A Fresh Look at Evaluation to Support Energy Efficiency in the 21st Century

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ABSTRACT

As a society we need to quickly and effectively move towards economic, social, political, and environmental energy sustainability. The growing effects of global climate change (GCC) make it imperative to achieve significant de-carbonization of our economy immediately.

Energy efficiency offers the most cost-effective and socio-enviro-politically acceptable solution to help de-carbonize and reduce the energy resources society uses. The challenge that we face is how to best support accelerated societal uptake of energy efficiency.

Energy efficiency evaluation plays a key role to develop ever more effective and context-aligned public energy efficiency interventions. For this, both formative and summative evaluations are needed. More importantly, we need to ensure that the paradigms and methods used for evaluation are aligned and supportive of societal and market evolution towards a resource efficient culture.

This paper builds upon previous work to focus on the need to rethink the paradigm that currently governs attribution evaluations. We need to move away from a framework focused on net-to-gross (NTG), especially if only based on free-ridership (FR) where for full credit, your intervention needs to be both necessary and sufficient. The context under which this attribution paradigm was useful has changed. This paper, using examples that illustrate the next phase of energy efficiency, shows how the "necessary and sufficient" attribution paradigm has outlived its usefulness and suggests some options to consider.[1]

Introduction

Public energy efficiency interventions are at an all time high, encompassing several billion dollars in the USA (Molina et al. 2010). There is worldwide interest in using energy efficiency to deal with competitiveness, energy security, jobs, and environmental concerns—especially global climate change (Holdren 2006; Rodriguez & Friedmann 2009). These publicly supported interventions are taking place in an increasingly more crowded field of energy efficiency activities where the private sector is deploying significantly larger resources.

Ignoring this increasingly larger mix of private and public actors only leads to suboptimal results for public interventions. The potential for leveraging private actors' capabilities and much larger resources is huge. Worse, public efforts are increasingly at odds with the ultimate goal of establishing a mature, self-sufficient, energy-efficiency marketplace (Friedmann 2006, 2007; Friedmann & Dickerson 2009; Friedmann & James 2005).

Evaluation policies, procedures and methods are at the core of a program administrator's aversion to leveraging private actor's capabilities. Evaluation too often focuses on establishing causal relationships for the public interventions. This emphasis on causality leads to program administrators shying away from interventions where it is harder to establish such causality relationships, such as those that foster and leverage private market actors' capabilities. It is time to critically review evaluation

[1] Sufficient here means that the intervention resulted in the observed energy savings. A necessary action in contrast would still need other actions to get the observed energy savings.

practices and regulatory policies to ensure they support publicly-funded programs that seek to further accelerate societal uptake of energy efficiency. The situation facing evaluation today, where there are adherents and detractors to the need to modernize its approach and methods is typical of paradigms confronting the need to change (Kuhn 1962). Can only hope that the evaluation community can quickly work together to develop a new consensus paradigm and methodologies.

Business-As-Usual (BAU) Paradigm – Increasingly Problematic

Business-as-usual energy efficiency public interventions and evaluations are in an agonizing death spiral. We need to acknowledge our success in establishing an increasingly mature energy efficiency marketplace, and find ways to leverage it. To continue to assume only public programs are promoting energy efficiency and ignore the increasing array of market actors engaged in this arena will: 1. Result in less successful interventions that do not leverage other's efforts; and 2. More expensive and contentious evaluations to attribute savings to a specific intervention. We need new and expanded energy efficiency interventions that leverage other market actions to significantly accelerate and expand energy efficiency adoption. Given that what you measure affects what you do, we need to modify our evaluation paradigm and regulatory policies so that they lead to actions that are aligned with public policy objectives. More evaluation resources are needed to optimize and track the success of attempts to fully exploit synergistic effects between public and privately funded energy efficiency interventions

