IDAHO STRATEGIC ENERGY ALLIANCE

Energy Efficiency and Conservation Task Force

Cost-Effective Energy Efficiency Report

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At the request of the Idaho Strategic Energy Alliance (ISEA) Board, the Energy Efficiency and Conservation Task Force (Task Force) provides the following report defining cost-effective energy efficiency, identifying factors relevant to different stakeholders, and describing methods to calculate the cost-effectiveness of particular actions or policies.

Executive Summary:

In general, an action is cost-effective when the value of the benefits exceeds the costs. For energy efficiency, this raises five main factors: (1) the *actions* that can improve energy efficiency; (2) the *costs* incurred to implement the action; (3) the *benefits* that result from the action; (4) the length of *time* necessary for the benefits to payback the costs; and (5) identifying who (which *stakeholder*) incurs each cost and receives each benefit. The report discusses these five factors and describes a set of tools to calculate cost-effectiveness from different stakeholder perspectives (energy consumers, energy providers, and policymakers).

Each stakeholder can often choose from a variety of <u>actions</u> that will use energy more efficiently. When choosing from various options, stakeholders should focus on actions that can deliver the maximum net benefit of energy savings for the longest time. Energy consumers should rank potential energy efficiency actions (e.g. projects) from highest net benefit to lowest net benefit. When considering several options, ranking potential projects from highest to lowest potential energy savings is useful. Energy providers should focus on reducing demand for the most expensive energy to produce and deliver (peak hour energy such as cooling and heating loads as opposed to off-peak such as street lights), as well as programs that are large enough to defer the need for large capital investments in new power supply. Policymakers should focus on actions that encourage large energy savings, and options that encourage energy consumers and producers to work cooperatively on efficiency actions. Each stakeholder should also consider whether bundling individual actions together might save more energy than taking each action separately.

The <u>costs</u> of energy efficiency include: (a) the direct costs of materials, labor, and other resources necessary to implement an energy efficiency action; (b) the costs of administering a program or managing a project; and (c) the "cost" to an energy provider of forgone revenues attributable to reduced energy sales. Typically, the direct costs are shared between stakeholders, such as an energy provider and the state offering an incentive to offset some of the costs for the energy consumer. Some administrative costs are not shared between stakeholders, such as increased labor costs. Other administrative costs are shared, such as project management assistance from the energy provider to the energy consumer. The energy provider's forgone revenue from reduced energy sales can be somewhat mitigated through regulatory mechanisms, but remains an important issue. Importantly, because some costs are shared while others are not, whether a specific energy efficiency option is cost-effective may be different for each stakeholder, and therefore determining which perspective or perspectives are relevant is critical.

The benefits of energy efficiency include: (a) avoiding the cost of higher-priced energy, (b) deferring the need for additional power generation and transmission capacity, and (c) non-energy benefits[1], such as water and sewer savings, possible net job creation[2], or minimizing future environmental regulatory risk. Each utility in Idaho calculates their unique avoided costs for energy and capacity. For investor owned utilities', the Idaho Public Utilities Commission (PUC) reviews the inputs and calculations. Bonneville Power Administration (BPA) follows the Northwest Power and Conservation Councils' (NWPCC) methodologies outlined in the Sixth Power Plan. Avoiding energy and capacity cost benefits the utility in the short term and, by controlling the utility's cost of business, benefits the consumers in the long term. While complex and sometimes not possible, including non-energy benefits is highly beneficial to properly analyze the cost-effectiveness of some energy efficiency actions.

The time frame for energy efficiency actions is important to consider because this, along with the difference between the costs and benefits, defines the payback period[3] for any action. The time factor raises two primary issues. First, each energy efficiency action has a different lifespan. For instance, insulating a home could save energy for decades, while new lights may burn out in fewer years. Second, the material, labor, and administrative costs are generally incurred immediately, but the benefits of energy efficiency actions accrue over time. In this example, stakeholders should consider that insulating a home my provide a small amount of annual savings over many years, while replacing lighting may save a large amount of energy annually while the lights may burn out in years rather than decades. Which action is determined to be more cost-effective depends on the specific conditions and locations of individual homes and how occupants use them. A complete cost-effectiveness calculation must balance the stream of benefits against the costs incurred throughout the life of the efficiency action

The final factor considers that energy efficiency often requires several stakeholders to take actions and to incur costs. And these actions may provide more or less, or even different, benefits to different stakeholders. Because of this, an action may be cost-effective for some stakeholders, but not for others. In other words, cost-effectiveness is a matter of investment and return that differs from stakeholder to stakeholder based on who invests and who reaps the return. By not considering a potential energy efficiency action from the position of all stakeholders as well as the position of each stakeholder, Idaho may under or over invest in energy efficiency and may create unintended subsidies among different stakeholder groups.

