Perspectives on Doubling Energy Efficiency in California

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Abstract

California recently adopted Senate Bill 350, which lays out the ambitious goal of doubling energy efficiency by 2030, and Assembly Bill 802, which focuses on building benchmarking and increasing the efficiency and reducing the energy consumption of existing buildings. While California has been an Energy Efficiency (EE) leader for decades, SB350/AB802 push the agenda forward by setting a specific goal, supporting new approaches, and giving California's energy agencies authority to review and revise energy efficiency programs and take regulatory actions necessary to reach this target.

The CEC, CPUC and PG&E will share their unique perspectives on what these mandates mean and how California can accomplish the goals.

1) CEC will describe how the SB350 EE categories might contribute to the 2030 goal:

- Clarify the basis for the 2030 EE potential and targets
- Identify how the various SB350 EE categories are captured in the demand forecast
- Discuss options for how metered data will change the demand forecast's analytical methods

2) PG&E will review potential opportunities to increase EE savings such as:

- Using AMI interval meter information and data analytics to:
  - Target the state's least efficient buildings for energy consumption reduction
  - Expand operational, behavioral and retrocommissioning activities
  - Leverage financing and technical assistance to support EE savings
  - Encourage deeper retrofits
  - Simplify energy measurement and verification (EM&V)
- Role of Codes and Standards

3) CPUC will identify challenges and opportunities the laws present including:

- Energy Efficiency as a carbon mitigation measure within a Cap and Trade system
- Potential unintended consequences resulting from the shift from code/standard practice to existing condition baseline to capture "stranded" savings
- Moving from front-loaded incentives to programs that pay incentives based on actual energy savings
- Alternatives to incentive-based programs

Introduction

Energy efficiency in California had a watershed year in 2015. Governor Brown enacted two major energy bills: the Clean Energy and Pollution Reduction Act of 2015 (Senate Bill 350), which doubles energy efficiency goals across the state and increases the state's use of renewable fuels, and Assembly Bill 802, which focuses on meter-based savings, bringing existing buildings from their existing condition up to and beyond code, and providing new access to data and benchmarking for building owners and policy makers.

Together, these bills create a new vision for energy efficiency in California. But they also raise important questions about how best to bring this vision to pass. Without a clear plan to set targets, implement actions to achieve those targets, and assess whether we've succeeded within a reasonable cost, California risks falling short of the objectives embodied in these lofty pronouncements. This paper highlights the unique perspectives of three key players: California's energy policy agency, one of its major investor-owned utilities, and the oversight agency for those utilities, as they seek to interpret these mandates and ensure that California can make this vision a reality.

California Energy Commission

The Energy Commission is the state's energy policy and planning agency, whose electricity demand forecast is defined as the starting point to "establish annual targets for statewide energy efficiency savings and demand reduction that will achieve a cumulative doubling of statewide energy efficiency savings in electricity and natural gas final end uses of retail customers by January 1, 2030." The doubling applies to what is called "additional achievable energy efficiency," (AAEE) or savings based on potential studies.

SB 350 defines the 2017 Integrated Energy Policy Report as the proceeding by which the Energy Commission will adopt utility specific targets. This is the proceeding in which the California Public Utilities Commission, the California Independent System Operator, and the Energy Commission agree on the "single forecast set," the combination of a baseline case and an AAEE scenario to be used for procurement and transmission planning studies.

SB 350 establishes a starting point for the Energy Commission to use in setting statewide and utility-specific targets for energy efficiency goals to be achieved by 2030. The language is open to multiple interpretations of how to translate legislative wording into numeric values. The Energy Commission proposes to interpret the SB 350 statutory language to "double" energy efficiency savings from a known AAEE scenario by using a linear "ramp up" that achieves a numeric doubling only in year 2030.

SB 350 outlines a variety of programs that may be used to achieve the doubling of energy efficiency. Greater savings in California's existing residential and nonresidential buildings; operational, behavioral, and retro-commissioning activities; and conservation voltage reduction are among those enumerated.

Related to SB 350, Assembly Bill 802 expands the Energy Commission's existing authority to collect individual customer data from utilities for use in the demand forecast. Future demand forecasts will have a greater emphasis on detailed, localized, and sector-specific analysis of energy demand trends. This more granular analysis will be needed to support the state's policy goals including setting, assessing, and advancing energy efficiency goals set forth in SB 350, and the requirements to use meter-data for assessing the "effect of energy savings on electricity demand statewide, in local service territories, and on an hourly and seasonal basis."

In addition to the new data that the Energy Commission will be receiving, AB 802 also allows a different baseline to be used for existing buildings. In the past, utility programs received only "above code" credit to determine savings, meaning that they could only give incentives for programs that went above current energy codes and standards. Without incentives, many people were not making energy efficiency improvements to existing buildings that were below code. Now the utilities can offer incentives to their customers for energy efficiency measures that improve the efficiency of a building from actual current existing conditions.

