Cost-Effectiveness
Board Learning Paper

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EnergyTrust of Oregon

Preface

This paper is part of a series that describes a variety of topics identified by the Energy Trust of Oregon's Board of Directors as potentially influential to the organization during the time period of its next strategic plan (2020-2024). This series of papers will educate and inform the Board about the potential impact of these topics and enable its Directors to better to assess risk, identify opportunity and guide the direction and goals of Energy Trust.

Remaining current on potentially significant and influential developments in the clean energy industry is critical to the fundamental role of the Board. These topics have been identified because of their potential to influence, impact or otherwise affect Energy Trust's ability to serve the ratepayers of Oregon and Southwest Washington. These papers should not be interpreted as policy proposals or recommendations for roles in which Energy Trust intends or desires to be directly involved.

Overview

Energy efficiency is the cleanest, cheapest and most important resource for the utilities and ratepayers of Oregon, and Energy Trust is the prime organization delivering that resource.

Cost-effectiveness is the investment test for ratepayer-funded energy efficiency. The basic question cost-effectiveness answers is whether an investment in efficiency lowers costs to ratepayers as a group, or in some states, to society. Regulators, utilities and Energy Trust express cost-effectiveness as a ratio of benefits to costs. If the ratio is greater than one, the investment passes the test. Many variations stem from this basic question, depending on (1) whose costs and benefits are included, (2) whose perspective is being considered, and (3) how difficult-to-estimate costs and benefits are handled. The level at which the test is applied is also important. For example, should the test be applied to measures, programs, or the entire portfolio of programs? Also, because benefits occur over the life of the efficiency

measures, which can be many years, the way that future costs and benefits are discounted influences the result. Increasingly, cost-effectiveness depends on how much energy the measure or program saves at times when there is the highest energy requirements (peak) on the gas or electric system. Additionally, Oregon utilities, the OPUC and Energy Trust are just beginning to assess how to value location-based savings that depend on the ability to avoid expensive local expansions of the grid.

This paper does not address renewable resource investment tests. The legislation that established the Public Purpose Charge, SB1149, provided a different set of investment criteria for renewable resources based on the above-market cost. While energy efficiency investments are justified by costing less than alternative resources, Energy Trust can offer incentives for renewable energy only to cover part of the cost that exceeds the cost of the same power from grid resources. This reflects the view that when the cost of renewable energy is at parity to the cost of grid power, utilities will buy them as a least-cost resource. By contrast, Energy Trust is the agent of Oregon utilities for purchasing energy efficiency that costs less than the comparable power purchase.

Some key takeaways from this paper are that:

- Cost-effectiveness is a pass/fail test for whether efficiency investments reduce costs to ratepayers in a utility system. In Oregon and Washington, the process does not consider other government policy objectives nor benefits that accrue to parties beyond program participants and the power system.
- In valuing energy efficiency programs, Oregon already considers the value of carbon, albeit in a limited way. Unless carbon market prices are very high, future carbon regulation is likely to have only modest impacts on Energy Trust's program cost-effectiveness.
- Peak energy savings are increasingly important to Oregon's power and gas system. Efficiency actions that save energy during peak times will become increasingly valuable, and actions that only save energy at other times will be less valuable. A process is underway to assess how much of the value from reducing peak electric use derives from reductions during the summer versus the

winter peak. That decision may influence Energy Trust's future program portfolio. The extent of these changes and their impact on efficiency value will become apparent over the coming year.

- Locational differences in the value of savings are likely to become more important over the next few years.

Oregon tries to achieve balance by considering similar types of costs and benefits, but it does so in a different way from many other states. Oregon evaluates difficult-to-quantify benefits by considering them as the basis for exceptions from strict cost-effectiveness calculations.

Governance

For Energy Trust, as well as investor-owned utilities throughout the U.S., cost-effectiveness rules are determined by each state utility commission. Because Energy Trust operates in both Oregon and Washington, it is subject to slightly different rules in each state. The varying rules have not resulted in huge program differences.

For consumer-owned utilities such as Oregon's co-ops, municipalities and Public Utility Districts, much of the conservation funding comes from the Bonneville Power Administration (BPA). Their cost-effectiveness criteria are determined under Federal law by the Northwest Power and Conservation Planning Council.

