DOCKETED	
Docket Number:	19-IEPR-06
Project Title:	Energy Efficiency and Building Decarbonization
TN #:	229496
Document Title:	2019 California Energy Efficiency Action Plan - Draft Staff Report
Description:	The 2019 California Energy Efficiency Action Plan covers issues, opportunities, and savings estimates pertaining to energy efficiency in California's buildings, industrial, and agricultural sectors. The action plan fulfills the mandates in Public Resources Code 25310(c) and 25943(f). The action plan is separated into three goals that drive energy efficiency activity: doubling energy efficiency by 2030, removing and reducing barriers to energy efficiency in low-income and disadvantaged communities, and reducing greenhouse gas emissions from the buildings sector. The energy efficiency savings estimates have been updated from 2017 values.
Filer:	Harrison Reynolds
Organization:	California Energy Commission
Submitter Role:	Commission Staff
Submission Date:	8/20/2019 4:41:34 PM
Docketed Date:	8/20/2019

CALIFORNIA ENERGY COMMISSION

California Energy Commission

DRAFT STAFF REPORT

2019 California Energy Efficiency Action Plan

Gavin Newsom, Governor

August 2019 | CEC-400-2019-010-SD

California Energy Commission

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PREFACE

[Placeholder -Letter from Commissioner Andrew McAllister]

ABSTRACT

The 2019 California Energy Efficiency Action Plan covers issues, opportunities, and savings estimates pertaining to energy efficiency in California's buildings, industrial, and agricultural sectors. The action plan fulfills the mandates in Public Resources Code 25310(c) and 25943(f). The action plan is separated into three goals that drive energy efficiency activity: doubling energy efficiency by 2030, removing and reducing barriers to energy efficiency in low-income and disadvantaged communities, and reducing greenhouse gas emissions from the buildings sector. The energy efficiency savings estimates have been updated from 2017 values.

Keywords: Energy efficiency, existing buildings, SB 350, building decarbonization, equity, AB 758, SB 1477, AB 3232, low-income, disadvantaged, local government

Please use the following citation for this report:

Kenney, Michael, Heather Bird, Heriberto Rosales, and Antonio Cano. 2019. *2019 California Energy Efficiency Action Plan*. California Energy Commission. Publication Number: CEC-400-2019-010-SD

TABLE OF CONTENTS

LIST OF FIGURES

Page

LIST OF TABLES

Page

EXECUTIVE SUMMARY

The 2019 California Energy Efficiency Action Plan is the state's roadmap for an energy-efficient and low-carbon future for the built environment. Energy efficiency is a key piece of California's efforts to lessen the impacts of climate change, reduce the economic burden of energy on low-income populations, and complement numerous sustainability efforts in the State. The California Energy Commission's (CEC) action plan charts the progress toward doubling energy efficiency savings, achieving energy efficiency in existing buildings, and reducing greenhouse gas emissions (GHGs) from buildings. Through robust, sustainable efficiency marketplaces, California can achieve its energy and climate goals and deliver benefits to California residents.

Major Policy Changes

In 2018, two major pieces of legislation signaled the state's shift in focus from traditional energy conservation to building decarbonization. Senate Bill 1477 (Stern, Chapter 378, Statutes of 2018) allocates $50 million per year through 2023 from natural gas utilities to two new programs: Building Initiative for Low-Emissions Development (BUILD) and Technology and Equipment for Clean Heating (TECH). Assembly Bill 3232 (Friedman, Chapter 373, Statutes of 2018) requires the CEC to assess by January 1, 2021, the potential of reducing GHGs in buildings by 40 percent below 1990 levels by 2030. That assessment will illustrate the pathways to decarbonization, including electrification efforts that the state will need to undertake to reduce the carbon content of buildings, the impact of those efforts on the electricity grid, and a cost-comparison of the pathways to decarbonization.

Goal 1: Double Energy Efficiency Savings by 2030

In 2015, California set an ambitious goal to achieve a statewide cumulative doubling of energy efficiency savings and demand reductions in electricity and natural gas end-uses by January 1, 2030. Senate Bill 350 (SB 350; De León, Chapter 574, Statutes of 2015) directed the CEC to set annual targets that achieve this goal. The state will need to harness emerging technologies, progressive program designs, and innovative market solutions as part of this effort. The state can assist through efficiency policies, regulations, and financing. Encouraging and working with the private marketplace, including leveraging private capital, are critical to accelerating the transformation underway.