Because of this change in baseline, the Energy Commission's Demand Analysis Office must modify the demand forecast to adjust for market conditions and existing baselines. The Demand Analysis Office is currently exploring what adjustments will be needed in the forecast.

Since it is likely that to-code programs will accelerate savings otherwise expected to be introduced by standards, and potentially lose some savings by altering the timing of replacement purchases, encouraging programs that preferentially target the oldest and least efficient appliances and HVAC equipment found in buildings seems reasonable. To-code programs may diminish the impact of existing mandatory equipment standards.

Modeling Energy Efficiency in the Demand Forecast

Estimated energy efficiency impacts are incorporated within the Energy Commission's demand forecasts in two ways: through changes to model inputs, and through post-processing. The first method is used for most of the committed building and appliance standards implemented since 1975, where average consumption by end-use is adjusted within the commercial and residential models to reflect each updated set of standards. The Energy Commission's Efficiency Division standards impact studies, which are carried out with each new round of standards, are translated to the appropriate geography and forecast end-use categories. The second method, post-processing, is used to capture some of the most recent residential standards, committed efficiency programs, and AAEE savings. Committed efficiency programs are subtracted from model output based on utility expected savings, adjusted by EM&V studies when available. AAEE savings are derived from CPUC potential studies and subtracted from the forecast, accounting for any overlap that may occur with savings already included. Together, these two forecast components result in a 'managed" forecast that anticipates both known (committed) and future energy efficiency.

There is large uncertainty about the impacts of the new to-code retrofits. One way to help inform the impacts of to-code retrofits would be to start collecting data related to existing buildings and equipment measures to allow an assessment of where the savings potential of to-code programs might be highest. This would require first an inventory of existing data from California Measurement Advisory Council studies, evaluation data, utility audits, other data collection, and recent survey efforts. Any identified data gaps would require additional data collection, with the goal of developing a representative distribution of key actual technical characteristics of existing buildings by vintage.

Assessing the savings impacts of to-code measures by end-use also needs be considered. This requires, for a given geographic area, information regarding the average energy profiles of the more efficient technologies as well as the actual conditions of the technologies being replaced. A key aspect of this analysis involves determining what constitutes to-code within a building given the overall performance basis underlying the building codes.

Adjustments to the forecast model inputs would then need to be made to account for the findings from the data collection. This step is designed to develop a more accurate baseline that would then be adjusted for the impacts of to-code programs. The data collected would be used to adjust unit energy consumption, by home or by square foot, by end-use to reflect actual conditions. These adjustments would be calibrated by estimated historical consumption by end-use developed from metered data and other sources. Finally, adjustments to the forecast to account for to-code savings would need to be made.

SB 350 Implications

As new methods for energy efficiency savings are identified through the AB 802 analysis, they must be reconciled with plans for the major increase in energy efficiency savings called for by SB 350. Although SB 350 established intermediate targets for energy efficiency and renewable generation, at its heart SB 350's goal is GHG emission reductions.

Given current knowledge about the energy-using components in inefficient buildings, initial analysis indicates that to-code programs will shift savings from standards toward to-code programs, with only a small increase in total savings, albeit achieved more quickly. As more and better data about the existing building stock is acquired, from both general surveys of the population, and from in-depth reports of to-code program participants, an improved understanding may emerge. The demand forecast is meant to provide a range of reasonable scenarios given specific programmatic efforts rather than projections that automatically assume general policy goals are met. Thus it is critical to properly estimate net incremental savings from new AB 802 to-code programs relative to the former suite of program opportunities absent AB 802 to-code initiatives. Next will be periodically updating these estimates with new data and a better understanding of the extent to which to-code programs can tap this portion of overall energy efficiency potential. At the same time, this must be done in a manner that is cost-effective in achieving the GHG emission reduction goals.

Pacific Gas and Electric

Pacific Gas and Electric Company (PG&E) has been offering energy efficiency (EE) since the 1970s, working closely with government, nonprofit, and private-sector partners to design and implement programs and policies that allow Californians to do more with less energy. Serving more than 15 million customers across 70,000 square miles of service territory, PG&E

will play a vital role in actualizing the ambitious mandate of SB 350 to double EE savings by 2030. Achieving this will require a new generation of EE programs and tools that build on and go beyond the program portfolio cultivated by PG&E over the past four decades.

Unlocking Energy Savings in Existing Buildings

Signed by Governor Brown alongside SB 350, AB 802 authorizes IOUs to provide customers with incentives, rebates, technical assistance, and support to increase the energy efficiency of existing buildings based on all estimated energy savings and energy usage reductions. This takes into consideration the overall reduction in normalized metered energy consumption as a measure of energy savings.

