ACCELERATING CARBON REDUCTIONS FROM CALIFORNIA'S ELECTRICITY SECTOR

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AMERICA'S POWER PLAN

ENERGY INNOVATION
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EXECUTIVE SUMMARY

In his 2015 inauguration speech, Governor Brown lit the way to 2030 for California, with goals to generate half the state's power from renewable energy, double the energy efficiency of existing buildings, and cut transportation fuel use in half. With smart policies, California can achieve these goals while ensuring that electricity remains affordable and reliable, setting us on the path to meet our greenhouse gas mitigation goals.

If California plans to achieve these 2030 targets on the way to the state's 2050 greenhouse gas target, we must take significant action to build on our existing renewable energy supply and energy efficiency programs. On the supply side, the state's Renewable Portfolio Standard (RPS) plateaus in 2020, with no well-defined successor policy. The RPS has been successful in catalyzing growth of renewables and driving down costs. As a result, California boasts the largest share of renewable energy of any state in the country. However, as California moves from the early to middle stages of decarbonizing its electricity supply, a new challenge looms: ensuring that these variable resources are used to their fullest potential, which requires optimal grid integration to minimize system costs and build resilience.

Significant improvements to energy efficiency programs will also be required to meet the 2050 target. The Low Carbon Grid Study suggests that California must reduce its net electricity demand by six percent by 2030 to meet the 2050 target. Many of California's existing efficiency programs have been successful and should be continued and strengthened, such as the world class Title 24 building codes and the law requiring utilities to pursue all cost-effective energy efficiency opportunities, as well as federal and state appliance standards. However, the state's primary mechanism to incent utility investment in energy efficiency, the Efficiency Savings and Performance Incentive (ESPI), is unlikely to keep the state on track. The current mechanism has engendered a deep skepticism in the process—from both utilities and the Commission—that dissuades buy-in and undermines the mechanism. And today's process for setting utility targets sets conservative limits on efficiency, taking the state off track from its long-term goals. The state's approach to energy efficiency needs a fundamental shift.

We recommend California shift to performance standards that align the utilities' incentives with achieving the state's 2050 and forthcoming 2030 carbon targets reliably and at least cost. This proposal addresses needed reforms for both electricity supply and demand. Specific policy recommendations for electricity supply include:

- Deploy a system-wide **carbon standard (393lb. CO_2e/MWh or 48.9MMT CO_2e) by 2030**, including interim targets with incentives and penalties tied to performance. Alongside that binding target, set a 50 percent renewable energy procurement "backbone" to meet the Governor's goals. It is likely infeasible to meet the carbon standard without at least 50 percent renewables, but the procurement backbone will serve the purpose of maintaining the investment signal for renewables.

- Push to expand the Energy Imbalance Market (EIM) to a West-wide electricity market. Add flexibility to the system through increased trading within California and with other Western states.
- Reform resource procurement to allow all resources to compete on equal footing to provide carbon reductions and flexibility—including all low-carbon resources: demand-side, distributed, or centralized.

Recommendations to enhance energy efficiency in California include:

- Transition to a performance-based energy standard for electricity (kWh/capita) that targets a reduction in a utility's kWh/capita by approximately 1.2 percent annually through 2030, including incentives and penalties tied to performance. Ensure the standard corrects for electric vehicle (EV) load growth to ensure utilities do not have a disincentive to pursue EVs. Replace the program-by-program PUC oversight with this performance standard.
- Consider a comparable standard for natural gas (therms/capita). This standard should incent carbon reductions from building electrification as well as from decarbonizing the gas supply.
- Expedite implementation of AB 758, the Comprehensive Energy Efficiency in Existing Buildings law. Consider including a mechanism requiring building upgrades if progress is not fast enough.

Over the past two decades, responding to the scientific mandate of climate change, California has led the nation on greenhouse gas emissions reduction. Nowhere has this leadership been more apparent and more needed than in California's electricity industry.

The results of this energy transition have been remarkable for California: the state has become a hub for renewable energy and innovation, and has shown the rest of the country that fighting climate change is a driver for, not a demerit to, economic growth.

Decarbonization of the electricity sector in California has potential to continue to drive economic growth in the state. But it will require a new suite of policies and standards. California needs these new, more integrated policies now in order to be positioned in 2030 to meet our long-term goals. These recommended policies will likely create new economic opportunities and solidify California's position as a hub for innovation and job creation in low-carbon technology. If managed well, this transition will be a win-win for California citizens and the globe.

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I. INTRODUCTION

A multitude of policies affect the electricity sector in California, each of which is aimed at one or more policy objectives: promoting renewable energy, reducing the cost of renewables integration, or directly reducing carbon emission from the electricity sector. In the background, California's cap and trade program places a cap on greenhouse gas emissions and prices carbon emissions across the whole economy, including the electricity sector. In an economist's perfect world, California's decarbonization problems would be solved under a stringent enough carbon cap. But cost containment and innovation concerns, resulting from the acknowledgement of important market failures, have made it clear that sector-specific policies are necessary to put California on a path toward timely, affordable, reliable decarbonization of the electricity industry.

These decarbonization policies fall into two categories: driving policies and enabling policies. The driving policies are standards that require compliance and drive procurement decisions—they include the Renewable Portfolio Standard and the cap and trade program. Enabling policies, on the other hand, indirectly support decarbonization by getting new technologies off the ground, stimulating innovation, enhancing competition, or redistributing resources for social benefit. In a sense, a powerful enough driving policy would be all that is needed to drive decarbonization (e.g., a strict cap and trade program), but enabling policies are necessary to correct for market failures, contain costs, and promote innovation.

Of the current driving policies, this section addresses the Renewable Portfolio Standard (RPS), which has been a powerful driver of renewable energy development and decarbonization in California. It has allowed California to lead the nation and indeed the western hemisphere in renewable electricity generation. Going forward, however, a shift towards performance-based carbon regulation could build on the success of the RPS by capturing the full range of solutions to optimize the electricity system around the goals of decarbonization, affordability, and reliability. Coupled with a renewable energy "backbone," a performance-based carbon standard would take advantage of the fact that the RPS has made renewable energy ready for primetime, encouraging open competition between supply- and demand-side technologies to drive down costs, provide investment certainty, and incent innovation. For these reasons, we recommend that California move to a carbon standard for 2030, measured either as greenhouse gas output (carbon dioxide equivalent, or CO_2e) for each unit of energy produced (megawatt-hours, or MWh), or total emissions (millions of metric tonnes (MMT) of CO_2e).

II. THE RENEWABLE PORTFOLIO STANDARD AS A DECARBONIZATION POLICY

Despite the existence of California's cap and trade program, non-cap policies have accounted for most, if not all, of the carbon emissions reductions since the cap was put in place. Of these non-cap policies, the RPS is the driving policy that ensures a minimum level of total electricity production comes from qualifying low- or zero-carbon sources, e.g. solar, wind, biomass, geothermal, and small hydro. The RPS has been an effective tool to promote investment in renewable energy technologies, reducing California's carbon footprint and keeping costs relatively low by using a reverse auction mechanism (RAM). The state achieved its 20 percent renewable standard and is on track to achieve the 33 percent target by 2020—and electricity bills have decreased along the way.[1] Not only that, the RPS has provided an important long-term signal to developers that California is open for business, making this one of the most attractive markets for renewable energy in the world. Undeniably, the RPS has been very effective in driving carbon out of California's electricity system.

Because the current RPS only extends to 33 percent renewable generation in 2020, a successor policy is needed to continue and accelerate the decarbonization of California's electricity sector through 2030 and beyond. Consistent with the Governor's goals and the least-cost path toward meeting California's 2050 decarbonization targets, a staggering amount of renewable energy will come online to meet California's needs. As renewable electricity approaches a majority share of generation in the next decade, a policy shift will ensure they enhance, rather than antagonize, reliability and cost goals going forward.

The current RPS procurement framework siloes renewable energy from other system resources, as well as from other decarbonization options, e.g. support for distributed generation, demand response, energy efficiency, and regional coordination. Energy-only contracts for renewable energy under the RPS's RAM mean that utilities procure non-energy services (particularly ancillary services) elsewhere, generally from natural gas turbines, pumped hydro, or any mix of out-of-state generation. These energy services are essential to maintaining reliability, and can be provided by zero-carbon sources, particularly distributed energy resources (DERs) that can defer investments in conventional solutions. A comprehensive carbon standard more properly frames integration, demand-side, and electrification issues around the central question—"how do we build a reliable, low-cost, decarbonized grid?"

Additionally, the current RPS framework leaves no incentive for utilities, regulators, or grid managers to support renewable energy integration with low-cost, low-carbon solutions for grid reliability and flexibility (which we define as the ability of the grid to co-optimize variable supply with variable demand gracefully and reliably). The current system allows carbon-intensive flexibility options to prevail over innovative, low-carbon flexibility solutions.[2] Failing to set a

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[1] Inflation-adjusted residential energy bills are actually lower today than they were in 1992. Doug Henton et al., *California Green Innovation Index, 6th Ed.* (Next10, 2014), Table 2, 17, http://greeninnovationindex.org/sites/greeninnovationindex.radicaldesigns.org/files/2014-Green-Innovation-Index.pdf. (citing Energy Information Administration, *California State Profile & Energy Estimates*, 2014, http://www.eia.gov/state/?sid=CA). This is due in large part to energy consumption trends: per capita energy consumption has been flat since the 1990. Ibid. Fig. 11, 16.

[2] For example, a study by E3 recently concluded that a California RPS of 50 percent by 2030 would result in curtailment of renewable energy resources at or near 9% during peak capacity if no flexibility policies were

standard for low-carbon grid integration may result in the use of fossil fuel-fired generators to provide capital- and carbon-intensive grid flexibility, particularly because these are the most conventional solutions.[3] But many low-carbon options exist to provide flexibility, including storage, demand response, widening balancing areas, and smarter operation and procurement of renewable resources themselves. Unlocking this flexibility is a matter of enabling these resources to be considered on equal footing with more traditional flexibility options during resource procurement. Integrated resource planning (IRP) and integrated distribution planning (IDP) are steps towards achieving these goals. But a performance-based carbon standard would encourage utilities to become proactive drivers of innovation and decarbonization in support of—and beyond—the Governor's 50 percent renewable energy goal. These low-carbon resources could not only provide future flexibility; in many cases they could replace fossil fuels today at a lower price.

III. A CARBON STANDARD AS A DECARBONIZATION POLICY

Linking an overall carbon emissions standard for the electricity sector to a long-term carbon target for 2030 and beyond would encourage innovative low-carbon grid integration solutions while achieving, and potentially exceeding, the Governor's renewable energy target.

