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Order Instituting Rulemaking Concerning Energy Efficiency Rolling Portfolios, Policies, Programs, Evaluation, and Related Issues	Rulemaking 13-11-005 (Filed November 14, 2013)

APPENDIXES

Appendix A- Roadmap Better Energy Efficiency Policy

Appendix B- Restructuring Portfolios to Bring Out the Best in Energy Efficiency

Appendix C - Designing Cost-Effectiveness Tests for Demand Side Management Programs

Appendix D- Using the Total Economic Value of Benefits to Set Resource Energy Efficiency Goals

Appendix A: Roadmap: Better Energy Efficiency Policy

Energy efficiency portfolios suffer from a structural issue. The policy objectives of energy efficiency are not aligned with how energy efficiency is valued and tracked. Policy objectives of energy efficiency broadly include reducing carbon, enhancing equity, transforming markets, and meeting energy system needs. However, energy efficiency is only valued as an energy system resource, and that too done so incorrectly. This structural misalignment has so far remained hidden because of high cost-effectiveness of energy efficiency portfolios in past-years. This was due to the prevalence of widely available energy efficient lighting, and relatively higher priced fossil fuel generated energy.

The three accompanying papers described below present a complete policy solution to best apply energy efficiency to meet our energy needs and policy goals, of reducing carbon emissions and enhancing equity, at the least-cost to customers. Although all three papers are written with a focus on energy efficiency programs in California, the solutions outlined in these papers are applicable to all distributed energy resources in all jurisdictions. The three papers are:

<u>Restructuring Portfolios to Bring Out the Best in Energy Efficiency</u>: This paper explains the structural issues that ail energy efficiency portfolios. Then it explains the first step of energy efficiency reform: aligning energy efficiency portfolios with the energy system and policy objectives energy efficiency is expected to achieve. This can be done by cleaving the energy efficiency portfolio into three sub-portfolios, (1) a resource portfolio, (2) market transformation portfolio, and (3) an equity portfolio. The paper explains how goals and budgets for each of these three sub-portfolios should be developed.

<u>Cost-Effectiveness Policy for Demand Side Programs</u>: This paper presents three principles for developing an accurate cost-effectiveness test that resource planners can apply to both demand and supply side resources to meet energy system and policy goals at the least cost. The paper applies these principles to the three energy efficiency sub-portfolios described in the first paper.

<u>Using the Total Economic Value of Benefits to Set Resource Energy Efficiency Goals</u>: Currently, goals for resource energy efficiency programs are set in terms of annual energy savings with a minimum cost-effectiveness requirement. This does not provide a complete signal to program planners, administrators, and implementers to acquire the right type and amount of energy efficiency. This is because annual energy savings goals do not capture the fact that the value of energy savings varies with time and location and that some measures have longer lifetimes than others. The right metric to set goals and to track the progress of resource energy efficiency programs is the aggregate economic value of all energy system and policy benefits of resource energy efficiency. This metric applies to all distributed energy resources and can be used to plan and implement initiatives that contain multiple types of distributed energy resources

Appendix B: Restructuring Portfolios to Bring Out the Best in Energy Efficiency

I. Energy Efficiency Portfolio Structures Need to Evolve

Energy efficiency (EE) portfolios in California are expected to fulfill multiple policy objectives in addition to the primary objective of meeting growth in energy demand at the least cost possible.[1] For example, utility customer funded energy efficiency programs reduce greenhouse gas (GHG) emissions,[2] enhance equity by serving to make low- and middle-income customers' homes more comfortable and efficient, undertake research on and development for emerging technologies, conduct workforce training to ensure best energy practices are applied, and advocate for better codes and standards. Regulators have so far justified investing energy sector customer funds on achieving these disparate objectives because energy efficiency portfolios have proven to be cost-effective solely through their value as an energy resource.

However, recent developments have made it much harder for energy efficiency portfolios in California to fulfill all these multiple objectives while remaining cost-effective per current regulatory rules. These developments include a decrease in the cost of alternative energy options,[3] high penetration of efficient equipment in end-uses that energy efficiency programs traditionally target to cost-effectively conserve

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[1] CPUC, *Interim Opinion: Energy Savings Goals for Program Year 2006 and Beyond*, (D.04-09-060) p. 35. "cost-effective conservation and energy efficiency are first in the IOUs resource loading order—that is, energy efficiency is evaluated for cost-effectiveness and procured before supply-side resources are to be factored into the procurement plan"

[2] Senate Bill 350 requires the electric sector to develop plans to reduce carbon emissions to 40% below 1990 levels by 2030, Senate Bill 100 requires the electric sector to get to zero-carbon electricity by 2045.

[3] This includes both gas and renewables. For many reasons, including advancements in fracking, gas prices in the United States have decreased. California's Renewable Portfolio Standards (RPS) mandate investment in renewable energy. Once constructed, renewable resources produce electricity cheaply thus adding further downward pressure on wholesale electricity prices.

energy,[4] and adoption of more efficient codes and standards.[5] These developments compound a foundational pre-existing issue: the current cost-effectiveness policy undervalues energy efficiency.

Current California Public Utilities Commission (CPUC) cost-effectiveness policy, the total resource cost (TRC) test, undervalues energy efficiency by accounting for all costs of energy efficiency but only accounting for a part of its benefits.[6] The TRC counts costs incurred by both the customers that participate in energy efficiency programs and the costs incurred by the utility[7] system of running the program, but only values the benefits incurred by the customer-utility system. Although the CPUC's policy doesn't value any non-energy benefits incurred by participating customers, demands on energy efficiency portfolios to fulfill additional non-energy goals such as serving vulnerable communities remain

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[4] California Public Utilities Commission, *Upstream and Residential Downstream Lighting Impact Evaluation Report Lighting Sector – Program Year 2018 EM&V Group A* (April 2020), at 9. "Evaluation results suggest that the California lighting market has shifted to a point where LEDs are the dominate technology and are the preferred choice among most consumers. LEDs comprise well over 50% of the market for all three evaluated measure groups, and LED prices have fallen to a point where they are competitive with inefficient technologies, even without program incentives. Upstream lighting program incentives no longer influence customer purchases as much as they did when inefficient light bulbs dominated the lighting market."

[5] Energy end-uses such as residential and commercial lighting have seen high rate of adoption of light emitting diodes (LED) due to successful energy efficiency program activity. California's Title 20 and 24 continue to lead the nation in mandating efficient building and appliance energy codes.

[6] For a list of benefits of energy efficiency see: Lara Ettenson (NRDC), *Energy Efficiency: The Planets Superhero* (September 2019); and the Regulatory Assistance Project, *A Layer Cake of Benefits: Recognizing the Full Value of Energy Efficiency* (October 2013).

[7] The "customer-utility system" is short-hand for regulated energy utilities that are funded by their energy customers. All the spending of these utilities (including energy efficiency programs, natural gas supply, and supply side contracts for electricity) are recovered through billing energy customers.

and continue to increase.[8][9] Therefore, it is no surprise that recent energy efficiency portfolios in California have not proven to be cost effective when measured through the TRC.[10]

The energy efficiency portfolio is akin to doomed, aging ship. The demands made of the ship continue to increase. More cargo, additional destinations. But the ship's captain only gets paid for a third of the deliveries it makes. The captain can't afford to maintain the once-reliable ship. The very bits that made it buoyant wither with age. And the ship starts to sink.

In response to this decline in portfolio cost-effectiveness, the Commission raised the cost-effectiveness screening requirements for energy efficiency when developing energy efficiency goals and budgets to hedge the risk of energy efficiency portfolios' evaluated energy savings being found to be less than the amount of energy savings the energy efficiency portfolios claim. This action has the effect of incorrectly lowering energy efficiency goals and thus investment in EE; which is incorrect because it results in in missed opportunities to cost-effectively meet energy needs and policy goals through energy efficiency.

The energy efficiency portfolio goals for IOU programs are now less than 0.4 % of incremental sales,[11] the lowest they have been in the last ten years and these goals are half of what they were in 2015.[12] This is despite California's increasing carbon reduction goals and commitment to serving people in disadvantaged communities. Even more troubling is the fact that Program Administrators (PAs) have still not been able to construct portfolios that meet CPUC's reduced goals cost-effectively since the

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[8] For example, a recent CPUC Decision Addressing Business Plans (2018) stress the importance of continuing to serve hard-to-reach customers (at 43) and ordered IOU programs to continue to offer workforce training and education (at 182). The list of equity requirements of energy efficiency portfolios is long and are within recent CPUC energy efficiency Decisions and legislative requirements. See the section on equity programs in this paper for more details.

[9] Utilities market energy efficiency programs based, at least in part, on their customer non-energy benefits, which underscores the significant role these non-energy benefits play in customer decision-making. Therefore there is inherent bias in assuming that all customer contributions to the cost of energy efficiency measures should only be "allocated" to just the utility system benefits.

[10] CPUC, *Energy Efficiency Portfolio Report* (May 2018), at 12, and at 132.

The evaluated portfolio level cost-effectiveness ratio of all the Program Administrators' (PAs) energy efficiency portfolios is 0.87 for the 2013-15 program cycle per the TRC and 1.28 per the Program Administrator Cost test which this paper proposes the Commission apply for all demand side programs.

[11] Navigant, *2019 Energy Efficiency Potential and Goals Study* (September 2019), at 72.

[12] Navigant, *Energy Efficiency Potential and Goals Study for 2015 and Beyond* (July, 2015), at x.

underlying problem still exists: the misalignment between the multiple policy objectives of energy efficiency and how energy efficiency is valued.

Trying to solve the problem of low energy efficiency cost-effectiveness by reducing the budgets of the energy efficiency portfolio is not the right solution. This attempt to treat the symptom while ignoring the root-causes has the effect of reducing overall benefits of energy efficiency to meet our energy needs (instead requiring PAs to rely on more expensive and often polluting power), forgoing opportunities to accelerate investment to fight off the climate crisis, and missing opportunities to help improve customers' health while reducing their energy bills. This imbalanced approach also leads to an under-accounting of the available efficiency that could cost-effectively meet California's energy needs and related policy goals, thereby resulting in an energy resource mix that is more expensive, carbon intensive, and polluting for customers.

Moreover, because structural issues with energy efficiency policy remain unsolved, problems that plague the energy efficiency portfolio will persist even though energy efficiency goals are reduced as evidenced by the fact that PAs in California have not been able to submit energy efficiency portfolio plans that meet policy and cost-effective requirements (as measured through both the TRC and the Program Administrator Cost test or "PAC").[13] This could lead to further reduced energy efficiency goals and budgets. One of the expected impacts of these budget cuts is that non-resource programs, i.e., programs focusing on equity, workforce, and market transformation, will be disproportionate affected.[14] This means that some of policy objectives for EE, relating to equity and market transformation, will not be attained and the benefits of energy efficiency will not be as widely shared by workers and hard-to-reach or low and moderate income customers.

California has appropriately been a leader in setting aggressive policy goals to fight climate change. To meet these objectives, the energy sector must transform and lead the decarbonization of California's economy.[15] EE attributes will help California meet its future energy needs and comply with its environmental laws at the least cost possible, support vulnerable customers, and keep energy affordable for all Californians. To ensure that energy efficiency is prudently utilized as a resource to help

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[13] Southern California Edison Company2020 Annual Budget Advice Letter Workshop (March 16, 2020), at 9. SCE's portfolio has a TRC of 0.76 and a PAC of 0.85.