AB 802 allows IOUs to unlock the 'stranded potential' found in much of California's existing building stock, and to more cost effectively target the energy being wasted in California today. 'Stranded potential' typically exists in buildings in which old equipment− such as the 100 year-old boilers found through San Francisco's American Recovery and Reinvestment Act (ARRA)-funded EE program (Greco, 2012) − is not being replaced, or in inefficient buildings that have not been upgraded since their original construction. A CEC report found that "more than half of California's 13 million residential units and over 40 percent of the commercial buildings were built before 1978, when the first building energy efficiency standards were implemented." (CEC Staff Report, 2011)

AB 802 authorizes IOUs to objectively measure energy savings from an existing conditions baseline,[1] which will offer a more precise picture of how specific EE upgrades impact the grid by reducing energy consumption. Customers can be provided a clear picture of potential energy savings relative to their current consumption, and given an appropriate motivation to act because project savings estimates, financing, technical support and financial incentives can be based on their potential to reduce actual consumption, rather than a counterfactual baseline that may not reflect the customer's specific usage. The current counterfactual baseline, based on building codes, equipment standards, and Industry Standard Practice (ISP), bakes in the assumption that the customer was already planning to upgrade, failing to show customers the full energy savings opportunity of potential projects. The counterfactual baseline may be based on average use assumptions rather than a customer's actual consumption, and can often be complex to determine, verify, and communicate.[2] While counterfactual baselines will continue to have an important role in many EE programs, such as establishing deemed savings for downstream mass-market rebates, upstream, and midstream program interventions, AB 802's endorsement of existing conditions baseline opens the door to a broad range of avenues to seek out efficiency and eliminate energy waste.

PG&E anticipates leveraging past investments in smart meters to identify the least efficient buildings via remote analytics, and subsequently influencing customers to achieve identified energy savings opportunities. These opportunities could include behavioral,

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[1] Prior to AB 802, in certain cases such as early retirement, Advanced Home Upgrade utilities were able to use existing conditions as a baseline to estimate ex ante energy savings. The policy default was that measures must exceed code. See D.14-10-046 (pp. 52-59) for a full explanation on how energy savings baseline policies are applied for utility EE programs.

[2] "Part of what makes EE so complex is that savings – i.e. the absence of use – is a difficult thing to measure. Figuring out what you saved requires figuring out what you would have consumed without the efficiency measure. This hypothetical level of consumption is the "baseline," and it is the point of comparison for determining savings. (D.14-10-046, p. 52).

retrocommissioning, and operations and maintenance (O&M) improvements, in addition to building upgrades and equipment replacement.

This more holistic approach reduces the focus on what eligible ‘widgets’ customers can install to receive an incentive and supports a broad range of interventions and approaches to reduce energy consumption. The Measurement and Verification (M&V) of energy savings may also be simplified by reliance on data analytics to estimate reductions in consumption from billed usage post-project.

Current EE program design in California typically requires IOUs to provide a financial incentive for a specific ‘widget’ or technology in order to account for the energy savings a program delivers (Freehling, 2011). AB 802 paves the way for different methods of measuring energy savings via customer meter data rather than on a widget-by-widget basis. This affords IOUs more diverse avenues to obtain energy savings, such as financing and technical assistance, without the exchange of a financial incentive to a customer, manufacturer, distributor, retailer, or contractor. Using existing conditions as a baseline and measuring energy savings at the meter will make it easier to leverage private capital, since market-based finance solutions tend to be more successful when based on the actual anticipated customer bill savings (Haas, 2012).

There are advantages to leveraging financing and technical support to scale toward the doubling of EE savings. First, these approaches should mitigate to some extent the potential budget impacts that could otherwise stem from doubling EE savings. Second, concerns about free ridership may be reduced if reliance on financial incentives diminishes. Finally, expanding use of financing and technical support creates a scalable EE opportunity that will position IOUs to accelerate the adoption of EE, consistent with the objectives of SB350.

New Program Designs and Approaches

Developing programs and appropriate M&V methodologies to fully capitalize on AB 802’s flexibility will understandably take time, and will require a transitional path to portfolio-wide implementation. Accordingly, to jump-start the process, AB 802 includes a ‘call to action’ authorizing IOUs to apply the savings baseline provisions through immediate implementation of High Opportunity Projects or Programs (HOPPs), designed to have a high potential for energy savings which the CPUC may authorize beginning January 1, 2016. Expedited implementation of HOPPS should facilitate rapid realization of energy savings, as well as opportunities to glean insight and apply lessons-learned from these early-stage programs.