Because a carbon standard would cover the entire fleet, rather than just renewable energy power plants, the system as a whole comes under carbon regulation, requiring utilities and grid operators to account for the carbon intensity of flexibility options as well as traditional energy options. With more resources competing to meet the same system need, this should increase reliability and decrease costs. Natural gas peaker facilities, natural gas combined cycle, and pumped hydro storage have historically been the de facto sources of flexibility, but demand

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implemented to support renewables integration. Energy and Environmental Economics, *Investigating a Higher Renewables Portfolio Standard in California* (Energy and Environmental Economics, January 2014), 14, https://ethree.com/documents/E3_Final_RPS_Report_2014_01_06_with_appendices.pdf. Contrast this with the results of the Low Carbon Grid Study, which found that California can get beyond 50% renewables at a neutral cost. See http://www.lowcarbongrid2030.org/. See also Jim Lazar, *Teaching the "Duck" to Fly* (Regulatory Assistance Project, January 2014), http://www.raponline.org/featured-work/teach-the-duck-to-fly-integrating-renewable-energy.

[3] For example, under Southern California Edison's latest Local Resource Procurement to replace San Onofre Nuclear Generating Station in the L.A. & Moorpark load pockets with "preferred resources," SCE selected a profile of resources that included approximately 75 percent natural gas-fired generators, and only 25 percent "preferred resources" (energy efficiency, storage, demand response, and distributed generation). Southern California Edison, "Local Capacity Requirements RFO," [visited December 11, 2014], https://www.sce.com/wps/portal/home/procurement/solicitation/lcr/!ut/p/b0/04_Sj9CPykssy0xPLMnMz0vMAfGjzOK9PF0cDd1NjDz9nQxdDRyDPS1cXD1cDYL9zfQLsh0VAQ4EJ6E!/. Although the CPUC gave SCE a range of 1000–1700MW of gas procurement to meet this load, SCE chose to procure the full 1700MW of gas-fired generation, procuring only the minimum "preferred resources" procurement under the PUC's ruling. Decision Authorizing Long-Term Procurement for Local Capacity Requirements (California Public Utilities Commission, February 13, 2013), Decision 13-02-015.

response, energy storage, smart electric vehicle charging (V2G), and widening balancing areas may present even more attractive options to optimize the system.

A performance-based carbon standard for utilities also aligns motivations. A carbon target can be set along a spectrum, the exceedance or shortfall of which would result in a proportional reward or penalty for regulated electric utilities. Instead of relying only on regulatory oversight to ensure utilities are considering all least-cost options to add flexibility and meet system needs, a carbon standard ensures that utilities are financially motivated to do this proactively. Similar performance-based regulatory models are being proven out in the UK, and in other state-level energy efficiency programs such as Vermont and Massachusetts.[4] A similar "greenhouse gas metric" is also being implemented by the Illinois Commerce Commission.[5] Leaving the existing revenue requirement calculation process for investor-owned utilities largely intact, a carbon standard can provide a profit motive for California's largest utilities to innovate to exceed the standard: the lower their carbon emissions, the higher their profit, and vice versa.

Both positive and negative incentives can be powerful motivators for utilities to be proactive about meeting and exceeding performance standards. For example, Brattle Group performed a comprehensive empirical study of reliability performance incentives across jurisdictions in multiple countries. They concluded that "[an] incentive structure should include both bonuses and penalties. Such a structure ensures that there is not a "cliff edge" effect, whereby distributors will be reluctant to invest to improve [performance] when they are close to their target if this could lead to higher than target [performance] for which they will not be rewarded."[6] In other words, penalties can motivate utilities to perform to a bare minimum standard, but a bonus incentive motivates them to go beyond the performance standard, creating space and motivation for innovation.

IV. POTENTIAL CHALLENGES OF A CARBON STANDARD FOR THE ELECTRICITY SECTOR

A carbon standard is likely to leave some gaps that necessitate complementary policies. An intensity standard (CO_2e/MWh) or mass-based standard can be gamed or create undesirable outcomes without oversight. Of particular concern are the possibilities of lost investment

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[4] For an in-depth discussion of these case studies, see Sonia Aggarwal and Eddie Burgess, *New Regulatory Models* (Energy Innovation & Utility of the Future Center, March 2014), http://westernenergyboard.org/wp-content/uploads/2014/03/SPSC-CREPC_NewRegulatoryModels.pdf.

[5] Kristin Munsch and Michael Panfil, Verified Petition of the Citizens Utility Board and Environmental Defense Fund to Initiate a Proceeding to Adopt a Metric for Reductions in Greenhouse Gas Emissions Associated with Smart Grid Advanced Metering Infrastructure Deployment Plans filed Pursuant to Section 16-108.6 of the Public Utilities Act (Illinois Commerce Commission, September 2014), Case Number 14-0555, Sept. 10, 2014.

[6] Serena Hesmondhalgh, William Zarakas, and Toby Brown, *Approaches to Setting Electric Distribution Reliability Standards and Outcomes* (Brattle Group, January 2012), 11.

signals, carbon accounting and leakage, and suitability for publicly-owned utilities. Each of these can be addressed with fairly simple complementary policies.

First, an intensity standard does not inherently provide the same long-term investment signals to renewable energy developers as a RPS. Renewable portfolio standards provide a clear market signal that long-term investments in renewable technologies will pay off. This investment, in turn, produces competition and innovation, which has successfully driven down the price for renewable energy technologies such that they are now competitive with fossil-fueled generators in many instances.[7] It has also consistently created jobs for Californians.[8] An intensity standard can be met in ways other than by procuring renewable energy, such as by investing in innovative flexibility solutions (e.g. demand response and storage) that decrease the need to ramp fossil units, which may undermine the policy's ability to drive consistent investment in renewable energy supply. But that concern can be mitigated with an analysis of the options for meeting an ambitious standard, which show that it is nearly infeasible to meet the standard without a substantial share of renewables. This kind of analysis could give comfort that a renewable energy procurement backbone is not redundant, and can be included alongside the carbon standard to maintain investment certainty.

In fact, this kind of analysis has been done. As discussed in Section V, below, a carbon standard on track to 80 percent reductions by 2050 would require that at least half of California's electricity come from non-hydro renewable generation, in line with Governor Brown's renewable energy goal.[9] For example, Energy and Environmental Economics (E3) found that by 2030, 50 to 60 percent of electricity (including distributed generation) must come from renewable energy sources to keep the state on a trajectory to meet its 2050 decarbonization goals.[10] The National Renewable Energy Laboratory (NREL) used its Low Carbon Grid Study to show that 58 percent of California's energy consumption could be met with renewables in 2030 to stay on pace at neutral cost.[11] But each of these studies further assumed smart renewable integration policies that ensure grid operators take advantage of all options for flexibility (see Part VI, below). Therefore, it is clear that any carbon target that gets California's electricity sector on track to

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[7] See generally *Lazard's Levelized Cost of Energy - Version 8.0* (Lazard, September 2014), 2, http://www.lazard.com/PDF/Levelized%20Cost%20of%20Energy%20-%20Version%208.0.pdf. This can depend on resource availability, location, load profiles, and transmission constraints, to name a few.

[8] See Hal Harvey and Chris Busch, *Carbon Free Prosperity in California* (Energy Innovation, February 2014), http://energyinnovation.org/wp-content/uploads/2014/06/Carbon-Free-Prosperity-in-California.pdf.

[9] *California 2030 Low-Carbon Grid Study (LCGS) Phase I Results Summary* & *Workpapers, Supplement 1* (National Renewable Energy Laboratory, September 2014), http://www.lowcarbongrid2030.org; *Investigating a Higher Renewables Portfolio Standard in California*, 14.

[10] *Summary of the California State Agency's PATHWAYS Project: Long-Term Greenhouse Gas Reduction Scenarios* (Energy and Environmental Economics, February 2015), 2, https://ethree.com/documents/E3_Project_Overview_20150130.pdf.

[11] See *California 2030 Low-Carbon Grid Study (LCGS) Phase I Results Summary*.

meet its greenhouse gas targets in 2030 will send a clear investment signal: procure at least 50 percent renewable energy by 2030.

But given the particular need to maintain strong investment signals for renewable energy in California, it makes sense to set a minimum renewable energy procurement "backbone" of 50 percent to support the carbon standard through 2030. This is a policy that would largely build on the RPS, but rather than driving procurement decisions, it would serve as an insurance policy for renewable energy developers that their projects will be in demand through 2030. Setting the carbon standard at a more stringent level than would be met with 50 percent renewables, or including performance incentives for surpassing the standard, would provide room for innovation by the utilities. Simultaneously, the prospect of a penalty for noncompliance with the carbon standard ensures that siloed procurement decisions that gold-plate the system will not prevail.

Second, an intensity standard may create new opportunities for gaming, some of which are already apparent under the cap and trade program. Determining the carbon intensity of imports under a carbon standard illustrates this point. Today it is difficult to determine the carbon intensity of imports; the current "unspecified imports" methodology under cap and trade is not adequate because it allows utilities to account for imports at a flat rate equivalent to the emissions of a very efficient natural gas plant.[12] The result has been a significant movement of "specified" coal into "unspecified" imports, the effect of which has been to obfuscate, and likely understate the emissions rate of coal imports.[13] A transparent and effective carbon standard would require safeguards to ensure this sort of gaming does not occur. One way to do this would be to reevaluate the emissions rate for imported electricity to reflect the fact that baseload coal makes up a portion of the electricity imported to California—perhaps by using the average emissions of the entire fossil-fueled generation fleet connected to California. Another option would be to require importers to account for emissions more accurately based on the balancing areas from which the unspecified imports are coming. Solving this problem may already be underway because of reductions in coal generation across the West which will continue under the Clean Power Plan. However it is done, this potential for emissions shuffling

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[12] This rate, 961lbs/MWh, was chosen by CEC and CARB because approximates the "marginal" generation that would be brought online in the Western Interconnection to meet demand in California. The unspecified power emission factor is calculated as a rolling three-year average of the marginal plants in the Western Interconnection, where marginal plants are defined as facilities producing at 60 percent of generating capacity or less, which is almost entirely natural gas plants in the West. CEC and CARB's justification for this rate was that "baseload" generation (hydro, nuclear, and coal) was already fully committed because of its relatively low cost and high capacity utilization and would not be dispatched to meet out-of-state demand. Likewise, renewable generation was all bound up in contracts to meet state RPS requirements, and so was not considered in the "unspecified emissions" rate. The result was a rate equal to a fairly efficient natural gas plant. James Bushnell, Yihsu Chen, and Matthew Zaragoza-Watkins, "Downstream Regulation of CO 2 Emissions in California's Electricity Sector," *Energy Policy* 64 (2014): 6.

[13] Ibid, 22; Arizona Public Service, 2012 Integrated Resource Plan, March 2012, 6.

should be improved to ensure that the carbon standard better reflects emissions from California's electricity consumption.