Each of the five utilities that fund Energy Trust in Oregon have different forecasts of avoided costs, which are the costs of purchasing and delivering energy. These costs are compared to the cost of reducing that energy use through efficiency. In their Integrated Resource Plans, which determine how much efficiency Energy Trust should deliver, each utility uses their own avoided cost forecast. However, in determining which measures to support, and in reporting on program and measure cost-effectiveness, Energy Trust uses a blend of the values from all the Oregon gas and all the electric utilities. This allows us to run an efficient program for all Oregon investor-owned utility service territories. Energy Trust uses different avoided costs in Washington.

The inconsistencies between values at different individual utilities versus the combined values used by Energy Trust usually result only in minor differences in outcomes, because most efficiency measures are highly cost-effective. However, if utilities forecast different peak periods (e.g., summer versus winter), utility values for various efficiency measures may differ more substantially. This possibility is under discussion in a current regulatory docket.

The Tests

The California Standard Practices Manual established the basic cost-effectiveness tests in 1983. Following are the questions each test answers.

Utility Cost Test (UCT): Sometimes called the Program Administrator Cost test. Are the benefits to ***the utility system*** in avoided generation, fuel, delivery and other costs greater than the costs paid by the utility?

Total Resource Cost Test (TRC): Are the benefits to ***the utility system and utility ratepayers combined*** greater than the costs paid by both?

Societal Test: Are the benefits to ***everyone*** greater than the costs paid by everyone? Different state policies may limit “everyone” to the state, or the country, or the planet. This test has no formal role in Oregon or Washington.

Rate Impact Test (RIM test): Does the investment reduce rates, not just utility costs, but the actual rate per unit of power or gas purchased? This is a much more restrictive test, because efficiency reduces power or gas sales. Most efficiency program portfolios reduce total utility costs, but rates may go up slightly due to lower sales volume. The reason is that a utility recovers fixed costs (e.g., pipes, lines, wires, billing and customer service) over fewer units of energy sold, so the cost per unit is higher. The RIM test tends to allow for demand reduction programs that shift the time of energy use but do

not reduce sales. In states where it is the primary test, there are very few efficiency programs.

Participant Cost Test (PCT): Are the benefits to the ***participant*** greater than the participant's costs?

Oregon and Washington commissions both focus primarily on the UCT and TRC tests, meaning the focus is on benefits exceeding costs for the utility system and for all ratepayers combined. In these states, the RIM test and PCT do not play significant roles. Benefits to the participant are considered in program design; if the participants do not benefit, there is no participation.

According to a 2017 Esource review of 29 states, the TRC test is most commonly employed, followed by the societal test and then the UCT. The RIM test and participant cost test are least frequently used (Figure 1).

Cost-Effectiveness Test	Number of States Using Test
Total Resource Cost Test	20
Societal Cost Test	14
Utility Cost Test	12
Ratepayer Impact Measure	11
Participant Cost Test	8

Figure 1: Number of states using each cost-effectiveness test

Do we apply the tests to measures? Programs? The portfolio?

Under Oregon commission rules, Energy Trust applies the cost-effectiveness rule to individual measures as well as to programs. There are details in the rule that govern

when measures should be combined for cost-effectiveness analysis because they are interdependent from a marketing or engineering perspective; the rationale is that combined they are worth more than the sum of the parts.

Washington focuses primarily on applying the TRC test at the portfolio level, but sometimes scrutinizes individual measures if a utility proposes to add them to the portfolio.

Regardless of which tests are required, based on the same Esource report, 70 percent of states require the program and/or the portfolio of programs to pass tests. Only 40 percent ask that the project pass the test, and only 30 percent of the states embrace Oregon's policy of focusing on individual measures.

Exceptions

Any economic calculation, including cost-effectiveness tests, provides a limited perspective, because not every consideration can be reliably turned into a number and added to the calculation. Thus, cost-effective thinking often is more than a simple ratio. If a measure passes the TRC test but does not pass the UCT, one possible solution is to reduce incentives, since this reduces the utility cost. Oregon's cost-effectiveness rule provides for a number of exceptions or circumstances where efficiency investments are appropriate even if the measure does not pass the TRC test.