PG&E currently envisions the following types of EE program activities spurred by the new legislation, some of which are under development as demonstrations or HOPPs at this time:

- **Commercial Whole Building (CWB)** creates a scalable vehicle to cost effectively procure deep energy savings in commercial buildings, derived from retrofits or operational, behavioral, or retrocommissioning activities. Incentives are performance-based, and tied to post-installation savings estimated using interval meter and other data over an extended period of time (typically 12 months before and after implementation). PG&E implemented a CWB demonstration program in 2013. Currently 12 projects are moving forward, with a second round of enrollment planned.
- **Residential Pay-for-Performance** is a new program seeking to work with existing market actors to advance and scale residential retrofits. Aggregators receive financial incentives to work directly with residential customers to achieve broad energy savings

through behavioral, operational, and retrofit interventions. PG&E submitted this program as a HOPPs proposal on March 25, 2016.

- **On-Bill Financing (OBF) Alternative Pathway** builds on PG&E's existing OBF program, but provides a new option allowing participation without a rebate or incentive. It provides a customer and contractor-driven solution that leverages third-party project certification and requires contractors to provide monitoring technology over the lifetime of a loan. PG&E submitted this program as a HOPPs proposal on March 25, 2016.
- **Targeted Retrocommissioning (TRCx)** leverages remote audit and analytic tools, made possible with the widespread installation of smart meters, to target inefficient buildings for optimization of existing systems and behavioral, retrocommissioning, and/or operational interventions.
- **Targeted Removal of Inefficient Equipiment** would seek to address situations where inefficiency equipment is left in place, rather than upgraded, modernized, or replaced with more efficient equipment.

SB 350 challenges California to double energy savings from an already aggressive four-decade commitment. AB 802 supports this objective by creating a new paradigm for EE in California. The bill supports leveraging the smart meter infrastructure to identify and capture energy savings in the most cost-effective manner, allowing IOUs to focus on reducing customer bills, energy consumption, and waste, while enhancing grid and pipeline savings. As such, EE programs can target those buildings most in need of modernization, and where the most savings, or 'stranded potential' resides, with a more comprehensive tool box that includes behavioral, retrocommissioning, and O&M, in addition to equipment replacement. Furthermore, tying energy savings to reduced consumption enables market-based finance solutions and technical assistance to be employed, thereby decreasing the average incentive/kWh or therm going forward. This approach can reduce both risk and cost to Californians who both fund and benefit from the State's energy efficiency programs.

California Public Utilities Commission

Energy Efficiency as a Carbon Mitigation Measure – "Roles and Responsibilities"

By setting the goal of doubling energy efficiency by 2030 in Senate Bill 350, California has identified efficiency as a major contributor to achieve its ambitious greenhouse gas reduction goals. No longer is California endeavoring to maximize energy efficiency strictly as a cost-effective alternative to supply-side energy resources or to encourage good stewardship of limited natural resources – efficiency is now a codified cornerstone in California's global leadership in combatting climate change. With this heightened role comes heightened responsibilities.

Because the energy sector is regulated within California's cap and trade system,[3] which sells a pre-determined amount of carbon allowances each year, energy efficiency does not directly reduce California's carbon emissions. Instead, efficiency serves essentially the same

[3] California Air Resources Board, retrieved May 6, 2016. http://www.arb.ca.gov/cc/capandtrade/capandtrade.htm

purpose as a carbon offset: it reduces the demand for – and in turn, the cost of – California's carbon allowances and increases the program's likelihood of success (economically…and therefore politically).

From the perspective of the durability of California's cap and trade program, it is arguably even more important that the carbon reductions from the "complementary policies" that California is pursuing within the capped sectors[4] reduce carbon emissions than it is for actual offsets to result in bona fide carbon reductions. Because even if offsets do not achieve their claimed carbon reductions – be they well-intended projects that fall short of the credited reductions or complete scams – they still reduce the amount of carbon reductions required within the capped system, provided they are recognized by that system. However, if efficiency savings are not realized, then the carbon allowance cost pressure is not relieved, even though the cost of the efficiency programs has been added to the bills of all of the customers who must directly or indirectly pay for the allowance costs of the cap and trade program.

Cap and trade programs require offsets to possess several key qualities in order to serve as proxies for carbon allowances. The Air Resources Board requires California's offsets to be, among other things, "real, additional, and quantifiable."[5] To facilitate third-party verification that offsets achieve real and additional carbon reductions, offset projects typically focus on equipment or activities that have a stable and clearly quantifiable baseline. For instance, installing an anaerobic digester or a hydrofluorocarbon collection and destruction facility in countries or regions in which these practices are rare or do not exist provides for a fairly clear emissions baseline.