Last, a carbon standard may not be an appropriate policy for public power entities, which respond to different incentives than investor-owned utilities and fall under different regulatory oversight. For example, Los Angeles Department of Water and Power (LADWP) has already made reducing greenhouse gas emissions a main part of its IRP, along with coal divestment, smart grid investment, and distributed energy resource proliferation, all without a CPUC directive.[14] Additionally, public utilities are not under CPUC jurisdiction, so carbon regulation of these entities would have to be legislative. In some cases, the accounting for a carbon standard may be too resource intensive for smaller public utilities. A state-wide 50 percent renewables "backbone" can also ensure public utilities remain on track with California's renewable energy goals while still leaving room for innovation and demand-side solutions.

V. DETERMINING THE APPROPRIATE LEVEL OF A CARBON INTENSITY STANDARD

One way of calculating electricity's "share" of decarbonizing California's economy is to base the standard on the level that keeps the electricity industry on pace to reduce its emissions to 80 percent of 1990 levels by 2050. What is "on pace" differs based on perspective, however. For example, in setting AB32's 2020 economy-wide carbon target, the California Air Resources Board (CARB) calculated 1990 greenhouse gas emissions from the electricity sector to be 110 million metric tons of carbon dioxide equivalent (MMT CO_2e),[15] which would imply a 2050 goal of 22 MMT CO_2e (80 percent reduction from 1990 levels). Using equal percentage reductions in sector emissions from 2015 onward, a 2030 target that is "on pace" to meet the 2050 goal would be 48.9 MMT CO_2e. Dividing this by total projected load (minus energy efficiency projections based on the Governor's goals)[16], the "on pace" carbon intensity standard should be 393lb. CO_2e/MWh by 2030. A standard that is on pace to 80 percent reductions by 2050 requires significant investment in renewable energy, getting investor-owned utilities just beyond the Governor's goal of 50 percent in 2030:[17]

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[14] "2014 Power Integrated Resource Plan" (Los Angeles Department of Water and Power, December 2014), https://www.ladwp.com/ladwp/faces/wcnav_externalId/a-p-doc?_adf.ctrl-state=pffxzuqpb_4&_afrLoop=577376658457078.

[15] Jamesine Rogers, *California 1990 Greenhouse Gas Emissions Level and 2020 Emissions Limit* (California Air Resources Board, November 16, 2007), 6, http://www.arb.ca.gov/cc/inventory/pubs/reports/staff_report_1990_level.pdf.

[16] In his 2015 inaugural address, Governor Brown announced a goal of doubling efficiency in existing buildings in California by 2030. http://gov.ca.gov/news.php?id=18828.

[17] The following calculations assume that Diablo Canyon Nuclear Power Plant is retired on schedule in 2024–2025, although its license may be renewed, which would alter the resource mix to require less renewable generation (approx. 5.5 percent) in order to meet the same carbon intensity standard. Furthermore, energy efficiency is not included in the resource mix, although there are subtracted from the projected load.

Figure 1 – "On Pace" carbon standard

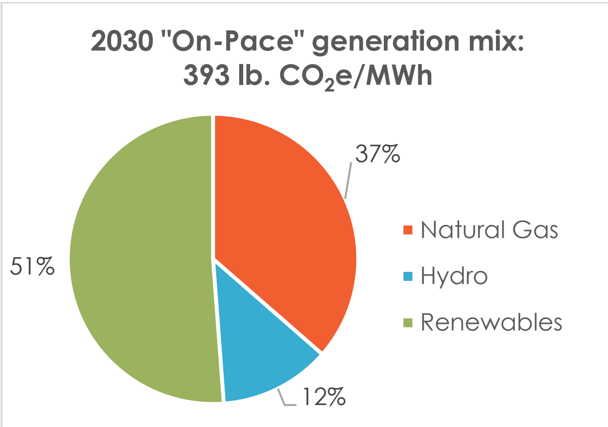
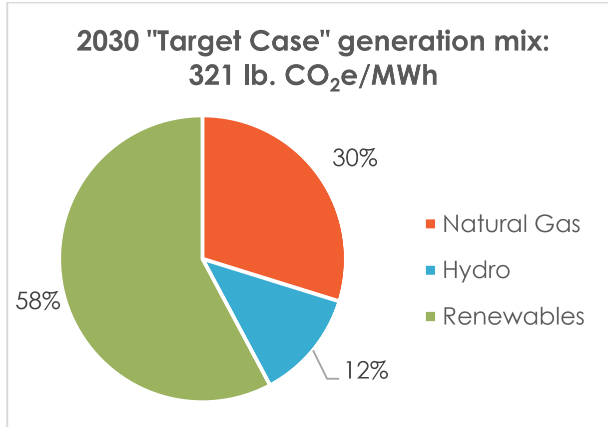


Figure 2 – "Target Case" carbon standard



However, unlike industries such as cement manufacturing and agriculture where greenhouse gas emissions are a more fundamental part of the industrial process, the electricity industry can, and likely must go further than 80 percent below 1990 emissions if California hopes to achieve its 2050 goal.[18] Instead of looking at what is "fair" for the electricity sector alone, another study by E3 took an economy-wide look at technology pathways to the 2050 goal, and concluded that over 90 percent of California's electricity production would have to come from zero-carbon sources in 2050, including 74 percent renewable energy with significant load growth due to electrification of fuels for buildings and vehicles.[19] This deeper decarbonization scenario, however, is not cost-prohibitive within the 2030 timeframe, according to the Low-Carbon Grid Study (LCGS). Rather, the LCGS concludes that a more aggressive "Target Case" could achieve greater emissions reductions than the "On Pace" case at *neutral cost*, meaning all additional costs could be offset by fuel savings, reduced operation costs, and carbon emission credits.[20] This case projects total emissions of 40 MMT CO_2e from the electricity sector in 2030 under the assumptions for complementary policies discussed below. Using the same energy demand growth projection as the "On Pace" case, the corresponding carbon intensity standard would be 321lb. CO_2e/MWh by 2030, and the resource mix would well exceed the Governor's goal of 50 percent renewables in 2030 (See Figure 1).

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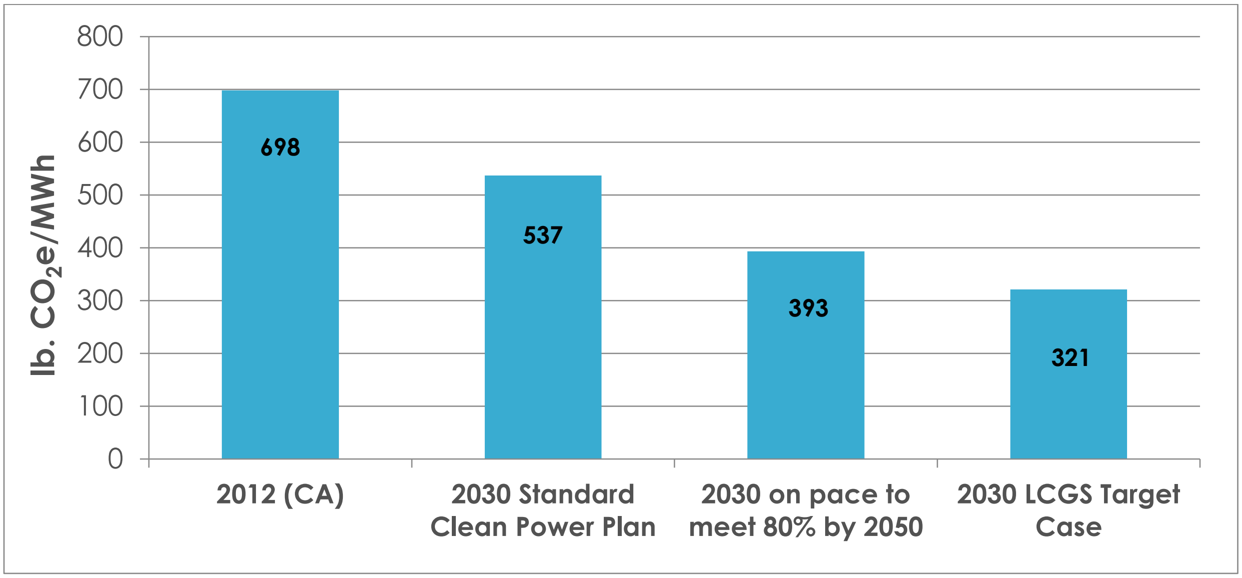
[18] James H. Williams et al., "The Technology Path to Deep Greenhouse Gas Emissions Cuts by 2050: The Pivotal Role of Electricity," *Science* 335 (January 6, 2012): 2. See also Max Wei et al., *Scenarios for Meeting California's 2050 Climate Goals* (Lawrence Berkeley National Laboratory & University of California at Berkeley, September 2013), http://www.energy.ca.gov/2014publications/CEC-500-2014-108/CEC-500-2014-108.pdf;James Nelson et al., *Scenarios for Deep Carbon Emissions Reductions from Electricity by 2050 in Western North America Using the SWITCH Electric Power Sector Planning Model* (Lawrence Berkeley National Laboratory & University of California at Berkeley, February 2013), http://www.energy.ca.gov/2014publications/CEC-500-2014-109/CEC-500-2014-109.pdf..

[19] Williams et al., "The Technology Path to Deep Greenhouse Gas Emissions Cuts by 2050: The Pivotal Role of Electricity."

[20] *California 2030 Low-Carbon Grid Study (LCGS) Phase I Results Summary*, Slide 11–14.

It is worth noting that the EPA's Proposed Rule under the Clean Power Plan has projected a target of 537lb. CO_2e/MWh for California by 2030: [21]

Figure 3 – Comparing carbon intensity standards

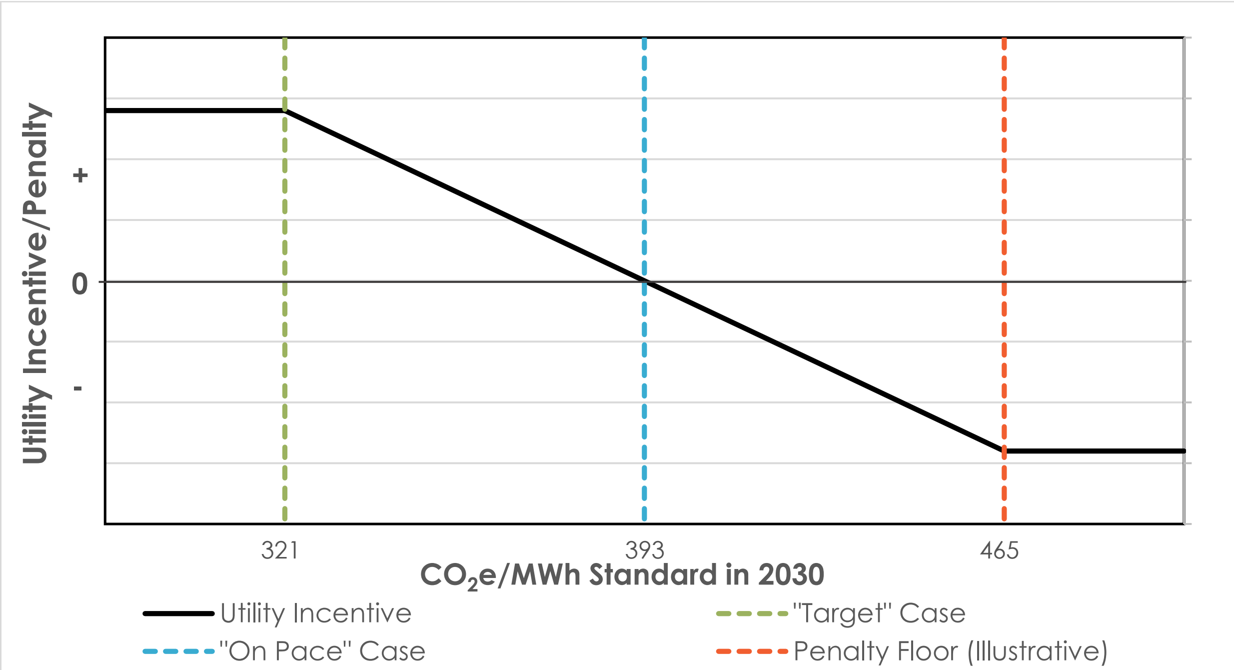


By EPA standards, these numbers are ambitious, but the LCGS suggests that the lower targets are achievable at a cost-neutral level.

