Options for Improving Energy Efficiency Evaluation in California: "Houston, We Have a Problem…"

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ABSTRACT

California evaluation policies and practices are in need of an in-depth review to re-align energy-efficiency portfolio and program evaluation with the broader societal goals that seek to mitigate global climate change. This paper discusses key issues being faced by current policies and practices and how these issues can be changed for the better to reflect the emerging context in which energy efficiency and evaluation are now being called upon to operate.

Increasing attention to the impacts of global climate change make it imperative to rethink how we use evaluation resources for energy efficiency. California leads the nation with public and private efforts that seek to mitigate the consequences of climate change. California consumers show an awareness and willingness to adopt more environmentally attuned lifestyles. This "green" context for operations affords the opportunity for going beyond "efficiency + business-as-usual" to significantly change social mores, practices and behaviors affecting resource use, by the orders of magnitude which will be required if we are to have any chance of mitigating the threats of climate change.

In order to not just allow, but also foster that order of magnitude increase in energy efficiency and conservation uptake, California needs to rethink how it uses public resources and the policies that guide publicly funded efforts. In the current context, public resources could be used to "oil" a much larger "machinery" of private entities that sell energy products and services. This may require a substantial re-thinking regarding the traditional roles of energy efficiency evaluation.

Introduction

The energy efficiency evaluation community set out years ago to establish that energy efficiency load impacts could be rigorously measured in an attempt to demonstrate the value of energy efficiency to a then largely skeptical array of decision makers operating in a traditional supply-side utility and regulatory context. This endeavor has been wildly successful as evidenced by the fact that today, policymakers are increasingly convinced that efficiency has a role to play in reducing energy costs, consumption and greenhouse gas emissions and, in so doing, create green jobs to stimulate the economy. However, the focus on quantifying load impacts attributable to the programs, primarily for the purpose of determining net benefits as a means of apportioning shareholder earnings is hampering progress in achieving greater levels of efficiency. The ability to empirically demonstrate the presence of load impacts has created sufficient trust that the effects of efficiency are "real" to engender development of a multi-billion dollar annual industry. These impacts are also becoming increasingly difficult to detect, especially from the perspective of attributing the effects to specific program activities. Energy efficiency professionals, evaluators and policymakers, in particular, find themselves in the difficult position of believing that efficiency can have real and valuable effects while simultaneously confronting the fact that effects from particular programs are harder to detect and quantify with the level of certainty that has previously been the cornerstone for justifying public investments in efficiency programs. The path out of this logical conundrum can only be achieved with an honest and full dialog that enables stakeholders to re-assess the context and establish priorities going forward.

First, it will be useful to acknowledge that the context for "measuring" impacts from energy efficiency programs has changed. The current energy efficiency evaluation paradigm in California is based on a conceptual framework that posits a high "signal-to-noise ratio" between program impacts arising from discernable entities versus background "noise" in energy use, markets for efficient goods and services, and market actor behavior. It also presupposes a relatively static baseline for future energy use, markets for efficiency-oriented products and activities against which the "impacts" of resource acquisition and market transformation can be measured. The framework may have been appropriate in earlier eras, but is becoming increasingly stretched due to the accumulated impact of program implementation over time, market effects arising from the programs, increased activities and messaging from a variety of sources encouraging energy efficiency, and a wide array of activities in the marketplace including codes/standards, legislation, and programs being implemented by local and state governments and non-governmental organizations. In other words, detecting a clear "signal" regarding the energy savings directly attributable to the programs is increasingly difficult to do since the background level of activity is high and is changing, producing a high level of "noise" that renders the attribution of program savings difficult and at odds with achieving desired outcomes. Worse, spending so many resources chasing after high levels of accuracy and precision for specific program attribution leaves fewer resources for carrying out formative research to continuously improve program and portfolio results.