Finally, any decision related cost-effectiveness calculations should be made with an understanding of the dynamic context associated with the inputs. For example, commodity prices (e.g. natural gas, coal etc) fluctuate, sometimes dramatically in short periods of time,

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[1] While commonly referred to as non-energy benefits, it is important to understand that some non-energy impacts are benefits and some are costs.

[2] Generally, cost-effective jobs lead to net job creation, cost-ineffective jobs lead to net job reduction, and transferring funds from customers to utilities has an indeterminable impact upon job creation.

[3] "Payback period" in this report means the time necessary for the benefits to recoup the costs, which can be measured in a variety ways including via simple payback, rate of return, or lifecycle cost analysis.

and can dictate whether an action is cost-effective or not. Similarly, as building energy codes and equipment manufacturing standards evolve, the baselines of comparison for potential energy savings associated with a particular efficiency action change. More stringent environmental regulation presents similar changes in context that must be considered.

Experts have devised a set of tests that weigh costs and benefits from a variety of stakeholder perspectives: (a) the entity taking an efficiency action, (b) the entities who contribute to an energy efficiency action, (c) the entity administering the program, and (d) all entities within a defined geographic area affected by the action. This report describes four standard tests[4] that calculate cost-effectiveness from these primary stakeholder perspectives. These tests should not be used in isolation. By comparing the results of these four tests, policymakers, and utilities, can design programs or policies that will encourage cost-effective energy efficiency, individuals can decide whether to participate, and program administrators can establish the optimal incentives that should be offered.

The <u>Participant Cost Test</u> takes the perspective of an entity considering an energy efficient action. The test captures the costs to the entities taking the action and the benefits they receive. This test does not capture costs incurred or benefits received by entities that administer the program or do not participate in the action. This test is appropriate for an individual or business considering whether to take action to use energy more efficiently.

The <u>Program Administrator Cost Test</u> takes the perspective of the entity offering a program to encourage energy efficiency, typically, a utility providing incentives to customers. It captures the costs of administering the program and incentive payments. These are balanced by the benefits of any costs avoided by the program, for example, not having to purchase higher-cost energy or build a new power plant. This test can also help program designers determine the optimum incentive they can cost-effectively offer to encourage energy efficiency actions.

The <u>Total Resource Cost Test</u> takes a broad view and includes a utility and its customers in total affected by an energy efficiency action within a defined geographic area. This test comprises all costs incurred by the program participant and the administrator. The test compares all the costs to all the benefits, including energy, some non-energy benefits, and funds that originate outside the geographic area, like federal and state tax credits or other incentives. Because this test looks from the perspective of a utility and its customers in total, it captures a broad range of non-energy benefits. A variation of this test is the <u>Societal Test</u>, which expands the benefits to include less-quantifiable non-energy benefits like distant environmental effects, but excludes the benefits of federal or state tax credits and incentives that are counted as such in the TRC. Because the Total Resource Cost test takes a broad view of costs and benefits, it is a primary tool for considering public policy

[4] Some experts describe five or more different tests. This report covers the four tests used by the investor owned utilities in Idaho and BPA when reporting their energy efficiency activities. Note: BPA also considers the Utility Cost Test (UTC), but does not base any cost effectiveness thresholds on this test. See the references section for additional information.

options to encourage energy efficiency. But again, policymakers should consider the results of all tests.

The <u>Rate Impact Test</u> takes the perspective of persons or companies who contribute money to energy efficiency actions. This test captures the costs of the action, including any forgone utility revenues from reduced energy sales. These costs are weighed against the benefits of avoiding energy and capacity costs. The results of the test measures the potential impact to utility rates on non-participating ratepayers overall. This test is useful for utilities and policymakers to compare various energy efficiency alternative actions by their utility rate effects.

Beyond identifying the various costs and benefits, in practice these tests raise three additional complexities. First, because the costs are generally incurred immediately, while the benefits accrue over time, stakeholders must accurately calculate the present value of the stream of future benefits. Accurately forecasting the value today of benefits tomorrow requires detailed technical tools and some important policy decisions.

Second, to accurately balance the costs and benefits of a program, stakeholders must distinguish the benefits that occurred because of the program from those that would have occurred despite the program. The difference between savings that are attributable to programs and those that would have occurred in their absence is referred to as the *net to gross ratio (NTG).* Utilities and policymakers should estimate what would happen in the absence of rebates and credits in order to estimate program cost-effectiveness using the total resource, and program administrator, and rate impact cost tests[5]. Of course, determining an accurate and reliable NTG estimate is both difficult and uncertain. Utilities, regulators, and policymakers must use good judgment in deciding what level of NTG precision is acceptable and how to apply NTG estimates.[6]

The third complexity is that some non-energy benefits are easy to quantify and attribute to energy efficiency actions, while others are quite difficult. The risk of under-valuing non-energy benefits could be to foreclose energy efficiency options that could deliver energy savings, job growth or other benefits. Or, the risk could be requiring one stakeholder to subsidize a non-energy benefit that accrues to another stakeholder, or does not accrue at the rate estimated.

