Market Transformation, Codes and Standards, and the Attribution Dilemma

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ABSTRACT

The energy use of nearly all types of buildings and all types of appliances and equipment is currently regulated by stringent energy efficiency requirements and codes. While we take this for granted today, energy codes did not exist as recently as 45 years ago. In this short timeframe, energy use resulting from codes has dropped dramatically. Does this mean that energy codes are an unqualified success? This paper revisits the context and rationale that led to the existing code process, and discusses why we should reconsider the limitations of the regulatory framework for codes and standards in today's vastly changed energy landscape. This paper examines and questions the current California attribution model that credits all of the code savings to those involved with the code development process. We discuss the risks of continuing to give little to no credit to, or even punishing, those who transformed the market in order to pave the way for measures to become code: some of the contributors of the market transformation subsequently have their program savings potential slashed. While it may be difficult to accurately identify the quantitative contribution for individual entities, it should not preclude some credit given to each contributor. Various scenarios for attributing the cause of measures getting into code are examined. There is a compelling case for an energy policy framework that motivates coordination of energy efficiency, codes and standards, and market transformation to produce a truly comprehensive energy portfolio that would be able to achieve all savings potentials.

Introduction

The purpose of this paper is to begin a discussion of high priority issues currently facing California's portfolio of energy efficiency programs. These issues are complex and cannot be fully addressed within this short paper. The authors will, however, attempt to provide the historical background and conceptual foundations of these issues, with hopes that the recommendations that are made in this paper will trigger and elicit further discussion.

History of building codes. The first known building code was contained in the Code of Hammurabi (Lotha, 2018). This code was a collection of Babylonian laws developed during the reign of Hammurabi (1792–1750 BCE) of the 1st dynasty of Babylon. The specific codes relating to buildings was 229 to 233. The most prominent was 229 that set the tone of the other codes: "If a builder builds a house for someone, and does not construct it properly, and the house which he built falls in and kills its owner, then that builder shall be put to death" (Lotha, 2018).

Building codes since the time of Hammurabi continued in the theme of emphasizing life safety to keep building occupants safe from fire, structural damage, unhealthy indoor environmental quality, and to provide safe exiting from buildings. Many of the life safety codes were developed empirically as a result of tragic accidents that caused loss of life or injuries. Over the past hundred plus years, several building-related codes have been developed for such things as electrical, plumbing, heating, cooling, and ventilation; all with emphasis on life safety.

History of building energy codes. Unlike building codes that have existed for over 3,700 years, energy codes did not exist as recently as 45 years ago. However, in that short time span, energy codes have become ubiquitous. The building industry has largely embraced energy codes, but a few treat them as a lower priority because they are not perceived as critical to a building's life safety priorities. While this may reflect pragmatic thinking, it does tend to ignore long-term effects of energy waste in buildings on global climate change which some consider to be a life safety issue of equal priority.

One of the key triggers that brought energy use into the forefront was the 1973 oil embargo by OPEC (Organization of the Petroleum Exporting Countries) (ASE, 2013) which caused gasoline shortages and consumer panic resulting in gasoline hoarding and long lines at gas stations. Federal policies soon followed that were aimed at reducing energy use in the transportation, appliances, and building sectors. A couple of the highlights of the progression to energy codes included the ASHRAE voluntary consensus 90-75, Energy Conservation in New Building Design standard, and the US Department of Energy BEPS (Building Energy Performance Standards) (Shankle, 1994). The BEPS was passed by the US Congress to become code, but was opposed by the building industry and ultimately vetoed by the president.

Meanwhile, in California, Public Resource Code (PRC 25402) was passed by the California Congress and the Warren-Alquist Act was signed into law by Governor Ronald Reagan in 1974. PRC 25402 addressed the reduction of wasteful, uneconomic, inefficient or unnecessary consumption of energy. More specifically, it regulated lighting, insulation, climate control system, and other building design and construction standards that increase the efficiency in the use of energy and water.

The Warren-Alquist Act established the California Energy Commission (CEC) that developed the Residential and Nonresidential Building Energy Efficiency Standards that were first adopted in 1978. These Standards are Part 6 of California's Title 24 suite of building codes, but are generally referred to in shorthand as, "Title 24." Compliance with Title 24 is required for all new building permits with a few exceptions.

The Warren-Alquist Act featured a key provision that requires updates to Title 24 every three years. These updates are key to recognizing the pace at which research, technology, design practices, and construction practices can progress. To ensure that Title 24 does not get ahead of the building industry, the Warren-Alquist Act requires that Title 24 in its entirety is cost-effective on a life-cycle basis (30 years for residential and 15 years for nonresidential) and only relies on technologies that are available in the marketplace, and feasible to construct. Despite these constraints, Title 24 has been able to steadily improve and reduce building energy use for each three-year code cycle since its inception. See Figure 1 that illustrates the progress of Title 24 reflecting the concepts of continuous improvement and the effects of market transformation.