Methodological and Target Updates

Since the initial target setting in 2017, the CEC has improved several methods in forecasting and tracking energy efficiency savings. The CEC improved and created new tools to track "beyond-utility" program contributions. These include estimating end-use impacts in programs, estimating the share of savings

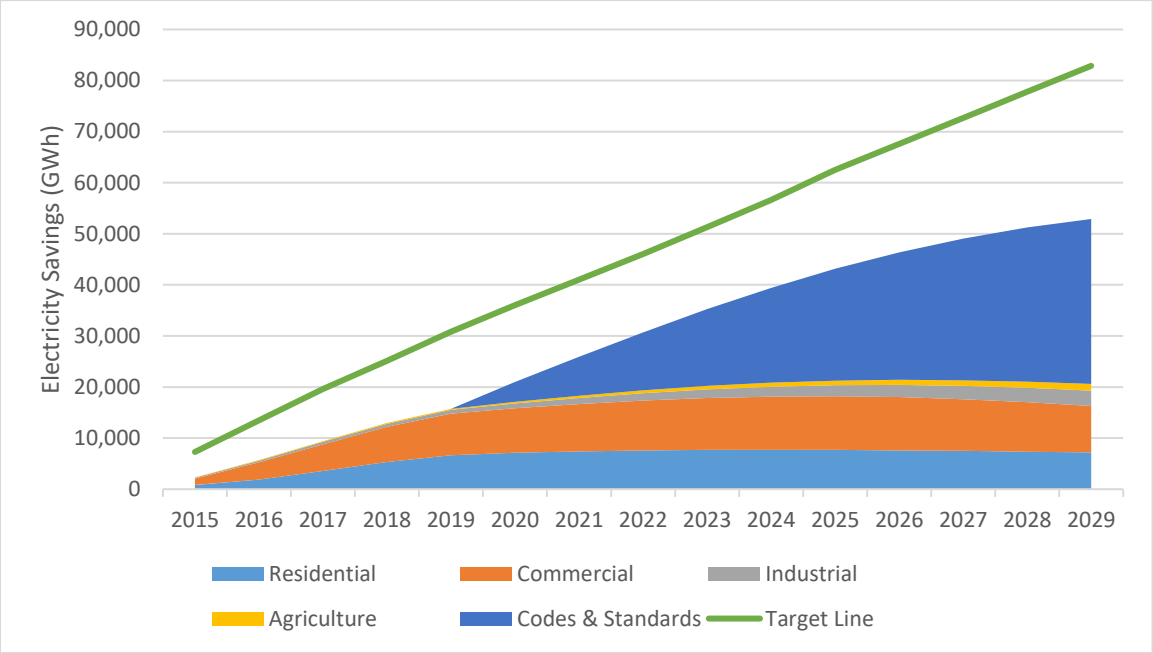
between utility territories, and improving savings decay estimates based on effective useful life of efficiency measures. The targets now include improved agricultural and industrial savings beyond those estimated in utility portfolios. CEC staff updated data for several programs including Proposition 39, Energy Conservation Assistance Act, building standards, appliance standards, Property Assessed Clean Energy, and the Low-Income Weatherization Program. Many other programs received minor updates or small forecasting improvements.

[Figures and savings values are still in development. Final values will be added for the final Action Plan]

SB 350 Doubling Efficiency Targets- Electricity

The statewide cumulative savings target for electricity is updated in Figure ES-1. Most savings are expected to come from codes and standards.