Anomalies in the Current Evaluation Context

The evaluation of energy efficiency has traditionally been based on a context tied to the avoided costs of energy (including energy, demand, and transmission, some environmental adders, etc.). This is an elegant construct that relates the contribution of energy efficiency programs to net benefits based on the avoided cost of procurement. Over time, the calculation of avoided costs has become increasingly sophisticated. In some states (including California), avoided costs reflect differences in the price for serving customers at different locations at different times of the day and year. In order to estimate avoided costs using this system, it is necessary for evaluation to be able to determine what technologies were installed, where, when, and at what cost, compared to a base case technology. Assuming that this information can be obtained, it is possible to develop an estimate of the value of the benefits stemming from efficiency versus the costs incurred for program implementation, and then one can calculate a benefit-cost ratio. Policymakers use this information for a variety of purposes, including ensuring that public funds are spent wisely on energy efficiency investments.

One problem with this sophisticated approach to avoided costs is that the approach has been developed while concurrent trends in program design aim toward mass market and upstream interventions that render it difficult or impossible to determine exactly when or where technologies are eventually installed. Another feature of this method of analysis is that one must be reasonably able to attribute the source of savings to the program in order to make the benefit-cost calculation. Due to the accumulated effects of programs, codes, and standards over time, plus increasing attention to energy efficiency and greenhouse gas reduction by multiple market participants, it is no longer possible to determine the source of energy efficiency effects with the same level of accuracy and precision in a cost-effective manner. It is still possible to estimate the gross savings arising from the installation of energy-efficient measures versus a standard measure, and our methods allow us to make such estimations reliably. However, determining whether the selection of energy-efficient measures was a result of "naturally occurring" market change, or due to one program or another, or even due to the cumulative effects of the programs, has become increasingly difficult over time and may soon become impossible. The truth is that all of these factors now play a synergistic role in influencing the adoption of energy efficiency, while evaluation and policy frameworks continue as if program effects can and should be isolable.

A recent study noted that nonresidential lighting market opportunities continue to have significant savings potential because substantial portions of lighting are still standard efficiency (Itron, 2008). However, according to the same research "an overwhelming percentage (78%) of those who responded [to the survey] and indicated that they were planning to install new lighting also stated that they were planning to install high efficiency lighting" (Itron, 2008, p. 3-35). In the current evaluation framework, these potential savings would be considered energy savings associated with free riders (if rebates or other program services were provided), and the savings would be subtracted from the gross program savings to get net program savings. Even if rebates were not provided and the efficient measures were installed outside of a program, it is not clear whether the installation of efficient measures would represent "savings" from a load forecasting perspective, since most of the installation were, presumably, due to occur anyway. In the parlance of climate change mitigation, energy savings and/or greenhouse gas reductions accruing from these measures would not be considered "additional" because they would have occurred as part of the baseline of naturally occurring conservation.

Would the savings *actually* occur in the absence of programs? This is a counter-factual question, and evaluation does not have a good method for accurately answering that question. Meanwhile, research shows that savings are still achievable based on the joint assessment that a) the opportunities still physically exist and that b) that savings can be measured as effectively as before without considering that the effects from capturing the physical opportunities are now more difficult to attribute to program interventions. The expectation that programs should be offered and goals must be achieved, and that it will be possible to cleanly identify savings from programs going forward from savings that arise for a multiplicity of reasons sets the stage for disagreement among implementers, evaluators and policymakers. Part of the reason is that the evaluation and policy goals are misaligned.

The likelihood of being able to accurately identify and quantify impacts arising from the programs using existing evaluation methods is coming into question. Recent evaluation studies have had difficulty in identifying and quantifying effects. In a study of the market effects from residential CFL programs, for example, the authors write:

> Although the study noted substantial changes in awareness of CFLs, attitudes and acceptance of CFLs, CFL availability, and CFL retail prices, these changes may simply be due to market changes and not market effects (i.e., they may have occurred for reasons other than the California energy-efficiency programs). The market effects team assessed these alternative hypotheses and whether or not these changes could be attributed to the California programs. The results of this analysis … indicated that for most indicators the market effects could not be determined with a high degree of confidence due to the fact that much of the evidence was qualitative in nature (The Cadmus Group, 2009, p. v-i-vii).