Business-as-Usual: Decreasing Bang-for-the-Buck From Programs

Current public expenditures on energy efficiency are about $6 billion (Molina et al. 2010). They have been increasing significantly recently, as a result of a heightened awareness and recognition that pursuing "negawatts" is the cheapest and most desirable option to address the many social, political, and environmental crises that result from our relentless appetite for energy to produce a growing array of products and services.[2]

At the same time, we see decreasing energy savings for each dollar spent. The cost of saving energy is inching upwards from under 3 cents/kWh to somewhere between 3 and 5 cents/kWh. Easier to tap opportunities, based on single widget replacements with more efficient options (e.g., incandescent lights with compact fluorescent lamps) are reaching a level of market maturity that leads to questions about a large public spend to bring these to full market maturity. Ever more stringent building codes and appliance minimum energy performance standards result in reduced energy use per volume of building or piece of equipment, reducing future energy saving opportunities at the next building retrofit or widget replacement.

Business-as-Usual: Decreasing Accuracy and Precision of Evaluation

Current impact evaluation practice seeks to ascertain the counterfactual to determine the net savings attributable to an energy efficiency intervention. Although this is a laudable goal, in reality it tends to fall short with significant uncertainty on both accuracy and precision. Long term efforts in the marketplace have been successful at creating a broad spectrum of energy efficiency market actors. It is this same relatively mature energy efficiency marketplace that makes it very difficult to apportion the energy savings accurately and decisively among the multitude of market actors. In the past, when the program administrators were the sole or at least the main promoters of energy efficiency uptake by customers, it was easier to link activities such as an incentive payment to a customer's actions and

[2] The term "negawatts" is used when talking about energy savings that save "watts".

consequent energy savings. As energy efficiency programs succeeded in accelerating the evolution of an increasingly more complex energy efficiency marketplace, determining causality and attributing savings to specific actions became more difficult. Attribution was further complicated by the increasing societal attention to the environmental, social, political, and economic impacts from increased energy use. The resulting changes in customers' and market actors' awareness of global climate change, corporate social responsibilities, and economic and political implications of a reliance on foreign energy have all led to important changes in how consumers and market actors relate to energy. At the same time we are witnessing increased support for public spend to foster faster, deeper and broader adoption of energy efficiency. Publicly funded energy efficiency portfolios have become more complex, typically offering a variety of services and products to customers and increasingly seeking to leverage market actors' efforts. With these changes, the capability of attributing energy savings to specific interventions has become difficult and problematic.

Is BAU Impact Evaluation Based on Free-Ridership (FR) and Net-to-Gross (NTG) Meaningful Today?

NTG and FR are key aspects of net impact evaluations seeking to determine energy savings attributable to specific energy efficiency interventions and thus, their cost-effectiveness. Treating interventions as stand-alone efforts ignores the reality that they are deployed in a context with a milieu of supporting, competing and/or antagonizing messages and choices. In the end, attribution results are at best contentious and most likely inaccurate and imprecise and not very useful.

Under BAU evaluation there is an assumption that customers face at the core four key barriers to adoption of more energy efficiency: awareness, availability, accessibility, and affordability (Friedmann 2006; Friedmann & James 2005). Public interventions seek to overcome these barriers and hasten the market evolution of a new product or service following Rogers' technology adoption curve (see Figure 1) (Rogers 2003).

Even if we believe that products follow this societal adoption curve, with early adopters followed by early majority and finally laggards, we see that the value of FR changes dramatically as markets evolve. Early adopters would have a very high likelihood of energy efficiency uptake. Surveys of their likelihood to adopt would lead to very high FR values. Yet, without there being an availability and accessibility to these products, early adopters might not be able to find and purchase them. As the market continues to evolve, we reach the early majority (between points A and B in Figure 1) of customers. These customers need more prodding and support in the form of information and incentives to reduce the first cost to take action. With this market evolution, we see the FR value decrease significantly as we leave the early adopters and enter the early majority, and later begin to increase as the energy efficiency product becomes more mainstream. Yet, there is always a significant portion of the population (the "laggards") that will only adopt the more energy efficient technology if codes or standards make it the only choice. These laggards have a low FR, as none of them will adopt the energy efficient technology if given a choice.