Note: this is an illustrative example, and this issue isn't limited to solely to Southern California Edison. All investor owned utilities (IOU) are in the same situation.

[14] Ibid at 14.

[15] Senate Bill (SB32) requires a 40% decrease in GHG emissions from 1990 levels by 2030. SB100 requires zero-carbon electricity by 2045 and 60% RPS by 2030. Executive Order

meet all these energy system[16] and policy needs cost-effectively, California's policy needs an unbiased and accurate framework to be able to determine how much to spend on energy efficiency and what type of energy efficiency programs to invest in.

II. A Way Forward: Restructure the Energy Efficiency Portfolio into Three Sub-Portfolios

The first step of the solution is to restructure the current energy efficiency portfolio in accordance with the policy goals and energy system needs that energy efficiency fulfills. This can be accomplished by cleaving the existing energy efficiency portfolio into three separate segments: Resource, Market Transformation, and Equity energy efficiency. Each of these three segments of energy efficiency aim to achieve different (but complementary and sometimes overlapping) impacts and work in tandem to attain our energy, environmental, and equity needs. While the purpose of this categorization is to develop portfolios that are best aligned with state policy objectives, existing programs may overlap some or all of these three segments. The categorization needs to be based on the primary objective of the program (e.g., is the main purpose of the program to cut energy use, to advance markets, or to serve vulnerable customers).

- **Resource energy efficiency initiatives** are actions taken to meet near-term energy system and greenhouse gas reduction needs by reducing the amount of energy customers use and by changing when customers use energy. These programs can be directly compared with supply side resources to determine how much Resource energy efficiency should be procured and could, for example, take the form of customized programs to address the unique energy needs for commercial and industrial customers or residential retrofit programs. This is not to mean that resource programs should not consider contributions to equity and market transformation efforts whenever possible, but rather it is not the primary objective of these programs.
- **Market Transformation (MT) initiatives**, as defined by the Northwest Energy Efficiency Alliance (NEEA),[17] are market interventions that create lasting change in market behavior by removing identified barriers or exploiting opportunities to accelerate the adoption of all cost-effective energy efficiency as a matter of standard practice. MT initiatives ready the market for potential resource programs of the future and conduct market-wide interventions (some of which could qualify as resource programs) to accelerate energy efficiency adoption with minimal direct interaction with program participants. Examples of these programs include (1) research,

[16] The term "energy system needs," as used in this paper, refers to the amount of energy production from existing resources (or "energy"), new resource builds (or "capacity"), and transmission & distribution upgrades required to maintain a reliable energy grid that can meet all customers' energy demand.

[17] The CPUC has a definition for these programs as well which is aligned with NEEA's definition. See the section on MT programs for more detail.

development, and demonstration of emerging technologies to introduce new ways of saving energy, (2) programs that intervene at the manufacturer or retailer level to increase availability and lower cost of products, (3) workforce programs to ensure sufficient skilled labor, and (4) codes and standards advocacy. Although these initiatives ultimately aim to meet energy system needs as well, they differ from Resource programs in three ways: (1) these initiatives accrue benefits to the energy-system over a longer time-horizon, (2) they have a different target intervention, and (3) some MT initiatives indirectly accrue energy system benefits by making existing Resource programs more effective (e.g., contractor training programs lead to improved energy practices which then result in better savings realized through existing Resource programs).

- **Equity initiatives** prioritize the most vulnerable Californians so that they benefit from equitable access to previously untenable resources, and thereby avail themselves of the benefits of energy efficiency including, but not limited to, reduced bills, more efficient and better functioning homes, which lead to increased health, comfort, and productivity. Currently this is accomplished through programs that are designed to reach low- and middle-income, rural, hard-to-reach, and multifamily customers, to name a few. The success of these initiatives needs to be determined through metrics that are better aligned with these objectives, as explained in Section V-A.

These three facets of energy efficiency work well together to create an equitable, low-cost electric system. MT initiatives plough and sow a nascent market to ready it for future Resource initiatives. Resource initiatives reap the benefits of a bountiful market to meet near-term energy system and policy needs, MT initiatives then take-over the task of completely transforming the market from Resource initiatives. Equity initiatives ensure that EE's benefits are evenly distributed across all customers by prioritizing the most vulnerable Californians. When designed to complement one another instead of competing for energy efficiency funding (as is the case under the current policy structure), these portfolios will better fulfil the policy objectives of energy efficiency.

This energy efficiency portfolio reorganization better assesses the various benefits and costs of energy efficiency, and therefore enables a more effective way of achieving the state's multiple climate, energy, and equity policy objectives. This is because this reorganization will:

- Enable regulators to maximize the various benefits of energy efficiency while increasing transparency and accountability throughout the regulatory system. E.g., energy system benefits such as reduced spending on costlier and more polluting energy resources and non-energy benefits, such as enhanced equity and customer well-being.
- Increase accountability across the board by providing a more direct way to assess progress for each sub-portfolio.
- Improve deployment and quality of energy efficiency programs because PAs and implementers will have a clear sense of how policy objectives translate to program goals and program tracking metrics.

- Lead to a better experience for all actors in the energy efficiency ecosystem because regulators, stakeholders, PAs, local governments, and third-party providers will have a clear sense of what the various program objectives are and how progress will be measured.

The rest of this paper describes this energy efficiency reorganization proposal by explaining (a) how each energy efficiency sub-portfolio functions, (b) the organizational principles and changes needed in existing regulatory mechanisms to enable this change, and (c) the steps required to facilitate and manage this change.

Although this paper presents a policy proposal for energy efficiency, the principles of this proposal and this paper's recommendations apply to all demand side management programs that offer distributed energy resources.

III. Resource energy efficiency Sub-Portfolio

Resource energy efficiency initiatives are actions taken to meet near-term energy system and policy needs, such as greenhouse gas reduction, by reducing the amount of energy customers use and by changing when customers use energy. By doing so, resource programs allow energy providers to rely less on more expensive supply side resources which include carbon emitting power plants, thus reducing energy costs for customers, reducing carbon emissions, and local air pollution. Reducing energy use also alleviates the need to build new supply side resources and avoids costly transmission and distribution system upgrades. Changing when energy is used helps make sure we make full use of our renewable resources. For e.g., consuming more energy during the day to take advantage of solar energy and reducing the amount we need at night when we rely more on costlier and carbon intensive electricity from power-plants.

These programs, which could include customized retrofits in commercial and industrial facilities among other interventions, should be directly compared with supply side resources (e.g., power plants, large solar and wind facilities) and correctly treated as an energy resource. This is typically done through a central planning process, called the integrated resources planning (IRP) process, where planners compare all energy resources on equal footing to determine how much of each resource to buy to serve customer energy demand and meet policy goals, such as California's carbon reduction policy, in the cheapest possible manner. This plan, that meets all goals with the least spending, is called a "least-cost-best-fit" solution or plan.

A. Challenges with the Current Framework

1. The Current Process of Determining Resource Procurement Goals is Fragmented and Inaccurate

A resource planning process that fairly compares all resources together to determine a least-cost best-fit solution is the ideal way to determine Resource energy efficiency investments. The existing CPUC methods for determining Resource energy efficiency investments have two shortcomings, the combined effect of which is that the resulting mix of energy resources that the CPUC analysis recommends investing in, the "energy resource portfolio", is more expensive, carbon intensive, and polluting than it should be.

Firstly, the CPUC separately plans for demand side resources and programs, including Resource energy efficiency, and then determines a least-cost plan for supply side resource investment. This process doesn't allow the CPUC to estimate the right amount of investment in energy efficiency and other demand side programs because to be able to find the least-cost best-fit solution to energy system and policy needs all resources must be analyzed together. This is because each resource picked by planners has a domino effect on which remaining resources are chosen. To start with, resource planners have a list of energy system needs and policy goals to fulfil. Resource planners first select the cheapest resource that meets most energy system and policy needs. The remaining system and policy needs then dictate which resource the energy planners pick next, and so on until all energy system needs are met and policy goals fulfilled.

Therefore conducting demand side resource analysis separate from supply side resource procurement analysis precludes the possibility of developing a least-cost-best-fit portfolio thereby leading to the development of more expensive resource plans.[18] The CPUC tries to overcome this analytic shortcoming[19] by applying a carbon abatement benefit[20] when valuing energy efficiency and other DERs. Although this is a reasonable stop-gap solution, it does not truly consider energy efficiency alongside supply side resources to determine what the right amount of Resource energy efficiency investments are needed.

Secondly, the CPUC does not fairly compare demand and supply side resources with each other. The CPUC should evaluate Resource energy efficiency in a similar way to other resource options. To do so, the CPUC needs to apply a cost-benefit framework that accomplishes two related things: (1) it should

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[18] The existing CPUC IRP analysis includes a predetermined amount of energy efficiency as a fixed load-modifying resource and then selects individual supply-side resources to meet California's future electric demand in a least cost manner.

[19] Analyzing energy efficiency accurately through the IRP is complex because each energy efficiency measure is unique and has different costs and benefits that need to be accounted for in the IRP model. Some IRP analytic software may not be able to handle this complexity. When confronted by this analytical shortcoming, resource planners must decide whether simplifying the IRP model to account for energy efficiency or analyzing energy efficiency separately would lead to more accurate results.

[20] The cost of selected resources in the IRP model informs the cost of carbon abatement. The cost of carbon abatement (per the IRP) for a given year is equal to the difference between (1) the cost of the most expensive supply side resource procured by the IRP model in that year, and (2) the cost of a resource that would be at the cost-effectiveness limit (i.e., its TRC = 1.0) without a carbon constraint in that same year.

accurately account for energy efficiency's benefits and costs as it relates to the energy utility customers and (2) by doing so, it should fairly Resource energy efficiency with supply side resources.

B. Changes Necessary to Develop Accurate Goals and Budgets

1. Change Cost-Effectiveness Test to Maximize the Return on Program Administrator Spending

The current cost-effectiveness test applied to energy efficiency, the TRC, treats energy efficiency differently from supply side resources because it counts costs incurred by both the customers that participate in energy efficiency programs and the costs incurred by program administrators of running the program, but only values the benefits incurred by the program administrators.[21] To develop a least-cost-best-fit resource mix, the CPUC needs to change the cost-effectiveness test for Resource energy efficiency from the TRC to one that guides resource planners to maximize the return on customer funds spent for resource acquisition in the form of most energy system needs met and policy objectives attained.