In Oregon, exceptions provisions allow a measure to be considered if it does not pass the TRC if any of these conditions apply:

- There are significant benefits other than energy that are not included in the benefit cost calculation.
- Over time, lower costs are expected due to increased market acceptance, leading to the measure passing the test.
- The measure is included for consistency with other programs in the region. For many measures, consistency makes all programs in the region more effective.
- The measure helps increase participation in a cost-effective program.

- The measure incentive is offered during a transitional period until a program revision is complete.
- The measure is a pilot or research project for a limited number of customers.
- The measure is required by law or consistent with Commission policy and/or direction.

All these exception criteria (with the possible exception of the last one) support the rationale behind the cost-effectiveness tests. They recognize situations where thinking more strategically complements the numerical calculation as a means of providing cost-effective results. This extensive use of a non-quantitative exception process to address shortcomings of the TRC test is unusual among states.

Non-Energy Benefits

Businesses and households make few investments solely for energy purposes. Energy Trust and its regulators deal with the other reasons (called non-energy benefits) in a few different ways.

Incremental Measures. For new homes and buildings and for mechanical equipment replaced near the end of its life, Energy Trust does not assume its help is making the whole investment happen. For example, programs can rarely offer incentives at a level that will significantly influence when a consumer buys a house or a heating system. In these types of cases, the “incremental cost and savings” is considered. That is the cost and savings difference between what the consumer typically purchases (called the “baseline”), and the more efficient version that the program is encouraging through its technical assistance and incentives. A “typical” purchase may be include the minimum efficiency legally allowed under codes and standards. Sometimes a purchase may be for a more efficient level that is not required, but most commonly purchased. A good example of this is LED lights. Today many LED lights are more efficient than the minimum required by law, and an increasing number of consumers purchase them without incentives.

Quantifiable Non-Energy Benefits. Where Energy Trust can estimate the value to consumers of non-energy benefits with reasonable effort and precision, Energy Trust includes these benefits in the TRC calculation. For example, for efficient showerheads, faucet aerators, washing machines and some other measures, Energy Trust calculates the dollar value of the savings from reduced water use, including the reduced cost of water treatment at municipal waste plants. Energy Trust adapts values for these benefits from the Regional Technical Forum (RTF), a regional analytic group that Energy Trust co-funds. For some industrial process measures, it is practical to calculate increases in volume produced, improvements to product quality or reduced labor needs. Since industrial value streams are sensitive issues, Energy Trust calculates them only when measures otherwise do not pass cost-effectiveness tests and when that information is available.

Difficult to Quantify Consumer Non-Energy Benefits. Many benefits vary greatly from site to site or their value may vary based on perception making them difficult to quantify with any precision. These include benefits such as comfort, health and aesthetics. States diverge in how they address these types of benefits.

- In Oregon, the Oregon Public Utility Commission (OPUC) will consider exceptions to the TRC for measures where Energy Trust can show that the benefit is clear, significant in size and applies in most situations. There is a formal process for Energy Trust to apply for exceptions. OPUC follows a relatively simple approval process for situations where measures with these non-energy benefits are a small portion of program savings. The OPUC uses a more formal track for major measures. Energy Trust puts considerable effort into documenting reasons for exceptions and often clarifies the request one or more times at OPUC staff request. Exceptions are only requested when there is a strong case, and consequently, OPUC grants most exception requests. If the OPUC grants an exception based on the prospect of future changes in cost-effectiveness, it may be granted for only a limited time. As a general guideline (not a formal rule), the OPUC will only consider difficult-to-quantify non-energy benefits if the measure has at least a TRC of 0.5 (the benefits to the utility

system and participant are at least half the costs). If the TRC is less, the OPUC may question whether ratepayer funding for the measures is influential and important. The OPUC in one case allowed an exception for measures that had TRCs of significantly less than 0.5. In this instance, this exception was for home weatherization measures which, for gas heated homes, sometimes have TRCs of 0.2 or 0.3, meaning that the benefits to the utility system and participant were roughly a quarter of the cost. In this case, the OPUC allowed continued incentives up to a limit, or cap. It did this on the principle that many of the people who had not yet installed these measures were from limited income households. Providing incentives on these improvements for years to higher income customers and then discontinuing them without providing specific support to limited income customers seemed inequitable.

