Incentive Scenarios in Potential Studies: A Smarter Approach

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ABSTRACT

Utilities can easily spend tens or even hundreds of millions of dollars in incentive payments over the life of a portfolio of efficiency programs. In doing so, they are faced with the decision of how to provide incentives for hundreds of measures to get the "biggest bang for the buck." This decision is complicated by the fact that utilities often face constraints in their program spending (e.g., legislated spending caps). Balancing a portfolio of efficiency measures, including determining the appropriate incentives for each technology, can be a daunting task. As a result, very simple rules of thumb (e.g., percentage of incremental cost) are often used when setting incentive levels, especially in energy efficiency potential studies. This approach can result in a portfolio that is substantially more expensive than required for a targeted level of savings. This paper suggests an alternative method for setting incentives and conducting scenario analysis that can significantly reduce the estimated cost of a portfolio relative to more common methods. Specifically, we recommend that incentives be adjusted based on a measure's levelized $/kWh rather than using a percentage of incremental cost approach. This paper provides simulated estimates of the magnitude of cost savings possible (30%, or up to $90 million in some scenarios) for a large Southwest utility. This paper also discusses limitations of the proposed approach and makes suggestions regarding the focus and constraints of some regulatory environments.

Introduction

An increasing number of states have targets for energy and/or peak demand savings that utilities are compelled to achieve, either due to a legislative requirement or simply due to pressure from stakeholder groups. As of October, 2011, 24 states had energy-efficiency resources standards (ACEEE 2012), and 3 additional states have voluntary goals. These energy-efficiency resource standards are becoming increasingly aggressive, and questions remain as to whether utilities will be able to meet these targets.

However, some utilities operate under constraints on their annual spending on energy-efficiency programs, which can make it challenging for utilities to meet their targets. Even when utilities do not face legislated spending constraints, they may have internal budgets for energy efficiency programs that program managers must consider. In general, program administrators are interested in achieving a targeted level of energy savings at least cost to the utility. Achieving targeted savings at least cost is especially of concern in regulatory environments where there is a financial disincentive for a utility to lose revenue from energy efficiency savings. Adjusting measure incentives is a lever often used by program administrators to control both annual expenses and program participation with the competing objectives of high energy savings and low program cost. Thus, program administrators are keenly interested in the likely impact of incentive levels on achieved energy or peak demand savings and annual incentive expenses.

Incentives and Incremental Costs

Incentive payments in energy-efficiency programs often take the form of a rebate, a dollar amount provided to a customer by the administrator of an efficiency program, often an electric utility. In other cases, program administrators will coordinate with upstream manufacturers to buy down the cost of efficient equipment, making the incentive invisible to the consumer. The purpose of these rebates or buy-downs is to reduce the purchase cost of the efficient equipment (referred to herein as measures), which helps to overcome one well-known barrier (among several) to adoption of efficient technologies -- the first cost of the technology. In the energy-efficiency vernacular, the difference between the purchase price of the efficient measure and the purchase price of the inefficient measure is referred to as the incremental cost.[1] Typically, program administrators set incentive levels that consider the magnitude of the incremental cost, and usually constrain incentives to no greater than 100% of the incremental cost, although values of between 25% and 75% of incremental cost are more typical. The percentage of incremental measure cost that is covered by the program administrator varies considerably across utilities, measures, and programs.

Utilities often use the Total Resource Cost (TRC) test (CPUC 2001) in determining whether energy-efficiency (EE) measures or EE programs (bundles of measures) are cost-effective. Since the TRC test largely treats incentives as a "transfer payment"[2] in calculating a benefit-cost ratio, the level of the incentive offered by the utility does not actually affect cost-effectiveness at the measure level. This statement assumes a net-to-gross (NTG) ratio of 1.0. If the NTG ratio does not equal 1.0, incentive levels do factor into the TRC test (CPUC 2007).