The following report provides more detail on the five factors (actions, costs, benefits, time, stakeholders) and the four primary cost-effectives tests (Participant Cost Test, Program Administrator Cost Test, Total Resource Cost Test, Rate Impact Test), and gives examples of how to use the tests from a variety of stakeholder (energy consumers, energy providers, policymakers) perspectives.

[5] See References, Idaho Public Utilities Commission, 2009.

[6] It should be noted that because the NWPCC and its RTF use the Total Resource Cost test to assess cost-effectiveness these entities do not attempt to estimate NTG ratios. The NWPCC and RTF attempt to account for the level of energy efficiency purchases or behavior already occurring in the marketplace when estimating savings potential. In a sense, they account for freeridership and spillover “up front” rather than after a program has been in operation.

SUPPLEMENT:
This supplement details to the outline provided in the executive summary.

I. Cost-effective energy efficiency defined

In general, an *action* is cost-effective when the value of the benefits exceeds the costs. In regards to energy efficiency, the action can be purchasing a product, or improving a process, that delivers a desired service while using less energy. Two simplified examples are: a homeowner replacing a refrigerator with one of the same size that uses less energy, or a business installing new lighting that uses less energy to deliver the necessary amount of light. These actions cost the homeowner or business money to purchase and install the products and deliver the benefit of reduced energy bills. If the money saved in lower energy bills throughout the lifespan of the improvement exceeds the cost of the action, then the action is considered cost-effective.

There are five broad factors that all stakeholders should consider: (1) the *actions* that can improve energy efficiency; (2) the *costs* incurred to implement the action; (3) the *benefits* that result from the action; (4) the length of *time* necessary for the benefits to payback the costs; and (5) identifying who (which *stakeholder*) incurs each cost and receives each benefit. The first section of this report describes these factors in more detail. The second section describes a method to calculate the cost-effectiveness of an energy efficiency action.

The ISEA Board asked the Task Force to discuss how these factors affect each energy use sector: residential, commercial, industrial, and irrigation. However, three of these factors - *actions*, *costs*, and *benefits* – are similar for each energy use sector and a fourth, *time*, is largely an individual preference. By contrast, a unique feature of energy efficiency is that several *stakeholders* may contribute to the costs or enjoy the benefits of a particular action. Therefore, the important distinction is *which stakeholder* takes the action, incurs the cost, or receives the benefits – the energy consumer, the energy provider, or policymakers. This report describes how to determine if an action is cost-effective for these three types of stakeholders.

II. The factors that influence cost-effective energy efficiency

A. <u>Actions to improve energy efficiency</u>

Delivering the maximum net benefits of energy efficiency typically requires several stakeholders to work together. Energy consumers can install more efficient products or processes. Energy providers can run programs that identify and help implement these actions. And policymakers can adopt policies that encourage consumers and providers to take these actions. By cooperating in identifying, designing, and implementing energy efficiency actions, Idaho can realize greater energy efficiency than if each stakeholder were to work alone. The key to working together is for each stakeholder to properly calculate the costs and benefits from their perspective of any possible action. This section describes some of the factors relevant to each stakeholder when considering possible energy efficiency actions.

Energy consumers in all sectors should focus on actions that can save the largest and most cost-effective amount of energy and therefore provide the greatest amount of net benefits. When considering several options, a good first step is to rank potential projects from highest to lowest potential energy savings as well as by cost-effectiveness. This calculation requires establishing a baseline, or how much energy would be consumed absent the action. Energy consumers then compare the amount of energy consumed by the more efficient action to the baseline. The difference is the saved energy. Another important factor to consider are "lost opportunities," such as replacing a broken furnace, appliance, or motor. Replacing broken or obsolete equipment or buildings provides an opportunity to procure cost-effective energy efficient items with long lives. While the action may not provide the most energy savings as other discretionary actions, replacement is an opportunity to ensure efficiency that should not be lost.

The following highly simplified example may help explain this further. A homeowner faces two hypothetical options: (1) replace a refrigerator using 1000 units with a new one that uses 800 units; or (2) insulate their home and reduce heating energy use from 10,000 units to 8,000 units. Because the total energy savings from insulation is 2000 units, compared to 200 units for the refrigerator, the homeowner should focus on the insulation first. If the insulation project is not cost-effective, then the homeowner can consider the refrigerator project. But in this situation, if the refrigerator is broken, the homeowner should defer the insulation project if the money is needed to purchase a energy efficient refrigerator. These examples are greatly simplified. The point is that when choosing among various discretionary energy efficiency actions, consumers should begin by weighing the costs and benefits of big energy uses against the costs and benefits of lost opportunities.