Because it roughly equates to the Governor's 50 percent renewable energy target and it represents the "fair share" of emissions reductions by 2030, California should set the utility performance standard at or around 393lbs. CO_2e/MWh. This would be coupled with symmetrical financial rewards and penalties. In order to provide utilities with an incentive to achieve this standard that creates incentives to go beyond the governor's 50 percent renewable energy goal, the financial reward maxes out at the LCGS target and the penalty threshold is pegged to electricity's "fair share" of the 2030 trajectory toward the 2050 carbon target. Figure 4 (below) provides a rough illustration:

[21] "Goal Computation Technical Support Document" (U.S. Environmental Protection Agency, June 2014), Appendix 5, http://www2.epa.gov/sites/production/files/2014-06/documents/20140602tsd-goal-computation.pdf.

Figure 4 – Illustrating a Carbon Performance Incentive Structure



The graph illustrates the profit opportunity presented to utilities if they can meet the cost-neutral performance level that goes beyond the proposed targeted performance standard, as well as the penalty for failing to meet the on-pace standard. The values on the x-axis could be translated for a mass-based approach. Likewise, the values on the y-axis are left blank for demonstration and should be calibrated using economic analysis that appropriately apportions the costs and benefits of carbon reduction between consumers and utilities.[22]

In addition to the 2030 target, appropriate intermediate targets will also be necessary to drive consistent, investment in decarbonization technologies, including both utility-owned and distributed resources. Much like the existing RPS structure, a new framework would require periodic demonstrations that the utilities are on pace to meet the 2030 carbon target (perhaps each year).[23]

Using these carbon standards has at least three distinct advantages. First, it aligns utility incentives with state public policy goals by providing financial upside for contributing more than their share to decarbonization. This provides head-room above the governor's renewable energy target to promote innovative, low-carbon sources of flexibility, while precluding the gold-plated, high-carbon solutions of the past. Utilities that refuse to integrate innovative low-carbon

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[22] For an example of this type of financial analysis, see Peter Cappers et al., *Financial Analysis of Incentive Mechanisms to Promote Energy Efficiency: Case Study of a Prototypical Southwest Utility* (Lawrence Berkeley National Laboratory, March 2009), http://eetd.lbl.gov/sites/all/files/publications/report-lbnl-1598e.pdf.

[23] More flexible frameworks should also be examined and may be more attractive to utilities, including banking and borrowing between years, credits for exported renewable energy, or two- or three-year rolling averages.

flexibility options will certainly fall short of the goal, but those who innovate will reap the benefits of the performance incentive.

Second, the target ties performance directly to the state's 2050 carbon reduction goal and removes existing siloes between carbon reduction planning (CARB's Climate Change Scoping Plan),[24] system reliability planning (CPUC's Long Term Procurement Plan),[25] and electricity procurement under the RPS Renewable Auction Mechanism (RAM).[26] Renewable energy procurement that had taken place under the RAM would be shifted to include both supply- and demand-side low-carbon resources and oriented toward meeting the carbon performance standard. Furthermore, the CPUC should reexamine the minimum procurement level in the RAM of 3MW to ensure that distributed energy resources can compete with centralized generation to decarbonize the electricity sector.[27] This framework, combined with a new generation of energy efficiency policies, can provide a path toward decarbonization of the electricity sector while maintaining affordable, reliable power.

Because the carbon standard is directly linked to the 2050 target, ongoing calibration of the standard will also be necessary to stay on pace to meet the target. This tie to the 2050 target may mean that the appropriate stringency of the standard depends on some exogenous factors beyond the control of the utility: levels of independent energy efficiency adoption, load growth from population and electrification, proliferation of distributed generation, weather patterns, interstate trading, etc. It will be important to project an appropriate standard for 2030 based on current expectations, but also to clarify an adjustment methodology based on well-defined trigger points at substantial deviations from those expectations.

VI. COMPLEMENTARY POLICIES

In order to assess the need for complementary policies, this section briefly surveys the current policies that help to complement renewable energy goals, then discusses what other complementary policies are necessary to ensure the success of a carbon standard. These or similar efforts may need to be maintained or created under a carbon standard to ensure consistent investment signals and incentivize system optimization and low-carbon flexibility, including increasing regional cooperation and implementing regulatory reforms that provide flexibility. Starting from the principles of creating customer value, enhancing transparency and access to information, and incentivizing innovation, these complementary policies can ensure that the decarbonization of electricity supply is low-cost, efficient, and job-creating.

[24] http://www.arb.ca.gov/cc/scopingplan/document/updatedscopingplan2013.htm.

[25] http://www.cpuc.ca.gov/PUC/energy/Procurement/LTPP/.

[26] Decision Adopting the Renewable Auction Mechanism (California Public Utilities Commission, December 16 2010), Decision 10-12-048, http://docs.cpuc.ca.gov/word_pdf/FINAL_DECISION/128432.pdf.

[27] Ibid.

a. *Existing Investment Signal Policies*

Several current policies can help provide the investment signals that might be unclear under a carbon standard:

- Net metering policies support distributed generation.
- The Long-Term Procurement Plan (LTPP) provides longer-term planning that will be necessary to avoid superfluous investments while meeting the carbon standard; the LTPP should center around meeting the carbon standard, and the extend the planning period from ten to twenty years.
- The loading order (under SB-1037) remains an important mechanism to derive the most value from demand-side resources and renewable energy, although utilities and the CAISO have wide discretion under the LTPP to choose conventional sources.

It will be important to ensure that the LTPP process becomes directly related to meeting the carbon intensity target, and is explicit about the new renewable energy generation needed to meet that target—as a part of an integrated portfolio. A reverse auction like the one existing to meet the RPS would also be a useful tool for procurement that ensures cost containment. However, more could be done to increase the transparency of the procurement process, including disclosure of contract terms.[28]

In addition, CPUC enforcement of the loading order under the LTPP can help ensure natural gas is procured minimally, and only for the premium services it is well-suited to provide. If California's grid operators can avoid burning natural gas for energy, the resources can be spared to use for high-value flexibility and system back-up capacity—reducing total emissions and taking advantage of natural gas plants when they're really needed. A carbon standard would help to drive this enforcement by incenting the utilities to offer more innovative, low-carbon flexibility options in their long-term procurement plans.

b. *Existing Grid Optimization and Reliability Policies*

As the share of renewable energy on the grid increases, sources of flexibility and ancillary services to support those variable resources will become increasingly valuable to maintain reliable electricity service. As of now, natural gas and hydro storage are the de facto flexibility resources in large part because they are proven technologies that require little change in the way the grid is operated and provide long-term revenue growth for utilities. However, natural gas turbines are a source of carbon emissions that will erode gains in renewable energy generation so long as they are the predominant source of flexibility. Today, low-cost, zero-carbon technologies are able to replace this relatively carbon- and capital-intensive source of

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[28] Several parties recommended this in the 2012 LTPP proceeding, but the Commission decided to make no significant changes to transparency under the reverse auction. Decision Modifying Long-Term Procurement Planning Rules, 22–25 (California Public Utilities Commission, February 27, 2014) Decision 14-02-040, http://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M088/K729/88729621.PDF.

flexibility. With encouragement for utilities and nascent industries, these options can proliferate, providing low-cost, low-carbon flexibility to support variable generation and demand.

Several programs already support low-carbon flexibility options in California:

- SB-1414, requiring demand response's consideration in the Long-Term Procurement Plan (LTPP)
- AB-327, requiring Integrated Distribution Plans
- AB-2514, and the resulting target for energy storage

These policies represent a solid portfolio, giving California one of the most ambitious programs in the nation to support low-carbon flexibility options like demand response, energy storage, and smart grid technologies. However, more will likely be needed, including expansion of intrastate and interstate energy trading, as well as regulatory reform to encourage the procurement and optimization of distributed energy resources.

c. New Complementary Policies

i. Create a 50 percent Renewable Energy "Backbone"

Perhaps the greatest success of the RPS in California has been the consistent demand it has created for renewable energy technologies. This has ensured that tens of thousands of Californians could find work in renewable energy industries, and it has created a consistent investment signal for research and development and manufacturing that leads to lower costs of renewable resources. One potential worry under a carbon standard for utilities is that it does not necessarily provide the same clear and consistent investment signals as a renewable energy mandate would. Without a complementary policy, it is possible that the carbon standard would lead to a temporary drop in renewable energy contracts, particularly if innovative applications of distributed energy resource become more cost-effective at meeting system needs in the future. Although in the long-term a carbon standard would drive renewable energy investment well beyond 50 percent, a renewable energy procurement backbone policy of 50 percent by 2030 would strengthen the investment signals that are otherwise more ambiguous under a carbon standard.

A carbon standard that is on pace for reductions by 2030 sets the penalty for utilities very close to a level that could be met with 50 percent renewables by 2030.[29] With a renewable energy procurement backbone to support it, utilities and developers have a clear procurement signal that reinforces the floor of the carbon standard and ensures that they do not fall short of the pace to meet 2050 goals. At the same time, the carbon standard provides head-room for innovative approaches to decarbonizing the electricity system, exceeding the carbon standard, and possibly integrating shares of renewable energy beyond 50 percent by 2030. Thus, a

[29] See Figure 1, above.

renewable energy procurement backbone of 50 percent by 2030 safeguards the investment signals needed to maintain a vibrant clean energy industry in California for years to come.

ii. Expand Intrastate and Interstate Energy Coordination and Trading

One of the most cost-effective ways to integrate high shares of renewable energy is to increase geographical diversity of the resources being balanced. Over larger distances, wind tends to even out, and east-facing solar balances with west-facing solar, reducing the need for costly baseload or peaking generators.[30] Currently, the California Independent System Operator (CAISO) has entered into agreements with PacifiCorp and NV Energy to launch an energy imbalance market (EIM)—but increased coordination should start at home. There is large potential for coordination between the Los Angeles Department of Water and Power (LADWP), the Sacramento Municipal Utility District (SMUD), and CAISO to reduce the cost of serving each territory. More should be done to ensure that municipal utilities see value in joining the EIM. The Governor can continue to promote the expansion and evolution of the EIM and other wide-area market mechanisms throughout California and the rest of the Western Interconnection to cultivate an increasingly diverse portfolio of resources that facilitate integration.