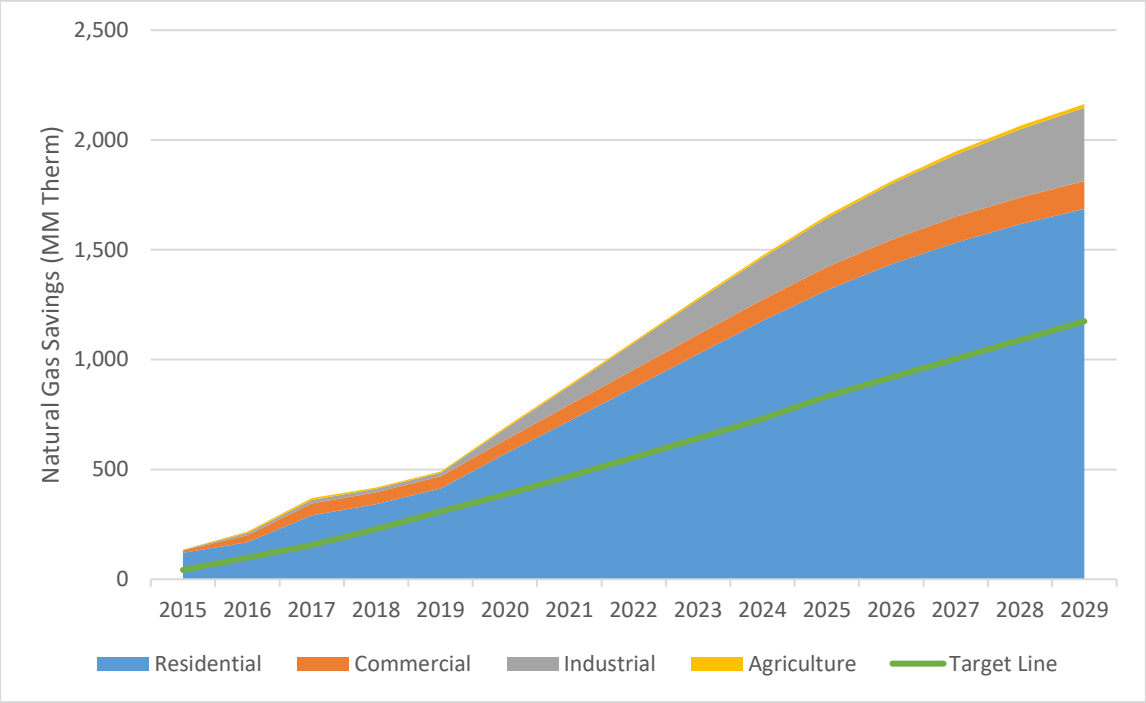
Figure ES-1: SB 350 Electricity Savings (GWh)



SB 350 Doubling Efficiency Targets- Natural Gas

Figure ES-2 presents the statewide cumulative savings target for natural gas. Most savings come from the residential sector. The savings in that sector are driven primarily by utility programs and codes and standards.

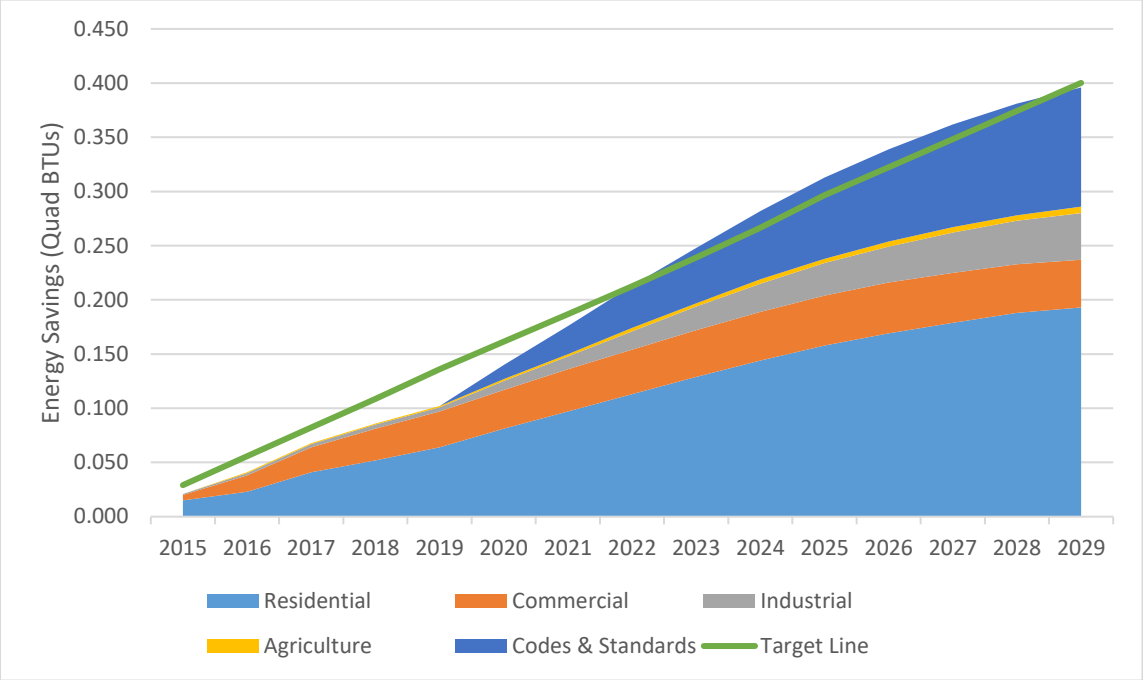
Figure ES-2: SB 350 Natural Gas Savings (Million [MM] Therm)