The objective of the CPUC resource planning process is to meet energy system needs and policy objectives through minimal increases in electric rates and bills[22] which is accomplished by the cost-effectiveness test proposed in the accompanying paper*, Cost-Effectiveness Policy for Demand Side Programs*, because it correctly solves for getting the most energy efficiency benefit from each program administrator dollar spent. [23]

2. A Well-Designed and Fair IRP is the Ideal Avenue to Develop Cost-Effective Resource Energy Efficiency Budgets

The IRP model compares the costs of procuring each additional tranche of energy efficiency with the costs of alternative resources to meet system needs and policy goals. The IRP analysis will therefore incrementally buy more energy efficiency until the cost for the next marginal amount of energy efficiency is more than that of a feasible alternative. The total Resource energy efficiency selected by the IRP will thus be the amount and type of energy efficiency that program administrators need to attain. Then the total customer funds that the IRP spends to buy this selected energy efficiency is the budget to attain this amount of Resource energy efficiency. The IRP is analytically complex and to ensure

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[21]Both costs and benefits incurred by program administrators of regulated utilities are transferred to the customers of these utilities in the form of increases and decreases to rates for electricity and gas.

[22] In other words, through minimizing program administrator spending by maximizing the energy system and policy benefits of each program administrator dollar spent.

[23] When applying the PAC, it is important to account for all the environmental and climate policy objectives that a traditional PAC test does not account for. This is explained in the accompanying paper on cost-effectiveness.

that the IRP model selects the right amount and type of resource energy efficiency, the IRP needs to be set up correctly through a transparent stakeholder driven process.

These estimates of total Resource energy efficiency investments, and the costs associated with this procurement, provides resource planners with the information required to set Resource energy efficiency budgets. These results should also be used to develop cost-effectiveness requirements and goals as explained next.

3. The Avoided Cost Calculator Should be Aligned with the IRP's Least-Cost Best-Fit Plan

Once Resource energy efficiency procurement is determined through resource planning, PAs and implementors need to test specific energy efficiency measure installations to determine whether those installations are cost-effective, i.e., whether they conform to the type of energy efficiency identified by resource planners for procurement.

To that end, currently, the total energy system and policy benefits of all demand side program measures are calculated through a tool called the avoided cost calculator (ACC). To ensure that this ACC correctly guides on the ground energy efficiency investments, the ACC needs to be aligned with the least-cost-best-fit resource plan developed through the IRP and include all energy system and policy benefits that energy efficiency attains. The benefits represented in the ACC should represent the costs avoided of investing in the more expensive alternative to demand side programs in order to attain energy system and policy needs.

In order to do so, the ACC's benefits need to be calculated through the IRP by (1) first determining a least-cost best-fit portfolio that considers all DERs, and (2) then determining what this resource portfolio would look like if no incremental DERs were available. The difference in total resource procurement costs between these two scenarios represents the total benefits of procuring incremental DERs. This difference between the two portfolios can be applied to develop an ACC that will correctly guide on the ground Resource energy efficiency procurement.

4. The Right Metric for Setting Resource Energy Efficiency Program Goals is Total Lifetime Benefits Expressed in Dollars

Once the resource planning process determines the right amount and type of energy efficiency, which is a part of the least-cost best-fit plan, it is then necessary to ensure that the goals for energy efficiency programs meaningfully guide program administrators to attain those very energy efficiency benefits that were selected by the IRP.

Existing energy efficiency goal setting process, which sets goals in terms of annual energy savings, does not accomplish this. Representing energy efficiency goals in terms of annual energy savings and a minimum cost-effective requirement is flawed because:

- Resource planners look at a wide range of energy system and policy needs (such as reduced carbon emissions, and less need to build more supply side resources) when developing their least-cost best-fit plan. The energy efficiency that planners identify thus fulfils these multiple energy system and policy requirements, energy savings are just one of those many requirements. Therefore, setting goals in terms of energy savings incompletely values energy efficiency.

- Annual energy savings are even less representative of the benefits that resource planners seek because the economic value of energy savings varies significantly by time of day and year and where that energy is saved. Annual energy savings goals, by ignoring when and where energy is saved, do not capture this variation.
- Setting Resource energy efficiency goals in terms of annual energy savings therefore provides a misleading signal: energy efficiency attainment should focus first on measures that fulfill the annual energy savings requirement. Resource energy efficiency goals should direct program administrators and implementers to cost-effectively attain that energy efficiency which best meets energy system needs and policy goals.

To resolve these shortcomings, the appropriate metric to represent Resource energy efficiency goals is the total economic benefits of Resource energy efficiency expressed in dollars. These total benefits can be analytically determined by inputting the total Resource energy efficiency through the avoided cost calculator. The resulting total benefits amount accurately accounts for all the energy system and policy requirements that energy efficiency serves, and thus provides the signal that PAs and implementers need to procure the right amount and type of energy efficiency. This metric is also flexible enough to accommodate a change in either policy priorities or energy system needs.[24] These goals would still be subjected to cost-effectiveness requirements, like for existing energy savings goals, to ensure that the spending to attain these total benefits is prudent.

See the accompanying paper, *Using the Total Economic Value of Benefits to Set Resource Energy Efficiency Goals*, for further details on why this is the right metric for developing energy efficiency goals.

IV. Market Transformation (MT) energy efficiency Sub-Portfolio

The Northwest Energy Efficiency Alliance (NEEA) defines market transformation as:

> "Market Transformation is the strategic process of intervening in a market to create lasting change in market behavior by removing identified barriers or exploiting opportunities to

[24] E.g., if the electric grid is short on capacity, then the value of this benefit will increase, and this increase will be reflected in the ACC as a higher dollar value in the hours when the system needs capacity thereby encouraging acquisition of that energy efficiency which fulfils this capacity need.

accelerate the adoption of all cost-effective energy efficiency as a matter of standard practice."[25]

The CPUC, through a recent market transformation focused decision, defined market transformation as:

> "Market transformation is long-lasting, sustainable changes in the structure or functioning of a market achieved by reducing barriers to the adoption of energy efficiency measures to the point where continuation of the same publicly-funded intervention is no longer appropriate in that specific market. Market transformation includes promoting one set of efficient technologies, processes or building design approaches until they are adopted into codes and standards (or otherwise substantially adopted by the market), while also moving forward to bring the next generation of even more efficient technologies, processes or design solutions to the market."[26]

Both definitions are aligned and underscore the importance of strategic market interventions that identify and eliminate barriers to energy efficiency adoption until energy efficiency is standard practice.

A. Challenges with the Current Framework

Resource energy efficiency programs differ from MT programs due to the different nature of their intervention: they work directly with customers to address the specific barriers that prevent those customers from adopting the energy efficient product or practice. For regulatory purposes, MT programs need to be treated separately from Resource energy efficiency programs because:

- <u>MT initiatives' objectives benefit the energy system in the long-term</u>: MT programs focus on a pathway to move new technologies and practices into the market and through to codes, or to make the technology and practice the market standard. They therefore do not focus on near term acquisition like Resource energy efficiency programs. For example, a market transformation program may begin by focusing on an emerging technology to create opportunities for new energy efficiency markets by conducting research, development, and demonstration to facilitate the emerging technology's entry into the mass market. The next phase of a market transformation program could overlap with resource energy efficiency programs as specific incentives are designed to overcome customer adoption barriers. The final stage is when the product or practice is sufficiently adopted that monetary incentives are no longer needed. At this stage, the objective of MT is to get the product or practice into a code, standard, or to make it ubiquitous in the market.
- <u>In addition, some MT initiatives have a different target intervention</u>: MT programs interventions are often not directly experienced by the customer, such "upstream" interventions work directly with manufacturers or "midstream" with retailers to promote energy efficiency. Such

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[25] NEEA, *NEEA's Definition of Market Transformation* (2015), at 1.

[26] CPUC, *Decision* *09-09-047* (Sept. 24, 2009), at 88-89

interventions have far reaching benefits and ripple effects that are hard to measure through the traditional lens of Resource energy efficiency program attribution studies, which try to determine responsibility for specific energy efficiency uptake actions for each program participant. Resource programs could also use these midstream and upstream intervention approaches, the difference is that MT initiatives apply these interventions over the long-term to permanently alter the market.

    - An example of such interventions are long-term upstream programs that aim to benefit all customers in a marketplace through interventions such as marking down prices before they get to the store, changing stocking practices of major retailers (e.g., putting the most efficient option front and center while making the less efficient model harder to find), and through better branding of energy efficient equipment. In each of these cases, the program itself is invisible to the customer and the impact of the program on any one customer's actions are hard to figure out after the fact. When offered over a long-time horizon, these interventions will cause permanent changes in stores stocking practices and customer purchase practices. Further, the ripple effects of these interventions exist in aggregate and are hard to parse out using traditional Resource program attribution methods.

- <u>Some MT initiatives indirectly benefit the energy system</u>: MT programs may not always directly cause energy system benefits (e.g., an immediate reduction in energy use), but they still cause significant benefits such as increasing the uptake in adoption of energy efficiency measures offered through other programs and increasing the efficacy of other programs.
    - Examples of such initiatives are workforce training programs, and other programs that focus on education and outreach.

MT initiatives therefore need to be planned, designed, tracked, and evaluated differently from resource programs but in alignment with MT initiative objectives and how these programs intend to achieve those objectives. As things currently stand, some MT programs are offered through IOU energy efficiency portfolios and are being valued with and like Resource energy efficiency programs. This misalignment between program intent and program measurement inhibits the program from reaching its full potential and results in these programs being considered a "drag" on portfolio level cost-effectiveness.

B. Changes Necessary to Develop Accurate Goals and Budgets

The Commission, through the recent Decision 19-12-021,[27] has acted upon the need to develop separate market transformation initiatives. This decision requires the investor-owned utilities to set-up an independent third-party market transformation authority (MTA) through a competitive solicitation. In

[27] CPUC, *Decision Regarding Frameworks for Energy Efficiency Regional Energy Networks and Market Transformation* (December 2019)

addition, the Commission outlined a structure to develop, approve, implement, track, and evaluate market transformation initiatives in California through that decision. Per the Commission decision, each market transformation initiative, developed through an "accord," would have their own budget setting, measurement and tracking, and cost-effectiveness process that is aligned with the objective of that accord.

This paper does not delve into the details of how MT initiatives need to be regulated, funded, and implemented as the Commission has outlined the key considerations of this sub-portfolio as well as directed the California Energy Efficiency Coordinating Committee (CAEECC) to continue working out details of coordinating such a MT portfolio with the other existing energy efficiency programs.[27] The main recommendation put forth in this paper is that MT initiatives should be regulated separately from Resource energy efficiency initiatives.