Determining a stable and quantifiable baseline for utility efficiency projects in California is, in most cases, much more difficult than typical offset projects, since it is clouded by the interplay between Federal and state codes and standards, technology advances unrelated to program supported R&D that improve the efficiency of energy-using equipment over time, and the fact that a significant portion of buildings and energy-consuming equipment are periodically upgraded to higher levels of efficiency without any nudge from utility programs. Further complicating this determination is the little studied – and therefore not well understood or quantified – spillover effects that voluntary energy efficiency program (i.e., excluding code advocacy) have on code advances, standard practices, and customer choices outside of the rebate programs, all of which also influence baseline.

Evaluation results for California's large custom projects have historically reduced forecast gross realization rates by approximately 30 percent, and estimated free ridership levels of roughly 50 percent (2013 Custom Impact Evaluation). Combining these two factors suggest that these programs have been delivering 35 percent net actual savings per gross forecasted savings. Reasonable minds may disagree, as they always will as we endeavor to quantify the counterfactual, over whether these adjustments are liberal, conservative, or "about right," but what is not in dispute is that significant overestimates of gross and net savings exist in these

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[4] Ibid.

[5] Per the Air Resources Board's Compliance Offset Protocols (CARB, May 2013), California's offsets must also be "permanent, verifiable, and enforceable." Verification and enforcement of efficiency program savings are the responsibility of the state and are not addressed in this paper. The assumption that California will continue to authorize efficiency portfolios that maintain savings on a trajectory to achieve the SB350 efficiency goal is essentially being relied upon to ensure the permanence of these "intra-system offsets."

custom programs, and this was the case even when the California utilities were overseeing evaluations. It makes sense that it would be far more difficult to accurately estimate savings and eliminate free riders from programs intended to induce efficiency improvements in ubiquitous energy-consuming buildings and equipment than it would be from funding an anaerobic digester at a hog farm in a developing country; consequently, efficiency programs have been considered successful for years despite "real and additional" adjustments to forecast estimates that would be deemed scandalous in traditional offset programs.

Given the challenges illustrated by this difference between efficiency and typical offsets, it is somewhat ironic that at the same time California has elevated the role of efficiency in achieving its carbon reduction goals, it has complicated the challenge of determining whether efficiency savings are real and additional with AB 802, which requires savings in existing buildings, in many cases, to be calculated based on an "existing conditions" baseline.

AB 802 and "Stranded" Savings

Proponents of existing condition baseline policy argue that California's code baseline / early retirement policy was resulting in significant amounts of "stranded" energy savings in existing buildings. To date, however, these arguments have been supported largely by anecdote, cherry-picked examples such as one hundred year old boilers still in operation (relatively few of which exist and for which asbestos abatement renders their replacement not cost-effective via traditional utility rebate-programs, even with incentive payments for below code savings), and old, inefficient indoor lighting.

Such anecdotes are not new, nor have they been ignored historically. Statistically, they are already understood and captured in estimates of the effective useful lifetime of equipment represented by a statistical distribution of lifetimes (a survival function) around the mean. More importantly, since the outset of energy efficiency programs analysts have explored the cost effectiveness, based on the energy savings rationale, of replacing various types of equipment before the end of their useful lives. For a limited but important number technologies, such early replacement has been cost effective (e.g., T12 lamps with magnetic ballasts or ordinary incandescent light bulbs) and have aggressively pursued by programs; while for many others, especially high capital cost equipment, cost effectiveness of early replacement has simply not been borne out by the economic and behavioral facts.

For instance, the "indefinite repair" of air conditioners is an oft-cited example of savings stranded by a code-based savings policy. Table B provides the costs and savings estimates for the replacement of a 3.5 ton 1990s-era residential air conditioner with a code-minimum unit and two higher efficiency units compared with repairing the existing unit.[6]

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[6] Table B assumes an energy price of 30 cents/kWh to reflect higher tier rates for customers with significant summer air conditioning loads, uses a cost escalator of 5% for electricity and future equipment/repairs, and are net present valued using 8% customer cost of money (i.e., the cost of financing the purchase at a point between a home equity loan and a credit card payment). Savings and equipment cost values derived from the currently adopted California Database of Energy Efficiency Resources. Other assumptions for the "repair indefinitely" case are that a repair is required every five years, each repair costs $1500 (a fair current cost of a compressor replacement or other major repair), and no savings result from the repairs, although a repair would typically also include a tune-up that

Efficieny Level	Installed Cost	Savings vs 1990s era AC (kWh/yr)	NPV of ROB Replacement vs 5-yr $1500 Repair	NPV of ER Replacement vs 5-yr $1500 Repair	ROB Simple Payback	ROB Simple Payback With $400/ton Rebate
SEER 14	$4,800	515	$513	-$695	21.4	12.3
SEER 15	$5,200	605	$469	-$739	20.4	12.7
SEER 19	$6,100	780	$271	-$938	19.7	13.7