Energy providers should focus on reducing demand for energy that is the most expensive to produce and deliver. For example, throughout much of Idaho, energy is often most expensive on hot summer afternoons, but less expensive during nighttime. Focusing on energy efficiency actions that reduce summertime peak demand is more likely to deliver greater benefits to energy providers. A related factor is that one of the largest drivers of rising electric rates is the need to build new generation or transmission projects. By focusing on programs that can reliably deliver large amounts of energy efficiency, providers may be able to defer new capital expenses. Reducing demand during expensive times, and in sufficient quantities to defer new capital expenses, is more likely to realize large benefits to offset the costs of energy efficiency, and in the long run benefit consumers through more stable pricing.

Policymakers evaluating various options should focus on three main areas – scale, establishing minimum baselines, and encouraging stakeholders to go beyond these minimum requirements. First, policymakers should focus on policies to encourage large amounts of energy efficiency. For instance, encouraging better building insulation can have a large impact because heating and cooling loads are directly affected by the building envelope efficiency daily and the savings will persist for many years. By contrast, encouraging efficient toasters will have a low impact since they run for a short time. Second, policymakers should establish minimum baselines for energy efficiency, such as through building codes and appliance standards. Building codes are a good example as they establish a minimum level of energy efficiency by prescribing minimum levels of insulation (etc.) for new buildings.

Third, because there are cost-effective best practices that may provide efficiency gains beyond established baselines policymakers should encourage energy consumers and providers to go beyond the minimum as long as it can be shown that this has value both to the consumer and to the state as a whole. Importantly, policymakers should focus on policies that provide options for energy consumers and producers to cooperate on energy efficiency actions that are cost-effective for these stakeholders.

B. Costs

When determining whether an action is cost-effective, stakeholders should consider both the cost of the action along with the time and resources needed to implement the action. There are three types of costs: the direct cost of the action, the cost of administering the action, and indirect costs that result from the action. This section identifies these costs. Section II.E. discusses who incurs these costs. Section III describes how to balance these costs against the benefits.

The direct cost of the energy efficiency action is often the largest cost component. For instance, an energy consumer incurs both material and labor costs from installing a new refrigerator, insulation or a different method of freezing french-fries. Additionally, an energy consumer may incur a "cost" by having some of their home being unusable during remodeling or a business may see reduced productivity or sales during project implementation. Energy consumers must consider the cost of the equipment, the labor to design and install the equipment, and other associated costs. Energy providers incur direct costs, including payments, rebates, credits, or other incentives offered to encourage the energy efficiency action. Policymakers can incur costs by, for instance, providing a tax credit that will reduce state tax revenue, or requiring a state agency to administer an energy efficiency program. Typically, direct costs are shared between stakeholders, such as an energy provider offering an incentive, and the state offering a tax credit, to offset some of the costs incurred by energy consumer.

Administering an energy efficiency policy or program also incurs costs. When an energy provider offers an incentive for new lighting, employees must be hired, overhead paid, and regulations met. An energy consumer may incur additional labor or overhead costs to manage the project. Likewise, if policymakers implement a tax incentive, this requires public agencies to incur the costs of training employees and ensuring compliance. Some of these costs are not shared between stakeholders, such as increased labor costs; other administrative costs are shared, such as project management assistance from the energy provider to the energy consumer.

Using energy more efficiently can cause indirect costs, or more precisely, cause energy providers to forgo potential revenues. A prominent example occurs when energy providers sell less energy than they forecast. Under traditional ratemaking, the price a consumer pays for each unit of energy includes some fixed costs and some variable costs. If the utility sells fewer units, it still incurs fixed costs, which are not collected because of reduced energy sales. This forgone fixed cost recovery is a "cost" to the energy provider. Another cost is the forgone return on investment utilities earn by making capital investments, such as building power plants. If consumers save enough energy to defer the need for a new power plant, the utility forgoes potential profit. These "costs" can be somewhat mitigated through regulatory mechanisms, but remain important issues.

When calculating whether an action is cost-effective, each stakeholder should calculate the costs incurred that may be offset by incentives or other contributions from other stakeholders. Policymakers should consider the overall costs to all stakeholders. Section III of this report describes a method to calculate these costs from each perspective.

C. Benefits

Energy efficiency produces two categories of benefits: energy benefits, and non-energy benefits[7]. Properly identifying, quantifying, and valuing the benefits of energy efficiency is critical to ensuring an action is properly evaluated for cost-effectiveness for several reasons. First, for energy efficiency actions, the costs are incurred immediately, but the benefits of reduced energy bills for program participants accrue slowly. Second, energy efficiency often benefits people beyond those who incur the costs, such as a program to insulate homes which creates jobs for contractors [8], Third, defining the appropriate range of non-energy benefits used to offset the costs is as much a matter of policy as mathematics. This section identifies the range of possible benefits. Section III describes a method of valuing these benefits for each stakeholder's perspective.