Although the evaluation was not able to identify significant market effects attributable to the programs, it was also not able to rule out the possibility that the market effects were caused by the programs. Thus, both perspectives remain plausible – that is the most that our evaluation tools are able to say at this time. Part of the problem was that the available data were insufficient to reliably estimate market effects, which points to the need for better, national data collection efforts if research in this vein is expected to continue. In part, however, these and similar results beg the question regarding whether there will ever be sufficient data to estimate market effects "reliably". The notion that program effects could be estimated as a result of analyzing market data was developed (a) before such market data had been collected, and (b) in an era where fewer market actors were actively sponsoring energy efficiency programs and seeking to claim "credit" for any identified market changes (see, for example, Sebold et al., 2001).

The changing environment requires setting realistic expectations about what can and cannot (or should and should not) be determined through the measurement and evaluation of energy efficiency in the current environment, and creating policies on the basis of such expectations (Perich-Anderson and Friedmann, 2008). Using the current framework, significant potential savings will no longer have as much value using the current net benefits metrics. Several recent papers have noted that the these metrics and the regulatory framework limit program design by focusing inordinate attention on installation of devices, a "physical-technical-economic model (PTEM)" of energy efficiency. This PTEM model has driven program design that has oriented energy efficiency policy and programs since the mid-1970s. "Social scientists and a number of energy analysts have been highly critical of the PTEM policy frame and its narrow focus on devices, purposive behavior, costs, calculation, rationality, information, program accountability, services, averages, and so on" that leads to programs targeted at capturing "low hanging fruit" at the expense of interventions that could have more dramatic effects (Lutzenhiser et al., 2009).

From the regulator's point-of-view, there are a variety of reasons why the PTEM model has *worked* for several decades of *resource acquisition* activity. First, the legalized context of utility regulation opens all policies to challenge, encouraging economic and mechanical problem framings that link well with accounting practices and administrative law defenses. Second, and just as important, the goals of energy efficiency policy have long been based on framing energy efficiency as a *least-cost supply of energy*. These goals have been quite *modest* in the sense that their *big picture* payoff is the delay of power plant construction through modest efficiency (Lutzenheiser et al., 2009, p. 65-66).

Sullivan (2009) makes a related point that he calls "the elephant in the room." He notes that policies requiring implementers to achieve savings based on the view that energy efficiency must be cost-effective as an alternative to energy supply severely limit program designs and impede development of interventions that would be more effective in reducing energy use. The key problem is that the next generation of programs "do not fit well within the existing framework for evaluating the efficacy of energy efficiency programs which is focused on documenting direct energy savings" (p. 33-34).

Indeed, the California Public Utilities Commission (CPUC) has acknowledged that the current evaluation framework (and in particular, the incentive mechanism implied by this framework) has limitations including:

- Inability to accurately place a value on many indirect benefits of the program[s], even if such benefits are known to exist.
- May not adequately and accurately value the risks and costs of climate change.
- Are complicated and data intensive.
- Do not encourage the optimal mix of program activities because benefits produced by all desirable activities are not valued and the necessity of maximizing net benefits often leads to "cream-skimming" (California Public Utilities Commission, 2009, p. 14).

Policy should enable and welcome collaborative ventures where public resources help "oil" private enterprise efforts to promote energy efficiency and conservation. Successful efforts to hasten the evolution of markets abound. However, under the current evaluation policy framework, it is difficult to measure attribution to these efforts. Recently, a utility convinced a multi-national corporation to adopt a high-efficiency refrigerator case. The utility incentive "tipped" this "green" multi-national to change practically all of its purchases of this product line. Due to their worldwide market presence, a product that did not even exist before is now becoming the standard. It is quite likely that, soon, this multi-national's major competitor will also have to purchase the high efficiency equipment. This utility was able to leverage the multi-national's worldwide market presence to transform the market for this equipment. Yet, why stop there? Given the relationship that has been established, the utility is now well positioned to help this multi-national or its major competitor to continue to enhance the efficiency of this equipment or others that they purchase.