SB 350 Doubling Efficiency Targets—Combined

The updated combined electricity and natural savings show the state meeting its 2030 goal (Figure ES-3). The savings are driven by residential programs and codes and standards. The CEC expects the state to surpass the 2030 goal about seven years early.

Figure ES-3: SB 350 Combined Energy Savings (Quad British Thermal Units [BTUs])

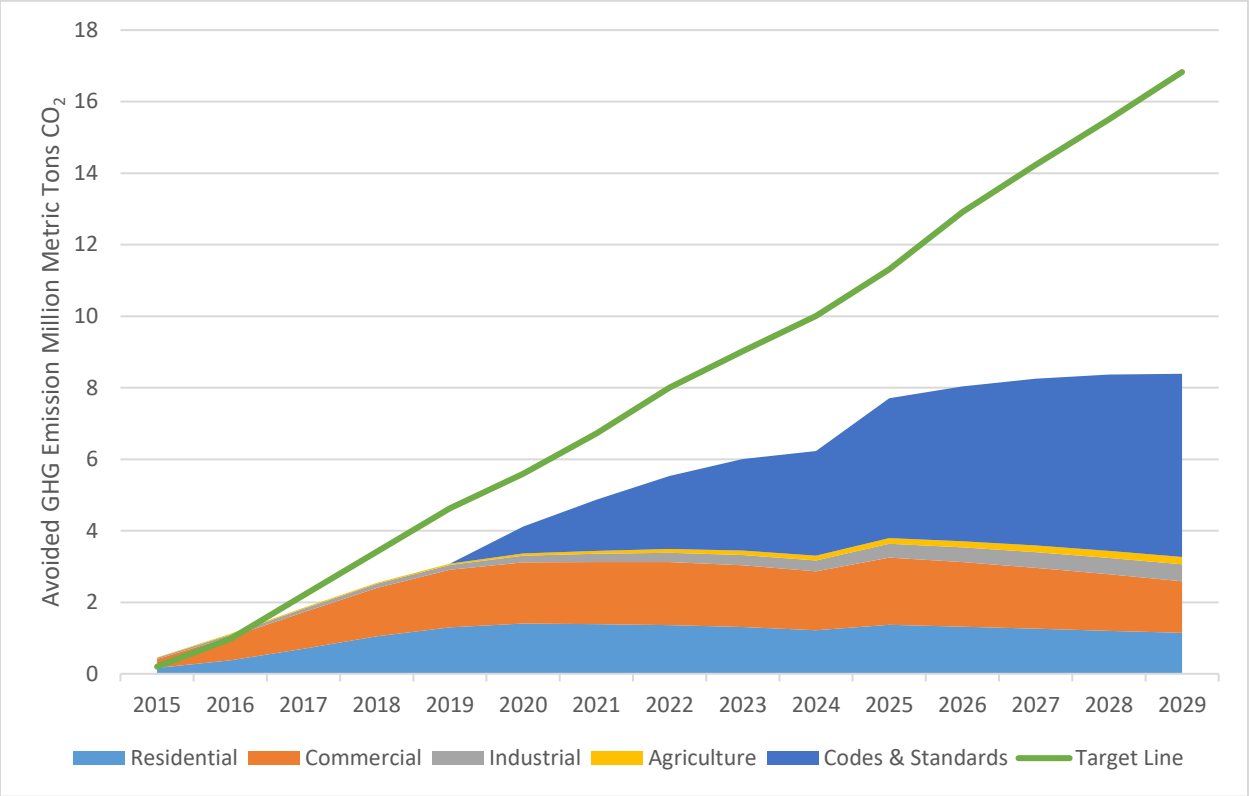


To meet the 2030 goal, the analysis relies on market transformation occurring, along with an acknowledgement that addressing GHG emissions is as crucial as addressing energy savings.