In BAU evaluation, a single value of FR and NTG is used to characterize the attribution of energy savings to specific interventions.[3] It is important to realize that the market is always composed of early adopters, majority and laggards. Under this simplified scenario, FR could be a useful metric that indicates where a product's market evolution is. This can enable programs to shift their intervention strategies accordingly. Public energy efficiency interventions would go from mostly awareness campaigns for early adopters, to adding financial support to improve availability, accessibility and

[3] In this discussion, NTG = 1-FR to exemplify more clearly the issue. Some jurisdictions add spillover (i.e., what participants and sometimes also non-participants adopt outside of but due to the energy efficiency intervention).

affordability to entice the majority to adopt, and finally using new codes or standards to ensure laggards adopt. Furthermore, in today's world where consumers face a multitude of influencing factors affecting their decisions, NTG and FR as indicators of a specific intervention or program's value does not seem valid (Friedmann 2007; Peters and McRae 2008). There is too much "noise" to "signal" going on to be able to accurately and precisely determine FR and NTG.

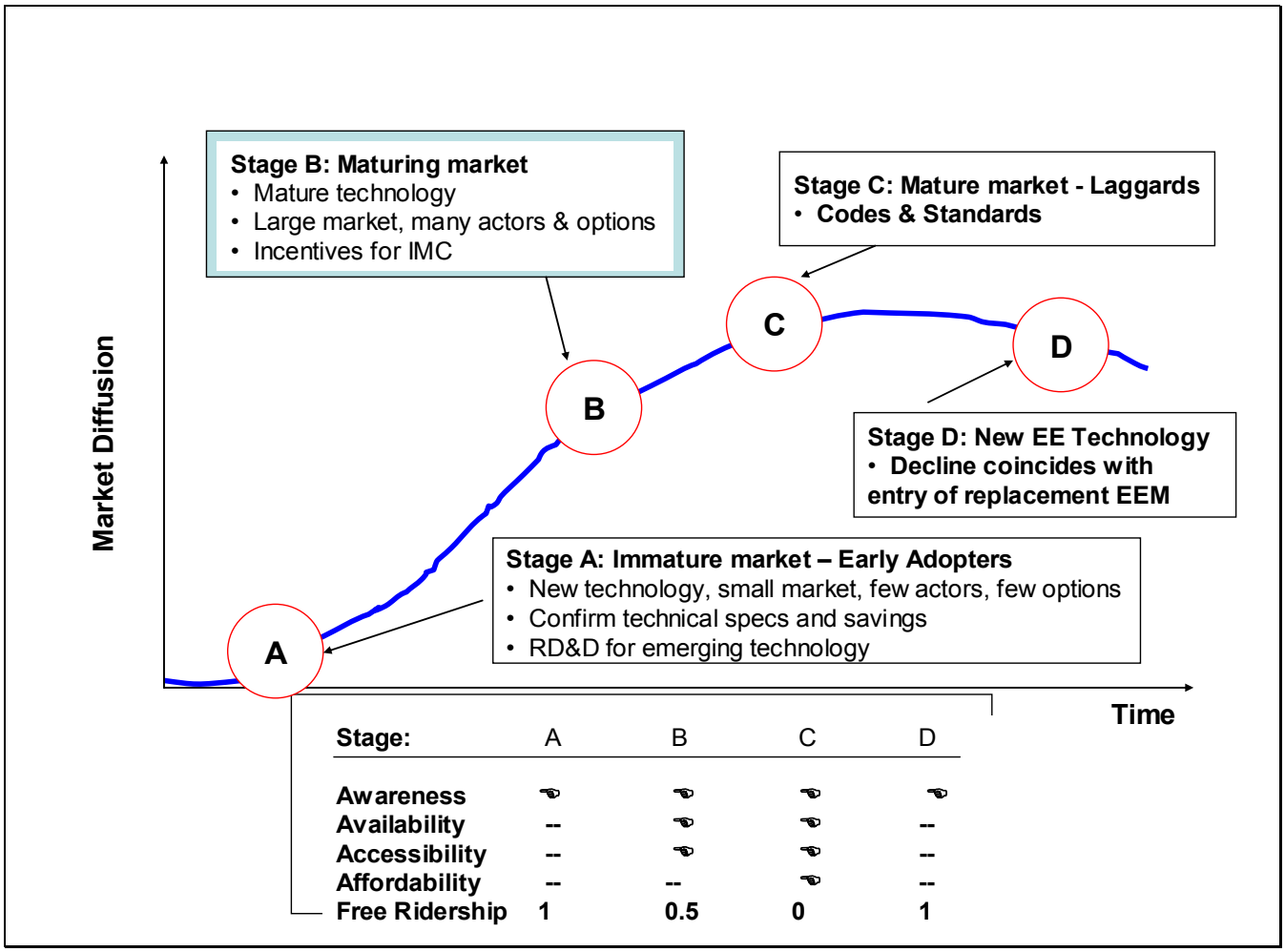

Figure 1. Technology Adoption Curve and Key Customer Barriers to Adoption and Free Ridership

What Improvements do we Need to do to Energy Efficiency Evaluation?

Energy efficiency evaluation needs to expand to allow for and support the evolution of new types of publicly funded energy efficiency interventions (see below for some illustrative examples). A new evaluation paradigm is needed for these new types of public interventions that seek to value the leveraging of other market actors' efforts and capabilities, and longer-term strategic partnerships initiated to tap more energy efficiency opportunities. The success of an intervention or program should be based on how well it leverages these capabilities and resources across multiple actors to help markets evolve towards self-sustaining energy efficiency. Without this key change in the evaluation paradigm, risk-averse public energy efficiency fund administrators will, at best, dabble with these new types of efforts leading to suboptimal results.

Isn't "Necessary" Sufficient?