1. Managing the Transition to a Separate MT Sub-Portfolio

The CPUC ordered PG&E to hire a third-party market transformation administrator (MTA) through a competitive solicitation process and set a budget of $250 million for the first five years of market transformation initiatives and a $20 million annual budget to cover administrative expenses through that time.[28] It will take at least a year to set up this statewide MTA and for this MTA to start considering market transformation initiatives. In the meantime, the CPUC should take the following next steps to ensure a well-managed transition towards offering MT programs through their own dedicated sub-portfolio. These recommendations could be integrated into the forthcoming CAEECC Working Group process:

- <u>Identify existing MT initiatives in the IOU energy efficiency portfolio that need to be shifted to the MT sub-portfolio</u>. Program objectives and the types of interventions these programs take on should determine whether a program belongs in Resource energy efficiency or in MT. Two prominent examples are emerging technology initiatives and upstream retail products programs.
    - Research on emerging technologies is often the first step in a MT plan and an investment in future resource acquisition; including these programs in the MT sub-portfolio will incentivize program administrators (PA) to meaningfully connect these programs to related market transformation initiatives.
    - Although some upstream incentive programs are often classified as "Resource," these programs are better classified as MT programs as they aim to change purchase behavior through a strategic market intervention. Classifying these programs, which aim to make permanent changes to the market through longtime strategic interventions, as MT enables thoughtful program design development to best achieve market transformation

[28] Ibid. at 90.

through upstream channels as opposed to designing a program for widget level energy savings measurement. Classifying these programs as Resource programs that are incentivized to claim most energy savings could also lead to situations where programs inadvertently focus on moving the most possible widgets to claim energy savings without causing incremental energy system benefits.[29]

- Redefine IOU codes and standards advocacy programs as MT: Adoption of an efficiency measure into a state (or federal) code or standard is a common final step in market transformation for many energy efficiency measures. Any theory of change being applied to a market transformation initiative will likely consider codes and standards adoption as the final barrier to market transformation. To this end, as outlined in the recent MT decision, the CPUC should regulate IOU codes and standards advocacy initiatives through their proposed MTA and utilize the CAEECC Working Group process to resolve any outstanding questions about how to account for the savings.[30]
- Develop a mechanism for bridge funding of existing MT initiatives until the Commission MTA process starts working. Energy efficiency programs, especially MT initiatives, require consistency in funding to be able to sustain momentum and fulfil their market transformation objective. Lack of funding and discontinuation of MT initiatives that are currently funded through the energy efficiency portfolio may cause the market to slip towards inefficient practices and require even more resource to transform; thus, proving to be a more costly strategy in the long-term. The CPUC should identify those MT initiatives that provide valuable services and are thus candidates to be implemented through the forthcoming MTA and develop a mechanism to ensure that these initiatives aren't lost in the meantime.

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[29] CPUC, *Administrative Law Judge's Ruling Seeking Comment on Upstream Lighting Program Impact Evaluation For Program Year 2017* (January 2020), at 6. "In all, approximately 15 million lamps could not be tracked by the DNV GL evaluators. Therefore, the evaluation report adjusted the savings claims by SCE and SDG&E to reflect the unaccounted-for lamp shipments."

[30] The Commission recognizes that codes & standards programs need to be integrated with IOU energy efficiency programs and that they are the final step in some market transformation initiatives. In Decision 12-05-015 (page 243) "The Staff Proposal calls for 'a redesign of the statewide codes and standards program,' placing it in 'a central strategic position within the IOU energy efficiency portfolio.'"

Decision 12-05-015 at 249 states that: "The codes and standards program should engage in Emerging Technologies Program planning activities early on to collaborate in the development of advanced technologies and practices that could be adopted in future codes. While the IOUs prepare Codes and Standards Enhancement studies and engage in advocacy work with the code-setting bodies, the IOUs' programs can help improve market code readiness for targeted measures"

V. Equity Energy Efficiency Sub-portfolio

Equity initiatives prioritize the most vulnerable Californians so that they benefit from equitable access to previously untenable resources, and thereby avail themselves of the benefits of energy efficiency including, but not limited to, reduced bills, more efficient and better functioning homes, which lead to increased health, comfort, and productivity. Currently this is accomplished through programs that are designed to reach low- and middle-income, rural, hard-to-reach, and multifamily customers, to name a few.

Multiple initiatives across various CPUC proceedings aim to enhance equity through energy efficiency. The CPUC oversees the Energy Savings Assistance Program (ESAP), focused on low-income customers that meet income eligibility requirements through A.19-11-003 et al. In addition, the general energy efficiency proceeding (R.13-11-005) aims to serve customers who could benefit the most through programs such as the Middle-Income Direct Install (MIDI) programs, a Multifamily Energy Efficiency Rebate Program (MFEER) and offerings through the Regional Energy Networks which are designed to serve hard-to-reach customers. In addition to energy efficiency programs, the CPUC also oversees programs for other DERs such as the California Solar Initiative (CSI) for Single Family and Multifamily Affordable Homes (SOMAH), the San Joaquin Valley Affordable Energy Proceeding, and the Building Decarbonization Proceeding, which requires a portion of its funds be spent on new low-income housing.

A. Challenges with the Current Framework

Each of these equity enhancing programs are managed and implemented separately, overseen very differently, including different policy rules, cost-effectiveness, and metrics of success. Yet they all aim to reach similar customers and face somewhat similar barriers to implementation. This regulatory fragmentation also hinders participation for equity advocates and members of the very communities the CPUC aims to serve because of the amount of time and resources required to meaningfully participate in these processes.

Those equity enhancing initiatives that do not have their own CPUC regulatory process are included within an IOU portfolio, which is then subject to the portfolio cost-effectiveness requirements described above that primarily relies on energy savings to justify investments. Program administrators are then forced to choose between programs that serve the people who need help the most and those that will allow them to serve energy-system needs cost-effectively and meet the CPUC's requirements. The result of this impossible choice is that program administrators are forced to substantially cut funding for equity enhancing programs. The result is a portfolio that does not serve all customers to enhance equity and for some utilities, still does not result in a cost-effective portfolio.

The benefit of these equity enhancing programs cannot be measured solely through the energy system benefits they accrue because their focus is to enhance equity. The CPUC recognizes and tries to address this to some extent. For example, programs offered through the energy efficiency portfolio by Regional Energy Networks are exempt from cost-effectiveness requirements. The CPUC has also developed a different cost-effectiveness test, the energy savings assistance cost-effectiveness test (ESACET), for the

ESAP that accounts for non-energy benefits of energy efficiency and allows for the inclusion of some measures that result in health, comfort, or safety improvements. A recent evaluation further demonstrates that these equity enhancing programs serve many diverse needs over and above energy savings and that also show that it is hard to rely on these programs to fulfil energy system needs. This is because the energy benefits from these programs, whose primary focus is to enhance equity, are hard to predict.[31]

In sum, there are two underlying issues inhibiting the ability of CPUC regulated equity initiatives to perform as they as well as they could. The first is that equity enhancing initiatives are fragmented even though the individual requirements for these programs have similar and overlapping objectives, are all funded by utility-customers, and a similar target customer base. The second is that these initiatives aren't measured according to their policy objectives. Some equity enhancing energy efficiency initiatives are mixed with resource programs and the efficacy of the resulting mix is measured through a resource only metric which disincentivizes spending on valuable equity enhancing programs. The way forward is to start a new proceeding, that subsumes all existing equity focused initiatives,[32] to oversee all equity enhancing demand side programs funded by utility customers.

B. Changes Necessary to Develop Accurate Goals and Budgets: A Proceeding Focused on Equity Enhancing Programs

A proceeding that provides common oversight to equity enhancing programs will increase regulatory efficiency of these initiatives, increase the accountability of all actors involved, enable the CPUC to better coordinate across these initiatives, deliver better and more comprehensive programs to customers, and develop guiding principles for success and an overarching budget that meets those requirements. In sum, it will enable the CPUC to best enhance equity, by providing the most energy and non-energy benefits, for each customer dollar spent.

In the following sections we lay out the guiding questions and tasks that the CPUC and stakeholders need to explore to better develop this new equity proceeding, highlight the advantages of this

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[31] DNV GL, *ENERGY SAVINGS ASSISTANCE (ESA) PROGRAM Impact Evaluation Program years 2015–2017 Southern California Gas Company* (April 2019), at 3. Savings realized vary from between 35% to 70% of savings claimed.

This is due to the uncertainties in baseline equipment efficiency, and in how the efficient equipment is used. In sum, it's difficult to estimate how the energy efficiency energy subsidy provided to cash-strapped customers materializes, to what extent it materializes as energy savings or non-energy benefits. These programs are also costlier to implement as they buy-down a much greater percentage of the incremental energy efficiency measure install cost than other resource programs (in some cases they cover all equipment and installation costs).

[32] This would thus combine by aggregating the budgets, aggregating and streamline goals of existing initiatives such as the ESAP, hard-to-reach programs, MIDI, CSI, and others.

approach, and propose that the CPUC consider a minimum level of bridge funding to sustain existing equity initiatives until this proceeding is established.

1. Setting Equity Objectives and Resultant Metrics

An overarching goal as complex as enhancing equity needs to be represented in terms of tangible objectives with accompanying metrics that can be used to develop effective regulatory goals and program expectations. This approach would inform a reasonable funding amount, allow for improved oversight, and provide regulators with information on program performance such as which types of programs, implementation models, and design features are appropriate to achieve the objectives of this proceeding. Individual programs that are a part of this proceeding can then have their own metrics aligned with the proceeding's goals that address the performance of these individual programs and individual customer experience/ satisfaction.

To develop these proceeding-wide common objectives and metrics, the CPUC must solicit input from the following perspectives at minimum:

- utilities, energy planners, and state energy policy decision-makers,
- environmental and environmental justice advocates,
- social justice advocates
- consumer advocates,
- local governments,
- health and human services providers, grant administrators and advocates,
- housing owners, managers, tenants and affordability experts, and
- clean energy and economic development (training and employment) providers.

Working with these stakeholders to arrive at a workable set of common meaningful objectives and metrics for this proceeding would allow the CPUC to develop a program budget to support these objectives.

Although a consolidated proceeding could help community members and equity advocates participate in regulatory processes, the CPUC should also ensure that the format and opportunities to participate in this proceeding are accessible. Any process should include interested community members that work during the day, live outside of the major cities where CPUC meetings are held, and experience other logistical barriers, such as lack of access to transportation or childcare needs.

2. Setting the Budget for this new Equity Proceeding

Once the objectives and metrics for this proceeding are established, the proceeding would develop a budget that will best achieve these objectives. The items following need to be considered by the CPUC and stakeholders to develop an appropriate budget for this proceeding:

- What are the near-term and long-term goals of this proceeding?
- What is the existing level of spending on each equity focused initiative that the CPUC oversees, including legislative requirements for existing programs?
- What is the total economic benefit of resource energy efficiency and MT programs net of program costs? Should this net-benefit help fund equity programs and to what extent?
- What energy system and policy benefits are expected from these programs?
- What is the customer willingness and political directive to spend these energy sector funds to enhance equity?

Until this proceeding is established, the CPUC should identify valuable existing equity programs that are in danger of being defunded and then consider to what extent these programs should continue to be funded to avoid losing the positive momentum these programs may have built.

Appendix C: Designing Cost-Effectiveness Tests for Demand Side Management Programs

I. Introduction

Cost-effectiveness tests should guide resource planners to meet all energy system needs and related policy goals, such as reducing carbon, at the lowest cost to the utility's customers. Unfortunately, many jurisdictions' cost-effectiveness tests for demand side programs are inaccurate because they don't correctly balance the benefits and costs of such programs. This inaccuracy leads to customer money being wasted through avoidable over-investment in supply side resources.

This paper presents three principles for developing an accurate cost-effectiveness test that resource planners can apply to both demand and supply side resources. These principles are then applied to the three categories of energy efficiency programs (resource programs, market transformation programs, and equity programs) explained in the accompanying paper *Restructuring Portfolios to Bring Out the Best in Energy Efficiency*. This paper also explains common errors made in demand side program cost-effectiveness analysis. The appendices to this paper show that a test developed through these principles is in accordance with California's law and addresses common misconceptions regarding cost-effectiveness tests.