Thus, in theory, a program administrator could achieve high levels of gross energy or peak demand savings by providing rebates of 100% of the incremental cost of a measure while still passing a TRC test. Providing incentives that are 100% of the incremental cost would bring payback times for the efficient measure effectively to zero, thereby maximizing the likely adoption of that measure as well as energy and peak demand savings. However, a number of reasons are sometimes suggested[3] for program administrators to set incentives to less than 100% of incremental cost, including:

- a requirement in some jurisdictions to keep efficiency program expenses within legislated spending caps (e.g., the budget for efficiency programs in Michigan is less than 2% of sales revenue for the preceding two years after 2012 (Michigan Act No. 295 2008)).
- a desire for program participants to contribute toward equipment costs,
- a desire to avoid over-paying participants who would be willing to participate at lower incentive levels,

[1] For replace-on-burnout measures, the incremental cost is typically calculated as the difference between the cost of the efficient technology and the cost of the baseline, or inefficient, technology. For retrofit measures, incremental cost is often assumed to be full purchase price of the efficient technology plus installation costs. For new construction, the incremental cost is typically the difference between the efficient measure and code (or standard practice).

[2] A transfer payment is an economic term for the redistribution of capital or wealth.

[3] The validity of each of these reasons is not addressed in this paper, as some of the rational is subjective. Rather, the list represents rationale that is sometimes provided by program administrators.

- a desire to limit the ratepayer impact of efficiency programs (since participants in programs are in many cases effectively subsidized by non-participants via increased rates in the event that the Ratepayer Impact Measure test (CPUC 2001) is less than 1.0),
- a requirement in some jurisdictions that programs or measures pass a Program Administrator Cost test (CPUC 2001), since this benefit-cost test *is* effected by incentive levels, unlike the TRC test,
- a desire to limit program administrator annual expenses on efficiency programs to within budgeted levels,
- a possible reticence on the part of a program administrator to achieve high levels of energy savings – particularly in situations where no allowance is provided for lost revenue recovery, where no performance incentives are provided, and where de-coupling of revenues and energy sales is not in effect.

Scenario Analysis in a Demand-Side-Resource Potential Study

The discussion presented in this paper stems from analysis Navigant conducted for UNS Energy Corporation as part of a demand-side-resource potential study, which was completed in May of 2011. As with most potential studies, the client was interested in conducting scenario analysis on the forecasted energy savings and costs. Consistent with the discussion presented earlier, many other potential studies use the incentive level as a scenario variable in their estimation of energy or demand savings potential. Often, these studies provide scenario results that vary the level of incentive provided by adjusting the percent of incremental cost assumed to be provided by the program. For instance, one scenario might assume a very high level of incentives (e.g., 75%-100% of incremental cost); another might assume a low level of incentives (e.g., 25%-50% of incremental costs). The actual value of the assumed incentive level for each scenario is irrelevant. The relevant issue is that incentive levels are often adjusted by making across-the-board changes (for all measures) to the percentage of incremental cost that is covered by the program. In other words, the scenario would assume that all measures have incentives equal to 75% of incremental cost, or 50% of incremental cost, for instance. Table 1 offers several examples of past demand-side-resource potential studies that conduct scenario analyses consistent with the approach described above.

Table 1. Examples of Potential Studies where Scenarios Adjust Incentives by Varying the % of Incremental Cost Across all Measures.

Source	Region Studied	Incentive Scenarios
(XENERGY 2002)	California	33%, 66%, and 100% of Incremental Cost
(ICF 2005)	Georgia	25%, 50%, 100% of Incremental Cost
(Itron 2008)	Texas	33%, 67% of Incremental Cost
(GDS 2007)	Vermont	50%, 100% of Incremental Cost
(KEMA 2007)	New Zealand	33%, 50%, 75% of Incremental Cost
(Nexant 2010)	WY, NM, NE, CO	25%, 50%, 75%, 100% of Incremental Cost

However, our contention is that such an approach to scenario analysis, while very common in potential studies, will result in estimates of cost that can greatly exceed the cost truly required to achieve a particular level of energy savings (which is often the primary area of focus for efficiency programs). This approach is likely to mislead stakeholders and will indicate that the cost to achieve savings is higher than actually required. The reason is that any approach that treats all measures equally from an incentive perspective (e.g., all measures have incentives equal to 50% of incremental cost) ignores important differences among measures in the cost required to achieve one kWh of savings. The incremental cost per kWh of savings varies dramatically among measures, even among a subset of measures that all pass a TRC test. On the low end of the spectrum, compact fluorescent light bulbs provide savings at a cost of about $0.03/ first-year kWh saved (or about $0.005/kWh levelized). On the other end of the spectrum, some measures (e.g., residential air sealing in homes with electric space heat) can provide savings at a cost of $1.76/ first-year kWh (or about $0.13/kWh levelized) while still passing a TRC test.