- Washington has no formal policy for difficult-to-quantify non-energy benefits. In situations where these benefits are important, they provisionally allow utilities to use the UCT instead of the TRC test. The UCT does not consider consumer costs or benefits. Because the Washington Commission focuses most on the cost-effectiveness of a utility's entire program portfolio, this issue for individual measures has not become a significant issue.
- Some other states, such as Massachusetts, have reviewed a range of studies for many of these benefits, and arrived at accepted values per kWh or therm. The OPUC has been critical of this practice, however, as it requires that the analyst choose a number within a wide range of values provided by different studies. The OPUC believes that its use of exceptions with specific justification allows the Commission to consider these benefits without arbitrarily selecting a number from a large range.

There have been efforts in the Northwest to quantify some of the more difficult-to-measure benefits. The Regional Technical Forum studied the health benefits from reduced atmospheric wood smoke that resulted from replacing wood stove use with ductless heat pumps. They concluded that the benefits were very large, but highly variable from location to location and uncertain.

One way to quantify such benefits is to find someone with a different value stream to pay for them. This is the topic of the board learning paper on partnering to capitalize benefits beyond energy.

Societal Non-Energy Benefits. Some positive aspects of efficiency measures benefit society in general and not only the utility or ratepayers. Examples include: (1) the overall benefits from reducing atmospheric carbon dioxide, (2) health benefits from improving moisture control in homes, and (3) overall economic benefits from energy efficiency jobs. However, these societal benefits are not included in the Oregon version of the TRC test[1]. This is because the Oregon Public Utility Commission considers them to be outside of the scope of the role set out for them by the Oregon Legislature.
The subject of non-energy benefits has generated far less attention in Washington because there is not so much focus on measure-by-measure analysis.
In states that utilize the societal test, benefits such as reducing the social cost of carbon, health benefits, and employment benefits may be considered in that test. States vary considerably in the range of societal benefits included and in the effort to quantify them.

Carbon Costs

Carbon dioxide emissions present a special case of non-energy benefits. In Oregon, utilities are required to consider the potential future cost of carbon regulation to the utility in forecasts of gas and electric costs. Thus, these “carbon compliance costs” are included in the avoided costs used in the UCT and the TRC to show the benefits of efficiency. If carbon regulation comes, whether it is in the form of a tax or a cap and trade system, there will be a cost imposed on fossil fuels that will be paid through utility rates. Given the uncertainty about future Federal and state carbon regulation, however, utility approaches to carbon cost estimates have varied. Utilities often present a range of scenarios for these possible future carbon costs. NW Natural, in its most recent Integrated Resource Plan, included significant likely carbon costs. By having this non-energy benefit identified, the cost-effectiveness ratios for Energy Trust’s programs for NW Natural improved.

Carbon compliance costs are not necessarily the same as the societal cost of carbon. Estimates of the societal cost of carbon vary significantly. The Federal government recently rescinded an estimate of this cost that was created under the Obama administration.

Is future carbon regulation likely to significantly increase the value of energy efficiency? This does not seem too likely. A preliminary estimate conducted by Energy Trust of the initial 2017 legislative proposal for "cap and invest" shows that carbon pricing might constitute about 10 percent of the value of electric efficiency and 20 percent of the value of gas efficiency. However, utilities have already incorporated a significant portion of that value into Energy Trust's avoided cost forecasts as prospective compliance costs. Therefore, carbon legislation, at least as initially envisioned, might have a modest additional impact of Energy Trust's efficiency cost-effectiveness calculations[2].

Alternative Tests

Recently, an advocacy group called E4THEFUTURE published an update to the California Standard Practice Manual, called, the National Standard Practice Manual (NSPM). The NSPM is not a replacement to the California Standard Practice Manual. It is more of a guide to how to apply alternative tests to produce reasonable and balanced results.

Much of the practice guidance outlined in this new NSPM is consistent with how Energy Trust and the Oregon and Washington commissions apply cost-effectiveness tests. However, a few of the more interesting recommendations differ with Oregon and/or Washington practices. These are discussed below.