At the core, our current evaluation paradigm requires interventions to not only be "necessary" but also "sufficient" for the desired outcome to give them full credit. We propose moving to a paradigm that instead focuses on measuring how well interventions or programs are achieving the desired gross outcomes. Under this paradigm, full credit accrues to interventions that contribute to the ultimate result and are therefore deemed "necessary". In essence, it acknowledges that an intervention that contributes to the ultimate result and is deemed "necessary" should get full credit for the observed energy savings.

To confirm the full value of the intervention or program, evaluation methods based on a preponderance of evidence can be used to review and adjust as needed program theories and logic models, ensuring that interventions stay current with changing market conditions and opportunities. Developing broad, consensus market evolution indicators and methods to estimate these could potentially be used to confirm the value of the intervention. These indicators would ensure that public interventions are designed and positioned to work together and leverage all the other market actors' efforts to maximize energy savings results with minimum public effort.

Making Public Investment in Energy Efficiency More Effective

Various jurisdictions in the USA have more than a quarter century of experience promoting energy efficiency. This has resulted in an increasingly more mature energy efficiency marketplace of manufacturers, retail chains, key trade allies, and other experts who can identify and implement ever more complex energy efficiency systems overhauls rather than one-at-a-time widget replacements. Major multinational and national corporations face increasing public pressure to demonstrate good corporate responsibility and/or environmental stewardship. Indeed, Wall Street increasingly rewards being "green" and avoiding controversial reliance on non-renewable energy resource investments. Companies are finding that reducing resource inputs and waste bolsters the bottom line, making companies more profitable and better able to survive downturns in the business cycle. The "Green Economy" has been one of the few arenas with significant growth during the latest recession, including venture capital inflows. For example, energy efficiency related businesses employed about 73 thousand people in 2007. Approximately $944 million of venture capital was invested in this space between 2006 and 2008 (Pew 2009). Interest in energy efficiency continues to grow with significant increases expected in the coming years (Tweed 2011).