A more cost-efficient strategy (i.e., one that would achieve a targeted level of energy savings at least cost) would first reduce the incentives of the most-expensive measures before reducing incentives for the least expensive measures. Otherwise, one would inadvertently reduce the likely adoption of the least expensive measures in the portfolio, thereby increasing the average cost of the portfolio. To implement this approach, we suggest that instead of indiscriminately adjusting the percentage of incremental cost covered by incentives for all measure*s* (irrespective of the $/kWh saved), scenario analyses forecast savings at different levels of maximum "incentive payment ($)"/kWh of savings (calculated on a levelized basis).[4] In other words, one could start with an aggressive scenario where all measures have incentives equal to 90-100% of incremental cost. That scenario would maximize adoption across all technologies, but would also result in very high annual expenses that may exceed program budgets or legislated spending constraints.

For less aggressive scenarios, one could reduce the maximum incentive amount for any given measure on a levelized $/kWh basis. For instance, one could conduct a scenario where the incentive for any given measure is constrained to be less than $0.05/ kWh saved (levelized). For measures that already provide savings at less than $0.05/ kWh (without any incentives), this limit would not be constraining, and therefore the incentive level as a percentage of incremental cost would remain at the level of the most aggressive scenario (e.g., 90-100%). However, for more expensive measures whose costs exceed $0.05/kWh (without incentives), the constraint would effectively reduce the percentage of incremental cost provided as an incentive for that measure. For instance, if a measure has a levelized cost of $0.10 (incremental)/kWh without any incentives, an incentive constraint of $0.05/kWh (levelized) would effectively result in an incentive that covered only 50% of the incremental cost of that measure. Such an approach would more efficiently bring a portfolio of EE measures down the EE supply curve. Inexpensive measures would still have high levels of adoption, at corresponding high levels of incentives, whereas expensive measures would have lower levels of adoption due to decreased incentive levels, resulting in a more cost-efficient portfolio.

Using this approach to conducting scenario analysis for a potential study is not to suggest that incentive structures for prescriptive measures should actually move from a $/widget model to a $/kWh model. Rather, this approach suggests that the $/widget provided as an incentive be set by considering the levelized $/kWh of the measure.