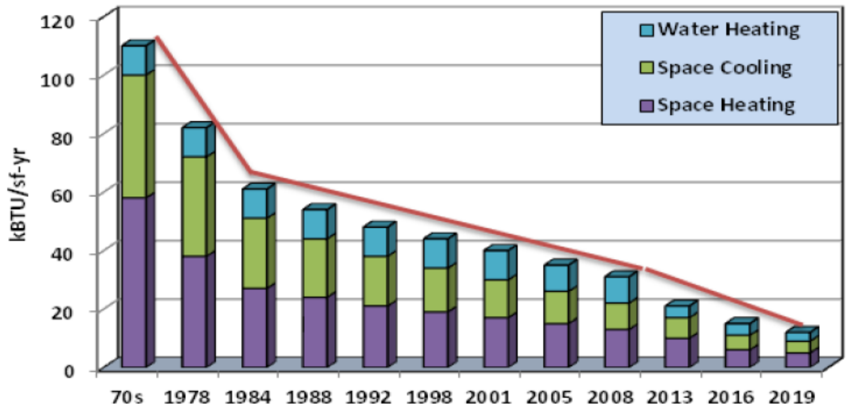

Figure 1. Reduction in energy use intensities resulting from continuous improvement resulting from the effects of market transformation *Source:* CEC. 2019

After a few Title 24 code cycles that proved the effectiveness and market acceptance of building energy codes, the federal government was able to pass the Energy Policy Act (EPAct) of 1992 that established ASHRAE 90.1 (successor to ASHRAE 90-75 explained previously) and the ICC (International Code Council) MEC (Model Energy Code, subsequently renamed IECC (International Energy Conservation Code)) as national building energy codes for nonresidential and residential buildings, respectively. EPAct 1992 allows states to either adopt 90.1 and IECC or certify to the DOE that their state energy code meets or exceeds these codes. California continued developing Title 24 and, in the few code cycles after EPAct 1992, was able to far exceed the national codes. However, in the past few code cycles, the national codes began to catch up and Title 24, in a few cases, struggled to stay ahead (see Figure 1 for the large change from 2008 to 2013).

The national building energy codes generally did support higher levels of energy savings, but without an effective means of enforcement, there are many states that have not adopted 90.1/IECC, nor any energy code. Therefore, the longer-term effect on the rest of the country is still unknown, but there has been a slight indication that the gap may be closing as seen in Figure 2.

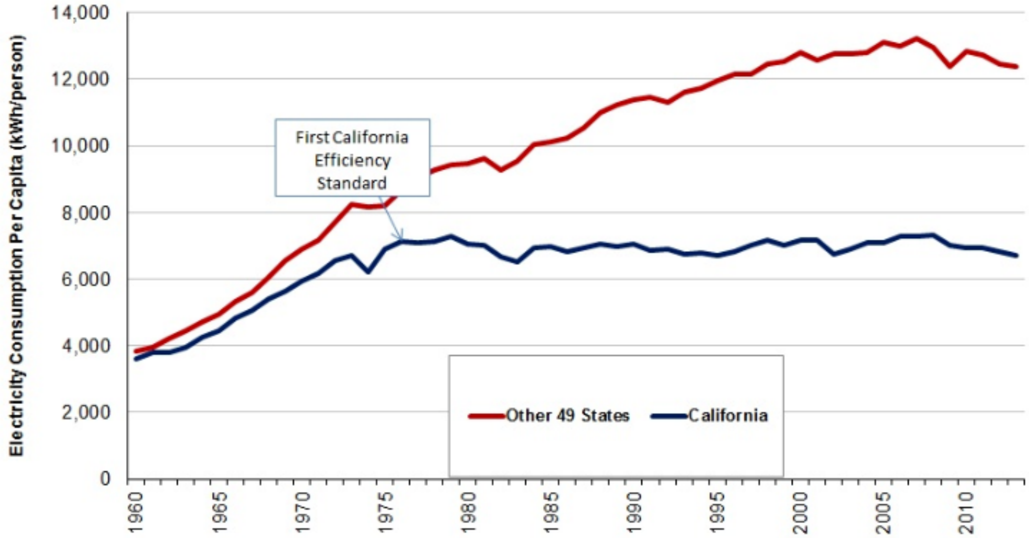

Figure 2. – "Rosenfeld Graph" Title 24 and other Efficiency Programs Helps Keep Per Capita Electricity Use Flat. *Source:* (Carter, S. 2017.)

Market Transformation. There have been a number of energy efficiency breakthroughs including the commoditization of improved technologies such as LED lamps, dimming fluorescent ballasts, low-e double-glazed windows, cool roofs, and variable capacity heat pumps. Other improvements include advanced construction practices to increase building enclosure insulation and reduced air leakage, more comprehensive energy simulation tools, integrated design practices, and functional testing requirements. These advances contributed to energy use reductions that caused buildings to drill down below the previous limits of "maximum achievable technology."