Although this paper is written from the point of view of cost-effectiveness analysis of energy efficiency programs in California, the principles of this paper can be applied to develop accurate cost-effectiveness tests for all demand side resources in and beyond California.

II. Principle of Cost-Effectiveness for Demand Side Management Programs

Utility cost-effectiveness tests should adhere to the following principles:

- <u>The test should be comprehensive</u> by accounting for all relevant benefits and policy goals that utilities are required to meet through energy programs.
- <u>The test should be balanced</u>, all costs of attaining the energy system benefits and meeting policy objectives should be accounted for. So, if the test considers a benefit then it should account for the cost incurred to attain that benefit. No costs should be included that does not also include a measure of its benefit.
- <u>The test should be applied to all energy resources fairly,</u> so that resource planners can use it to select the best mix of demand and supply side resources.

A cost-effectiveness test that follows these principles will guide planners, program administrators, and implementers to figure out how to best spend their customers' (or "ratepayers") funds to meet energy system needs and relevant policy objectives.

Following these principles, the costs accounted for by a demand side program that acquires an energy resource should be the costs a utility incurs when offering the program. The benefits accounted for should be the economic value of all the energy system needs met and related policy objectives, such as reducing carbon emissions, attained through the program. Structuring the test in this manner also allows resource planners to accurately – and fairly – compare demand side resource programs with supply side resources. The selection of which is based on bids for energy services provided to pick the best mix of resources to meet energy system needs and related policy goals.

This approach to cost-effectiveness testing for utility programs is consistent with the National Standard Practice Manual (NSPM) framework that guides resource planners to develop accurate and balanced cost-effectiveness tests for distributed energy resources.

A. Cost Effectiveness Analyses for Energy Efficiency Programs Are Often Inaccurate, Leading to Higher Costs for Customers

Many jurisdictions, including the California Public Utilities Commission (CPUC), incorrectly value energy efficiency through a version of the total resource cost test (TRC) that does not symmetrically account for the benefits and costs of energy efficiency and treats energy efficiency differently from supply side resources. This is because it counts the costs to program administrators to run the program as well as additional costs incurred by program participants for participating in the program, but only values the benefits incurred by the program administrators.[1] This asymmetry causes the utility to spend more on more costly and polluting supply side resources to fulfil energy system needs and meet policy goals than it otherwise should and also inhibits customers from realizing the benefits of energy efficiency.

This can be explained through the following example. A California utility compares two bids through a competitive resource solicitation. The first bid is from a thermal power plant. It can supply the energy the utility needs for $100,000; the second bid is from a third-party demand side management contractor who will apply energy efficiency to meet the utilities' energy needs for $60,000. The contractor proposes to provide incentives to encourage customers to replace their aging baseboard electric resistance heaters and window air-conditioners with efficient heat pumps to heat and cool their homes. The customers who participate in this program willingly pay for and adopt this technology because, for example, they see value in this upgrade now that the utility incentive reduces the additional cost of a heat pump and they better understand the benefits of the heat pump. The heat pump keeps their home more comfortable and reduces their utility bills. In aggregate, the customers who participate in this program will pay an additional $70,000 from their own pockets to buy this more efficient technology on top of the money paid by the utility to the third-party demand side management contractor (i.e., $60,000).

The efficiency proposal, if it were to be compared in a similar manner to the thermal plant, meets the utility's needs at far less cost to the utility than the thermal power plant bid. However, under the current misaligned TRC cost methodology, the utility must incorrectly account for these additional customer costs (i.e., $70,000) without including any of the benefits that participating customers get from the heat pump. This incorrect logic leads the utility to value the energy efficiency bid at $130,000, which is the

[1]Both costs and benefits incurred by program administrators of regulated utilities are transferred to the customers of these utilities in the form of increases and decreases to rates for electricity and gas.

sum of costs of running the program plus what customers pay from their own pocket, and it thus selects the bid from the thermal power plant.

This incorrect decision would result in an excess spending of $50,000 by the utility, which would be borne by their customers in the form of higher electricity rates. Moreover, the customers don't learn about these new heat pumps and don't adopt them because they consider them as unaffordable. Customers continue to pay higher energy bills and continue to live in a less comfortable and healthy home. Finally, the thermal power plant emits carbon to generate electricity, so the utility in accordance with California's laws will have to pay for those emissions by either paying more into the state's cap-and-trade system or trying to offset the unnecessary emissions by more (avoidable) investments in renewable technology. Either choice means more expensive electricity for customers.

The result of applying an incorrect and incomplete cost-effectiveness test leads to loss, or a decrease in welfare, for every actor in this transaction. All utility customers pay more for the more expensive contract, the would-be program participants continue to pay higher bills and live less comfortably, more carbon emissions and pollutants further degrades the environment, and utility customers pay extra to the state's cap-and-trade system for the additional carbon emissions.

B. The Participant Experience is Best Understood Through Effective Regulatory and Stakeholder Oversight

An argument often put forth by proponents of the TRC is that the participant's perspective is considered when their contributions are included in the test, thereby protecting them from higher energy costs.[2] This isn't accurate. Firstly, by accounting for participant costs but not accounting for participant benefits the TRC does not correctly consider the full participant's perspective. Secondly, most state regulator's rules, including those of the CPUC, require that the full portfolio of energy efficiency programs to be cost-effective in aggregate, meaning not all programs or measures will individually pass the TRC and therefore allow programs to offer individual measures that do not pass the TRC.

A single "on-average" portfolio wide metric does not explain an individual participant's experience of an energy efficiency program.[3] This is achieved through rigorous regulatory oversight by scrutinizing and understanding program offerings to make sure that they do not, intentionally or unintentionally, harm the participant. Then evaluating programs regularly to understand the impact these programs have on customers and participants' satisfaction levels with these programs.

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[2] California Public Utilities Commission, *D.19-05-019: Decision Adopting Cost-Effectiveness Analysis Framework Policies for All Distributed Energy Resources* (May 16, 2019), at 19. "The TRC test represents the broadest range of perspectives, including the utility and participant costs and benefits"

[3] For example, the average American household income in 2014 was approximately $72,000 per the census bureau, while the poverty line in America for a family of four is approximately $26,000. These on-average numbers should not be taken to mean that poverty or inequality isn't a problem in America. Averages don't completely explain the situation for the whole population, which is only understood through further study and rigorous analysis. References: "Race and Hispanic Origin of Householder-Households by Median and Mean Income". US Census Bureau. March 2018. Retrieved March 25, 2019; and Office of the Assistant Secretary for Planning and Evaluation.

As illustrated by the example above, use of an incomplete cost-effectiveness test such as the California TRC is more likely to harm the consumer through higher energy bills and missed opportunities to realize the benefits of efficient technology to better their lives.

C. Societal Cost Tests Provide Useful Information, But Are Impractical

An alternative to using this approach of a cost-benefit analysis that focuses on utility costs and benefits, could be to fully account for all costs and benefits incurred by society when conducting cost-effectiveness of energy efficiency programs. This means including all applicable non-energy benefits and environmental externalities when conducting cost-effectiveness for both demand and supply side resources.

This is impractical because of the enormous analytical complexity it entails. For energy efficiency measures, this means trying to determine all non-energy benefits that a customer will realize and then assigning an accurate economic value to them. Similarly, for supply side resources the societal cost test would have to account for all environmental externalities such as air quality impacts from producing energy, land-use impacts of acquiring fossil fuels, and many more.

Energy efficiency measures come in many shapes and sizes. Each have unique non-energy benefits that different customers value to differing extents; the degree to which each individual customer values each non-energy benefits varies. For example, one customer could mainly value the appearance of new energy efficient windows while another customer could primarily value the noise cancelling quality of these new windows. Developing monetary values for each of these non-energy benefits, then aggregating them to be able to apply them as forecasted benefits for new customers is near impossible. It will lead to either incomplete analysis or conclusions pre-determined by the analyst's biases.

What is certain is that each participant perceives enough value in the efficient equipment to purchase it through the program. The participant therefore values the additional benefits of the efficient equipment to be greater than its incremental costs, or what it costs for them to participate in the program.[4]

III. Applying Cost-Effectiveness Principles to Resource Programs

Resource energy efficiency initiatives are actions taken to meet near-term energy system and policy needs, such as greenhouse gas reduction, by reducing the amount of energy customers use and by changing when customers use energy. By doing so, resource programs allow energy providers to rely less on more expensive supply side resources which include carbon emitting power plants, thus reducing energy costs for customers, carbon emissions, and local air pollution. Reducing energy use also alleviates the need to build new supply side resources and avoids costly transmission and distribution system upgrades. Changing *when* energy is used helps make sure we make full use of our renewable resources. For example, policies and rate structures can encourage more energy during the day to take advantage of solar energy, which thereby reduces the amount we need at night when we rely more on costlier and carbon intensive electricity from power-plants.

[4] There is a slim possibility that some program offerings may pass a utility centric cost-effectiveness test and garner participation but negatively impact participants in the long run. These rare events can be accounted for through careful program oversight as recommended above, and societal cost tests could help with identifying such rare issues.

These programs, which could include customized retrofits in commercial and industrial facilities among other interventions, should be directly compared with supply side resources (e.g., power plants, large solar and wind facilities). This is typically done through a central planning process, called the integrated resources planning (IRP) process, where planners compare all energy resources on equal footing to determine how much of each resource to buy to serve customer energy demand and meet policy goals, such as California's carbon reduction policy, in the cheapest possible manner. This plan, that meets all goals with the least spending, is called a "least-cost-best-fit" solution or plan. In California, for example, the objective of the CPUC resource planning process is to meet energy system needs and policy objectives through minimal increases in electric rates and bills (i.e., minimizing program administrator spending by maximizing the energy system and policy benefits of each program administrator dollar spent).

A. Benefits

Following the principles outlined in Section II, the benefits of resource programs should include all energy system needs met and policy goals attained through energy efficiency. Energy efficiency fulfils energy system needs by avoiding the need for costlier energy production from existing resources (or "energy"), avoiding the need for new resource builds (or "capacity"), and deflecting expensive transmission & distribution upgrades required to maintain a reliable energy grid that can meet all customers' energy demand. The main policy benefit that these resource programs attain in California are the carbon emissions reductions required from the energy sector and reducing the amount of supply side renewables needed to comply with the state's renewable portfolio standards.[5]

The economic value of each of these benefits should be relevant through the energy efficiency program's lifetime. The National Standard Practice Manual (NSPM) provides step by step instructions to resources planner to help them develop an exhaustive list of energy system needs and relevant policy objectives that need to be accounted for in cost-effectiveness.[6]

B. Costs

In accordance with the aforementioned principles, the costs to evaluate a resource program are the costs a utility incurs to attain these energy system and policy benefits. Specifically, this is the cost of running the program which includes total funds spent on program administration (including marketing and outreach), incentives to participants, any other non-monetary support to participants, and program evaluation.[7] Collectively, these costs are the program administrator costs as defined by the California Standard Practice Manual (SPM).[8]

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[5] Senate Bill 100 requires zero carbon electricity by 2045, and a 60% renewable portfolio standard by 2030.