Conversion of Efficiency Savings to Avoided Greenhouse Gas Emissions

The CEC has developed new methods to study the GHG content of the electric grid that are used to calculate avoided GHG emissions. The SB 350 targets are converted into avoided GHG emission in Figure ES-4. With current savings projections, the state is missing the 2030 goal in terms of avoided GHG emissions. This missed benchmark speaks to the need to redesign programs to reduce energy use when GHG content of electricity is highest, and to shift energy use when GHG content is cleanest.

Figure ES-4: Avoided GHG Emissions From SB 350 Targets



Goal 2: Expanding Energy Efficiency in Low-Income and Disadvantaged Communities

SB 350 strives to ensure California's clean energy transformation includes a strong focus on equity to ensure benefits are realized by all Californians, especially those in low-income, disadvantaged, or rural communities. In its 2016 Low-Income Barriers Study, the CEC studied the barriers to energy efficiency and weatherization investments for low-income customers, including those in disadvantaged communities, and made recommendations on how to increase access to energy efficiency and weatherization investments The CEC and its partner agencies have since taken steps to implement the recommendations in the Barriers Study, including convening the Disadvantaged Communities Advisory Group in 2018, adopting a Clean Energy in Low-Income Multifamily Buildings (CLIMB) Action Plan, and tracking and updating key metrics to understanding barriers through its energy equity indicators report. An interactive map that accompanies the report highlights key opportunities to advance clean energy in low-income and disadvantaged communities.

Goal 3: Reducing Greenhouse Gas Emissions from Buildings

For California to achieve its ambitious goals to combat climate change, the state must decarbonize its buildings. California continues to be a national leader in energy efficiency and renewable energy, yet the state's buildings rely heavily

on fossil fuels for water and space heating, and for cooking. Even as the state creates a pathway to electrify new homes, existing homes and businesses will remain a challenge. Other challenges exist to build low-carbon commercial and industrial buildings and reliably satisfy higher electric demand that will result from electrifying transportation, space heating, and water heating. Buildings must be transformed from contributors of carbon emissions into clean distributed energy resources for the state via effective policies, creative financing, and new technologies

There is a growing consensus that building electrification is the most viable and least cost pathway to achieving significant GHG reductions in buildings. This consensus is due to the increasing availability of off-the-shelf, highly efficient electric technologies (such as heat pumps) and the continued reduction of GHG emission intensities in the electricity sector. Governor Brown's signing of SB 100 (De León, Chapter 312, Statutes of 2018) that calls for a 100 percent carbon free electricity grid by 2040, and his Executive Order (B-55-18) calling for economy wide carbon neutrality by 2045, will continue the downward trend of GHG emissions from the electricity sector. Renewable gas can be a part of the solution to reducing GHG emissions from buildings, but its role is likely constrained by availability, cost, and ongoing methane leakage concerns. Therefore, future building decarbonization efforts will focus on electrification of new and existing buildings.

To promote building decarbonization, the California Legislature passed SB 1477 that directs the California Public Utilities Commission (CPUC), in consultation with the CEC, to develop the BUILD and TECH programs with a combined annual budget of $50 million per year focused on reducing direct greenhouse gas emissions from buildings. Additionally, AB 3232 calls upon the CEC to conduct an assessment of the feasibility of achieving a 40 percent reduction in building GHG emissions by 2030. Using new sources of funds and financing mechanisms and adapting California's current energy efficiency programs to help enable greater building decarbonization will be key in mobilizing the large investment in California's building stock necessary to achieve building decarbonization.

Recommendations

Recommendation	Lead	Partners
Goal 1: Double Energy Efficiency Savings by 2030		
a. Develop non-portfolio funds for efforts that move markets toward energy efficiency and carbon free technologies and practices.	*CEC*	*CARB, CPUC, Local Governments, Legislature*