While the evidence of this market transformation is generally observable, the underlying cause of market transformation is more complicated and perhaps not as well understood. However, what is clear is that market transformation is potentially caused by several drivers that include public policies, legislation, market demand, technological breakthroughs, and environmental awareness. The relative contribution of each of these factors is debatable and is a function of the technology, process, market acceptance, and a number of other considerations. One commonly overlooked factor is the impact of codes and standards and the interplay between the ET (Emerging Technologies), EE (Energy Efficiency), and Codes and Standards (C&S) Programs.

There is common prevailing notion that market transformation occurs when a code is adopted. The underlying reasoning is the belief that once an EE measure is adopted into code, the market is transformed and the process ends. This "end-point" is considered to be somewhere along the green line (depending on the measure) labeled "Codes & Standards" in Figure 3.

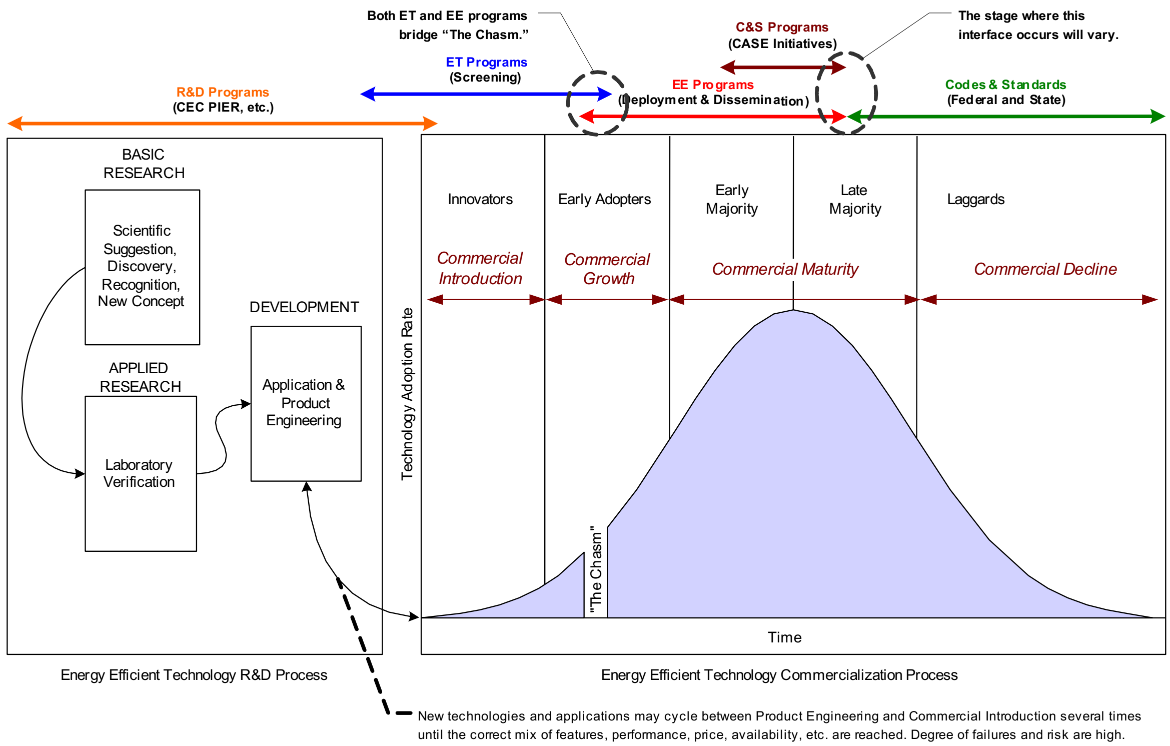

Figure 3. Technology Diffusion Curve. Source: SCE Emerging Technologies Program. 2007.

However, a more nuanced approach may be to consider market transformation as a process or cycle that may begin with R&D and migrates to ET to EE to C&S Programs, and if applicable, back to R&D. This circular depiction is shown in Figure 4.

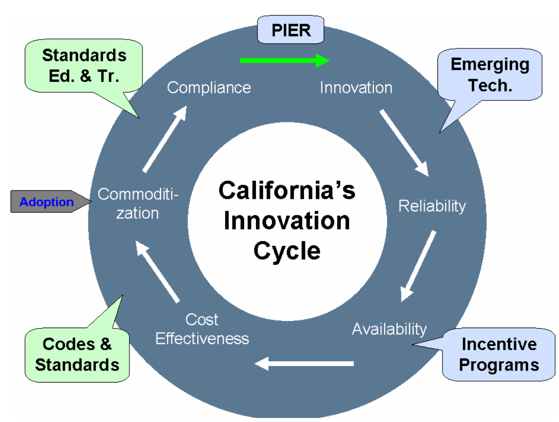

Figure 4. Technology Innovation Cycle. *Source:* PG&E Codes and Standards Program

This circular approach facilitates the framework of continuous improvement where certain measures such as fenestration (aka windows) began in code in 1978 with clear single-pane glass. Over time, glass became tinted to reduce solar transmittance (low SHGC (solar heat gain coefficient)) but absorbed heat and radiated this heat into the occupied space. It nonetheless reduced energy use by reducing cooling loads. Early tinted and reflected glass also had very poor visible transmittance which blocked so much daylight such that electric lights were needed for interior illumination. Over time, R&D breakthroughs in low-e double glazing, which had low SHGC and high visible transmittance, combined with growing market adoption, brought down the cost such that it was sufficiently cost-effective to be adopted into code. This breakthrough in glazing allowed more daylight into buildings and potentially reduced electric lighting energy use. The next iteration of R&D produced reliable and cost-effective daylighting controls and commodity priced dimming ballasts that allowed lights to be dimmed in accordance with available daylight. At present, R&D is being conducted to evaluate the feasibility and cost-effectiveness of a "skinny" triple-pane window that is the same width as a double pane window but with a thin glazing element between the inner and outer glazing elements reducing manufacturing and installation costs.