TABLE B: Residential AC Replacement Versus "Indefinite Repair"

The middle box of Table B provides a comparison of the net present value (NPV) of replacing on burnout (ROB) or the early retirement (ER) of a 1990s air conditioner versus repairing it "indefinitely" (i.e., a major repair of their existing unit every five years throughout the replacement unit's 15-year design life). The ROB calculation assumes a failure has triggered the decision to replace, so the first counterfactual repair of this 1990s air conditioner occurs in year 0, whereas the ER case assumes that the air conditioner has not failed when the program influences the customer to replace it, so the first repair occurs in year 5. The comparison in the middle box illustrates that the 15-year NPV calculation favors the replace rather than repair scenario at the time of a major cost failure under these assumptions. The NPV turns negative (i.e., become a cost) under the early retirement scenario.

But of course, customers are not performing complicated NPV calculations to evaluate the benefits of a costly replacement versus a much lower cost repair when their air conditioner fails on a hot summer day. The right-hand box in Table B considers the choice between replacement and repair – and the extent to which a utility rebate might influence this choice – through the lens of a typical customer.

This analysis uses a simple payback comparison of the difference in cost between a new system and a $1500 repair using the same cost and savings assumptions as the middle box (there is no early retirement case considered here, but similar to the NPV analysis, the benefits shrink considerably without an initial counterfactual repair cost). However, the values in the right-hand box do not include costs of future repairs, energy and equipment cost escalations, or the time value of money. Under these conditions, the simple payback period for the different efficiency units ranges from 19 ½ to 20 ½ years with no utility rebate. Including a $1,400 utility rebate (i.e., rebating a 3 .5 unit at $400 per ton, which is the current rebate for Southern California Edison's residential AC early retirement pilot program in the region impacted by the unanticipated closure of the San Onofre Nuclear Generating Station) reduces the customer's payback period to approximately 13 years.[7]

These simple payback results suggest that when a residential air conditioner fails, it is unlikely a customer will decide to replace it instead of repair it based on the bill savings they

could improve performance. The replacement case assumes one more minor ($750) repair at the midpoint in the new unit's 15 year EUL.

[7] Note that rebating a to-code SEER 14 unit would not have been allowed in utility programs prior to the passage of AB802, but appears to be permissible under the new law.

anticipated they would enjoy, and it appears that this calculus persists even with a substantial utility rebate. The analysis suggests that access to easy financing may be far more likely to induce a customer to choose replacement over repair at the time of an air conditioner failure than a rebate representing a small portion of the cost of a new unit. This is especially true for an early retirement rebate, and in fact the early retirement of older, functioning air conditioners does not appear to represent a cost-effective efficiency intervention. Since inevitably many customers faced with these simple paybacks will continue to choose repair over replacement, development of air conditioner repair programs that maximize savings during a repair event may also be a wiser use of ratepayer funds than rebates which pay down only a small portion of replacement air conditioner costs.

What's NOT Stranded?

A fact-based approach to revising code baseline / early retirement policy to address "stranding" savings would include a broad set of financial/cost-effectiveness/GHG analyses for a range of measures, such as the example above, along with a comprehensive saturation survey designed to determine what types of equipment in what types of buildings are consistently remaining in situ well beyond their design lives.

For instance, a lighting saturation study presented at the 2015 IEPEC conference indicated that while inefficient T12 lighting and relatively inefficient T8 lights (i.e., excluding higher efficiency T8s) represented approximately 65% of the indoor lighting in businesses during the study's 2009-2012 time period, there was a dramatic reduction in purchases of these lamps from over 60% in 2010 to less than 30% in 2012, suggesting that the combined impact of codes and design life was preventing significant stranding of this equipment (Shelton, 2015).

A broader analysis of this type is for another paper, but Table C turns this question on its head to consider the amount of old equipment that is not stranded in the economy. Table C provides a forecast of annual to-code building upgrades and equipment turnover occurring in California's economy without utility program support that, given the state's new definition of energy efficiency included in AB802, could now be incented by the utilities and claimed as program savings.