The Super Efficient Refrigerator Program (SERP) of the 1990's is another example of an effort to hasten market evolution. Several utilities and the U.S. Department of Energy joined resources to offer a $30 million reward to the manufacturer who could build a residential refrigerator that was at least 25 percent better than the current standard. The disbursement of the reward was tied to refrigerators sold. This allowed manufacturers to retool their facilities and enabled a higher federal minimum energy efficiency standard to be enacted for refrigerators (Feist et al., 1994). A more recent example of market evolution efforts underway by utilities, seeks to engage the electronics industry to continuously improve the energy efficiency of their business consumer products. By working with key major manufacturers, the utilities are able to enhance competition amongst them, develop new efficiency tiers for rebates, and leverage the market leadership of these manufacturers to significantly affect the products available for sale and the promotion of efficient ones. However, current evaluation practice has a difficult time in determining what percent of these manufacturer efforts are attributable to utility programs, presenting a problem for portfolio implementers.

Energy efficiency evaluation industry leaders are increasingly coming to the conclusion that the framework under which energy efficiency programs and evaluation have been operating needs to change (Friedmann and James, 2005, Friedmann, 2006, 2007a, 2007b). This perspective begs the question: if so many impacts are being left on the table due to a narrow policy focus that is largely driven by what evaluations are able to effectively measure, what role can evaluation play in ensuring that new program designs are well-implemented and do indeed succeed in saving energy? Thus a key question is if new program designs will achieve better outcomes, how will the effects of these programs be measured, and what types of formative contributions can evaluators make to facilitate uptake of efficiency? Currently, the field is caught between acknowledging that change is needed, but lacking a new conceptual framework to replace existing metrics that characterize net benefits primarily as measurable reductions that can be attributed to a particular program.

A new paradigm for evaluation and policy is necessary, and it will require a partnership among evaluators, policymakers and other stakeholders to agree upon suitable metrics and notions of "success." The first step is to accept that change is inevitable and that it is here.

Paradigm Shift

Thomas Kuhn first described the concept of the "paradigm shift" in his book *The Structure of Scientific Revolutions (Kuhn, 1962)*. A scientific revolution occurs, according to Kuhn, when scientists encounter anomalies that cannot be explained by the universally accepted paradigm within which scientific progress has thereto been made. The paradigm is not simply the current theory, but the entire worldview in which it exists, and all of the implications which come with it. It is based on features of a landscape of knowledge that participating actors can identify around them. In any given paradigm, there are anomalies that are acknowledged but are treated as acceptable levels of error, and not fully addressed for a period of time. These anomalies have varying levels of significance to the practitioners of science or a particular discipline. When enough significant anomalies have accrued against a current paradigm, possibly due to the changing environment in which the paradigm once existed, the discipline is thrown into a state of crisis. During this crisis, new ideas, perhaps ones previously discarded, are tried, and a new paradigm may be accepted.

The first phase of the shift is the pre-paradigm phase, in which there is no consensus on any particular theory. This phase is characterized by several incompatible and incomplete theories. The philosophies preceding and succeeding a paradigm shift are so different that their theories are often not comparable. The paradigm shift does not merely involve the revision or transformation of an existing theory or approach — it changes the way terminology and goals are defined, how the practitioners in that field view their subject, and, perhaps most significantly, what questions are regarded as valid, and what rules are used to determine the value of a theory or approach.