Attribution Models for "Traditional" Energy Efficiency Programs

A "traditional" energy efficiency program provides monetary incentives for replacing a low-energy efficiency widget with a high-efficiency widget. For most programs, the energy savings is not necessarily the difference in energy use between the two widgets but utilizes a baseline from which energy savings are counted. This baseline had traditionally been the applicable energy code but later transitioned to also include "industry standard practice" (ISP) and to factor in "realization rate" and "free-ridership", which considers the counterfactual condition of what would have been done absent the program intervention. The resulting formula for the savings attribution to the program is therefore:

$$\text{Widget Replacement Energy Savings Claimed by Program} = \left(\text{Widget Code or Baseline Energy Use} - \text{Widget Energy Use}\right) \times \text{Realization Rate} \times \text{Free-Ridership Factor} \times \text{\# of Widgets}$$

Note that energy savings in the above equation are generally expressed as annual energy savings or energy savings over the deemed Expected Useful Life (EUL).

New construction programs have a more complicated attribution issue as there is no incumbent technology to replace and because there are a large number of widgets with project-specific interactive effects. The baseline can also be subject to interpretation even though Title 24 can be used as the baseline. Complications can occur when taking into account the prevailing Title 24 compliance rates and the vintage of Title 24 that should be applied. Current new construction program rules generally use a Title 24 baseline (assuming 100% compliance) and the code in effect when the building is built and not the code under which it was permitted. While this may simplify program administration, it does not reflect the counterfactuals of energy use absent the program.

While there may be a reasonable basis for these attribution rules and policies, there doesn't seem to be a clear connection between the attributed energy savings and customer bill reductions. If the goal of EE programs is to cost-effectively reduce customer overall energy bills including the higher bill surcharges to operate these programs, this may need to be taken into better consideration in attribution models.

Attribution Model for the Codes and Standards (C&S) Program

The C&S Program was originated by PG&E and was initially a non-resource program focusing on advocacy activities to support the CEC. Over time, the other IOUs and some publicly owned utilities (POUs) also initiated C&S Programs that worked in coordination with PG&E. As the C&S program became more successful at saving energy by developing and supporting more stringent codes, it was simultaneously raising the baselines for traditional EE programs thus inadvertently reducing their attributed energy savings and reducing Total Resource Cost (TRC) cost-effectiveness. Yet there was agreement that it was necessary to continue utility participation in the code development process as it supported the overall market transformation process by migrating more measures into code.

To address this issue of the EE programs' dwindling energy savings potentials resulting from more stringent codes, the SCE EM&V organization in 2004 developed a white paper in conjunction with the Heschong-Mahone Group that proposed a process to attribute savings to the C&S Program advocacy effort that would offset the loss of savings from the traditional EE programs (Heschong Mahone Group, 2005). A key point in the white paper was that if utilities were not able to claim savings for their code advocacy work, the continued escalation in code baselines would eventually make cost effective incentive programs mathematically impossible, and ratepayers would lose an important channel for helping them reduce energy costs. The attribution model was adopted by the California Public Utilities Commission with the provision that the CPUC impact evaluators could propose updates to the attribution model. Beginning with the 2006-2008 program cycle, the C&S Program became a resource program with energy savings associated with Title 24 advocacy contributing to each of the IOU's overall EE portfolio savings and TRC. Over time, appliance advocacy savings (state and federal) were also included.

In a nutshell, the top-down attribution model can be depicted as follows:

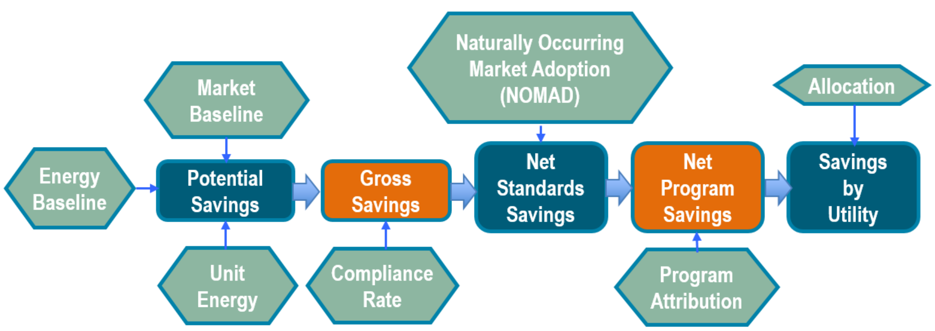

Figure 5. Codes and Standards Program Energy Savings Attribution Model. *Source:* Heschong Mahone Group. 2005.