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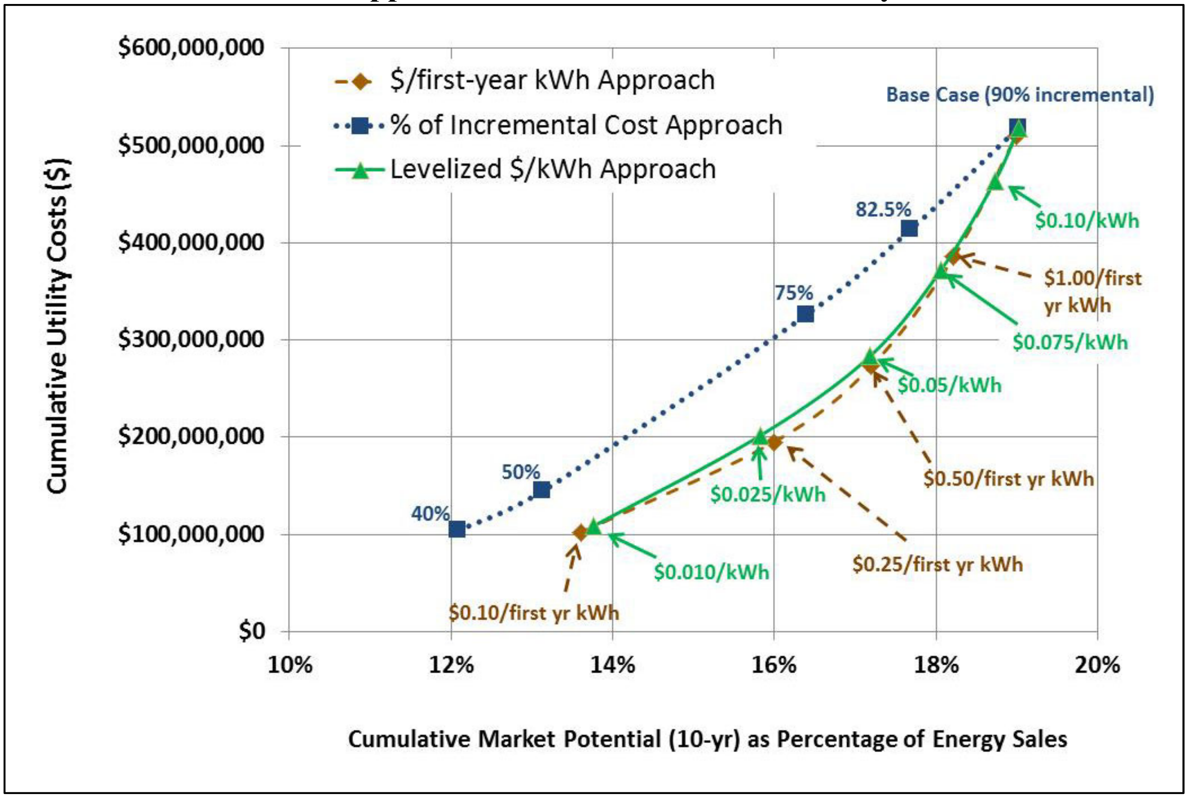
[4] Since regulatory agencies often set targets based on cumulative "first-year" savings, one can also envision conducting the analysis using the $/first-year kWh as a constraint. However, while this approach maximizes "first-year" savings, it does so at reduced "net benefits" relative to the proposed approach, as will be illustrated later in this paper. As a result, we recommend using the levelized $/kWh as the basis for the incentive constraint when conducting scenario analysis.

To illustrate the potential significance of these two disparate approaches, we created what is effectively a market potential supply curve. We adjusted incentive levels using both of the above described methods and calculated total utility costs (incentive and non-incentive) as well as total energy savings (expressed as a percentage of energy sales). In both cases, incentives in our analyses never exceed 90% of the incremental cost of the measure, since the client felt that values exceeding 90% of incremental cost would not be palatable to other stakeholders.[5] Figure 1 provides the results of this analysis. This figure illustrates how the percentage-of-incremental-cost approach results in significantly greater cumulative utility costs (over a ten-year period) than the proposed approach (using levelized $/kWh) for a targeted level of cumulative energy savings (as a percentage of energy sales).

Figure 1. Cumulative Costs vs. Cumulative Market Potential -- Three Approaches to Incentive Scenario Analysis



Source: Navigant Analysis of Achievable Potential[6] for Tucson Electric Power – Conducted using Navigant's Demand Side Management Simulator (DSMSim™) Model

[5] The 90% of incremental cost constraint explains the convergence of the two curves. As both approaches are limited by this constraint, no additional savings can be achieved beyond this level.

[6] We note that the curves presented here include regulatory credits for past program EE savings as well as savings credit for Demand Response programs. Thus, the absolute value of savings potential on the x-axis would be somewhat lower if only energy savings potential for new EE programs were included.

In addition, Figure 1illustrates the effective market potential supply curve if the incentive constraint is based on the $/first-year kWh rather than the levelized $/kWh. As can be seen in this figure, cumulative first-year savings are somewhat higher if the $/first-year kWh is used as the constraint, although the difference is small compared with using the levelized $/kWh approach to constraining incentives. However, since using the levelized $/kWh approach produces greater "net benefits," as will be illustrated later, we recommend this approach rather than use of a $/first-year kWh approach to constraining incentives. We note that differences in assumed discount rates, measure lives, and measure mixes will of course affect the magnitude of the difference between the more common approach and the proposed approach.