[6] See NSPM for energy efficiency and NSPM for distributed energy resources at: https://nationalefficiencyscreening.org/national-standard-practice-manual/

[7] For portfolio cost-effectiveness analysis, any incentives provided by regulators to program administrators to encourage program performance also needs to be accounted for as a cost.

[8] The TRC applies the total incremental cost along with program administration and evaluation costs. The total incremental cost is usually greater than program incentives; incentives are a fraction of the total incremental cost. As an example, the California Potential and Goals Study assumes that incentives equal 50% of the total measure incremental cost.

This choice of costs (and symmetrical benefits) also enables resource planners to fairly compare demand side resources with supply side resources to figure out the best resources to invest in. Electric sector spending for centralized supply-side resources typically manifests itself as contracts with service providers and power purchased through an independent system operator (in California, this is the California Independent System Operator). Similarly, the costs borne by the electric sector to acquire energy services from energy efficiency is the amount of money spent by the utilities to cause incremental change in demand for energy – which are the program administrator costs or the value of the contract with a third party energy efficiency provider. This argument is well articulated by Neme and Kushler[9] who also conclude that program administrator costs are the best and most practical option to develop a fair comparison between demand and supply side resources.

This proposed framework better signals to program administrators to be innovative and get the most out of demand side resource programs because it encourages them to focus solely on figuring out the most effective ways to acquire the most energy system benefits for each customer dollar spent. The more benefits they cost-effectively acquire, the more money they save utility customers by displacing more expensive supply side resources.

IV. Applying Cost Effectiveness Principles to Market Transformation Programs

The Northwest Energy Efficiency Alliance (NEEA) defines market transformation as:

> "Market Transformation is the strategic process of intervening in a market to create lasting change in market behavior by removing identified barriers or exploiting opportunities to accelerate the adoption of all cost-effective energy efficiency as a matter of standard practice."[10]

The CPUC, through a recent market transformation focused decision, defined market transformation as:

> "Market transformation is long-lasting, sustainable changes in the structure or functioning of a market achieved by reducing barriers to the adoption of energy efficiency measures to the point where continuation of the same publicly-funded intervention is no longer appropriate in that specific market. Market transformation includes promoting one set of efficient technologies, processes or building design approaches until they are adopted into codes and standards (or otherwise substantially adopted by the market), while also moving forward to bring the next generation of even more efficient technologies, processes or design solutions to the market."[11]

As explained in Section IV.A. of the accompanying paper, *Restructuring Portfolios to Bring Out the Best in Energy Efficiency*, market transformation initiatives differ from resource programs because (1) they have longer term goals as compared with resource programs, (2) they have different target interventions, and (3) some market transformation programs aim to support resource programs to help them better meet energy system needs.

[9] Neme and Kushler, "Is it Time to Ditch the TRC? ," *2010 ACEEE Summer Study on Energy Efficiency in Buildings*, Page 5-304

[10] NEEA, *NEEA's Definition of Market Transformation* (2015), at 1.

[11] CPUC, *Decision 09-09-047* (Sept. 24, 2009), at 88-89.

A. Benefits

The benefits for those market transformation initiatives that aim to meet energy system needs and energy system related policy goals, such as carbon emissions reduction, are the same as those for resource programs as explained in Section III.A. of this paper. The difference is that the cost-effectiveness analysis for these market transformation initiatives needs to be conducted in accordance with the near-term and long-term goals of the market transformation initiatives, many of which aren't designed to meet immediate energy system needs like resource programs are.

For example, a market transformation initiative may start as a pilot program which introduces an energy efficiency technology to the market with the objective of making the technology standard practice in the market in fifteen years. To correctly value this initiative, the analyst needs to do two things. First, the projected lifetime impact of this program, which is that this technology will be adopted much faster and by more people than it otherwise would've over a fifteen-year horizon, needs to be accounted for to determine whether near term investment in this market transformation technology is worth it. Second, near-term goals of this program need to be carefully designed and tracked to make sure that this initiative is likely to lead to the longer-term energy system benefits that it aims for over its fifteen-year horizon.

There are some market transformation initiatives which support non-resource programs and don't directly lead to energy system benefits. For example, heating ventilating and air conditioning contractor training programs improve contractor practices so that air-conditioning equipment installed through resource programs have the most impact. The benefits of these programs are hard to value in economic terms. Judging these programs requires developing tracking metrics, and then evaluating these programs through those metrics to judge their performance relative to the spending on these programs.

B. Costs

These initiatives need to be valued at their program administrator costs like resource programs for the reasons as explained in Section III.B.

V. Applying Cost Effectiveness Principles to Equity Programs

Equity initiatives prioritize the most vulnerable customers so that they benefit from equitable access to previously untenable resources, and thereby avail themselves of the benefits of energy efficiency including, but not limited to, reduced bills, more efficient and better functioning homes, which lead to increased health, comfort, and productivity. Currently this is accomplished through programs that are designed to reach low- and middle-income, rural, hard-to-reach, and multifamily customers, to name a few.

Traditional cost-effectiveness tests are of limited use to value these programs because equity programs have many non-energy goals, such as reducing energy poverty, that are hard to quantify and even harder to boil down to one cost-effectiveness number. The objective of valuation for these programs should be to make sure that the available budget for these programs is being used to best achieve objectives of these programs: enhancing equity.

A. Benefits

An overarching goal as complex as enhancing equity is hard to measure through a set of additive economic values as is the case for resource programs. Tangible equity objectives and accompanying metrics need to be developed by regulators and stakeholders through a transparent and inclusive process. This approach would inform the benefits that these equity programs try to attain. Individual programs could have their own metrics that are aligned with a jurisdiction's equity goals so that the performance of these individual programs can be judged.

B. Costs

Most equity programs pay the full installed cost of energy efficiency equipment. Therefore, the costs that need to be accounted for equity programs are the total costs of running the program including the costs of buying and installing the equipment in customer's homes. The participant costs for programs that include a modest co-payment from customers should be similar to that of Section III.B noted above.

Appendix

I. Appendix A: The California Public Utilities Commission's Integrated Resource Planning (IRP) Process Requires Cost-Effectiveness to Maximize the Return on Program Administrator Spending

The IRP analysis is by law required to develop a resource mix that meets the state's carbon reduction targets and ensures that the state's future electricity needs are reliably met at least increase in electric rates, i.e., through minimizing utility program administrator spending. The IRP process accomplishes this through complex electric grid and economic modeling. Figure 1 presents a summary of the statutory requirements of the IRP proceeding.

Figure 1 IRP Related Statutory Requirements[12]

IRP-Related Statutory Requirements

(All references are to the Public Utilities Code)

- Identify a diverse and balanced portfolio (454.51)
- Meet state GHG targets (454.52(a)(1)(A))
- Comply with state RPS (454.52(a)(1)(B))
- Ensure just and reasonable rates for customers of electrical corporations (454.52(a)(1)(C))
- Minimize impacts on ratepayer bills (454.52(a)(1)(D))
- Ensure system and local reliability (454.52(a)(1)(E))
- Strengthen the diversity, sustainability, and resilience of the bulk transmission and distribution systems, and local communities (454.52(a)(1)(F))
- Enhance distribution system and demand-side energy management (454.52(a)(1)(G))
- Minimize air pollutants with early priority on disadvantaged communities (454.52(a)(1)(H))

As illustrated in Figure 1, Public Utilities Code 454.52(a)(1)(C) requires that energy procurement planning result in just and reasonable rates for corporations of electric sectors, and Public Utilities Code454.52(a)(1)(D) requires the IRP to minimize impact on customer bills. The Public Utilities Code thus directs the Commission to minimize total customer-funded electric sector spending while complying with the state's GHG reduction mandates, renewable portfolio standard (RPS) mandates, and maintaining a reliable electric grid.

II. Common Arguments for Applying the California Total Resource Cost Test (TRC)

Argument 1: The TRC considers the broadest range of perspectives, including the utility and its customers.

The TRC does take total costs incurred by the utility and participant into account but it does not correctly account for all the benefits accrued to the participant. The TRC does not value any non-energy benefit to the participant even though the incremental cost of the energy efficient measure is not solely a function of efficiency upgrades. Non-energy benefits of an energy efficiency measure are oftentimes the primary reason for the participant to pay more for the energy efficiency equipment. In each of the cited evaluations,[13] customers participating in energy efficiency programs reported that non-energy

[12] California Public Utilities Commission, "Attachment A," in *Administrative Law Judge's Ruling Seeking Comment on Proposed Reference System Plan and Related Commission Policy Actions, ,* (9th September 2017), page 112.

[13] 1. Impact Evaluation Report: Home Upgrade Program – Residential Program Year 2017, DNV GL, 2019.

related benefits such as enhanced home comfort, improved indoor air quality, and improved home value were as important or more important than the energy and bill savings of the energy efficiency program. The fact that a customer is willing to pay supplemental costs to acquire the energy efficiency service is proof that there are more benefits than just energy savings. This leveraging of private capital should be encouraged to enable the customer dollars to go further rather than penalized under the current structure.

This asymmetry in how costs and benefits are treated is one of the reasons why the California TRC is inaccurate.

Argument 2: The TRC in California is Adjusted to Ensure that all Non-Energy Costs are Excluded from the Costs of a Measure. Thereby Accurately Comparing Benefits and Costs from the TRC

Although the Commission tries to isolate energy costs of energy efficiency measures to determine cost-effectiveness for like technologies (e.g., refrigerators), this practice is rarely implemented successfully and is often outdated. The last attempt to quantify and remove non-energy participant costs was a 2014 study which analyzed measure costs from the 2010 – 2012 CPUC energy efficiency portfolio.[14] The study conducted statistical analysis on a significant set of data to estimate what portion of total incremental costs of a measure are due to efficiency upgrades versus non-efficiency upgrades.

This is in part because these studies are resource intensive and (by nature) best suited to mass-market measures, where it is easier to collect massive amounts of data to conduct analysis that provides statistically significant results. This limitation means that non-energy costs cannot be accurately studied for all measures in the energy efficiency portfolio. Moreover, these studies are backward looking whereas the make-up of energy efficiency portfolios continually evolves, as do the costs of energy efficiency measures. Thus, this approach is not practical because it can't be effectively applied to the whole portfolio in a consistent and up-to-date manner for planning purposes.

Argument 3: We consider full costs of supply side resources and we consider full costs of demand side resources for parity.

This is a misleading statement because a supply side resource's only purpose is to provide energy service. Demand side resources, especially energy efficiency, provide many non-energy benefits to participants while saving energy. Participants purchase energy efficient equipment for mainly for their non-energy benefits as explained above through "Argument 1."

An accurate way to analyze demand and supply side resources against each other is to compare the costs of attaining energy system services from each resource. These costs, as explained in Section II, are the costs incurred by the utility in offering the program or program administrator costs. For supply side

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2. Energy Upgrade California – Home Upgrade Program Process Evaluation 2014-2015 EMI Consulting, 2015. CALMAC ID: PGE0389.01
3. PG&E Whole House Program: Marketing and Targeting Analysis. Opinion Dynamics Corporation, 2014. CALMAC ID: PGE0302.05

14 2010-2012 Ex Ante Measure Cost Study Final Report, Itron (2014). This study utilized hedonic price modeling to eliminate non-EE costs for a number of deemed measures. This study was supplemented by: CPUC Measure Cost Study for Work Order 017-1 Industrial Custom Measures, Energy Resource Solutions (2015).

resources this means the cost of the contract with the power producer, or for a utility owned resource the cost of building and operating a new resource, or the cost of operating an existing resource. For demand side resources, such as energy efficiency, this means the cost of acquiring incremental energy savings, which is the costs incurred by the utility or the program administrator cost such as through a contract to procure energy efficiency services.