Sector	Renovations to Meet:	Average Annual Spending (2016-2026)
Com	Federal Standards	$1,760,000,000
Com	Title 20	$1,150,000,000
Com	Title 24	$800,000,000
Com	**All C&S**	**$3,710,000,000**
Res	Federal Standards	$374,000,000
Res	Title 20	$410,000,000
Res	Title 24	N/A
Res	**All C&S**	**$784,000,000**
Res & Com	**All C&S**	**$4,494,000,000**

TABLE C: Forecast of Annual CA To-Code Existing Building Upgrades and Equipment Turnover[8]

8 This table represents an informal estimate based on communications with Amul Sathe of Navigant Consulting, October 2015, and is not an official Navigant Consulting work product. Total energy savings from C&S were estimated using the CPUC potential

This annual spend represents about ten times the amount of customer incentive dollars currently paid by California IOUs. This estimate suggests that without careful implementation, AB802 could result in a portfolio of projects delivering meter-verified energy savings made up largely of to-code upgrades that were already occurring in the economy. Since this equipment cost represents so much more than the entire EE portfolio budget, this new source of portfolio savings could readily sop up a significant portion of the available portfolio budget and deliver far less additional savings than the portfolio has historically delivered.

Great care must be taken to ensure that California's new definition of energy efficiency does not result in a significant increase in reported efficiency savings that is made up largely of projects that are already occurring in the economy, hiding under a thin veneer of high-value projects that capture truly stranded "real and additional" savings. It is not hard to imagine a new cottage industry of "rebate mill" implementers stationed outside every permitting office in the state, offering rebates to contractors as they exit those offices with permits already in hand. This was certainly not what the state had in mind in adopting this well-intentioned law and its new definition of energy efficiency.

"Getting Real" (and Additional)

A number of steps can be taken to prevent the unintended consequences described above and for the utility portfolios to deliver significant quantities of real and additional efficiency savings that the state's carbon goals are counting on.

Properly designed meter-based, pay-for-performance programs can help address the real and quantifiable qualities of energy efficiency projects. These programs have historically been hampered by disagreements over whether higher post-treatment energy usage than forecast is due to project underperformance or new sources of site energy usage. Consequently, the majority of pay-for-performance efforts now focus on less litigious public entities with stable loads and limited access to the level of upfront cash and private financing (government buildings, hospitals, etc.).

Smart meters and advances in data analytics allow us to better specify the cause(s) of unanticipated increases or decreases in load, which can reduce disagreements over the cause of unexpected post-treatment consumption and facilitate early warnings and corrective actions, especially for projects that involve behavioral, retro commissioning, and operational changes.

SB 350's requirement that "incentives be based on measured results" also helps ensure that efficiency's carbon reductions are real, since it requires program administrators to tie payments and reported results to actual savings. It also sets an expectation and accountability for measurement and verification strategies to be embedded in the program design rather than be solely the responsibility of regulators long after the intervention has occurred. While this

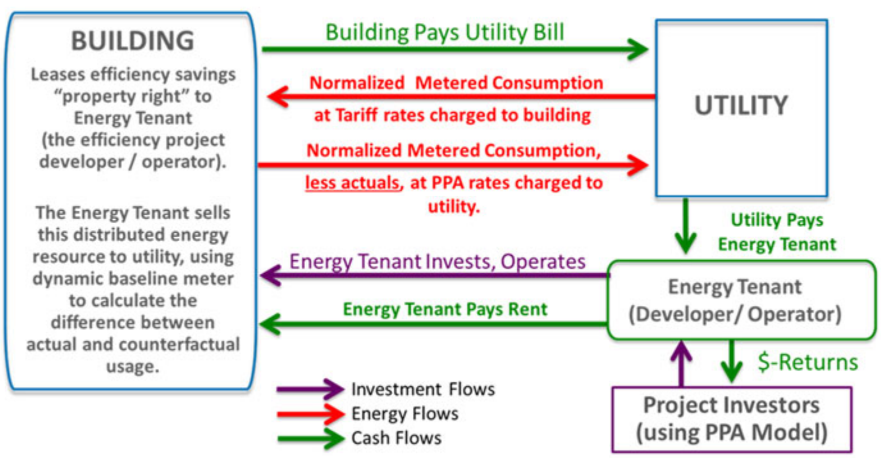
study. These were then adjusted downwards to reflect savings that would occur in existing buildings (subtracting an estimate of new construction activity). Finally, these savings were multiplied by an equipment cost per unit savings derived from deemed measures already in utility energy efficiency programs Residential Title 24 data is N/A as additional data is needed to determine the amount of renovation activity that triggers code vs. new construction activity in the residential sector, so the potential model uses a conservative assumption that all Title 24 Residential sector costs represent new construction.

statutory requirement represents a challenge to traditional incentive program design and implementation, it provides a significant opportunity to ensure that program dollars are spent on real carbon reductions.