Energy efficiency produces two types of energy benefits: avoiding the need to produce energy and deferring or avoiding the need for new capacity. For instance, a new refrigerator that uses 100 units less energy benefits a consumer by reducing their energy bills. Reducing energy demands can benefit a utility by avoiding the costs incurred by producing and delivering this energy, including fuel or market purchases, operations and maintenance costs, and transmission charges. The second type of energy benefit is avoiding the need to build new capacity, such as another power plant or transmission line. If energy efficiency efforts reach a very large scale, they can slow the growth of energy demand sufficiently to defer the need for additional power plants. Each utility in Idaho calculates their unique avoided costs for energy and capacity. The Idaho Public Utilities Commission (PUC) reviews the investor owned utilities' calculations. Avoiding energy and

[7] While commonly referred to as non-energy benefits, it is important to understand that some non-energy impacts are benefits and some are costs.
[8] But, as previously mentioned, it is the net value of jobs created that should be measured, i.e. when funds are transferred from ratepayers to pay for energy efficiency programs and lost revenues, those funds are no longer available for other uses that may have supported other jobs. Generally, it is assumed that cost-effective efficiency programs result in a net gain of jobs, but these are difficult to determine.

capacity cost benefits the utility in the short term and, by controlling the utility's cost of business, benefits the consumers in the long term.

Energy efficiency also provides a variety of non-energy benefits. A straightforward non-energy benefit is water and sewer savings from installing a more efficient clothes washer. The homeowner sees lower energy bills from the more efficient washer, and lower water and sewer bills as a by-product of taking the energy efficiency action. By contrast, fixing a drafty home saves energy for heating and provides a non-energy benefit of a more comfortable home. Measuring and valuing the increased comfort is very difficult, but the homeowner clearly benefits by being more comfortable. Net job creation is another non-energy benefit. For instance, insulating homes puts people to work leading to increased wages and tax revenues. And, if a business can reduce energy costs they are more competitive and may retain, or hire, additional employees. But because it is the net value of job increases that is important, the value of jobs that may be lost due to rate increases caused by energy efficiency's direct costs and revenue losses must also be determined.

These examples demonstrate the variety and in that complexity of quantifying some types of non-energy benefits. Some are easy to attribute to energy efficiency and are easy to quantify and monetize. Others have a more attenuated link to energy efficiency and are hard to value. While difficult, including non-energy benefits is highly beneficial to properly analyzing the cost-effectiveness of an energy efficiency action. Consider a new manufacturing process that reduces the need for hot water. This delivers an energy benefit by reducing the company's energy bill. But this alone may not offset the costs, unless the company also factors in the non-energy benefit of reducing water and sewer needs. Without properly including a realistic assessment of non-energy benefits, individuals, businesses, and policymakers may under invest or overinvest in energy efficiency. Instead of listing the myriad of possible non-energy benefits, section III.C.2 suggests some criteria to apply when considering specific non-energy benefits in a cost-effectiveness calculation.

D. Time

Energy efficiency actions almost always incur costs immediately and deliver benefits over time, often many years. The time needed for the stream of benefits to recoup the costs incurred by each stakeholder is called the "payback period."[9] Because each stakeholder incurs different costs and receives different benefits, the payback period for any single action can vary for each stakeholder. When considering the payback period, stakeholders should look at two general factors, (1) the lifespan of the efficient action and, (2) individual payback period acceptability (including acceptable discount rate).

First, different energy efficiency actions deliver benefits for different lengths of time. For instance, better building insulation may last for 30 years, or more, whereas more efficient lighting may last only a few years. When calculating the cost-effectiveness of an action,

[9] "Payback period" in this report means the time necessary for the benefits to recoup the costs, which can be measured in a variety ways including via simple payback, rate of return, or lifecycle cost analysis.

stakeholders should determine the lifespan of the action and the appropriate discount rate to apply to future savings in order to value the entire stream of energy savings. If the discounted payback period exceeds the useful life of the energy efficiency action, it is highly likely to not be cost-effective. Instead, if the discounted payback period is less than the useful life, then the action is likely cost-effective, i.e. could benefit the stakeholder beyond the costs they incurred.[10]

Second, individuals or businesses have different payback periods, risk tolerances and other hurdle factors they are comfortable with. Some businesses or individuals may require that all investments deliver a large, riskless payback within two years, others may accept smaller savings over longer periods and with more risk. For policymakers, encouraging stakeholders to consider longer payback periods will encourage greater levels of energy efficiency.