So what would this leveraging of the energy efficiency marketplace and tapping into business models established over these past few decades look like? Two examples of this can be found in California.

Becoming the "Oil" Instead of the "Machinery" in the Energy Efficiency Market

With increased maturity in energy efficiency markets, traditional program administrators have the opportunity to move from being the "machinery," to becoming more the "oil" in the machinery, and letting other market actors be the 'machinery" (Friedmann 2006; Perich-Anderson & Friedmann 2008). The energy efficiency program administrator's role will shift from one where it is the major and usually sole intervener in the market to one where it seeks to set up strategic partnerships with other market actors. The goal of these strategic partnerships is to jointly provide market pull/push interactions to help market actors succeed at engaging consumers to adopt significantly deeper and broader energy efficiency services and products.

Public interventions must also seek to leverage consumers' self-interests that can result in increased energy efficiency uptake. Interventions need to demonstrate that saving energy aligns with

other personal and business objectives, leading to long-term agreements and/or relationships with major customers that develop into a culture of sustainability.

Going After Mass Markets: Business Consumer Electronics and Large Retailer Programs

Mass markets are typically comprised of end-users who are residential consumers and/or small-medium sized businesses. The energy efficiency opportunities for individual members of a mass market may be small but the number of members is huge, resulting in substantial energy savings potential in aggregate. Lighting is one of the most obvious efficiency opportunities—and the one that has garnered the most focus at utilities. Compact fluorescent lamps (CFLs) and tubular fluorescent lamps (T5s and T8s, or T-8/5s collectively) have been the "low-hanging fruit" for efficiency gains. Moving from downstream (end-user direct) rebates to upstream (retailer, distributor, or manufacturer) rebates has proven to be a key new strategy to make better use of rebate dollars by reaching end-user customers through point-of-sale materials in retail locations. Upstream lighting programs have led to sustained changes in wholesale stocking behavior and retail buying habits. In fact, some argue that basic CFLs and T-8/5s are close to having self-sustaining markets and that utility programs are no longer necessary. Others propose a different perspective on market transformation of CFLs (Ettenson & Long 2010).

Publicly-funded energy efficiency programs—at least until recently—have focused on mass markets by fostering consumer awareness and by providing incentives for the purchase of energy-efficient products. ENERGY STAR®-based programs are an example of this strategy. In some cases, incentives were paid directly to customers after they purchased the equipment. In other cases, incentives were paid either to mid-stream vendors (typically for HVAC) or even upstream to manufacturers (CFLs). By moving programs upstream, it was hypothesized that the manufacturer- or retailer-targeted incentives would lead to much larger retail price reductions and greater consumer acceptance of these products.

Pacific Gas & Electric (PG&E) has implemented a new program and a related large retailer outreach initiative that seek to build synergies in the marketplace though partnerships with other program administrators and retailers. PG&E's Business and Consumer Electronics Program (BCE) and Large Retailer Initiative (LRI) engage major retailers to address the growing electronics-related plug load challenge while expanding the efficient appliance uptake. Electronics currently account for more than 11% of residential electricity use and almost 8% of non-residential U.S. electricity use and are growing. Through these programs, public funds from utility customers are combined with the endorsement value of PG&E to significantly change the products retailers buy, stock, and promote (Mitchell-Jackson & Dougherty 2009).

Groundwork for the BCE program began late in 2006 when PG&E issued an unpublished white paper (PGE 20006) entitled "Consumer Electronics: Market Trends, Energy Consumption, and Program Recommendations 2005-2010." PG&E had observed growing sales of digital TVs, particularly those of larger sizes and high energy consumption. Given the falling price points of these units, the size of rebates that utilities could offer consumers was unlikely to be successful in shifting purchases to more efficient units. For example, a rebate in the range of $5 to $20 would not be sufficiently large so as to affect a customer's purchase decision for a product costing hundreds or thousands of dollars.