- **Symmetry.** The NSPM recommends that if a cost-effectiveness test includes costs of a specific type, then benefits of the same type should be included. For example, the costs the customer pays should be included in the TRC only if all the customer benefits are included. The OPUC discourages including benefit numbers in the tests when that number is highly uncertain, but instead attempts

to address these benefits through the exception process, which allows lower TRC values for measures with difficult-to-quantify benefits, as described above.

- **Policy Goals.** The NSPM encourages regulators to have all the state's policy goals drive the selection of cost-effectiveness tests. The OPUC structured its rules to reflect the responsibilities delegated to that agency by the Oregon legislature. However, other state policy goals (such as addressing climate change and economic development) that are held by Oregon's government, but not delegated to nor assigned by law to the OPUC, and are not reflected in the Oregon tests.
- **Level of Analysis.** The NSPM recommends against testing individual measures, but suggests that the tests be applied at the program or portfolio level. Oregon requires that measures be tested individually, while Washington largely does not. This has been an area of significant debate. While in theory testing individual measures reduces ratepayer costs by only funding measures that benefit ratepayers, it imposes a degree of additional, detailed work that (1) might not be worth the effort or (2) provide meaningful results. Oregon is in a somewhat unusual position in that it has both the measure tests and the exception criteria, which address many of the objections typically lodged against measure-by-measure analysis. Energy Trust sees additional challenges with the measure-by-measure test as it expands its work with management-focused approaches to efficiency (e.g., Strategic Energy Management) and with use of load data to determine savings (e.g., in its pay-for-performance pilot). With the support thus far of OPUC staff, there has not yet been a need to distinguish individual measures for behavioral and management approaches. The commission has expressed willingness to explore other areas where measure-by-measure tests prove unworkable.
- **Discount Rate.** The NSPM recommends against using the utilities' risk-adjusted cost of capital as the discount rate for cost/benefit analysis, but recommends that regulators consider consumer and societal perspectives. Oregon uses the risk-adjusted cost of capital. Washington considers multiple perspectives. One analysis by the Northwest Power and Conservation Council indicated that the

average consumer discount rate is close to utility cost for capital, so this may be a distinction that does not cause much of a difference. If it is important, that may be the case for weatherization measures with very long lives because the discount rate has a larger impact on the value of long-lived measures.

A recent review of action in response to the NSPM manual shows that while a handful of commissions are beginning public processes to review the new guidance, there has yet to be little or no revision of cost-effectiveness rules as a result. Many of the reviews are just beginning. The Washington commission is planning a review in 2018.

Where Does the Value Come From?

Historically, most of the value of electric savings came from reducing energy generated by fossil fuel plants, regardless of the time of day, week, or year in which the measures save power. Most of the savings was from reduced generation, while small portions were from reduced losses on power lines and transformers, and from reduced transmission and distribution construction due to smaller loads. Likewise, almost all of the value of gas savings was associated with a therm of gas savings, regardless of the timing. Additionally, OPUC permits an additional 10 percent adder to value based on the premise that not all efficiency benefits can be quantified.

Recent utility cost forecasts show significantly reduced value from energy savings per se, and an increase in value from the *timing* of savings, specifically whether the savings occur at a time that reduces the need for system capacity. It is becoming expensive to buy additional power at peak times due to the cost to build a plant that runs very few hours a year to meet peak loads. For gas, reducing the maximum gas volume in a delivery contract by reducing energy use at peak times also has significant financial savings.

One of the benefits for efficiency is reduced costs for transmission and distribution construction. Energy Trust currently uses utility estimates that are average values for all the locations served by the electric and gas utilities. There is much variation around this

average. At any given time, there is no need for new construction for most of the distribution system, and therefore the value comes from a limited number of locations that are experiencing constraints on the installed capacity. The value is spread across the entire utility system, so on a per-kWh or per-Therm basis it is small. This “locational value” is complex to determine. It often depends on whether there are inexpensive solutions to local system constraints, such as shifting load between substations. It is most clear-cut at isolated, single-line parts of the system, as is the case in some rural areas. It is most complex where the distribution system is heavily networked, looking less like radial lines and more like a spider web. Energy Trust has begun working with Pacific Power, and separately with NW Natural, to develop pilot projects that use efficiency and renewable energy to reduce investment in energy delivery system upgrades.