In this model, the "Energy Baseline" is the prior standard, or the "Market Baseline" of industry standard practice (ISP) if no previous standard existed. Note that the "Gross Savings" and "Net Program Savings" are not exactly the same as for the attribution for traditional EE programs since the NOMAD can be interpreted to express a level of free-ridership. One last item to note is that the "Program Attribution" is based upon the opinions of industry code development experts that are asked to quantify in their best judgement the level of contribution that the C&S Program made to achieve the overall code savings; similar to the counterfactual condition of what savings would have occurred without program intervention.

Over time, the savings attributed to the C&S Program grew as depicted in Figure 6. Once the percentage began to rise close to the 50% level, the savings from C&S Program advocacy came under close scrutiny and the allowable C&S contribution to the portfolio began to be reduced until the current situation, where none of the C&S Program savings contribute to the portfolio savings nor the TRC.

So, we are back to the same situation California faced in 2004: Under California's new Rolling Portfolio, where portfolio level TRC has been set at 1.25, code baselines are continuing to increase while the avoided costs of energy generation, which are a key component in TRC, are rapidly dropping, making the value of EE programs mathematically difficult to justify. California utilities have begun to cancel programs that are no longer cost effective under the portfolio level TRC, to such an extent that third party vendors and ESCOs have petitioned California regulators to order the CA utilities to continue these programs due to fear of job losses (Wikler, 2019). What have we learned from 2004, if anything?

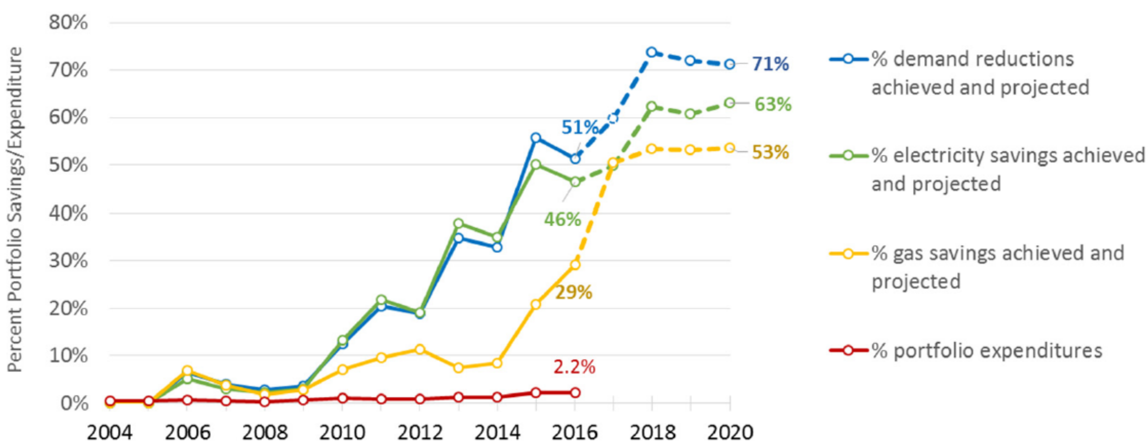

Figure 6. Codes and Standards Program Savings and Budget as Compared to the Total EE Portfolio. *Source:* PG&E Rolling Portfolio Business Plan 2018-2025

Attribution Model for Market Transformation

The CPUC adopted a preliminary framework of market transformation[1] that is heavily influenced by NEEA. NEEA has participated in California stakeholder workshops and shared that their market transformation objective is code change. At that point, they calculate cost effectiveness at the administrator level using a top-down approach, with a numerator based on all energy savings (including code), over a denominator of all program costs. The CPUC's adopted third party MT framework (CPUC 2019) leaves the computation of market transformation cost effectiveness up for future discussions through stakeholder groups, but is initially modelled after NEEA's methodology. This introduction of Market Transformation Initiatives that may also be

[1] California was on the brink of transitioning almost completely to market transformation programs, when the Enron energy crisis hit, and incentive programs became critical to achieving rapid and near-certain energy savings (CPUC 2005).

driving towards code change introduces additional complexities into attribution. In a situation where code baselines already are squeezing EE incentive programs, California needs to carefully consider whether the desire to attribute market transformation contributions as separate from EE and C&S would exacerbate that squeeze.

Problem Statement

The Big Picture. The relationship between EE, codes and standards, and market transformation are inextricably intertwined in ways that complement each other, supplement each other, and in some cases, work at cross-purposes. However, for the most part, they are treated as though they generate savings within silos, when in fact they operate quite synergistically. Part of problem may be due to the fact that while traditional EE and energy conservation programs have been operating for over 40 years, the C&S Program has been a resource for less than 15 years. Further, it is no longer treated as a bona fide program that produces "real" energy savings.