There isn't an example of supply side resources that mainly provides non-energy services. The closest analogy could be the Hoover Dam, which provides some non-energy services in addition to providing electricity. The Hoover Dam has a visitor center that attracts tourists and underwent expensive upgrades in the early 1990s. The costs of upgrading the visitor center were recouped through visitor center ticket sales and were not paid for through electricity sales.[15] The TRC logic would require the total cost of electricity from the Hoover dam to account for the costs of upgrading the visitor center without accounting for the tourism revenue the visitor center generated.

Question: How Would energy efficiency potential be impacted if we only considered program administrator costs and become an unattainable goal?

More measures will be cost effective under this proposed framework and the achievable energy efficiency potential will increase, which means there will be more ways to capture cheaper energy services. However, real world factors that determine and limit achievable potential for a cost-effective measure will continue to exist. These limiting factors include market barriers, available program infrastructure, and other external factors that impact energy efficiency measure uptake. In addition, energy efficiency potential under this proposal will identify all opportunities to cut energy waste that is cheaper than investing in conventional or supply side renewable energy (i.e., the cost of energy will decrease for every customer).

[15] See Energy and Water Development Appropriations for 2003, at 676.

Appendix D: Using the Total Economic Value of Benefits to Set Resource Energy Efficiency Goals

I. Introduction

Acquiring energy efficiency to meet energy system needs requires the cooperation of many actors, including but not limited to, resource planners, regulators, program administrators and designers, program implementers, and program evaluators. Once resource planners determine the right amount and type of resource energy efficiency needed to fulfil energy system needs and energy resource related policy goals, such as carbon emissions reduction, they then communicate that to regulators, program administrators, and program implementers in the form of program goals for acquiring energy efficiency resources.

Unlike supply side resources which are limited to a few resource types, energy efficiency resources take many different forms, from commercial lighting measures to specialized solutions to reduce agricultural energy use. It is therefore important that resource planners clearly describe the amount and type of energy efficiency needed to best meet energy system[1] and policy needs at lowest cost to utilities and their customers. This correct description of goals is necessary to guide program administrators to target the right type and amount of energy efficiency.

Currently, goals for resource energy efficiency programs are set in terms of annual energy savings with a minimum cost-effectiveness requirement. This does not provide a complete signal to program planners and implementers to acquire the right type and amount of energy efficiency because annual energy savings goals do not capture the fact that the value of energy savings varies with time, i.e., energy savings in some hours are more valuable than energy savings in others, and that some measures have longer lifetimes than others. This shortcoming is illustrated through two examples in the next section. Finally, this paper explains why the economic value of the sum of benefits of energy efficiency (i.e., expressed in dollars) is the right metric to set goals and to track the progress of resource energy efficiency programs because it accounts for the different benefits of energy efficiency and how they vary with time.

II. Annual Energy Savings Goals Don't Get the Most out of Energy Efficiency

The problem with setting goals in terms of cost-effective annual energy savings is illustrated here with the help of two examples, first using energy efficiency data for California and then for the Pacific Northwest. These two examples, each from a different region, illustrate that this issue isn't specific to

[1] Energy system needs

any one region; the findings and recommendations of this paper are germane to regulators of energy efficiency programs across the country.

Table 1 contains a list of twelve measures currently offered in California, their cost-effectiveness ratios calculated through the Total Resource Cost (TRC) test, and three scenarios through which these measures can be implemented to reach a goal of 100,000 kWh of annual energy savings. Also presented in Table 1 are the total benefits accrued through the measures' lifetime. This value of total benefits is the sum of the economic value of the energy system needs[2] met by energy efficiency and the monetary value of the policy goals met by energy efficiency such as reducing carbon emissions.

Table 1. California Example: Three Feasible Paths to Meeting a Cost-Effective Annual Energy Savings Target. Each Scenario Results in Very Different Total Benefits[3]

Filing ID	Measure Application	TRC	Scenario 1			Scenario 2			Scenario 3		
			Quantity	Annual Energy Savings	Benefits	Quantity	Annual Energy Savings	Benefits	Quantity	Annual Energy Savings	Benefits
SCE-2020-001121	Residential Smart Thermostat Heat Pump	1.97	55	8,350	$ 6,533	1	152	$ 119	260	39,471	$ 30,884
SCE-2020-001108	Faucet- Kitchen Aerator- 1.5 gpm- electric-AR	10.35	61	8,243	$ 4,096	1	135	$ 67	40	5,405	$ 2,686
SCE-2020-001106	Efficient Showerhead- Electric- 1.25 gpm	3.62	57	8,254	$ 3,823	1	145	$ 67	40	5,792	$ 2,683
SCE-2020-001252	Faucet- Kitchen Aerator- 1.5 gpm- electric-AR	17.38	52	8,431	$ 4,189	1	162	$ 81	40	6,485	$ 3,223
SCE-2020-001037	Interior LED Lighting - To-Standard Practice interior	2.67	8000	8,000	$ 3,073	16600	16,600	$ 6,376	40	40	$ 15
SCE-2020-001440	2 x 4 LED New Luminaire rated greater than or equal to 125 LPW and < 140 LPW	1.36	1040	8,497	$ 7,880	1	8	$ 8	5200	42,484	$ 39,400
SCE-2020-001401	(1) 48in T8 Lamp LED replacing (1) 48in T8 Linear Fluorescent	1.47	449	10,776	$ 2,897	1	24	$ 6	40	960	$ 258
SCE-2020-001009	Interior LED Lighting - To-Standard Practice Interior	2.84	8000	8,000	$ 3,075	16600	16,600	$ 6,381	36	36	$ 14
SCE-2020-001031	Agricultural pump system overhaul - retrocommissioning	1.18	8000	8,000	$ 1,048	16600	16,600	$ 2,175	40	40	$ 5
SCE-2020-001194	Process Motor - VFD	1.41	8000	8,000	$ 1,542	16600	16,600	$ 3,200	40	40	$ 8
SCE-2020-001150	HVAC - energy management system (EMS)	1.93	8000	8,000	$ 1,542	16500	16,500	$ 3,181	40	40	$ 8
SCE-2020-001144	Economizer - air side	1.24	8000	8,000	$ 1,542	16500	16,500	$ 3,181	40	40	$ 8
Total			49,714	100,550	$ 41,241	99,406	100,026	$ 24,841	5,856	100,833	$ 79,191

Each of these three scenarios are feasible ways to get to an annual energy savings goal of 100,000 kWh cost-effectively. However, each scenario results in very different total benefits from energy efficiency. Scenario 1, which gets to the annual savings goal through an even distribution of energy savings among the measures, results in benefits of $41,224 to California's energy customers. Scenario 2, which focuses on cost-effective measures that have lower relative benefits, gets to the goal of 100,000 kWh while resulting in benefits worth $24,841. Scenario 3, which focuses on measures with higher relative benefits results in getting to the annual energy savings goals and benefits worth $79,191. So, although each scenario represents a feasible way for programs to meet their goals, the resulting benefits that accrue to Californians from these three scenarios vary significantly: approximately by a factor of 3.

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[2] The term "energy system needs," as used in this paper, refers to the amount of energy production from existing resources (or "energy"), new resource builds (or "capacity"), and transmission & distribution upgrades required to maintain a reliable energy grid that can meet all customers' energy demand.

[3] The data to develop these calculations were taken from 2020 Energy Efficiency Filings records from the California Public Utilities Commission's CEDARS website. The "Filing ID" for each record can be used to obtain the data for each row in these calculations. The details behind these calculations are available upon request.

Table 2 applies six common cost-effective measures, developed by the Regional Technical Forum, to construct a similar example for the Pacific Northwest. Each scenario presented in Table 2 shows a cost-effective way to get to an annual energy savings goal of 100,000 kWh. But the total benefits associated with each scenario varies significantly. Scenario 1 gets to the annual energy savings goal through equal savings contribution from each measure, Scenario 2 focuses on measures with lower relative benefits, and Scenario 3 focuses on measures with higher relative benefits.

Table 2. Pacific Northwest Example: Three Feasible Paths to Meeting a Cost-Effective Annual Energy Savings Target. Each Scenario Results in Very Different Total Benefits

Sector	Measure Application	TRC	Scenario 1			Scenario 2			Scenario 3		
			Quantity	Annual Energy Savings	Total Benefits	Quantity	Annual Energy Savings	Total Benefits	Quantity	Annual Energy Savings	Total Benefits
Residential	Starting February 2018_Front Load_CEE Tier 2_Electric DHW_Electric Dryer	6	80	16,960	$ 41,077	0	-	$ -	155	32,860	$ 79,587
Residential	Retail_Any home_Any Electric_1_50 GPM	16,263	115	16,675	$ 28,014	0	-	$ -	15	2,175	$ 3,654
Commercial	Double Row T12 _High Power LED_Outside Refrigerated Space_HVAC Interaction	2	98	16,464	$ 4,359	160	26,880	$ 7,116	0	-	$ -
Residential	Tier2_indor2_HZ1_gas_0-55gallons	1	11	17,017	$ 17,255	32	49,504	$ 50,197	1	1,547	$ 1,569
Residential	Level 2 Networked to Level 2 ENERGY STAR Networked BEV & PHEV	9,999	370	15,910	$ 10,819	550	23,650	$ 16,082	0	-	$ -
Residential	Existing Single Family Home HVAC Conversion - Convert FAF wo/CAC to Heat Pump - Heating Zone 1	1	4	18,400	$ 34,739	0	-	$ -	14	64,400	$ 121,587
Total			678	101,426	$ 136,263	742	100,034	$ 73,396	185	100,982	$ 206,397

The result is similar to the result of the California example. Energy efficiency goals can be met cost-effectively, but the total amount of benefits that Pacific Northwesterners get from energy efficiency could vary by a factor of three. This shows that if energy efficiency measures are correctly prioritized by program administrators and implementers, Pacific Northwesterners can get three times the amount of benefits from energy efficiency in the form of lower electric rates and less carbon emissions than a scenario in which these measures aren't correctly prioritized.

These examples show that expressing energy efficiency goals in terms of annual energy savings with a cost-effectiveness requirement does not provide the right signal for program administrators and implementers to get the most out of energy efficiency. The effects of this issue have been felt by some resource planners and stakeholders who note that energy efficiency procurement does not have enough meaningful measures that save energy at the right time and for many years. Setting goals in terms of total benefits gives the signal to program administrators and implementers to implement these meaningful measures.

