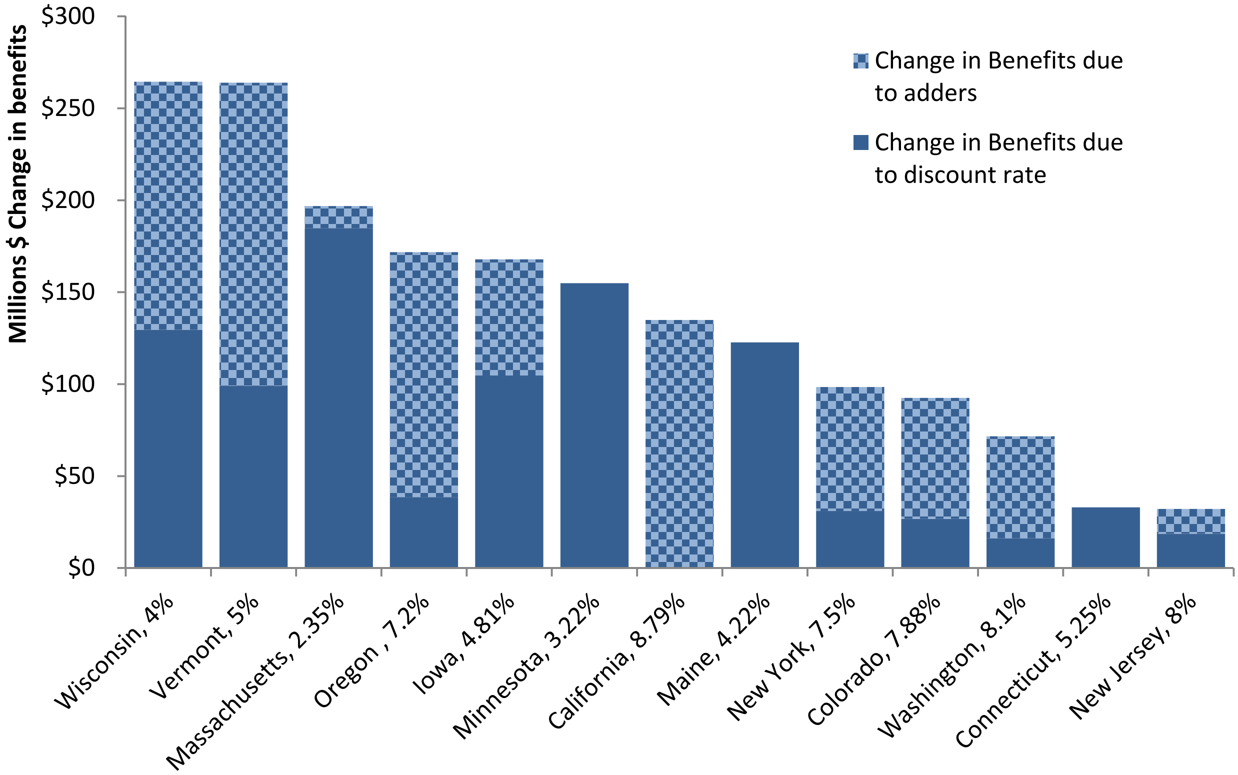

Figure 1. Hypothetical additional benefits to PG&E's 2012 portfolio under the cost-effectiveness assumptions used in each state; states are listed along with the discount rate from table 1. *Source*: PG&E 2012 and PG&E analysis of table 1 data.

For context, the PG&E 2012 portfolio (without the CO2 adder) had ~$655 million of benefits and $580 million of costs, for net benefits of ~$75 million. So, in the high cases presented by the Wisconsin and Vermont schemes, the net benefits would have been more than three times as great as the base net benefits calculated using the current California Standard Practice Manual assumptions, excluding the CO2 benefit.

Also recall that Massachusetts includes significant non-energy benefits that aren't included in the graph due to incorporation of those benefits at the measure level. As a result of not being able to incorporate these benefits into the analysis, the bulk of the Massachusetts benefit comes from the lower discount rate. So, while Wisconsin and Vermont in the above graph appear to be the most generous, it's likely that Massachusetts would take that spot if the non-energy benefits were included.[10] An examination of 2012 annual reports for National Grid and NStar seem to confirm this, as the non-energy benefits exceeded the base benefits for both administrators and comprised over 80% of the net benefits, a huge amount.

Comparison to PAC

Let's pause for a moment and remind ourselves of two reasons for modifying the TRC. The first is to treat energy efficiency programs from a different perspective, societal for instance, which involves a lower discount rate. The second is to correct for the disconnect that results in including all costs, but not all of the benefits in the TRC. Given that the PAC corrects for some issues with the second item, we felt that a comparison should be made to the benefits level that the PAC results would imply.