E. Who

Encouraging energy efficiency often requires several stakeholders to take actions, incur costs, and may confer benefits narrowly or broadly. Because of this, an action may be cost-effective for some stakeholders, but not for others. In other words, cost-effectiveness is a matter of perspective. The remainder of this section will explain this notion in greater detail. Section III describes a method for considering cost-effectiveness from four main perspectives.

Consider a hypothetical utility program to encourage efficient lighting in factories. The utility works with the factory owner and/or trade ally to implement the project. This action causes the utility to incur the costs of paying incentives to encourage the action and the cost of administering the program. The utility benefits by avoiding the cost of producing and delivering some amount of energy. The factory owner, or trade ally, installs the lights and incurs the materials costs, the labor costs to administer the project, and possibly reduced productivity or sales during project implementation. These costs are offset by the incentive from the utility and the reduced energy bills in the future along with non-energy benefits of increased productivity and safety from improved lighting. In this example, the costs and benefits to the factory owner and to the utility are different and illustrate the importance of proper accounting of costs and benefits for each entity. So, when calculating whether an action is cost-effective, two critical questions are determining who bears the costs, and who receives the benefits. The next section of this report describes a method to measure the cost-effectiveness of the lighting program from these two perspectives, the participant, and the administrator.

In reality, the example above creates a much broader set of costs and benefits for stakeholders beyond the utility and the factory owner. Often, in utility programs, all ratepayers contribute funds to pay for a utility's cost of administering the program and

[10] A discounted payback period less than the useful life of a measure is necessary, but not sufficient, for a utility to implement a program for that measure. It is not a sufficient criterion due to program administrative costs and customer participation factors.

paying incentives. These ratepayer costs are offset by the benefit of the utility avoiding the cost of energy or deferring new power plants. Because new power plants are the primary driver of rising utility rates, all ratepayers benefit by not building the plant. This describes why, from a ratepayer's perspective, it may be cost-effective to contribute to a program that delivers incentives to others – eventually the ratepayer's utility bill might be lower than it would have been without the program. The next section also describes a method to measure whether the lighting program is cost-effective for a ratepayer who contributes funding to an energy efficiency program.

To increase the complexity again, imagine this lighting program creates a net increase in work for engineers and electricians. These individuals receive the non-energy benefits of job creation and the state may enjoy higher tax revenues from higher worker incomes and increased product sales. The next section describes a fourth method to measure whether the lighting program is cost-effective for all stakeholders, including those who enjoy these non-energy benefits.

This hypothetical lighting program describes how cost-effectiveness is often a matter of perspective. Unless all of these diffuse costs and benefits are accounted for, the lighting program may mistakenly appear not to be cost-effective for some stakeholders and highly cost–effective for others. By not considering a potential energy efficiency action from the perspective of each type of stakeholder as well as all stakeholders, policymakers and utilities may under or over invest in energy efficiency. The other advantage of considering cost-effectiveness from a variety of perspectives is to properly design programs or policies so that each entity contributes costs commensurate with the benefits they may receive. The next section describes a set of tools that examine cost-effectiveness from four main stakeholder perspectives.

III. A common method for measuring cost-effectiveness

In order to ensure utility sponsored energy efficiency programs are cost-effective, experts have devised a set of tests that weigh costs and benefits from a variety of stakeholder perspectives. Any entity who potentially takes an action, incurs a cost, or receives a benefit of energy efficiency is a stakeholder. Idaho's investor owned utilities use these tests when designing, implementing, and reviewing potential programs. In order to provide a complete picture of whether an action is cost-effective the tests described in this section examine the issue from four primary stakeholder perspectives: (a) the entity taking an efficiency action; (b) an entity who contributes money to an energy efficiency action; (c) the entity administering the program; and (d) all entities within a defined geographic area affected by the action.

It is important to consider cost-effectiveness from a variety of perspectives because encouraging energy efficiency often requires several entities to work together to maximize the energy savings. Also, several entities may share in the costs, and the action may spread benefits widely. Accordingly, these tests should not be used in isolation. Rather by comparing the results of these four tests, policymakers and utilities can design programs or policies that will encourage cost-effective energy efficiency, individuals can decide whether to participate, and program administrators can establish the optimal incentives they should offer.

This section describes the costs and benefits included in each test and identifies the most appropriate use of each test. This section concludes by describing three main complexities of the tests and how each are presently resolved.

A. The Tests

1. The Participant Cost Test takes the perspective of an entity considering an energy efficient action. This test captures the participants' cost of purchasing and installing equipment or changing a process, including any planning, administration and reduced productivity or product sales. These cost are weighed against the benefits of reduced energy bills and any incentives, both from the utility and possible tax benefits. They may also enjoy non-energy benefits if the action makes a building more comfortable, improves worker productivity, or reduces other costs like water or sewer needs. This test does not capture costs incurred or benefits received by entities that administer the program or entities that do not participate in the action. As the name implies, this test is appropriate for an individual or business considering whether to take action to use energy more efficiently, including participating in a utility program.