Important policy papers in recent years have shown convincingly that energy efficiency, as the term is currently interpreted, is dramatically outweighed by increases in energy use. In this context, the effects of efficiency on reducing consumption are negligible (Moezzi and Diamond, 2004; Deumling, 2007). Part of solving this problem involves establishing a paradigm that in which the link between evaluation and policy are aligned (Friedmann and Rodriguez, 2008). The good news is the public consciousness now seems favorably disposed toward "green" solutions and policies are being put in place to support these trends (Dickerson and Friedmann, 2006). However, in California, the evaluation of energy efficiency is in the pre-paradigm phase. Evaluation approaches that once encouraged efficiency by lending it credibility are now limiting policy by too narrowly circumscribing the types of interventions that can be undertaken. Given the imperative need to reduce the negative consequences from power generation, we can delay no further in acknowledging this fact and moving as a community to develop a new paradigm where policies and procedures align to the current context. Furthermore, this is a lesson in embracing change, and we should learn from this experience and set in place a process to continuously revisit the core paradigm to adjust the policies and procedures as deemed necessary, or develop an entirely new set of policies and procedures.

Strategies for Developing an Improved Framework

A new policy framework for evaluating energy efficiency programs should encourage open discussion among evaluators and policymakers. It should begin by setting realistic expectations regarding what evaluation can be expected to accomplish, identifying the best use of evaluation resources, and finding ways for both policy and evaluation to assess program strategies that save energy even if the effects of the programs do not meet the narrow definition of "program impacts" that is currently in use. Below, we offer some first steps to help move our evaluation industry towards development of a new paradigm.

1. Establish a process wherein stakeholders are encouraged to candidly share opinions.

The CPUC (2009) has taken a bold step by acknowledging that the shareholder incentive mechanism needs to be revisited, which has direct implications for the role of energy efficiency evaluation. However, at the moment, the only public forum in which these issues are being addressed is a regulatory proceeding (R.09-01-019). This forum does not afford sufficient opportunity for evaluation professionals to interact with policymakers on a less formal basis, to discuss issues at length and weigh the merits of possible solutions. California used to have an active body for discussing evaluation efforts in the form of the California Measurement Advisory Committee (CALMAC), which has been less active in recent years since the evaluation function was transferred to the CPUC. California can learn from New York's Evaluation Advisory Group (EAG) where there is vigorous activity in discussing and coordinating evaluation. Utilizing venues such as CALMAC as an opportunity to have extended discussions between evaluators and regulators could facilitate sifting through ideas so that better, clearer approaches are proposed in regulatory proceedings.

2. Seek insight from other fields.

Energy efficiency evaluation and regulation is not the first industry to experience major paradigm shifts requiring new approaches to assessment and metrics. Yet, the field exhibits an inward focus toward ever more complex approaches to measuring certain metrics, in particular, net energy savings. Fields like education, healthcare, literacy, and environmental regulation have much to offer in terms of evaluation strategies, confronting change, and finding metrics that are measurable and yet meet policy needs. These larger evaluation fields have long ago had to become comfortable with near-term "indicator" metrics and the fact that the precise dollar value of benefits from these programs may be hard to measure. Yet large sums of public funds are still spent to achieve outcomes in these areas. Comparisons of the expectations in other fields with respect to dollars spent in light of evaluated outcomes, and the nature of outcomes that are deemed to be important or sufficient for justifying expenditures of public funds, would be useful.

4. Set realistic expectations for evaluation.

The conversation about evaluation activities in California is being positioned primarily in conjunction with the shareholder incentive mechanism. However, the issues could also be framed in terms of whether the right questions are being addressed by evaluation. That is: if stakeholders were convinced that evaluation results and metrics were able to identify the true benefits of the programs (in a timely fashion), there would not be such consternation regarding the incentive mechanism. One solution is to reframe the questions that evaluations are intended to answer, or in particular the level of rigor that is expected in impact evaluation. Impact evaluation in California is currently expected to meet requirements for 90 confidence that the results are +/- 10 percent of the actual value. This specification of confidence and precision levels involves only the statistical sample and does not address other sources of error in the research. Pretending that it is possible to reliably attribute savings to a particular source in a world with multiple activities and market actors only compounds the problem. Thus, it is likely that evaluations are reporting results with false precision, but with a lot of fuss devoted to achieving high levels of accuracy on paper at least. A more reasonable approach might be to relax the requirements for confidence and precision. This would arguably lead to more *accurate* estimates in that the expectations for the range of potential outcomes would be more in line with what can realistically be measured.