At the same time, these expansions have the potential to benefit California's economy and create jobs by promoting the export of clean power from California to the benefit of customers. Exporting abundant renewable energy during certain hours of the day can also minimize renewable curtailment, improving the cost-effectiveness of the whole system.[31] Just as California can take advantage of diverse resources throughout the West, California's unique power portfolio and renewable resources have the ability to meet needs in other states.[32] Expanding the EIM—and the broader electricity market–would increase the imported energy for California, and it would also provide tremendous potential to export power throughout the West. Any potential jobs lost to increasing imports would likely be offset by increased jobs related to exports as well as reductions in rates for California electricity customers. Furthermore, greater coordination could increase the impact of California's climate policies, driving investments in clean energy in states throughout the Western Interconnection.

iii. Improve Procurement to Add Flexibility and Drive Down Costs

The carbon standard is a pollution metric, not a reliability metric. As such, it only indirectly incents the flexibility the system needs to decarbonize by requiring more renewable energy. If utilities continue to increase the share of renewables on the grid, as outlined here, then California should also create a mechanism that properly values the flexibility needed to support those variable resources.

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[30] Andrew Mills, *Implications of Wide-Area Geographic Diversity for Short-Term Variability of Solar Power* (Lawrence Berkeley National Laboratory, 2010), http://escholarship.org/uc/item/9mz3w055.pdf.

[31] "Investigating a Higher Renewables Portfolio Standard in California," 14.

[32] For example, west-facing solar in California can provide some of the evening ramping needs in states to the east where the sun has already set.

The existing framework of IDPs has tremendous potential to identify innovative demand-side sources of flexibility. But the information from IDPs needs to be integrated into the procurement process. While programs like Southern California Edison's preferred resources "living pilot" show there is hope for demonstrating the ability of distributed energy resources to provide needed flexibility and ancillary services,[33] the default response is still to use fossil-fueled generation.[34]

Relevant regulatory reforms could include utility procurement or changes to the market rules in CAISO. While all resources should compete to provide flexibility, no market exists in which they can compete on equal footing. Defining the needed flexibility services and opening these services up to competition from zero-carbon, customer-sited resources such as demand response, storage, EV charging, and smart renewable generation would enhance the ability for the electric utilities to transition to a low carbon future and meet the standards articulated in this proposal. This could take the form of reformed CAISO product definitions that reflect the ability of DERs to provide these services—for example, the market should allow for aggregation of DERs to compete with conventional generation to provide flexibility or other ancillary services. Utilities should also be required to procure innovative sources of flexibility under integrated resource planning at the utility level, overseen by the CPUC. Either outcome would supply the grid with additional low-cost flexibility and ancillary services and lay the groundwork for phasing out fossil fuels entirely.

VII. CONCLUSION

Over the past two decades, responding to the scientific mandate of climate change, California has consistently led the nation on greenhouse gas emissions reduction. The executive leadership from Governors Schwarzenegger and Brown has reinforced this ethos for California policymakers and citizens. Nowhere has this leadership been more apparent and more needed than in California's electricity industry.

The results of this energy transition have been remarkable for California—the state has become a hub for renewable energy and innovation, and has shown the rest of the country that fighting climate change is a driver for, not a detractor from, economic growth.

Decarbonization of the electricity sector in California has tremendous potential to continue to drive sustained economic growth in the State. As innovative and progressive as current policies may be, California is still significantly short of the pace necessary to meet the state's target of 80 percent greenhouse gas reductions from 1990 levels by 2050. California needs new, more integrated policies for 2030 to incentivize and support the transition to a low-carbon system. If recent trends are any indication, these policies will likely create new economic opportunities and

[33] For more on the SCE pilot program, visit http://www.cpuc.ca.gov/PUC/131106_DefiningTheLivingProject.htm.

[34] See footnote 3, above.

solidify California's position as a hub for innovation and job creation in low-carbon technology. If managed well, this transition will be a win-win for California citizens and the globe.

A NEW APPROACH TO CALIFORNIA'S ENERGY EFFICIENCY PERFORMANCE INCENTIVE

I. INTRODUCTION

A significant improvement in energy efficiency is required for California to achieve its 2050 greenhouse gas target and Governor Brown's goal of doubling efficiency in existing buildings. Many current programs—such as AB 2021 (which requires procurement of all cost-effective energy efficiency), world-leading building codes, and federal and state appliance standards—have been successful and should be continued and strengthened. However, improving the energy efficiency of existing buildings continues to pose a challenge.

In addition to those already mentioned, one of the state's primary mechanisms targeting efficiency in existing buildings is the utility shareholder incentive mechanism, called the Efficiency Savings and Performance Incentive (ESPI). This mechanism allows utilities to earn a return on energy efficiency expenditures commensurate with the level of energy savings achieved. It is intended to provide utilities with a strong incentive to help building owners install energy-efficient measures by providing utilities an additional return on their spending. Unfortunately, this mechanism has had limited success. The past and current mechanism structure has required utilities and the CPUC to develop savings estimates for individual measures, a process which has proved complex, contentious, and time-intensive.[35] Additionally, the CPUC's reliance on estimated market potential based on conservative cost-effectiveness assumptions has limited the ambition of the ESPI. Another limitation is the inability of program administrators to count savings from improving existing buildings from below code up to code; utilities are only allowed to count savings in existing buildings to the extent they improve efficiency *beyond* the state's already stringent building codes that are triggered when new buildings are built or existing buildings undergo drastic renovations.

While the CPUC has attempted to overcome some of these issues in the most recent shareholder incentive mechanism, problems remain. For example, more than half of utility efficiency projects require both ex ante (conducted by the utilities) and ex post (conducted by the CPUC) evaluations of project savings. If the past is any indication, this process is likely to prove highly contentious and discourage utility participation. Efficiency savings goals used to set IOU-specific incentive amounts continue to be based on the market potential of efficiency.

This approach has created conservative efficiency goals[36] that are neither related to the broader efficiency and carbon goals of the state nor reflective of the actual achievable potential. Finally, by continuing to disallow utilities from earning on energy savings from bringing existing buildings

[35] Sangeetha Chandrashekeran, Julia Zuckerman, and Jeff Deason, *Raising the Stakes for Energy Efficiency - California's Risk/Reward Incentive Mechanism* (Climate Policy Initiative, 2014).

[36] Comprehensive Energy Efficiency Program for Existing Buildings Scoping Report (California Energy Commission, August 2012), 14.

up to code, utilities are dissuaded from improving efficiency in the buildings that are most in need of upgrades. To achieve the Governor's goal of doubling efficiency and achieving 80 percent greenhouse gas emissions reductions by 2050, a significant change is needed to the shareholder incentive mechanism.

In place of the current utility incentive mechanism, we propose a kilowatt-hour per capita (kWh/capita) standard and a therms per capita standard to more efficiently engage utilities, local governments, and third party non-profits and companies as partners in efficiency. These proposed standards are essentially a greatly simplified incentive mechanism. They allow utilities to earn an incentive commensurate with the level of savings achieved, moving away from the approach of calculating measure-specific savings to determine incentive amounts. The standards are based on projected population and targeted levels of efficiency improvement, and will include metrics to account for other macro level effects, such as electric vehicle integration and weather. Total utility sales are divided by the population in a utility's service territory to derive a utility's compliance with the standard, resulting in a reportable total for efficiency achievements. Energy efficiency goals are based on the state's carbon goals and the Governor's goal of doubling efficiency, instead of on the conservative market potential. To address annual weather fluctuations, compliance can be measured using a rolling multi-year average. EV integration can be accounted for through vehicle registration data and estimates of average EV electricity use.

Though the beauty of the kWh/capita and therm/capita standards is in their simplicity (overcoming a major challenge of the current program), they provide other benefits as well. Under the proposed standard, utilities have an incentive to invest in any measure that reduces kWh/capita, including those beyond "traditional" energy efficiency, like on-site generation. For example, a utility could earn incentives by investing in distributed energy resources like solar PV, which reduces the amount of kWh sold and therefore reduces the kWh/capita behind the meter. And by using a decreasing therm/capita standard, utilities will be incented to further electrify buildings, a necessary step to meet the 2050 target.[37]

Getting the state on track to meet its 2050 carbon target will require changes in many energy programs. Energy efficiency will play an important role in meeting this target, and will need to increase at rates not yet consistently achieved.[38] A kWh/capita standard and therm/capita standard can get utilities on track to meeting the 2050 target by removing the barriers of the current shareholder incentive mechanism.

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[37] Williams et al., "The Technology Path to Deep Greenhouse Gas Emissions Cuts by 2050: The Pivotal Role of Electricity."

[38] Ibid.

II. WHY CALIFORNIA NEEDS A NEW EFFICIENCY PERFORMANCE INCENTIVE

California's approach to energy efficiency has relied heavily on the ESPI to drive savings in existing buildings. Building codes apply to new buildings and are therefore not applicable for existing buildings. Appliance standards set stringent energy use requirements for new equipment and can therefore improve energy efficiency in existing buildings. The primary approach for existing buildings has been to provide utilities with an incentive—through the ESPI and its earlier iterations—to implement energy efficiency. The CPUC oversees implementation of the ESPI. In the 2013-2014 program cycle, the state's IOUs were forecast to spend $1.4 billion on efficiency, with a maximum potential incentive payment of more than $178 million.[39]

a. Energy Efficiency Goals are Overly Conservative

Energy efficiency goals for IOUs, which are used to set incentive amounts under the ESPI, are based on findings from the *California Energy Efficiency Potential and Goals Study* ("the Study"), updated every two years.[40] The Study uses modeling with specific filtering criteria to determine the maximum market potential for energy efficiency within each IOU's service territory. The total market potential includes projects which are technically feasible, have a 0.85 or greater Total Resource Cost (TRC) value (the ratio of costs to benefits), and could be expected in response to incentives and assumptions about market behavior.[41]

The current methodology is problematic for a couple of reasons. First, by limiting the economic potential of utility programs only to measures that achieve a 0.85 or greater TRC, the Study omits a significant number of projects that could be used to improve efficiency. Because utilities are already required to meet a cost-effectiveness threshold across their portfolios, it is not necessary to limit the economic potential of specific projects to those meeting a measure-specific TRC value. The overly conservative nature of the Study is evident in the fact that California's IOUs routinely exceed their savings goals. For example, for the 2010-2012 program cycle (the most recent cycle for which evaluated data exists), the IOUs' evaluated[42] gross savings were 2,814; 2,566; and 2,365 GWh for 2010, 2011, and 2012, respectively.[43] But the goals in

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[39] Order Instituting Rulemaking Concerning Energy Efficiency Rolling Portfolios, Policies, Programs, Evaluation, and Related Issues (California Public Utilities Commission, 2014), Decision 13–11–005.