Annual energy savings goals don't correctly describe the right type and amount of energy efficiency that program administrators and implementers need to target because:

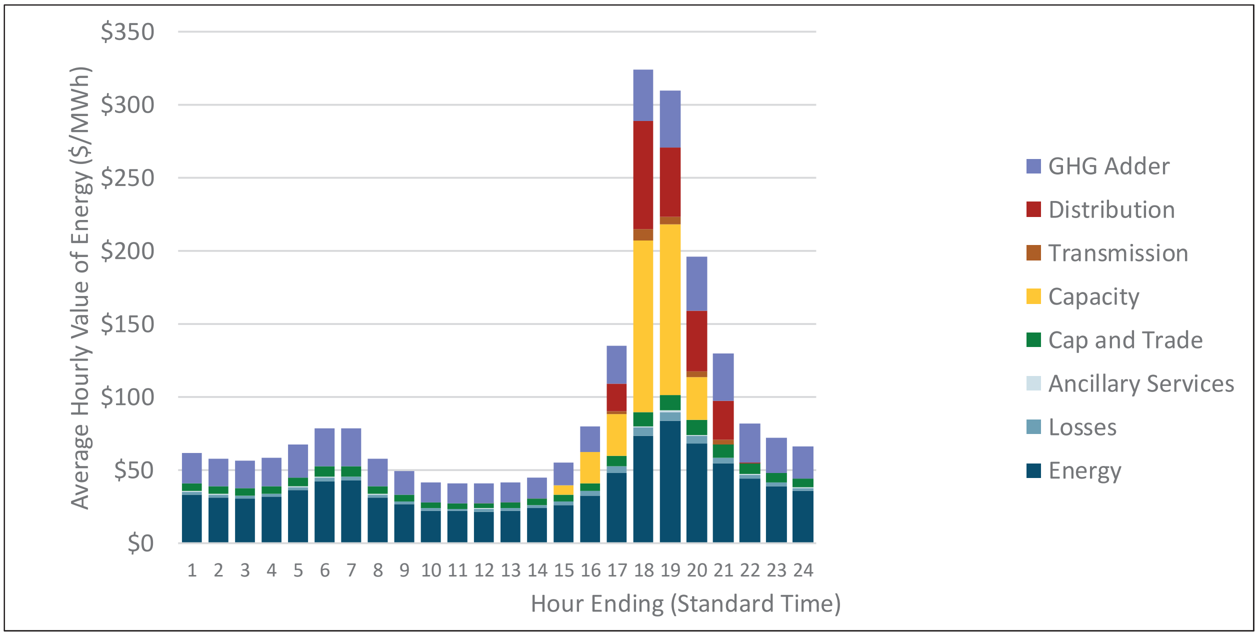
<u>Resource planners plan for more than energy</u>. Resource planners solve for a wide range of energy system and policy needs (such as reduced carbon emissions, and less need to build more supply side resources) when developing their least-cost best-fit plan. The energy efficiency that planners identify thus fulfils these multiple energy system and policy requirements, energy savings are just one of those

many requirements. Therefore, setting goals in terms of energy savings incompletely values energy efficiency.

Annual energy savings don't account for when, where, and for how long a measure saves energy. Annual energy savings are even less representative of the benefits that resource planners seek because the economic value of energy savings varies significantly by time of day and year and where that energy is saved. Annual energy savings goals, by ignoring when and where energy is saved, do not capture this variation.

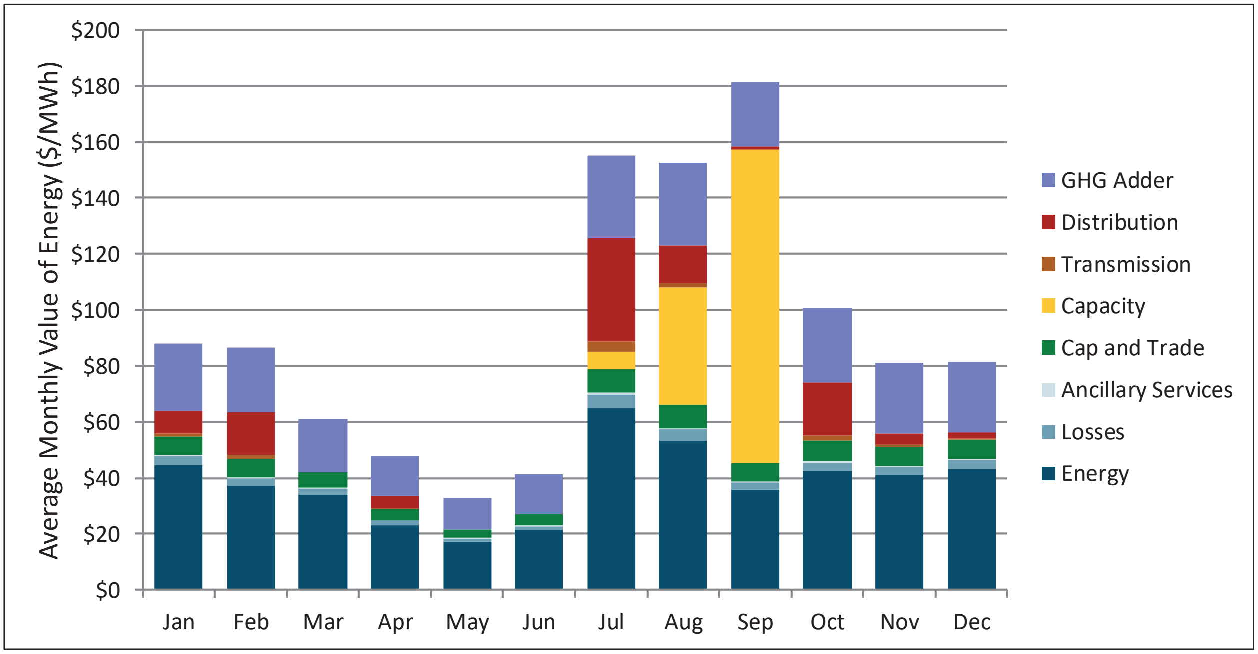
Figure 1 shows the economic value of benefits from saving energy in each hour of the day in California. Each hour's value is the average value for that hour across all days of the year. Figure 2 shows the average economic value of all the benefits of energy efficiency for each month of the year in California.

Figure 1 Annual Average Benefits of Energy Savings for Each Hour of the Day[4]



[4] Figure taken from California Public Utility Commission's (CPUC) Avoided Cost Calculator Spreadsheet "ACC_2019_v1b.xlsx," see tab: "Dashboard." CPUC Avoided Cost Calculator available here: https://www.cpuc.ca.gov/General.aspx?id=5267

Figure 2 Annual Average Benefits of Energy Savings for Month of the Year[5]



These figures clearly show that the value of saving energy varies significantly with time. Expressing energy efficiency goals as annual energy savings conceal this temporal variation and therefore does not encourage program planners and implementers to target the most valuable energy savings. Moreover, as explained above, the cost-effectiveness requirements do not completely correct for this shortcoming. Expressing energy efficiency goals in terms of annual energy savings becomes more counter-productive as we see more renewable energy on the grid.

<u>Cost-effectiveness requirements don't completely correct for these shortcomings</u>. Requiring annual energy savings goals to pass a cost-effectiveness test does not solve this problem either. This is because cost-effectiveness test results are expressed as a ratio. When the cost-effectiveness of a measure is greater than one, the benefits of energy efficiency are greater than the costs of attaining it. This ratio does not explain whether and to what extent the benefits of energy efficiency measures have been maximized to best meet energy system and policy needs, only whether the benefits are greater than the costs.

Setting Resource energy efficiency goals in terms of annual energy savings therefore provides a misleading signal: energy efficiency attainment should focus on measures that fulfill the annual energy savings requirement in the easiest manner. Instead, resource energy efficiency goals should direct program administrators and implementers to cost-effectively attain that energy efficiency that best meets complete energy system needs and policy goals.

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[5] Ibid.

III. A Better Way Forward: Set Goals for Energy Efficiency in Terms of Total Lifetime Benefits

To resolve these shortcomings, a better metric to represent resource energy efficiency goals is the total economic benefits of resource energy efficiency as expressed in dollars. These total benefits can be determined by inputting the total energy efficiency resources picked by planners through the avoided cost calculator, which is a tool to calculate the economic value of energy system and related policy benefits of demand side programs. To the extent that the avoided cost calculator accounts for the various benefits of energy savings and how they vary with time, as shown in Figures 1 and 2 above, the benefits calculated through the avoided cost calculator will capture the complete value of energy efficiencies benefits including the fact that energy savings in some hours are more valuable than energy savings in others.

These total lifetime benefits, calculated through the avoided cost calculator are the economic value of the energy system and related policy goals, such as carbon emissions reduction, that resource planners select energy efficiency to provide. Setting goals in terms of these total lifetime benefits will guide program administrators and implementers to then procure an energy efficiency portfolio that at least matches the total value of the energy efficiency selected by resource planners.

This metric is also flexible enough to accommodate changes in energy system needs. For example, if the electric grid is short on capacity, then the value of the capacity benefit of energy efficiency will increase. This increase will be reflected in the avoided cost calculator as a higher economic value of the energy savings in the hours when the system needs capacity. Expressing energy efficiency goals as total benefits will encourage program administrators to go after energy savings in these high value hours, thereby encouraging acquisition of that energy efficiency which fulfils this capacity need.

These goals would still be subjected to cost-effectiveness requirements, like for existing energy savings goals, to ensure that the spending to attain these total benefits is prudent. Expressing energy efficiency goals in terms of the total benefits of energy efficiency have the following advantages:

- <u>Total benefits better describe the type and amount of energy efficiency program administrators need to go after</u>: As explained above, total benefits better describe the impact of energy efficiency measures that resource planners seek. Setting goals as such would guide program administrators and implementers to target and acquire that type and amount of energy efficiency most needed by the energy system. Annual energy savings goals do not capture the complete value of energy efficiency.
- <u>Encourage regulators, program administrators, and program evaluators to better understand measure load shapes</u>: Currently the most scrutinized aspect of energy efficiency measures are their annual energy savings estimates. Expressing goals and tracking achievements in terms of energy efficiency's total economic benefits will direct the attention of analysts and evaluators to better understand the time-varying impacts of energy efficiency measures. These time-varying impacts, called measure load-shapes, are an under-researched aspect of energy efficiency, which is problematic because the value of energy savings varies significantly with time as explained above.

- Allow for combining distributed energy resources to offer more expansive programs. The value of all distributed energy resources, like energy efficiency, can be expressed in terms of their total economic benefits. This provides a common unit of valuation, measurement, and tracking across distributed energy resources. This metric will help to set goals for, plan, and implement programs that offer multiple distributed energy resources.

To get the most out of this metric the following needs to be accomplished:

- The energy savings load shapes for measures need to be up to date to understand how much energy each measure saves throughout the year. This is necessary to identify those measures that save energy when it is most valuable.
- Develop accurate estimates of the effective useful life of each measure so that investment in longer term measures can be encouraged,
- The value of reduced greenhouse gas – both from a compliance and environmental perspective - is accurate to ensure measures that reduce more greenhouse gasses have a higher value, and
- Guidance to program administrators is clear to enable them to shift the design of their portfolios to achieve maximum monetary benefit for resource energy efficiency programs.

This will result in the most effective procurement of energy efficiency as a resource, which will lower the cost of energy for everyone while reducing carbon emissions and pollution