For this part of the analysis, we estimated the amount of additional benefits that would be required on the TRC side to equal the PAC results for the 2012 PG&E reported results. This involves estimating the additional TRC benefits that would be required, through adders, cost reductions, or lower discount rates to achieve the PAC benefit-cost ratio that is calculated using the current California Standard Practice Manual assumptions, minus the CO2 adder. Our analysis suggests that $205 million of additional benefits would have to be added to the TRC to equal the PAC.[11] Figure 2 shows this value overlaid on the results from the earlier analysis.

The graph shows that current adders and lower discount rates used in at least two states are enough to exceed the PAC benefit results. The PAC screen still results in a higher level of cost-effectiveness for the other portfolios, but the graph shows that the states used in this analysis have made significant adjustments, two of which have completely accounted for the non-energy benefit/cost disconnect and many of which have come very close.

Given the results of the analysis, let's summarize the impact of the four main approaches for modifying the TRC:

- Change the discount rate: A lower discount rate will increase the value of long-lived measures and depending on the change can have a modest to significant impact on benefits.
- Introduce an adder / cost reduction: Our results indicate these energy efficiency sweeteners can have an even larger impact on benefits than the discount rate, but they are applied to all measures, regardless of whether they produce additional benefits or not.
- Value non-energy benefits: As Massachusetts has done, states can estimate the value associated with non-energy benefits and include these in technical resource manuals. This approach adds value to measures that present additional benefits, instead of the broad approach of the adders, but it also requires investing time and money to produce studies that estimate these values. Depending on what is included, it also appears to offer significant benefit increases, likely levels that are even greater than the PAC value.

[10] In a recent SEE Action (a DOE/EPA-facilitated effort to provide information, resources, and network opportunities for the energy efficiency industry) webinar, one presenter alluded to Massachusetts having the most inclusive set of non-energy benefits.

[11] The actual calculations involve benefit and cost output and TRC and PAC ratio results.

- Switch to the PAC: This approach offers slightly greater benefit increases than a discount rate or most adder approaches alone and is typically easy to implement. It also eliminates the need to undertake studies to quantify non-energy benefits.