Meetings between PG&E, other regional utilities, and major retailers of televisions and computers followed in 2007. Thereafter, PG&E partnered with QDI Strategies to offer retailers incentives to stock energy-efficient models that exceeded ENERGY STAR tiers. These upstream incentives, of similar magnitude to those being contemplated for end-users, offered far greater market leverage when applied upstream where they represented a substantial portion of the net profit retailers made per unit on retail sales of TVs. The BCE program grew quickly once word spread in the retailer community and PG&E was able to negotiate contracts to support retailers' purchases of more energy-

efficient equipment. At the same time PG&E was growing its retailer base, the utility reached out to other program administrators (e.g., Southern California Edison, Sacramento Municipal Utilities District, and the Northwest Energy Efficiency Alliance) to coordinate efforts. This consortium resulted in a larger market for the initiative and substantial amounts of public funding. As a result, more retailers became engaged. The TV energy-use tiers qualifying for incentives are frequently raised to more stringent levels in response to rising average efficiency standards of retail units so as to stimulate transformation of these retail markets.

The BCE program has been very successful. It has evolved into a partnership that includes four program administrators that together represent more than 10% of the national market. There are now more than a dozen retailers and distributors participating. As a result of program efforts and ongoing transformation of these markets, the efficiency of TVs being sold in the U.S. has improved dramatically over the past three years with a reduction of plug load of about forty percent. The U.S. Environmental Protection Agency's (EPA) ENERGY STAR Program has moved to increase the efficiency levels required for the ENERGY STAR rating to approach those required by the BCE program.

Given the success of the BCE program, PG&E is now expanding this upstream model to engage major retailers in longer-term agreements that cover a wider array of product categories. This expansion will enable PG&E and other program administrators involved in the consortium to leverage and partner in unison rather than through separate initiatives. This effort will lead to increased retailer efficiencies as well as uniformity in qualifying tiers and rebate levels.

Under the current evaluation paradigm, efforts to capture mass market energy efficiency opportunities by leveraging large retailers' market presence and purchasing power in an upstream fashion are facing attribution challenges. First, it is hard to ascertain with any degree of certainty what large retail chains would have purchased absent the utility rebates. Given the recent trend for large retailers to position themselves as "green" and/or "sustainable" and "good corporate citizens", it becomes increasingly difficult for IOU-led efforts to substantiate their unique role in transforming the market and to prove attribution related to program efforts. Still, these large retailers participating in utility programs will confirm that, absent the utility endorsements and incentives (that can as much as double their net profit), they would not have asked manufacturers to build more energy-efficient products. Unfortunately, retailer affidavits are seen by evaluators as conflicted; they stand to lose substantial financial incentives if they do not confirm the influence of utility programs on their buying decisions. Furthermore, the current evaluation paradigm seeks to ascertain what impact the incentives had on end-user purchase decisions. The need to substantiate downstream influence is at odds with the use of upstream or midstream incentives that seek strategic relationships with manufacturers and/or retailers.

The current evaluation paradigm makes program administrators shy away from using upstream or midstream incentives, even when, tactically, they have been shown to be very effective at changing the market and reducing administrative costs. To support program administrator's interest in pursuing midstream or upstream interventions, the evaluation community has to develop broad, consensus indicators and methods to track these, to confirm the value of these market-leveraging interventions.

Going After the Largest Customers: Continuous Energy Improvement (CEI), Superior Energy Performance (SEP) and ISO 50001

Larger customers present special challenges to accelerate their adoption of energy efficiency. Although in many cases they have access to capital and engineering expertise, they have complicated decision-making involving various levels in the institution, and a focus on staying competitive and/or increasing market share and production. Energy is usually a small percentage of their costs (McRae &

Peters 2008; Reed 2007; Russell, Rock & Cobb 2009; Stein 2006; Sullivan 2009; Tiedemann & Sulyma 2009).

Traditionally, these markets were mostly tapped via utility Account Service Representatives (ASRs). The ASRs dealt with their assigned customers' energy issues, mostly billing questions and ensuring adequate supply to maintain services and production. These customers were offered technical support and financial incentives to improve energy efficiency at specific sites.