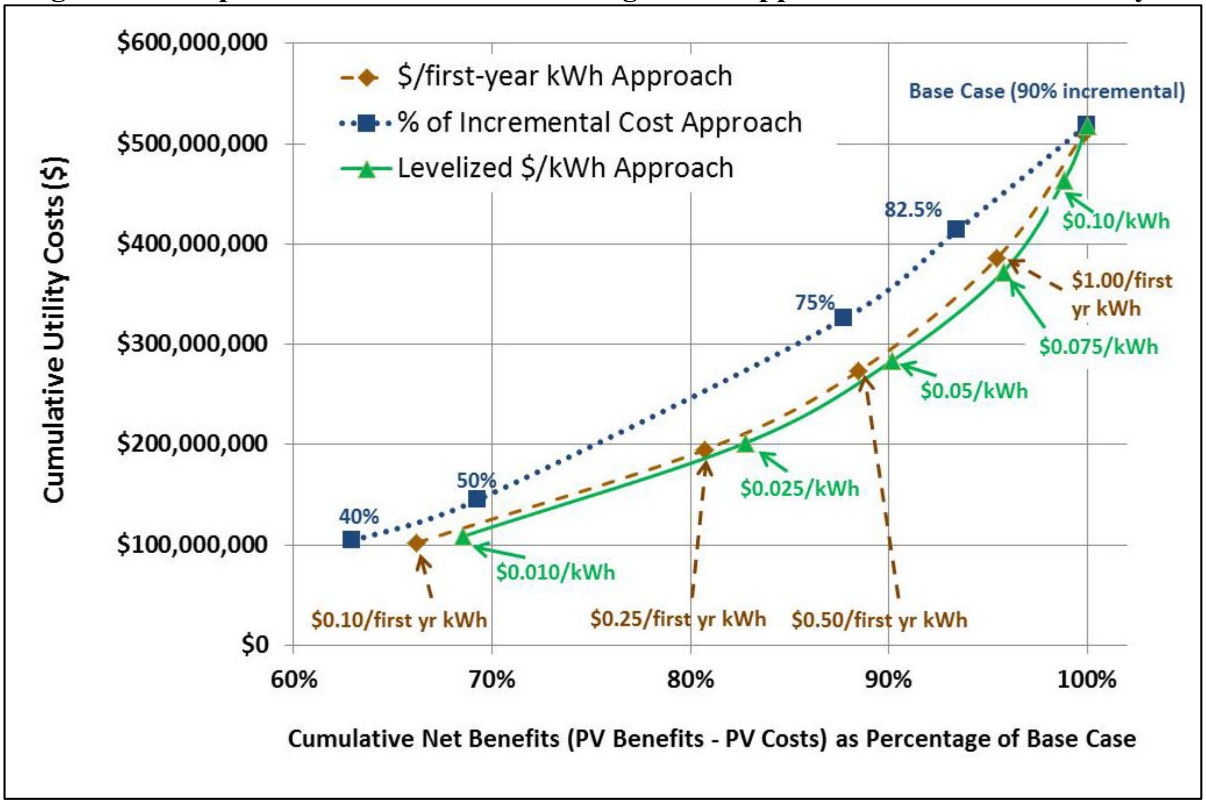
The first approach is illustrated in the figure above by the dotted line (squares), whereas the proposed approach is illustrated by the solid line (triangles). For instance, if the utility targets a cumulative energy savings of 16% of energy sales, a strategy that offers incentives for all measures at about 70% of incremental costs would achieve this result at a cumulative cost of $300 million to the utility. In contrast, a strategy that instead constrains the incentive paid per kWh to $0.027/ kWh (levelized) for any given measure achieves the same level of cumulative savings for about $210 million, a difference of $90 million (30% reduction). For many measures, the incentive paid per kWh will be lower than the constraint of $0.027/kWh (levelized), as the least expensive measures are not constrained by this maximum incentive payment of $0.027/kWh. The actual percentage of incremental cost assumed to be provided as an incentive would vary by measure depending on the incremental $/kWh of the measure.

Using the second approach to adjusting incentive levels means that some measures would have incentives that are a large percentage of incremental cost (up to a maximum of 90%), while other, more expensive measures will have an incentive level that is a small percentage of incremental cost (reducing participation for the most expensive measures). Again, the reason for the difference is that the first approach effectively penalizes the least expensive measures by reducing the incentive level, and therefore likely adoption, of those measures – resulting in a portfolio that, on average, has a higher cost on a $/kWh basis.