Working at Cross Purposes. As noted previously, the C&S Program saves energy primarily by causing energy codes to become more stringent by supporting and intervening in the code development process. Building codes have life-cycle cost-effectiveness thresholds that must be met by statute. For Title 24, the life-cycle, or EUL in EE terms, is 30 years for residential and 15 years for nonresidential buildings. In most cases, this causes the EUL for codes to be longer than the widget-based or even whole building EULs for EE programs. With everything else being equal, more aggressive EE may be possible from Title 24 than from EE programs. In the relatively recent past, the baseline for EE program energy savings has been code. However, in many cases, the baseline for EE program energy savings is set even higher than code (at ISP levels), and meeting the TRC cost-effectiveness requirements has become more difficult as code become more stringent.

This disparity in cost-effectiveness calculations between Title 24 and EE programs and baselines also sheds light on the cause for the C&S Programs savings to grow while the EE portfolio energy savings shrinks. This problem is further exasperated by the fact that the common understanding that measures are put into code when EE Program measures are retired as shown on Figure 3. However, as also shown in Figure 3, the C&S Program is developing the code change proposals (CASE – Codes and Standards Enhancements) beginning in the "Early Majority phase which overlaps the second half of the EE programs. In one of the 2018 CAECC (California Energy Efficiency Coordinating Committee) meetings, Martha Brook from the CEC summarized the more recent state of codes development by noting that Title 24 had evolved towards a means of establishing "best practices" in building design and construction rather than as acting as a means of sweeping up "market laggards." Assuming this to be true, this would shift the C&S Program activities even further to the left starting in the "Early Adopter" phase of the Technology Diffusion Curve and fully overlaps with EE Program activities. As noted in Figure 3, the stages for the EE and C&S Programs and the interfaces do vary on a measure-by-measure basis.

The overlap between the EE and the C&S Programs has tendencies to cause conflicts and tension. The EE Programs are concerned that measures are put into code too early or that the code becomes too stringent which reduces the EE Program energy savings and resultant incentive levels. This has the effect of reducing the EE Program Portfolio savings and TRC cost-effectiveness. As noted above, this problem was meant originally to be mitigated by attributing energy savings to the C&S Program to offset the loss of savings from the EE incentive Programs, but the allowable contribution of C&S savings to the portfolio has been cut to zero. For this and other reasons, the overall portfolio continues to become less cost-effective, threatening the existence of EE programs.

For the utility customer, this conflict between codes and incentives came to a head when the lighting retrofit industry challenged the Title 24-2016 requirements for simple commercial lighting retrofits. Their concern was that the Title 24 requirements caused retrofit projects to be too costly, and because the higher code baseline, the incentives were reduced. This industry alleged that these impacts caused many lighting retrofit projects to be put on hold or canceled due to excessive payback periods. Due to the pressure exerted by this industry, Title 24 requirements were relaxed.

As Title 24 evolves beyond EE to also include DR (demand response), on-site renewable generation, energy storage, more sophisticated building energy modeling compliance software, and a "move to a more GHG-based metric that promotes electrification," (Shirakh 2018) it is able to transition to a more holistic approach to decarbonization. Therefore, attribution of only EE may no longer be appropriate (especially since C&S Program savings no longer are counted in the EE portfolio), and consideration should be given to migrating from EE to a carbon-based attribution model.

Attribution Methodology Issues. The difference in attribution methodologies and approaches to calculating energy savings widens the chasm between the EE and C&S Programs, and the discussion of attribution methodology for market transformation has not even begun. The lack of alignment between the energy savings attribution approaches has evolved in accordance to the silos in which EE, C&S, and MT has evolved but doesn't reflect the way that they complement and supplement each other. The EE programs have undergone many decades of development and refinement. The C&S Program attribution approach is somewhat similar, though it has been sometimes criticized for not being as precise: The savings have been considered more "squishy" which may be partially due to its top down approach in contrast to the EE programs' bottoms up approach. This difference is largely because it is much easier to ascertain program effect for those participants who self-select (as in incentive programs) as opposed to the general population that are uniformly obligated to participate (as in code).

Due to the different approaches to attribution, the methodology to estimate free-ridership differs accordingly. The C&S Program attribution model attempts to capture free-ridership by the use of the "Program Attribution" step (refer to Figure 5) which relies on input from a panel of code experts. On the other hand, EE programs capture free-ridership by ascertaining the counterfactual condition by surveying a sample of individual program participants and generalizing to the participant population. Neither approach is perfect and cannot be determined with 100% certainty. Both require asking decision-makers or code experts about their opinions on program influence, usually long after the decision had been made and often foiled by staffing changes that have occurred in the intervening time.

For the C&S Program, the question of program influence is relatively straightforward while the question for EE Programs can be counter-intuitive for the following anecdotal reason: One effective strategy used by savvy EE program implementers is to convince customers that the idea to participate in the program is entirely due to the customer's own superior facilities management skills and is therefore undertaken 100% under their own volition. This ensures project success as the customer fully takes ownership of the project and is fully invested in it. However, the EE program is penalized because, when questioned, this customer (even if the correct person is contacted) will likely not attribute their participation decision to the EE Program and evaluators conclude free-ridership to be 100%.