2. The Program Administrator Cost Test takes the perspective of the entity offering a program to encourage energy efficiency, typically, a utility providing education, engineering assistance or incentives to customers. The administrator incurs the costs of any incentives, technical assistance and educational efforts, plus the costs of planning, running, marketing, and evaluating programs. The administrator is considered to receive the benefit of any costs it avoids due to the program, for example, not having to purchase higher-cost energy or build a new power plant. Because this test often takes the perspective of a utility, non-energy benefits that do not directly benefit the utility, like job creation or increased comfort, are excluded.

3. The Total Resource Cost Test takes a broad view and includes a utility and its customers in total affected by an energy efficiency action within a defined geographic area. This test comprises all costs incurred by the program participant and the administrator. The test compares all the costs to all the benefits, including energy, some non-energy benefits, and funds that originate outside the geographic area, like federal and state tax credits or other incentives. Because this test looks from the perspective of a utility and its customers in total, it captures a broad range of non-energy benefits. A variation of this test is the Societal Test, which expands the benefits to include less-quantifiable non-energy benefits like distant environmental effects, but excludes the benefits of federal or state tax credits and incentives that are counted as such in the TRC. Because the Total Resource Cost test takes a broad view of costs and benefits, it is a primary tool for considering public policy options to encourage energy efficiency. But again, policymakers should consider the results of all tests.

4. The Rate Impact Test takes the perspective of persons or companies who contribute money to energy efficiency actions. This test captures the costs of the action, including any forgone utility revenues from reduced energy sales. These costs are weighed against the benefits of avoiding energy and capacity costs. The results of the test measures the potential impact to utility rates on non-participating ratepayers overall. This test is useful for utilities and policymakers to compare various energy efficiency alternative actions by their utility rate effects.

Again, policymakers and other stakeholders should not use each test in isolation when designing and reviewing energy efficiency policies or programs. Instead, the set of tests were designed to allow stakeholders to consider each of the perspectives and to balance the tradeoffs among them. By reviewing the results of these four tests, policymakers can help design programs or policies that will encourage cost-effective energy efficiency, individuals can decide whether to participate, and utilities can establish the optimal incentives they can offer.

The Idaho PUC uses the results of these tests when reviewing energy efficiency investments of investor owned utilities. The goal is that all programs and individual measures are cost-effective from the total resource, program administrator, and participant perspectives. While the PUC does not have a goal that the rate impact test be cost-effective, these results can help keep utility incentives and other costs at levels that optimize net benefits while minimizing adverse effects on nonparticipating ratepayers.

B. The complexities that arise from each test

Beyond identifying the various costs and benefits, in practice these tests raise three additional complexities. First, because the costs are generally incurred immediately, while the benefits accrue over time, stakeholders must accurately calculate the present value of the stream of future benefits. Second, to properly balance the costs and benefits, stakeholders must attempt calculate the "net-to-gross ratio", that is the relationship between the energy savings incented by the program and all energy savings, thus determining the energy savings that would have occurred despite the program. Third, some non-energy benefits are easy to quantify and attribute to energy efficiency actions, while others are quite difficult. This section describes these three complexities and provides examples of how they are currently addressed.

1. Valuing immediate costs versus long-term benefits

A major complexity in determining whether energy efficiency actions are cost-effective is that costs are generally incurred immediately, while the benefits accrue over time. To resolve this complexity requires properly valuing the stream of future benefits at the time the entity is considering spending money to become more energy efficient. This is a three-step process.

The first step is to determine how long into the future the action will endure. For example, a refrigerator will last between 10 and 15 years, while insulating a building will last 30 years or more. Actions that save energy long into the future deliver greater benefits than shorter-lived actions.

The second step is to calculate the value of the energy saved by the action. This calculation requires establishing a baseline, or how much energy would be consumed absent the action. This baseline is then compared to the amount of energy that would be consumed by taking the more efficient action. The difference is the saved energy. Because the baseline is foundational to determining the energy savings, properly calculating this amount is critical. A simple, but less accurate, method is to compare the labeled energy use by each item, for instance a 300-watt motor replacing a 600-watt motor. The preferred method is to measure the actual energy used over a time-period before and after implementing the efficiency action. Measuring both pre- and post-implementation energy use captures the actual difference in energy use of the different motors and how often each operates. The value of the saved energy depends on the specifics of who delivers it, as well as the time of day and day of the year it is used. The Idaho PUC reviews these values for each Idaho investor owned utility. Unregulated cooperative and municipal utilities can determine this value internally.