In addition to providing greater energy savings at lower cost, the proposed approach to adjusting incentives results in greater net benefits (i.e., the present value of benefits[7] less the present value of costs) for a given level of program spending. Figure 2 illustrates that in all scenarios that were analyzed, the net benefits of the proposed scenario approach (solid line) exceed the net benefits of the more common scenario approach (dotted line) for every given level of cumulative utility spending. As expected, one can also see that an approach using the levelized $/kWh results in greater net benefits than using the $/first-year kWh. The reason is that the $/first-year kWh approach tends to short-change long-lived measures, whereas the levelized $/kWh approach takes measure life into account. Although using the $/first-year kWh provides greater cumulative first-year savings (the metric often used by regulatory agencies), we recommend an approach that instead focuses on the levelized $/kWh. The levelized $/kWh approach will maximize net benefits with only a small penalty paid on cumulative first-year savings (see Figure 1).

[7] The net benefits calculation considers not only the energy savings over the entire life of the measure, but also other benefits such as avoided peak demand and gas savings.

Figure 2. Comparison of Net Benefits Among Three Approaches to Scenario Analysis



Source: Navigant Analysis

Assumptions, Considerations, and Limitations

Implicit in this analysis is the assumption that the adoption of efficient technologies will increase as the purchase price decreases, a reasonable and typical assumption consistent with basic economic theory of demand curves. In this analysis, we assumed that the equilibrium market share of an efficient technology is a function of the payback time (which decreases with decreasing purchase cost) of the technology. While firms will inevitably have different assumptions about the relationship between purchase price, or payback time, and the expected market share of efficient technologies, it is safe to assume that market share will increase as costs decrease. Firms may also consider other parameters in their market share analysis; but, basic economic theory still suggests that demand will increase as costs decrease. We further acknowledge that the relationship between incentive levels, or payback times, and the ultimate market share of a technology is subject to considerable uncertainty. However, the direction of this relationship (i.e., higher market share can be expected to accompany reduced cost and payback time), regardless of its absolute magnitude, will generate results with conclusions that are consistent with those presented in this paper. The relationship between payback time and market share is assumed to apply to the "equilibrium" market share; however, our analysis further simulates the diffusion of technology awareness, which affects the dynamics of the approach to this equilibrium share and generates the familiar S-shaped growth of technology adoption. For more detail on this approach, refer to Navigant's online technology diffusion simulator.[8]

We note that regulatory environments that define savings targets as the cumulative summation of first-year savings (as most do) tend to push utilities away from measures that can be highly cost-effective (e.g., due to longer lives and/or high avoided peak demand savings), yet costly on a $/first-year kWh basis. As such, they effectively provide a short-term focus on near-term energy savings, even though an alternate focus may provide greater net benefits to society. For instance, one could envision a regulatory environment that focused on total net benefits achieved rather than on cumulative first-year savings. Such a focus may result in somewhat lower near-term energy savings, but could potentially produce deeper, sustained energy savings over the long-term. However, we recognize that such a focus can introduce a new set of complications, such as increased difficulty in estimating and verifying net benefits due to additional parameters of measure life and incremental costs (inherently uncertain parameters) that would have to be factored into any metric. Thus, a move in this direction would need to be carefully considered.

Likewise, regulatory environments that constrain annual spending on energy-efficiency programs also tend to push utilities toward lower-cost, and possibly shorter-lived, measures (to keep within annual budgets) at the possible expense of longer-term measures that can be highly cost-effective. If the objective is to achieve "all cost effective" savings, one might argue that any annual spending constraint artificially limits the ability of utilities to achieve all cost effective savings and could result in a sub-optimal portfolio, or in a portfolio that fails to harvest some savings.

One can envision more sophisticated approaches to conducting scenario analyses and/or setting measure incentives than the approach presented in this paper, which is fairly straightforward. For instance, one might preferentially incent measures that are highly cost-effective, even if they provide savings that are comparatively more-expensive on a $/kWh basis. One could, for instance, iterate and optimize incentive levels for each measure to maximize net benefits while simultaneously satisfying both annual savings targets and annual spending targets.