A tremendous amount of resources are reserved for evaluating the energy savings impacts of EE and C&S Programs. These evaluation impact studies are generally done under tight time constraints, with limited sample sizes. It is crucial to the CPUC that these studies are done accurately to assure that ratepayer funds are achieving the energy savings cost-effectively, but due to resource constraints, the CPUC often chooses to only evaluate "high impact" activities and "passes through" savings claims for other areas. To exacerbate the lack of resources, these studies are done in several silos with little to no alignment nor coordination, meaning duplicative efforts are producing different findings. For example, the code baselines for EE Programs are not aligned with the C&S Program code compliance rates.

The new Market Transformation Initiatives have yet to develop an attribution methodology. However, it does seem from the Decision Regarding Frameworks for Energy Efficiency Regional Energy Networks and Market Transformation (CPUC, 2019) that the attribution is to occur over a long period of time (e.g. 2 or more code cycles) and that the market transformation initiatives are expected to address the same customers and markets as the existing EE and C&S Programs. It is anticipated that the ongoing work by the Market Transformation Working Group will begin addressing these issues in the near future. However, an earlier CPUC Staff proposal for market transformation proposed that savings be estimated using Delphi panels to establish baselines, a proposal that sounds very similar to the C&S NOMAD models for attributing savings. It will be of great interest to see whether baseline estimation efforts can be aligned, or if the California regulators will decide to produce three competing baseline models in their attempt to oversee EE programs.

One of the key issues that seems to be frequently missed is whether the attribution models are providing the results that are important to customers, to the environment, to society, and to policy makers. It is clear that time dependent valuation of energy and GHG reduction will become important, and that California will need to give greater consideration of other benefits provided by utility customer programs. There needs to be a wholesale reexamination of the value of EE programs, because a host of factors has been chipping away at their original valuation. California should give further consideration of the effectiveness of these programs relative to

- Reducing utility customer energy bills
- Reducing GHG emissions, criteria pollutants, and water use
- Increasing safety, resiliency, and reliability (relative to a combustion turbine)
- Enhancing grid operations that reduces grid investments which results in lower rates, e.g., removing load from the grid when and where it's needed
- Promoting comprehensive, integrated, and deep energy savings retrofits and new building design
- Accelerating the rate of energy savings/reduction and GHG reductions
- Crediting DERs (renewable generation, energy storage, demand response, load management, etc.) while maintaining the loading order

Recommendations

The Big Picture. Not all of the problems can be solved in the near term, but addressing some of the issues will hopefully cause enough forward movement in the near term to meet policy goals that include GHG reductions. Therefore, the following recommendations are intended to provide food for thought on how the industry can reach solutions through upcoming California rulemakings, working group activities, program designs, attribution model updates, regulatory reform, and possibly legislation if needed.

In general, there should be movement towards integrating EE Programs, C&S Programs and market transformation activities to facilitate a more holistic evaluation process. A top-down approach to attribution to capture overall energy savings can be implemented with the understanding that the effects and contributions of the EE, C&S, and market transformation may not need to be specifically parsed out. Indeed, the CPUC in 2010 called for consideration of "macro consumption metrics" that could "accurately measure the impact of the CPUC's energy efficiency efforts on overall energy consumption and provide a more direct account of aggregate reductions in GHG emissions" (CPUC, 2010). More recently, the SB 350 goal to double cost-effective energy savings poses a more urgent need to evaluate the EE portfolio holistically. It seems to make more sense to use a common top-down methodology to conduct this evaluation than to try to assemble top-down results from C&S with bottom-up results from EE incentive programs. Rather than piecemeal evaluations of C&S and EE, there can be more of a focus on how C&S and EE programs can be coordinated to encourage customers to adopt and to reinforce a continuous improvement mindset.

Align and Coordinate Impact Evaluations. As an interim step forward, the separate impact evaluations can be better coordinated and integrated. For example, rather than have separate evaluators determine the code baselines for applicable EE Programs and the prevailing compliance rates for the C&S Program, it is recommended that thought be given to have one evaluator make this determination to assure alignment amongst the programs. While it may be argued that these two baselines are not the same, they are at least sufficiently similar that a single evaluator should develop these baselines for both EE and C&S Programs to reduce study costs while providing consistent results. With the introduction of widespread Market Transformation Initiatives, it may become impossible to separate out code-attributed changes in the baseline for evaluating market transformation or vice versa.

Remove Conflicts. Another step towards a more holistic solution is to minimize activities that expend enormous resources that work at cross purposes. The key example of this is when code becomes more stringent, EE program savings are reduced. Since the primary goal of an EE program is to maximize cost-effective savings for that EE program, there is a reluctance for an EE program manager to embrace more stringent codes that reduce their program's energy savings. The irony is that the EE program produces a strong market transformation effect by moving the market towards code adoption. In other words, the more effective an EE program is in transforming the market, the more it gets punished by having measures taken away when they become code.