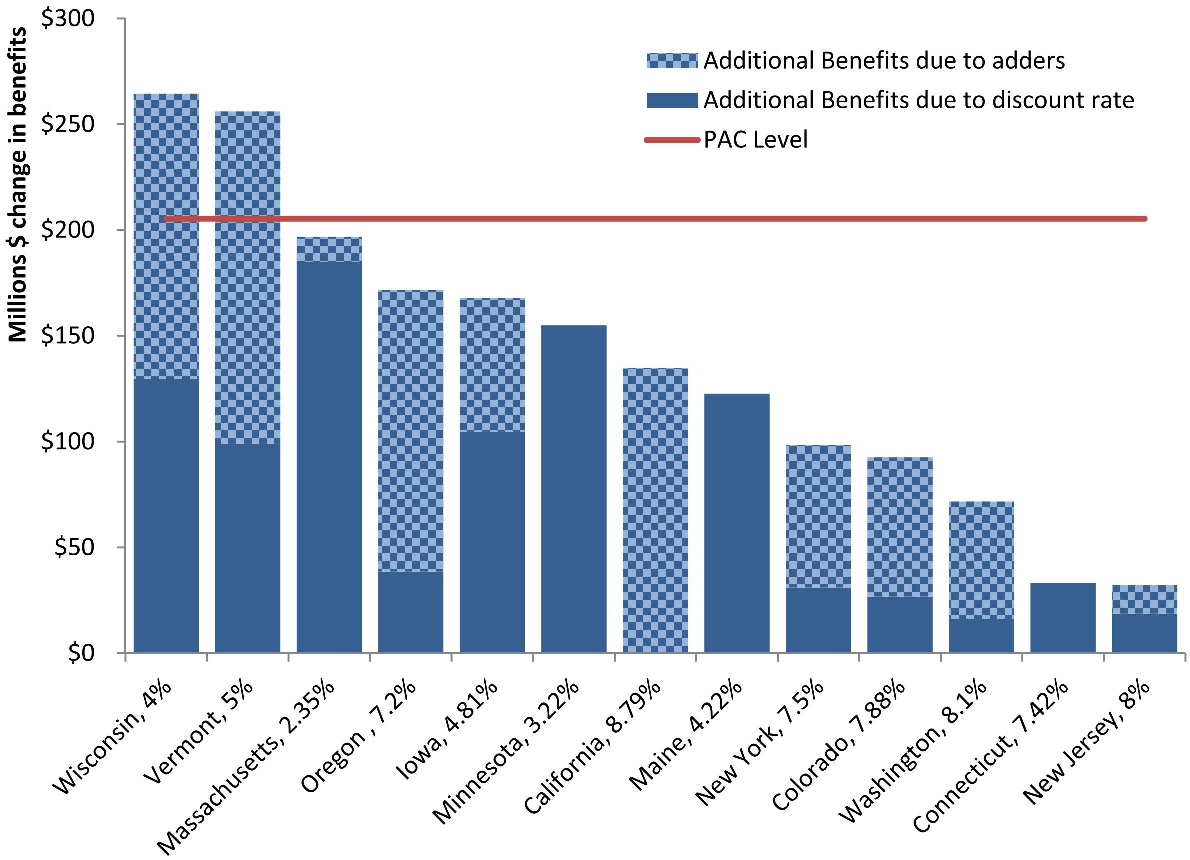

Figure 2. Change in benefits relative to those needed to equal PAC. *Source*: PG&E 2012 and PG&E analysis of table 1 data.

Conclusions and Suggestions for Further Study

The primary conclusion from our analysis is that the various adders and lower discount rates that have been employed by a number of states have been effective in significantly increasing the calculated cost-effectiveness of portfolios. However, a more straightforward approach to achieve that same end may have been to use the PAC test as the primary cost-effectiveness screen for portfolios rather than an adjusted TRC. The PAC test is very well understood and easy to implement and does not require the expense or effort of calculating the adjustments to the TRC identified in this paper. Nor does the PAC result in the high level of contentious debate among stakeholders associated with inclusion of non-energy benefits or societal discount rates. Finally, as mentioned in the paper, the PAC is the screening test which most closely replicates the supply side investment decision rule. Concerns that, because the PAC does not include incremental participant incurred costs, it will result in portfolio funding that is beyond the level that will be supported by customer under real-world circumstances could be easily mitigated by employing the participant cost test (PCT) at the measure or program level to ensure that the portfolio does not include measures that are simply unaffordable due to high incremental participant costs.

An area of further study based on the findings in this paper would be to test whether the measures and construct of an energy efficiency portfolio in various states would be materially different if the state were to choose the PAC test as the primary screen (perhaps augmented by PCT screening at the measure or program level) rather than an adjusted TRC. While the adjusted TRC may, in theory, provide additional insights into the optimal composition of the portfolio to address state policy goals, in practice the difficulty and vagaries in estimating the adjustment factors may render such adjustments meaningless in the eyes of many stakeholders. Such an analysis could reasonably be undertaken in several states (such as California) that require program administrators to report both the TRC and PAC at the portfolio and program level.

References

California Public Utilities Commission and California Energy Commission. 2001. "California Standard Practice Manual: Economic Analysis of Demand-Side Programs and Projects."

CPUC Energy Division Staff. "Addressing Non-Energy Benefits In The Cost-Effectiveness Framework." http://www.cpuc.ca.gov/NR/rdonlyres/BA1A54CF-AA89-4B80-BD90-0A4D32D11238/0/AddressingNEBsFinal.pdfDaykin, Elizabeth, and Jessica Aiona and Brian Hedman. 2012. "Picking a Standard: Implications of Differing TRC Requirements." Cadmus Group.

Daykin, Elizabeth, and Jessica Aiona and Brian Hedman. 2012. "Picking a Standard: Implications of Differing TRC Requirements." Cadmus Group.

Daykin, Elizabeth, and Jessica Aiona and Brian Hedman. 2011. "Whose Perspective? The Impact of the Utility Cost Test." Cadmus Group.

D.P.U. 08-50-A. Investigation by the Department of Public Utilities on its own Motion into Updating its Energy Efficiency Guidelines Consistent with An Act Relative to Green Communities. Massachusetts. March 16, 2009.

Eckman, Tom. 2011. "Some Thoughts on Treating Energy Efficiency as a Resource." Electricity Policy.

Energy and Environmental Economics. 2012. "Latest Distributed Energy Resources Avoided Cost Model (July 24, 2012)." https://www.ethree.com/public_projects/cpuc5.php.

Energy Efficiency Screening Coalition. 2013. "Recommendations for Reforming Energy Efficiency Cost-Effectiveness Screening in the United States."

Neme, Chris, and Marty Kushler. 2010. “Is it Time to Ditch the TRC? Examining Concerns with Current Practice in Benefit-Cost Analysis.” 2010 ACEEE Summer Study on Energy Efficiency in Buildings.

Pacific Gas and Electric Company. 2013. Energy Efficiency 2012 Annual Report.

SEE Action. 2014. “Energy Efficiency Cost-Effectiveness Testing.” http://www.emvwebinar.org/Meeting%20Materials/2014/index2014.html

Synapse. 2013. “Avoided Energy Supply Costs in New England: 2013 Report.” Synapse Energy Economics.

Woolf, Tim, et. al. 2012. “Energy Efficiency Cost-Effectiveness Screening: How to properly account for ‘other program impacts’ and environmental compliance costs.” Synapse Energy Economics.