Work on valuing savings from reducing gas loads is in its infancy. NW Natural has moved ahead of most of its peers nationally in creating an analytic framework to value peak gas savings. The value is significant, but not as dramatic as for electric. Energy Trust is just beginning to explore what this means for efficiency value. Additionally, other gas companies in Oregon are reviewing NW Natural’s work and considering their own approaches. Energy Trust’s work on targeted projects to reduce these costs has started by focusing on how we can locally accelerate efficiency and renewable energy where it is most valuable.

Separately, the OPUC is in the midst of a Resource Value of Solar docket. While the OPUC has focused this docket on developing a methodology to determine what value solar brings to different parts of the grid, the resulting approach may influence many aspects of how to value local efficiency, too. The docket is scheduled to conclude in summer 2018.

Quantifying Peak Savings

The increased value of peak savings to Oregon ratepayers challenges Energy Trust and utilities to create methods to reflect that value when making cost-effectiveness decisions and in reporting. There are several parallel projects underway, in addition to the

Resource Value of Solar docket, to create a sound planning environment for valuing peak.

- Historically, Oregon's winter peak has been highest, and utilities have estimated the value of avoiding peak loads based on winter load and price patterns. As summer energy use increases, and summer peaks increase in importance, Energy Trust is developing a method to value energy savings based on contribution of efficiency measures to reducing both summer and winter peaks.
- Energy Trust is reviewing load shapes provided by the RTF to make sure that the summer peak savings estimates are reasonable and consistent with available data.
- Energy Trust is co-funding a regional end-use metering project that will, over the next five years, provide improved data to estimate the impact of efficiency measures on peak (among many other uses of the data).
- Energy Trust is exploring with PGE a possible project to use smart meter data to evaluate actual peak savings from a selection of custom measures. This will complement the regional load research effort in a number of ways.
- The OPUC, Energy Trust, utilities and stakeholders are in a process to create a regular PUC-mediated process and a schedule to update avoided costs. As part of the first round of that process, these parties are developing a method to determine how much of the value from electric peak savings is from reducing summer versus winter peak. This may significantly influence the value and direction of Energy Trust's portfolio of efficiency measures. Conclusions are expected in mid-2018.
- As Energy Trust develops the tools described above to value peak, we will also need to provide improved guidance and training for Energy Trust contractors who are estimating savings from custom measures, to ensure that they are incorporating the most appropriate load shapes in measure analysis.
- Energy Trust will also commission a small best practices study to compare our approach to that employed in regions such as the Northeast and California, where peak savings have been a primary determinant of energy efficiency value for many years. There should be a great deal to learn from these regions;

although, the issues related to a dual summer/winter peak, with neither completely dominant, may be unique to the Northwest. The efforts of Energy Trust's Northwest peers, including the Northwest Power and Conservation Council, will also be informative in addressing these issues.

About Energy Trust of Oregon

Energy Trust of Oregon is an independent nonprofit organization dedicated to helping utility customers benefit from saving energy and generating renewable power. Our services, cash incentives and energy solutions have helped participating customers of Portland General Electric, Pacific Power, NW Natural, Cascade Natural Gas and Avista save on energy bills. Our work helps keep energy costs as low as possible, creates jobs and builds a sustainable energy future.

References

California Standard Practice Manual. National Standard Practice Manual. https://nationalefficiencyscreening.org/national-standard-practice-manual/

Oregon Cost Effectiveness Rule. Docket UM-551, order 94-590. Available from Oregon PUC, Administrative Hearings Division.

National Standard Practice Manual. https://nationalefficiencyscreening.org/national-standard-practice-manual/

Stout, Tim, 2017 Review of Utility Cost-effectiveness Practices, ESource, Inc.

[1] The next section discusses benefits to the *utility system* from reduced carbon emissions.

[2] There is a variety of other ways that such legislation might impact Energy Trust. This statement exclusively concerns cost-effectiveness.