[40] *2013 California Energy Efficiency Potential and Goals Study* (Navigant Consulting, 2014).

[41] Ibid.

[42] Evaluated savings are those that have been adjusted by the CPUC and are substantially lower the than those reported by the IOUs.

[43] California Public Utilities Commission, "2010-2012 Program Cycle," *California Energy Efficiency Statistics*, accessed January 21, 2015, http://public.tableausoftware.com/views/1012_IOUGWhTime/QuarterCumulative?:embed=y&:showVizHome=no&:host_url=https%3A%2F%2Fpublic.tableausoftware.com%2F&:tabs=yes&:toolbar=yes&:animate_transition=yes&:display_static_image=yes&:display_spinner=yes&:display_overlay=yes&:display_count=yes&:loadOrderID=0.

those years were 2,276; 2,324; and 2,365.[44] This data suggests the IOUs are capable of exceeding the CPUC's goals by a considerable margin.

Second, by using the Study to set IOU efficiency targets, the targets are divorced from the state's long term efficiency and decarbonization goals. For example, in the 2013-2014 program cycle, IOU goals were equivalent to roughly 0.6 percent of their forecast demand.[45, 46] However, previous studies have shown that the level of efficiency improvement needed to meet the state's carbon goals is closer to double this value. Price et al. concluded that an energy efficiency improvement of 1.2 percent per year was needed in the residential sector to meet the carbon target.[47] The Low Carbon Grid Study also concluded that an improvement of 1.2 percent per year was needed to meet the state's goals.[48] This target, an improvement of 1.2 percent per year, is also equivalent to Governor Brown's goal of doubling of the rate of existing building efficiency improvement.

b. Baseline Methodology Disincentivizes Efficiency Investment in Existing Buildings

Doubling energy efficiency in existing buildings will require building owners to not only replace failed equipment with code-efficient equipment (replace on burnout), but also replace still-functioning inefficient equipment with code- or beyond code-efficient equipment (early retirement). This is due to the fact that many building components can last 20 or more years,[49] so removing inefficient equipment as soon as possible will drive significant savings. While building owners have to replace failed equipment or other degraded building components with new, more efficient versions, they have a choice about whether or not to replace these components before they completely fail. One of the ways in which program administrators have targeted efficiency in the past is by offering an incentive to building owners who replace inefficient equipment or upgrade buildings before it is necessary.[50]

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[44] Decision Approving 2010 to 2012 Energy Efficiency Portfolios and Budgets, 09–09–047 California Public Utilities Commission (2009).

[45] Decision Adopting Efficiency Savings and Performance Incentive Mechanism (California Public Utilities Commission, 2013), Decision 12–01–005.

[46] *California Energy Demand Updated Forecast, 2015-2025* (California Energy Commission, December 2014).

[47] Snuller Price et al., *Meeting California's Long-Term Greenhouse Gas Reduction Goals* (Energy and Environmental Economics, Inc., November 2009).

[48] Low Carbon Grid Study, "Workpapers, Supplement 1: Detailed Load Forecast Projections Supplementing Appendix A of the Workpapers," 2015.

[49] See, e.g., https://www.fanniemae.com/content/guide_form/4099f.pdf. The CPUC has "capped" EUL at 20 years so the EULs in its DEER database are not necessarily representative of the actual EUL achieved by long lived building components.

[50] See, e.g., https://www.sdge.com/sites/default/files/documents/1480693430/Programs%20-%20Energy%20Efficiency%20Business%20Incentives%20Fact%20Sheet.pdf?nid=12376.

This distinction between replace on burnout and early retirement is important because the CPUC uses it to determine the baseline for energy efficiency: in the absence of policy, what would have happened otherwise? The performance of utilities relative to this baseline is then used to determine budgets and incentives (i.e. the ESPI) for utilities.

In the CPUC's *Decision Establishing Energy Efficiency Savings Goals and Approving 2015 Energy Efficiency Programs and Budgets*, it has explicitly prohibited program administrators (PAs) from "counting" efficiency savings achieved from bringing building components that are below code up to code. Instead, PAs can only count the additional savings from bringing buildings *above* the state's already aggressive building and appliance codes.[51] The Natural Resources Defense Council (NRDC) has accurately pointed out that the CPUC's rationale is falsely predicated on the belief that all retrofit projects are replaced on burnout, and therefore only allows credit for early retirement savings as an exception.[52] The CPUC's methodology has been criticized by many commenters, including the major utilities and independent third parties (like NRDC and the California Energy Efficiency Industry Council (CEEIC). The main problem with CPUC's approach is:

> *Since the "above code" incentive represents only a small fraction of the total dollars needed by highly inefficient buildings to implement comprehensive savings, the current system has the perverse effect of leaving behind buildings which are significantly below code. The result is a sizable lost opportunity to help the buildings with the most savings potential that frequently don't have the resources to move forward with large projects, and in effect strands those buildings/customers and prevents their participation.* [53]

c. The ESPI Has Significant Programmatic Issues

A Brief History of California's Efficiency Performance Incentive

The Risk Reward Incentive Mechanism (RRIM), California's first iteration of a shareholder incentive program since restructuring, was first implemented in 2006 for the 2006-2008 program cycle. The RRIM was designed allow utilities to earn a portion of the net economic benefits of their efficiency programs commensurate with the level of performance relative to an efficiency target. The CPUC set utility efficiency goals that the utilities were expected to meet on a portfolio-wide basis (in terms of kWh, kW, and million therms).[54] The performance incentive was capped at 12 percent of efficiency expenditures, with the level of the incentive falling into four

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[51] Decision Establishing Energy Efficiency Savings Goals and Approving 2015 Energy Efficiency Programs and Budgets (Concludes Phase I of R.13-11-005) (California Public Utilities Commission, 2014), Decision 14–10–046.

[52] Lara Ettenson and Peter Miller, "Opening Comments of the Natural Resources Defense Council (NRDC) on the Proposed Decision Establishing Energy Efficiency Savings Goals and Approving 2015 Energy Efficiency Programs and Budgets" (Natural Resources Defense Council, October 6, 2014).

[53] Margie Gardner, "Comments of the California Energy Efficiency Industry Council on Administrators' Proposal for 2015 Energy Efficiency Funding" (California Energy Efficiency Industry Council, April 4, 2014).

[54] Chandrashekeran, Zuckerman, and Deason, *Raising the Stakes for Energy Efficiency - California's Risk/Reward Incentive Mechanism*.

buckets: a penalty, no incentive, a nine percent incentive or a 12 percent incentive. The remainder of the savings was returned to customers in the form of lower bills.

Two design features of the RRIM led to significant problems. The first was that in a three-year program cycle, the first two years of incentive payments were determined based on utility ex ante savings, while the third year of payments based on confirmed ex post savings was determined by the CPUC.[55] This approach proved highly contentious; the CPUC staff's estimates of savings were drastically different than the utilities', with the result being a proposed enormous swing in incentive payments.[56] In one case, CPUC staff recommended a $75 million penalty for a utility that had been anticipating a $180 million incentive payment.[57]

The disagreement over actual savings, driven largely, though not exclusively, by the use of different assumptions about free-ridership, led the CPUC to ignore staff estimates[58], and to abandon its approach and instead used ex ante savings estimates combined with a lower incentive rate. The CPUC used this approach in the following program cycle as well, rewarding utilities with a seven percent rate of return on net economic benefits.[59, 60]

In the 2010-2012 program cycle, the CPUC abandoned this methodology altogether, offering a seven percent return on approved program spending.[61] While it avoided the problem of addressing ex post savings estimates, the CPUC's approach of rewarding utilities based simply on their expenditures generated criticism because it did not include any mechanism to account for actual savings.

The most recent iteration of the CPUC's incentive mechanism, known as the Efficiency Savings and Performance Incentive (ESPI), was implemented in 2013 for the 2013-2014 program cycle. The ESPI is a hybrid model of the previous CPUC incentive mechanisms and includes four incentive components: energy resource savings based on savings estimates, CPUC evaluation of the utilities' estimation methodologies, expenditures on building codes and standards, and non-resource program expenditures.

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[55] Ibid.

[56] Ibid.

[57] Ibid.

[58] The CPUC staff cannot officially represent the CPUC unless specifically authorized; the CPUC only "speaks" through formal orders.

[59] Net economic benefits are equal to the total avoided resource cost less than cost to administer the programs.

[60] Chandrashekeran, Zuckerman, and Deason, *Raising the Stakes for Energy Efficiency - California's Risk/Reward Incentive Mechanism*.

[61] Ibid.

Problems with the Existing Performance Incentive

Though it is intended to provide a transparent incentive and overcome past shareholder incentive issues, the ESPI is in fact a complex and opaque program that faces similar problems as its earlier iterations.

1. Ex post evaluations are still a significant component of the utility incentive

In the ESPI, energy resource savings are calculated using both ex ante and ex post evaluation, much like the approach used in the RRIM. The main difference is that for the ESPI, the CPUC has published "approved" values for utilities to use in calculating ex ante savings estimates, with the hope that these approved values will eliminate disagreement over project savings estimates. However, the CPUC still plans to use its own ex post estimates to calculate energy savings for "highly uncertain" projects, which do not have published ex ante values. The proportion of "highly uncertain" projects in each utility's portfolio appears to be substantial: 55 percent for PG&E, 53 percent for SCE, 45 percent for SDG&E, and 35 percent for SCG.[62] While the CPUC has made an effort to minimize potential disagreement, its approach of once again using ex post evaluations opens the door to controversy about incentive payments. Should devaluation of incentives occur—and there is no reason to believe that it won't—it is likely to be challenged by the utilities, resulting in program delays and further controversy.

2. Short program cycles fail to provide a clear long term market signal

The ESPI, as well as its earlier iterations, have all operated on a three year cycle. Furthermore, every iteration of the incentive mechanism has been issued well into the IOUs' program cycles. For example, the ESPI was issued in September 2013 for the 2013-2014 program cycle. The combination of short program cycles and continuous delays in program implementation has inhibited the ability of utilities to effectively plan their energy efficiency resource programs to achieve deep savings over the long run. The start-and-stop nature of funding can disrupt business planning and affect investment in personnel and infrastructure. Similarly, short funding cycles means that efficiency programs can't be designed to go beyond that, limiting the ability of these programs to move markets in the long run. As a step in the right direction, the CPUC recently announced continuous funding through 2025.[63] However, the CPUC has yet to decide if—and how—it will implement rolling portfolios. A clear long-term signal is needed to facilitate utility investment in efficiency projects with deep energy savings.