We additionally note that the methods suggested in this paper, as well as the potentially more complex methods suggested above, lend themselves well to potential studies but less well to program design activities. The reason is that, in a potential study, one inevitably must make an assumption about the relationship between technology demand and the incentive levels provided, even if there is large uncertainty in the strength of that relationship. Thus, it behooves one to make best use of those assumptions and to generate forecasts that are consistent with those assumptions and that provide the best estimate of the true cost to achieve a particular level of savings. Program design efforts, on the other hand, often occur without necessarily having to make such quantitative assumptions about the precise relationship between market share and incentive levels, which is admittedly highly uncertain. As such, application of these methods may be more difficult in a program design environment. However, the general principal that one should consider the levelized cost of measures in the development of measure incentives still applies. Likewise, the suggestion that administrators could achieve higher energy savings at lower cost if incentives are constrained using a levelized $/kWh approach rather than using a percentage of incremental cost approach still applies.

Finally, we recognize that there are many instances where one may legitimately wish to deviate from least-cost approaches to achieving savings. For instance, one may wish to incent

[8] See http://forio.com/simulate/navigantsimulations/technology-diffusion-simulation.

emerging technologies to help bring those technologies down the learning and cost curve so that future savings may be harvested from those technologies. Similarly, one may choose to incent measures differently for limited income customers, or in instances where one knows that a code or standard may obviate the need for a program incentive in the near future. Setting incentive strategies is indeed a bit of an art, even if the art can benefit from a scientific exploration of the likely effects of one incentive strategy over another.

Complications when Savings Targets are "Net" Rather than "Gross"

The arguments presented above are focused on a situation where a utility is attempting to meet a particular "gross" savings target. If a utility instead is targeting a particular level of "net" savings (i.e., gross savings less free-ridership and, potentially, adding spillover), the analysis becomes more complex. We consider that the primary conclusion of this paper holds whether net or gross savings are targeted. However, the analysis and forecast of potential savings at different incentive levels would become more complex if net savings are targeted. The reason is that the net-to-gross (NTG) ratio, while often considered to be a fixed value for a particular measure or program type, will inevitably change as the incentive level changes.[9] While we have begun to explore the relationship between NTG ratios and incentive levels, and have considered those relationships in development of this paper, a detailed exposition is beyond the scope of this paper. We encourage, however, continued research along these lines, as it is clear to us that a relationship indeed exists, even though that relationship is often ignored in analysis.

Conclusions and Recommendations

We offer the following conclusions and recommendations, based on the arguments presented in this paper:

1. We conclude that using a levelized $/kWh constraint when setting incentives in scenario analyses is superior to the more common approach of setting incentives using a percentage-of-incremental-cost constraint across all measures. The proposed approach not only provides a targeted "cumulative first-year energy savings" (the metric often used by regulatory agencies) at lower total utility cost, but also provides greater net benefits overall than does the broad-brush approach of adjusting incentives merely as a percentage of incremental cost. As such, demand-side-resource potential studies should move away from a scenario analysis approach that adjusts incentives indiscriminately across all measures as a percentage of incremental cost. Program design efforts can also benefit from focusing on levelized $/kWh when setting incentives rather than on the percentage of incremental cost, although the quantitative estimation methods used for potential studies may not translate well to program design activities.
2. We note that regulatory environments and targets that focus on cumulative first-year savings can result in short-changing long-lived measures that can provide greater net benefits and sustained savings over the long term. To maximize societal benefit, regulatory agencies might consider alternate strategies that focus instead on net benefits

[9] Additionally, as noted earlier, incentive levels are a factor in the TRC test when NTG is something other than 1.0 and must be taken into consideration, further complicating the analysis.

achieved. However, we recognize that such a focus can introduce a new set of complications, such as increased difficulty in estimating and verifying net benefits due to additional parameters of measure life and incremental costs (inherently uncertain parameters) that would have to be factored into any metric. Thus, a move in this direction would need to be carefully considered.

3. We suggest that annual spending limits on energy-efficiency programs have the potential to push program administrators away from measures that may be highly cost-effective, but that may be somewhat more expensive on a $/first-year kWh basis. Such spending limits therefore have the potential of hampering administrators' ability to achieve all cost-effective savings and/or can result in a portfolio that does not maximize overall net benefits of the portfolio for a given level of spending.

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