There are a variety of methods for meeting this statutory requirement. Administrators can design incentive structures that provide "low regrets" upfront incentives (i.e., costs that are unlikely to significantly exceed their benefits) based on conservative project savings assumptions, with additional payment commitments over time as metered savings are documented. Another alternative is to provide financing or pay-for-performance models that relay entirely on bill savings, both of which avoid a customer incentive payment altogether. One example of a pay-for-performance model that advanced meters and data analytics enable is a utility-centered performance-based contract that uses a "counterfactual meter" that normalizes for endogenous and exogenous changes (such as significant changes in building use or occupancy) to estimate the difference between a treated building's actual electric consumption and its counterfactual energy measurement absent the efficiency efforts. This difference is paid to the efficiency service provider by the customer through its utility bill for delivery of megawatts in the form of energy saved, rather than energy generated.

Figure 1 depicts this "Metered Energy Efficiency Transaction" model. The "energy tenant" invests in and maintains efficiency equipment and operational improvement. The utility uses the normalized baseline reading from the same counterfactual meter to bill the building. Effectively, the building continues to get charged for its "pre" condition, normalized to external factors at normal tariff rates. Such a contract and meter are currently being piloted by Seattle City Light.

Figure 1: Metered Energy Efficiency Transaction Structure



Source: The Metered Energy Efficiency Transaction Structure (MEETS) Coalition, MEETSCoalition.org[9]

While advanced meter technologies and data analytics can help ensure efficiency-driven carbon reductions are real and quantified, they do not inherently address or ensure additionality. New approaches that combine interval meter data and remote audits to identify buildings with

[9] The Metered Energy Efficiency Transaction Structure (MEETS) Coalition, http://www.meetscoalition.org/

load profiles that suggest significant underinvestment in efficiency upgrades and, therefore, allow program administrators to proactively target those buildings to capture the high potential for savings.

This proactive targeting must be embedded into program design: screening customers and proactively approaching them with information and value propositions related to program participation are likely to decrease, though certainly not eliminate, the amount of free rider participation, because potential participants are being screened and targeted proactively, rather than being solicited in a scattershot fashion through utility customer representatives or third party implementers. These tools can also be used to further segment program offerings by building use and ownership type to focus on owners and uses that have a history of deferred investments in efficiency upgrades and equipment.

Mining evaluation data for third party implementers and utility account representatives whose projects consistently result in low versus high levels of free ridership – and rewarding and/or penalizing these entities accordingly – is a straightforward and remarkably underutilized approach to increasing additionality.

In addition to using program design and screening implementers and account representatives to help reduce potential free ridership, data-rich methods such as development of dynamic baselines or experimental / quasi-experimental design offer opportunities to replace or augment traditional participant surveys to determine program influence. Embedding these strategies in the program from the beginning significantly improves their chances of accuracy and their ability to provide actionable feedback to make improvements.

Conclusion: One Goal, Three Perspectives

California is working to break new ground in energy efficiency, and it is inevitable that differences in perspectives among entities who play different roles in this effort will arise. Our willingness to highlight both our differences of opinion as well as our areas of agreement, stems from our recognition of the benefits of open dialogue and a desire to share with others our understanding of the opportunities and challenges that lie ahead as California moves toward its goal of doubling energy savings by 2030.

The CEC focuses on the need for more research and enhanced analyses, particularly related to modifications to energy demand forecasts and in modeling the impact of to-code retrofits authorized under AB-802. Ensuring robust and accurate modeling will play a critical role in ensuring that energy savings are accurately captured and investments in energy efficiency are paying off with the expected impacts on usage.

PG&E emphasizes the need to move swiftly to implement new program designs to reduce energy consumption from existing conditions using retrofit, behavior, operational, and retrocommissioning approaches, and leveraging financing and technical support in addition to financial incentives to garner savings.

The CPUC highlights the risk that stranded savings may be smaller than anticipated, and that program designs based on existing conditions are more susceptible to free ridership and could absorb a significant percentage of the available portfolio budget while delivering far less net savings than the portfolio has historically delivered.

Although there are some differences in our perspectives, we share many points of agreement as we look forward to the future:

- Research and data collection, such as a comprehensive saturation survey, to identify existing pockets of inefficiency would be very useful
- Leveraging interval meter data, analytics, and remote audits can cost-efficiently help identify opportunities for energy consumption reduction
- Targeting persistently inefficient buildings or end-uses is a key element of increasing energy savings
- Providing access to financing that leverages private capital will be increasingly important
- Measurement and verification approaches should be embedded in program design up front
- All cost-effective approaches should be pursued to achieve the state's goal of doubling EE savings

All three of these players, as well as the many other regulatory bodies, program administrators, program implementers, energy efficiency companies, businesses, and stakeholders across the state, will play a critical role in achieving California's energy efficiency objectives. Despite some differing concerns, the CEC, PG&E, and CPUC agree on the importance of open dialogue, cooperation, and the need to test, refine and adjust as we move forward to double energy savings in California.

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