It is entirely a construct of energy efficiency policy in California that the impacts of efficiency programs can or should be known and attributed with such high levels of statistical confidence and precision. In many cases where public funds are spent for useful purposes, the likelihood of positive outcomes is considered to be a sufficient criterion. For example, the range of possible costs and benefits, high and low, can be quantified. Then, a probabilistic assessment of the likelihood of high, low and mid-range outcomes can be made. In this manner it is possible to make decisions while relaxing the expectation of precision in measurement (Freeman, 2003).

5. Consider co-benefits of energy more explicitly in assessing the benefits of programs.

Energy efficiency programs are being embraced by policymakers for reasons beyond reducing load impacts – reduction of greenhouse gasses is primary among these goals, but job creation, health benefits and reducing pollution are also goals. The framework used to evaluate net benefits from the programs conceptually allows for co-benefits to be considered, but policy decisions have minimized efforts in this area. In order to align the evaluation and regulatory framework with the actual expectations for energy efficiency, the value of co-benefits should be more explicitly included. Simply adding the value of carbon while the price for trading is low and trading mechanisms have yet to be fully developed may not be sufficient to drive the increases in efficiency that are warranted in order to reduce consumption. The notion that in the future, marginal supplies will come from more expensive renewable energy also raises the avoided cost, rendering efficiency more cost-effective over time (though differential effects on pollution reduction must also be considered). Furthermore, carbon emissions are just one of many environmental damages caused by electricity generation and natural gas use. Traditional generation produces atmospheric emissions of pollutants including particulates, nitrates, and sulfates; ecological disruption caused by resource extraction, dams; and radioactive waste from nuclear facilities. There is nothing to preclude valuation of co-benefits from efficiency in a manner interpreted broadly to reflect the full value now of increasing energy efficiency options in service of longer term goals to reduce activities that cause these negative outcomes.

6. Focus more evaluation resources on formative research to improve the programs.

Relaxing requirements for and expectations regarding precision in evaluation would allow more resources to be spent on formative evaluation to aid in achieving better program results. Peters and McRae (2009) are among those highlighting the importance of increasing the percent of evaluation resources dedicated to formative work, which will increase the scarce human resources available to examine and better understand the ever smaller "niche" energy efficiency opportunities that we seek to tap. Increasing the formative effort will be crucial to maintain or even improve the cost-effectiveness of our energy efficiency efforts, by enabling programs and portfolios to continuously adjust to the changing context to maximize results.

7. Find ways to facilitate opportunities with good potential outcomes that are not supported in the current system.

Early efforts can draw from the experiences of other areas and/or carry out pilot evaluation efforts. These pilots will help test methodologies and metrics. Carrying out frequent assessment of broad market conditions will be useful. More in-depth market characterizations will help to inform program implementers how to work with the market actors that they seek to leverage. Ongoing monitoring of market conditions, of market allies needs and perspectives about current and/or proposed offerings will facilitate the leveraging of efforts and enhance synergies among them.

Conclusions

New policies and metrics need to be developed to track and reward administrators of public resources for successful efforts. Focusing only on how much energy savings can be attributed to portfolio administrators has stretched evaluation beyond its capabilities in the 2004-2008 program cycle in California. Current evaluation practice has focused too many resources (especially limited human resources) on summative, widget-focused activities for purposes of determining earnings, detracting from the value that timely evaluation can provide for other needs such as improved program design and implementation. This has limited the types of interventions that can be pursued, just at the moment when more creative approaches to reducing energy consumption are warranted.

Policy should enable and welcome collaborative ventures where public resources help "oil" private enterprise efforts to promote energy efficiency and conservation. The current paradigm for evaluating energy efficiency interventions is due for a major overhaul. The sooner that evaluators and policymakers acknowledge the need to work on its replacement, the better that the industry will be able to garner at least an order of magnitude increase in energy conservation and efficiency that will enable us to more effectively mitigate the impending impacts of global climate change.

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