3. Utility incentives are arbitrary and undervalue efficiency improvements

In the ESPI, utility resource incentives are determined on a per kWh, per kW, and per therm basis. The CPUC also includes measurements for the energy use life (EUL) and net-to-gross ratio

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[62] Decision Adopting Efficiency Savings and Performance Incentive Mechanism (California Public Utilities Commission 2013), Decision 12–01–005.

[63] Order Instituting Rulemaking Concerning Energy Efficiency Rolling Portfolios, Policies, Programs, Evaluation, and Related Issues (California Public Utilities Commission, 2014), Decision 13–11–005.

(NTGR) in determining incentive amounts to emphasize efficiency projects that are long lived (high EUL) and would not likely have occurred otherwise (high NTGR). In establishing the per unit incentive amount, the CPUC opted to use "stretch" values for the EUL and NTGR.[64] The problem is, as the CPUC acknowledges, these stretch values are likely not achievable on a portfolio wide level.[65] The result is that the use of the stretch values causes the per unit incentive amount to be lower than it would otherwise be, meaning that even if utilities successfully implement their entire portfolio, and pursue less cost-effective projects than they would otherwise, it is not possible for them to achieve the full incentive.

Another problem with the ESPI is that the Ex Ante Review payment is based on an arbitrary assessment of qualitative components of each utility's efficiency program.[66] Though the utilities have an opportunity to comment and challenge final scores, the CPUC exercises full discretion in evaluating the utilities.[67] The result is that this incentive has little meaning; it is primarily an arbitrary way for the CPUC to show its approval or disapproval of how the utilities behaved when dealing with the CPUC relative to actual programs.

Collectively, the issues discussed here significantly hamper the success of the ESPI. The problems with the ESPI are compounded by the fact that there is deep distrust between the utilities and the CPUC. To overcome these problems, a new framework for evaluating efficiency is needed. A new efficiency shareholder incentive should strive for simplicity, clarity, and transparency and should establish long term efficiency goals that provide an investment incentive for utilities.

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[64] The per unit incentive amount formula is: Incentive per unit savings ($/kWh, $/kW, $/MMtherm) = Utility efficiency budget ($) / [IOU savings goals (kWh, kW, MMtherm) * stretch EUL (12 for electric and 15 for gas)* stretch NTGR (0.8)]. To determine IOU measure-specific savings, savings, EUL, and NTGR values from specific projects are substituted.

[65] In its decision implementing the ESPI, the CPUC notes that the stretch values are not achievable across a portfolio: "These target EUL (12 years for electric measures, 15 years for gas measures) and NTG (0.8 for both electric and gas measures) values are not representative of recent experience and may not be achievable in the 2013-2014 portfolio. We utilize these target EUL and NTG values, however, in calculating lifecycle goals to emphasize the importance of challenging the IOUs to stretch their capabilities to reach higher standards of performance over time." For example, per the ESPI rulemaking, of the 57 measures or measure categories with approved NTGs, only 13 have NTGs are at or above the "reach" value of 0.8, of which only seven are straightforward projects.

[66] The evaluation is based on an array of metrics that range from the "timeliness of action in implementation of ordered ex ante requirements" to utility efforts to "incorporate cumulative experience from past activities…into current and future work products." Ibid.

[67] Decision Adopting Efficiency Savings and Performance Incentive Mechanism (California Public Utilities Commission, 2013), Decision 12–01–005.

III. PROPOSED POLICY SOLUTIONS

a. Energy Sales Intensity Standard

We recommend an intensity standard—kWh and therms per capita—to replace the use of measured savings as the metric for ESPI compliance. An energy sales intensity standard, like the kWh/capita and therm/capita standards discussed in detail in this section, shifts efficiency programs towards a performance based framework, provides transparent and clear program goals, decouples utility incentives from estimates of individual measure savings, and aligns efficiency targets with the state's long term decarbonization goals.

At this time we are not recommending the creation of a complementary standard for peak load. Addressing peak load may be better met through revisions to rate design than through utility performance incentives. Therefore, we suggest the CPUC take up the issue of peak load reduction separately. The kWh/capita and therm/capita standards set annual energy intensity targets based on population growth and linear reductions in energy consumption based on a final year target reduction in energy demand. The final year target would be based on a targeted rate of energy efficiency improvement, for example Governor Brown's goal of doubling the rate of energy efficiency improvement, and would aim to put the state on track to meet the 2050 greenhouse gas target. The standard is ratcheted down every year to meet the final year target. We suggest the use of a rolling target to account for annual variability in exogenous factors—like weather—that could affect a utility's performance relative to the standard. Compliance could then be measured using this multi-year average. Development of the target and of annual adjustments could be delegated to a blue ribbon panel of experts to ensure impartiality. Population values are based on the state's forecasted population growth, and are "locked in" during program cycles[68]. While actual population may vary, locking in these values provides utilities with a clear annual sales target and avoids having to meet a moving target as in the ESPI and RRIM.[69]

Accounting for EV growth is an important consideration under the kWh/capita standard. Without an adjustment mechanism, a kWh/capita standard would disincentivize EV growth because additional EVs increase the electricity load. To ensure EVs are not disincentivized, we recommend including an adjustment mechanism, wherein an average EV use rate is multiplied by the number of EVs within each utility's service territory and subtracted from the total load. By netting out EV load growth, the addition of EVs does not affect compliance with the kWh/capita standard. The average vehicle use could be determined by a blue ribbon panel of

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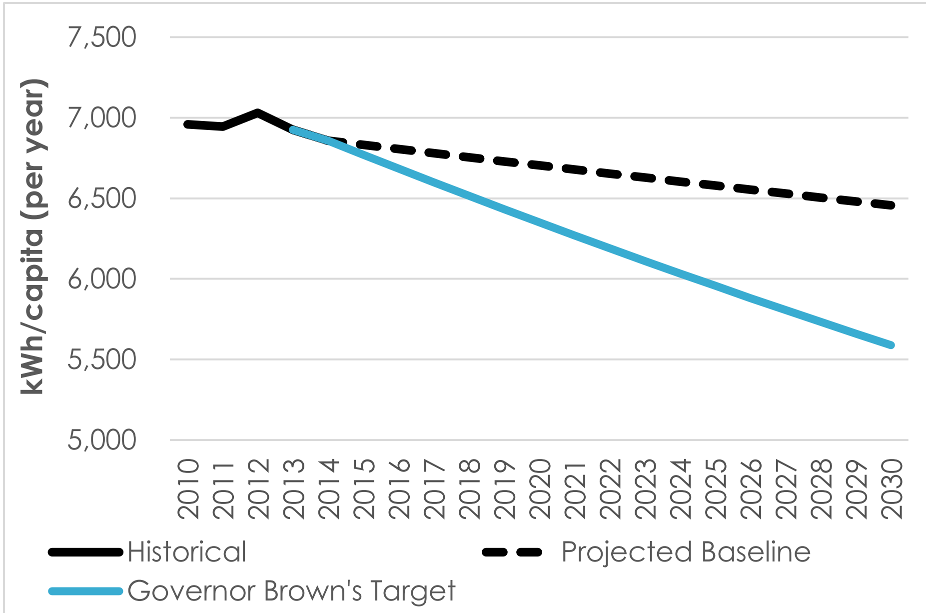
[68] Funding and cycles should be continuous, however the targets may need to be updated periodically to account for unforeseen outcomes.

[69] As discussed, because the ESPI still relies on ex post estimates, it still includes uncertainty regarding actual utility savings. In comments challenging the CPUC's RRIM findings, utilities clearly stated that the level of uncertainty associated with savings metrics made it much harder to meet program goals and discouraged utility buy-in.

experts and should be updated periodically to account for changes in the EV fleet and in vehicle use patterns.

Figure 5 – Illustrative kWh/capita standard, based on LCGS 2030 study



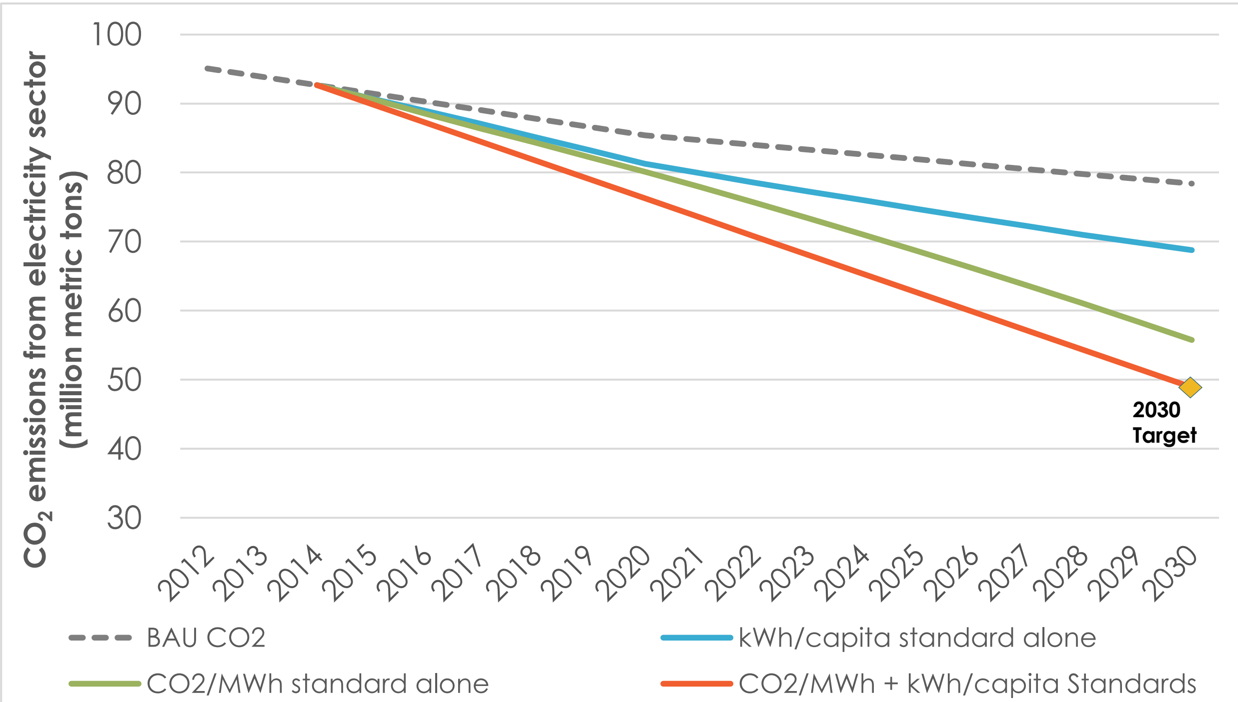
The therm/capita standard should encourage decarbonization of home energy use, whether through home electrification or decarbonizing the gas supply. To this end, we suggest "adjusting" a utility's delivered therms based on the degree of emissions reductions achieved in delivering a unit of gas. For example, if a utility' gas supply is five percent cleaner, i.e. less greenhouse gas emitting, than the previous year's supply, then the utility would multiply their delivered therms by 0.95, adjusting their metric for compliance. By allowing utilities to use an adjusted therms value in determining compliance, natural gas suppliers can maintain sales while achieving the desired carbon reductions. This allows utilities flexibility in meeting the energy efficiency standard.