Customers like incentive checks and dislike regulations. Intuitively, the incentive programs are the spoonful of sugar that makes the codes & standards medicine go down, in a balanced program portfolio. The decades-long presence of EE programs in the market has also created a priceless channel for reaching out and mobilizing utility customers, which could be particularly necessary as policy priorities expand to GHG and non-energy savings goals. It is also worth noting that the existing building stock is roughly two orders of magnitude larger than the number of housing starts each year, and the most direct way of serving the largest number of customers would be through programs for existing buildings.

Conceptually, the simple solution is to reward the EE program for their role in familiarizing the mass market with these measures that eventually get into code. This could have the effect of transforming the strategies and tactics for operating the program that may include a greater focus on outreach (awareness campaigns, education, technical support), collecting data and tracking projects in such a way that can be utilized to better support code changes, and developing program work papers that are more aligned with CASE proposal requirements.

The first step to rewarding EE programs may be to credit them to the extent EE program introduce lasting "market effects" (Barnes, 2007), that cannot be claimed under the current evaluation framework, and are attributed incorrectly to C&S's top down attribution methods. This goes beyond EE incentive programs to encompass the cumulative effects of the non-C&S program portfolio, which includes development and dissemination of best practices, workforce education and training, and continuous messaging about the benefits of reducing energy use. One relatively intuitive approach would be to continue using the current C&S's NOMAD-driven evaluations, but to have the C&S Delphi panels draw a second curve that estimates market effects from, say, 20 years of EE program implementation. The difference between the "incentive to code" curve and the "incentive only" curve, both compared to NOMAD will show the contribution of EE programs to the overall transformation of the market that undoubtedly increased code receptiveness.

In other words, a portion of the C&S Program energy savings should be passed to the EE program for their role preparing the market for code. Since the market continues to transform after code-adoption as a measure becomes more "commoditized," the EE programs should be credited for not only transforming the market enough to reach code adoption, but should also get credit for having a "trim tab" effect of magnifying the market transformation beyond code adoption. This then provides another platform on which further improvements can be made to perpetuate the cycle of continuous improvement as depicted in Figure 4.

In this scenario, the EE programs would be attributed a higher level of savings for their efforts which would boost EE programs cost-effectiveness and the C&S Program's savings would be reduced accordingly. This amount of attributed savings moving from C&S to EE Programs reflects the savings attributable to "emergent market transformation[2]." Therefore, for this scenario, the emergent market transformation savings are not incremental, but are a portion of the EE programs' energy savings reflecting the magnitude to which they caused the market to transform.

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[2] California's evolving definition of market transformation currently considers only "strategic" market transformation to be true market transformation, and does not credit EE programs with market transformation that results from decades-long implementation and messaging of energy efficiency incentive programs. In the context of this discussion, we refer to "emergent" market transformation as an unplanned but not-unexpected market transformation that accompanies long-term, billion-dollar EE program portfolios.

Therefore, only the overall savings need to be evaluated in a top-down approach, even when market transformation initiatives eventually reach the market. Further analysis and estimates can be made to determine the contribution of each program for the immediate purposes of improving the program itself, but would be largely unnecessary as the contribution by each program to maximize overall cost-effective savings may not relate directly to the allocation of resources to each program (see earlier discussion of interactive effects). In this approach, it should be emphasized that EE programs and C&S have different tools, and it would ultimately be more successful and cost-effective to bring energy savings to all market sectors (including low income, disadvantaged, and hard to reach markets), no matter the program type. The combined efforts of EE programs and C&S working in tandem to bring the highest level of EE technologies to the mainstream markets will as a whole yield results greater than can be produced by the sum of parts.

Conclusion

David Goldstein (Goldstein, 1993) summarized the need for an integrated, holistic top down attribution model:

> "An interesting consequence of the synergy between DSM and standards is that, over the long run, it may impossible for program evaluators to establish what fraction of the efficiency potential was realized through DSM and what fraction through building codes. For example, if a DSM program achieves a steadily increasing market share over a 3-year cycle, allowing standards to be promulgated at that level in the fourth year, can the savings from the standard be attributed to the DSM program?...The potential savings from DSM, as distinguished from other policy mechanisms, can therefore never be pinned down, either prospectively or after they have occurred. Program planners must be satisfied with the understanding that DSM can be part of a coordinated energy policy that can define and achieve the technical potentials."

The current EE framework has cost-effectiveness requirements for resource programs that are becoming mathematically impossible to achieve while discouraging market transformation. There is a compelling case for updating the framework to better integrate EE and C&S Programs and all sources of market transformation to increase cost-effectiveness and reduce customer energy bills, while also reducing GHG and criteria pollutant emissions, and to better serve all market sectors. The updated framework would also create the demand for continuous improvement to accelerate EE and other GHG reduction strategies to meet state's aggressive policy goals. The first step towards an integrated top-down approach is to encourage EE programs to transform the market by recognizing their attributable energy savings. There is a world of positive interactive effects between C&S and EE programs that can be achieved if we stop cannibalizing EE to feed C&S, and instead acknowledge that they are both important tools in a balanced EE program portfolio.

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