More recently, there has been a realization that engaging these customers via strategic partnerships that seek a longer term focus on energy management across all of their operations is likely to result in broader, deeper, and accelerated attention to improving their energy efficiency (Reed 2006; Russell, Rock & Cobb 2009; Sullivan 2009; Tiedemann & Sulyma 2009). Both CEI and SEP seek to get large companies to establish an energy management structure within the organization and to set clear, long-term savings goals with metrics that are periodically evaluated to ensure progress.

The upcoming ISO 50001 seeks to certify facilities and firms adhering to the SEP principles, endeavoring to make this ISO as well known as others in the environmental and quality fields (ISO 14001 and ISO 9001). Such worldwide recognition via ISO 50001 would likely confer competitive advantages.

Where CEI and SEP differ from past practice is in the formal agreements that are developed between the energy efficiency program administrators and the largest non-residential customers. Whereas in the past many of these customers had long-term relationships with utility ASRs, the focus was not on energy management across the enterprise. Instead, specific projects for individual sites were pursued, often as addendums to major facility retrofits already being considered.

CEI and SEP will enable much better evaluation of the long-term involvement by energy efficiency program administrators in helping large non-residential customers save energy. Documentation on how success with smaller projects led to more complex ones was often missing in the past. Personnel turnover only made it harder to understand how a project or projects came to happen and the decision-making processes and hurdles involved. With CEI or SEP, much better documentation will exist to track how a company and its facilities improve their energy management and save energy.

Under the current evaluation paradigm that takes the narrow attribution view of requiring a "necessary" intervention to also be the sole "sufficient" intervention for full credit, programs like CEI and SEP will likely get a low attribution score. As corporations move towards "greening" themselves, and CEI or SEP help them achieve this, including changes to their mission statements to encompass "environmental stewardship and sustainability", future IOU-led efforts as part of the CEI or SEP partnership may come into question regarding their "additionality" to the end result. Thus, CEI and SEP would, under the current paradigm, get low attribution scores for any actions the now "greener" companies undertake. The program administrator would be penalized for leveraging these efforts and for contributing toward the creation of a culture of sustainability. Again we see the need for the development of broad, consensus success indicators and methods to track these that are appropriate to the intervention strategy being undertaken.

Conclusions

The implications of continued BAU versus a move to a new evaluation paradigm are enormous. A major shift is needed in how we evaluate and run public programs that seek to get society to adopt all cost-effective energy efficiency as rapidly as possible. An in-depth examination of what effective public governance means and a focus on how to re-deploy and maximize increasingly smaller public resources to leverage increasingly larger private sector efforts is required.

For evaluation, a shift is needed away from current efforts focused on net savings from specific interventions and programs, towards evaluation that focuses on confirming that these efforts are helping evolve markets and practices in the context of increased resource efficiency and reduced energy consumption. This will require re-examining the use of the NTG and FR paradigm so that these metrics provide useful feedback about how public resources are allocated. Moving to a paradigm that at times accepts "necessary" and doesn't require also "sufficient" for full attribution is crucial.

Modernizing evaluation will enable public energy efficiency fund administrators to add new interventions to their portfolios that seek to leverage and/or engage in long-term relationships with both major market actors and consumers. Today, these administrators bear the risk that their efforts will not get full credit if evaluated with the old BAU paradigm. Yet these interventions offer much promise to significantly increase the uptake of energy efficiency in contrast to ever diminishing returns from BAU one-widget-at-a-time efforts.

Most importantly, the sooner we develop these new indicators and begin to measure them, the sooner we will be able to confirm that these interventions that seek to leverage those of other market actors, indeed do lead to more cost-effective energy savings with public spend. Insisting on using NTG and FR to attempt to estimate net savings effects from increasingly more complex portfolios and market conditions will only lead to continued waste of scarce evaluation resources, keep us from trying these new interventions in earnest, and reduce the potential to save significantly more energy.

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