Each utility will require a unique kWh/capita and therm/capita standard to account for differences across customer classes and service territories. In 2012, PG&E, SDG&E, and SCE had residential kWh/customer[70] values of 6,692, 6,107, and 7,083, respectively. The industry sector in particular may require further evaluation, given the high degree of heterogeneity across customers.

[70] Note that this metric uses customers instead of population. However, the data still demonstrate the difference in existing performance across the state's three IOUs. Data is from Energy Information Administration and can be found at: http://www.eia.gov/electricity/data.cfm

An example of a kWh/capita standard using data from the Low Carbon Grid Study[71] is included in Figure 5. Based on California's projected population growth[72], mid-case electric vehicle growth[73], and additional achievable emissions reductions scenarios[74], the projected kWh/capita standard, when combined with the CO_2e/MWh standard discussed earlier, reduces electricity-based CO_2e emissions to half of 2012 emissions by 2030 (see Figure 6).

Figure 6 – Illustrative electricity sector carbon reductions from CO_2/MWh & kWh/capita standards



The kWh/capita and therm/capita standards take advantage of incentives tied to the level of reductions relative to the standards. Below a minimum savings threshold, a penalty would apply. Above a savings level, the incentive amount would be capped (see Figure 7).[75] As in the ESPI, utilities are eligible to receive an incentive based on performance relative to the standard.

[71] See: http://www.lowcarbongrid2030.org/

[72] See: http://www.dof.ca.gov/research/demographic/reports/projections/view.php

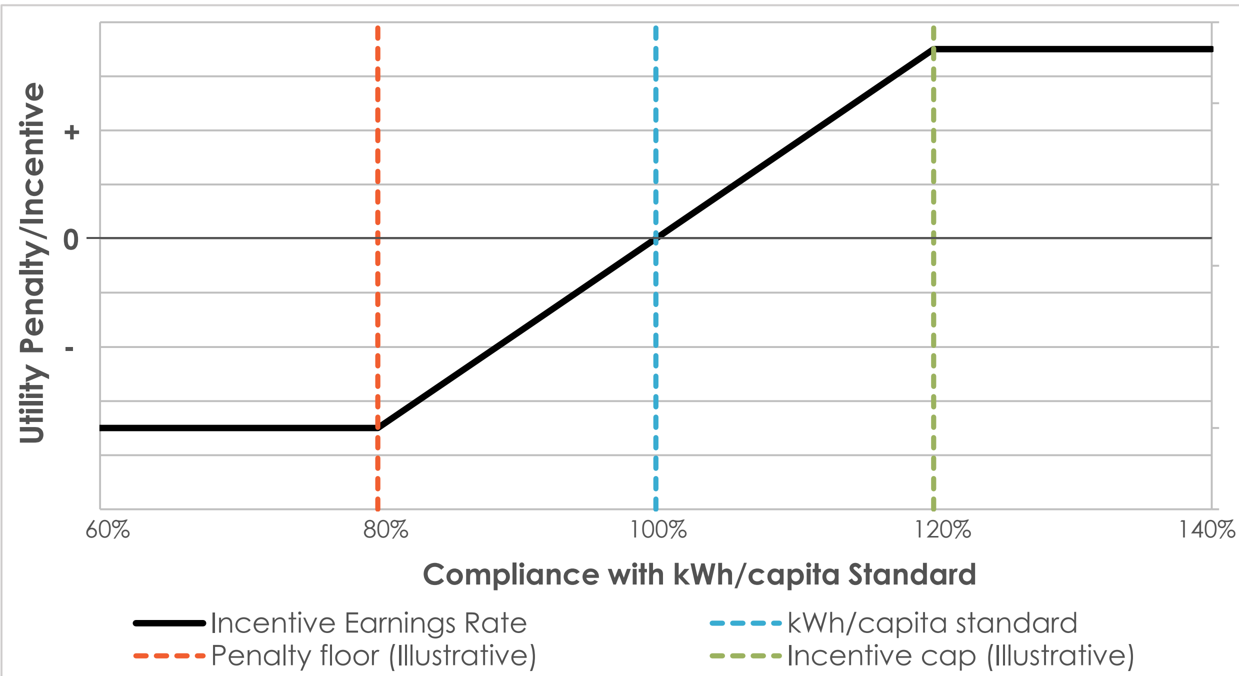
[73] Baseline and Target cases assume Mid Case EV growth (extrapolated from 2024 to 2030) from: Alcorn, B., M. Ciminelli, A. Gautam, C. Kavalec, K. Sullivan and M. Weng-Gutierrez, *California Energy Demand 2014-2024 Final Forecast Volume 1: Statewide Electricity Demand, End-User Natural Gas Demand, and Energy Efficiency*, (California Energy Commission, 2014).

[74] The baseline utilizes the mid AAEE scenario, while the target case uses the mid-high AAEE scenario (on which the standard is based).

[75] We recommend capping incentives to ensure that ratepayers are protected against excessive incentives.

The use of this standard eliminates the need for non-resource savings[76] incentives in the ESPI, including the Ex Ante Review, Codes and Standards (C&S), and Non-Resource Programs incentives. Instead, utilities can earn a return on the entire budget, including expenditures on C&S and non-resource programs, provided they are approved by the CPUC. Set correctly and with a long enough time horizon, the kWh/capita and therm/capita standards will incent utilities to invest in C&S and non-resource programs (to achieve higher levels of savings), as well as long-term savings from deep retrofits that are less cost-effective, one of the primary goals of the ESPI.

Figure 7 – Illustrative kWh/capita incentive curve



A significant benefit of the kWh/capita and therm/capita standards is simplicity. Under these standards, the total kWh and therms of sales in an IOU's service territory is simply divided by the number of people in its service territory to determine the level of efficiency improvement and the corresponding incentive payment. Measure-specific energy savings will no longer be used to determine a utility's incentive, eliminating a major point of contention in the program that has disincentivized utility buy-in. Future targets will need to account for programs and codes and standards already in place; these savings, which are already estimated by the CEC and can be easily incorporated into the standard.

Another advantage of these standards is that efficiency goals can be easily integrated with other statewide energy and carbon goals. In the ESPI, IOU efficiency goals and per unit incentive amounts are determined based on market potential from the Study. Utility goals are not assessed relative to the state's long-term carbon reduction goals, but instead on the "market

[76] Indirect savings meaning non-energy savings associated incentives.

potential" of energy efficiency. As discussed above, to reach the state's 2050 carbon target, an estimated 1.2 percent improvement per year in efficiency, in line with Governor Brown's target, is needed. This improvement rate could serve as the target for the efficiency standard. With an intensity-based metric, standards can conform to the state's decarbonization goals, accounting for changes in population growth or structural changes in energy use over time. Utilities are incented to exceed the standards by accessing higher incentives for achieving additional savings.

There are other indirect benefits of using the kWh/capita and therm/capita standards. For example, though not explicitly tied to renewable generation, a kWh/capita standard creates an incentive to support the growth of distributed energy resources (DERs). Because direct utility sales decrease with an increase in customer-owned DERs (lowering the utility's kWh/capita), utilities can improve their incentive-based earnings potential by boosting the use of DERs. However, because utilities can only earn a return on approved energy efficiency resource budgets, the kWh/capita standard creates an incentive for both energy efficiency and DERs together. Another benefit of using the kWh/capita and therm/capita standards is that when used together they can push utilities to further electrify buildings, a step that is needed to meet California's carbon target.[77] By ratcheting down the therms/capita standard and accounting for shifts in customer energy usage in the kWh/capita standard, utilities will have an incentive to shift customers to electricity, which they don't currently have.

Two other performance-based metrics were evaluated for energy efficiency: a declining, fixed sales limit and an annual percentage improvement metric. A fixed sales limit sets a cap on the kWh or therms of sales from the utility and rewards utilities based on their performance in meeting the limit. Though with decoupling utility revenues would, in theory, be shielded from lost sales, this approach may still not be palatable to utilities.

Annual percentage improvements are problematic because they do not clearly align utility sales targets with the state's long term energy and carbon goals and are instead they are based on year over year improvement.[78]

While all three approaches face similar challenges, a per capita intensity standard provides a balance of palatability, an incentive to exceed the standard, and clear annual targets (with multi-year compliance) based on the state's energy and carbon goals.

[77] Williams et al., "The Technology Path to Deep Greenhouse Gas Emissions Cuts by 2050: The Pivotal Role of Electricity."

[78] As a hypothetical, the goal is for a 10 percent improvement every year. This means that if I am on pace, in year one achieve 90 percent reduction, and in year two another 90 percent, for a total of 0.9*0.9 = 0.81 after two years. If however I miss my target in year one and only get five percent, but perform exactly as I should in year two with 10 percent improvement, my total is 0.95*0.9 = 0.85 after two years. Rather than having a long term decreasing target, annual targets are subject to change based on performance in the previous year.

b. Expedite Implementation of AB 758

California AB 758 requires the Energy Commission to develop a roadmap to unlocking further savings in California's existing buildings. To this end, the CEC published the *Comprehensive Energy Efficiency Program for Existing Buildings Scoping Report,* which included a number of programs and policies aimed at improving energy efficiency in existing buildings. Among them were a set of well-conceived voluntary programs to engage building owners in energy efficiency. However, there is some concern that these voluntary approaches may not be strong enough to push building owners to retrofit at the rate needed to meet the state's carbon goals. To improve the effectiveness of its voluntary programs and send a strong market signal to building owners, the CEC should consider the use of a mandatory retrofit policy in future years. Specifically, the CEC should consider signaling now that if the rate of progress does not achieve a predetermined level, then mandated measures such as required upgrades at time of sale, will come into force at a time certain in the future, such as 2025.

IV. CONCLUSION

The kWh/capita and therm/capita standards provide a transparent and straightforward approach to achieving significant energy savings through efficiency programs. The proposed standard avoids a number of existing policy barriers to scaling up efficiency, including the use of conservative goals, issues with using existing baselines, and measure savings requirements. When combined with a strong energy supply decarbonization program, this demand-side energy intensity standard will help California get on track to meet the 2050 greenhouse gas target. Additionally, expedited implementation of AB 758 paired with a promise for future action will send a strong market signal to building owners and developers.