The third step is to determine the current value of the future benefits in order to compare these to the cost of the action. For example, a homeowner pays today for a new refrigerator and enjoys lower utility bills for years to come. To accurately determine if this is cost-effective, one must balance today's cost, with today's value of future benefits. Economists calculate the value of future benefits by applying a "discount rate" to the stream of future benefits. A higher discount rate implies you perceive the future as less valuable, while a lower discount rate means you perceive the future as more valuable. Each test described in the prior section uses a discount rate that reflects the perspective of the stakeholder. The general rule of thumb is to apply a discount rate equal to what the stakeholder pays in interest on borrowed money or could earn by investing dollars in their other places.

2. <u>Net energy savings versus gross energy savings</u>

To accurately balance the costs and benefits of a program, stakeholders must distinguish the benefits that occurred because of the program from those that would have occurred despite the program. For instance, if a utility offers an incentive for a new efficient refrigerator, some people will take action because of the incentive, some would have taken the action even with a lower incentive, while others would have bought the new refrigerator anyway and the incentive is just a bonus[11]. The difference between savings that are attributable to programs and those that would have occurred in their absence is

[11] The fraction of consumers who would have purchased the efficient refrigerator without the utility incentive is referred to as the program's *"free ridership"* share. On the other hand, some consumers purchase an efficient refrigerator in response to a utility's marketing program, but, for whatever reason, do not use utility incentives and this is referred to as the "spillover" share.

referred to as the *net to gross ratio (NTG).*[12] Utilities and policymakers should estimate what would happen in the absence of rebates and credits in order to estimate program cost-effectiveness using the total resource, and program administrator, and rate impact cost tests[13]. Of course, determining an accurate and reliable estimate of what might or would have happened were it not for the presence of a program after the program has been in existence is both difficult and uncertain. Program evaluators have survey methods and statistical methods to make these estimates, but providing high levels of precision may not be possible. . Utilities, regulators, and policymakers must use good judgment in deciding what level of NTG precision is acceptable and how to apply NTG estimates.[14]

3. Valuing non-energy benefits

Often energy efficiency programs can deliver non-energy benefits along with energy benefits. Non-energy benefits include things like reduced water and sewer needs, a more comfortable home, a more productive workplace, or creating a net increase in jobs for contractors and trade allies. A key consideration for stakeholders to consider is which non-energy benefits to include, and how to value them. This scope varies depending on who is taking the action. For businesses or individuals, the appropriate scope is a matter of company policy or personal preference. For public entities, the scope is much different. An energy provider receives a much narrower range of non-energy benefits than might accrue to Idaho citizens more broadly. For example, a homeowner who participates in an efficiency program may have lower bills and be less likely to miss payments, which benefits the energy provider by avoiding the cost of collecting unpaid bills. By contrast, if an energy efficiency program creates a net job increase, this does not benefit the utility or a specific person, but does benefit the state and society.

While important, properly identifying and valuing non-energy benefits is a difficult task. The risk of undervaluing non-energy benefits could be to foreclose energy efficiency options that could deliver energy savings or other benefits. Or, the risk of overvaluing non-energy benefits could result in one stakeholder to paying for a non-energy benefit that accrues to another stakeholder, or does not accrue at the rate estimated. Non-energy benefits must be attributable, quantifiable and monetizable.

Non-energy benefits should be attributable to the energy efficiency action. For instance, sewer or water savings are directly attributable to installing a more efficient clothes washer. Likewise, a more comfortable home is attributable to sealing leaks and improving insulation. By contrast, increased worker productivity may or may not be attributable to improved workplace lighting or other efficiency actions. Policymakers should consider providing guidance on how loosely attenuated non-energy benefits are allowed to be with regard to an efficiency action while still being included in cost-effectiveness analyses.

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[12] Net Savings = Gross Savings - Savings from Free Riders + Savings from Spillover

[13] See References, Idaho Public Utilities Commission, 2009.

[14] It should be noted that because the NWPCC and its RTF use the Total Resource Cost test to assess cost-effectiveness these entities do not attempt to estimate NTG ratios. The NWPCC and RTF attempt to account for the level of energy efficiency purchases or behavior already occurring in the marketplace when estimating savings potential. In a sense, they account for freeridership and spillover “up front” rather than after a program has been in operation.

Non-energy benefits can be difficult to quantify and monetize. Some non-energy benefits are relatively easy, for example, reduced water needs can be measured and valued by water providers. Some are not easy, for example, the value of a more comfortable home is hard to quantify and monetize, even once the home is sold. Another example, net job creation, can be argued both ways; while there are methods to quantify and monetize potential job creation, the accuracy of these methods is subject to debate. Listing all the possible non-energy benefits and describing the ability to quantify and measure each is beyond the scope of this report. Instead, policymakers should provide guidance on how heavily non-energy benefits should be relied upon and how accurately a non-energy benefit must be quantified and monetized to be included when considering the cost-effectiveness, from each perspective, of a potential energy efficiency program or policy.

IV. References and Further Reading

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