Recommendation	Lead	Partners
b. Develop hourly and locational aggregated energy consumption datasets and privacy protected analytics for PAs, LGs, and others, for policy, planning, and research purposes.	*CEC*	*CPUC, LGs, PAs, Academics & Researchers*
c. Develop hourly energy efficiency savings estimates from interval meter data to verify and forecast SB 350 targets.	*CEC*	*CPUC, ISO*
d. Develop metrics to value the co-benefits of energy efficiency that enable consumers, the energy efficiency industry, and policy makers to better understand and integrate the benefits of energy efficiency into decision-making processes.	*CEC*	*Department of Public Health, CPUC, CARB, CSD, LGs*
e. Improve building standards compliance, for example, by implementing the findings from the Senate Bill 1414 plan upon its completion.	*CEC*	*CSLB, CPUC, Trade Unions, ESCOs, Western HVAC Performance Alliance, CALBO*
f. Develop and implement energy efficiency programs, outside of existing ratepayer funds, to support small, medium, and large industries to overcome barriers to improving energy efficiency and decarbonization.	*CEC, CARB, Legislature*	*Air Districts, Industry stakeholders, CPUC, International partners*
g. State agencies should collaborate on and accelerate the use of hourly (electric) and daily (gas) modern energy data analytics assets to inform policy decisions and identify cost-effective savings opportunities. All data warehouses and energy modeling methods should be shared across state agencies and made available to private energy market actors through systems that while ensuring the privacy of individual customer personal information, provides market details needed to make cost-effective energy efficiency investments.	*CEC, CPUC*	*GovOps, Department of Technology, CARB*
h. Publish best practices for commercial building energy audit tools in California. These tools are essential to properly valuing and addressing energy retrofits in nonresidential buildings.	*CEC, DOE*	*Appraisal industry, Commercial leasing agents, Contractors,*

Recommendation	Lead	Partners
		Acceptance Test Technicians
i. Work with CPUC integrated resources planning (IRP) process to develop the ability to incorporate aggregations of energy efficiency and demand response programs into long term planning	*CEC/ CPUC*	*Utilities, CAISO, Program Implementers*
j. For POUs, develop methods to integrate aggregations of energy efficiency and DR projects into IRPs. Work with POUs to establish minimum thresholds of cost effective energy efficiency and DR that must be included in IRPs.	*CEC/ POUs*	*CAISO, Program Implementers*
k. Continue to design and implement strategies that link water and energy efficiency, such as pairing water use assessments with energy audits, and including water efficiency measures in direct-install programs.	*HCD/ CEC*	*DWR, State Water Board*
l. Encourage pay-for-performance approaches and technology innovations beyond ratepayer-funded portfolio. This is enabled through aggregated NMEC measurement methods and shifts performance risk away from customers, does not risk public funds, enables markets and leverages private investment.	*Legislature*	*GO, CPUC, CEC, CAISO*
m. Create a one-stop shop for building energy efficiency and decarbonization programs and financing. This entails providing technical support to all building sectors, including industry and agriculture, and application information for local utility, state, and privately funded programs. Legislative direction is needed to coordinate the involved parties and assign funding for this structural change in program delivery.	*Legislature*	*CPUC, CARB, CEC, Utilities, Local governments (LGs), Treasurer's Office*
n. Fund new energy efficiency grant programs for schools.	*Legislature*	*GO, CEC, CCCO, citizen's oversight board*

Recommendation	Lead	Partners
o. Develop a new program to require retrofits in poorly-scored buildings under the benchmarking and disclosure program, similar to recently approved program in New York City (Local Law 97 of 2019).	*Legislature, LGs*	*CEC, Building Owners, ESCOs*
p. Improve building and appliance code compliance at the local level through locally-lead technical assistance, outreach, and education programs.	*LGs*	*California Building Officials (CALBO), CPUC, CEC, CSLB, Trade Unions, Utilities, ESCOs*
q. Integrate green leases and energy efficiency disclosures into the building purchase process so that efficiency is properly valued in buildings and considered during mortgage qualification.	*MLS, Realtor groups, Mortgage industry*	*CEC*
r. Expand use of the California Infrastructure and Economic Development Bank (Infrastructure bank) to provide another resource to LGs for financing energy efficiency and clean energy projects.	*Treasurer's Office/ Infrastructure bank*	*CEC, LGs*
s. Develop energy efficiency program designs that air districts can offer to reduce residential, commercial, agricultural, and industrial site emissions associated with energy. Programs at Bay Area AQMD and South Coast AQMD could inform the designs.	*CAPCOA*	*CEC, CPUC, CARB*
t. Develop an energy efficiency/clean energy workforce education and training implementation plan. Collaborate with community colleges, vocational schools, and workforce development agencies and programs, like the Employment Training Panel and Employment Development Department, to create an action plan that aligns training and education curriculums to clean energy goals. Coordinate the effort with the Office of Public Research's "Just Transition" work.	*CEC, EDD*	*Employers, Community colleges, CPUC, Trade schools, PAs, OPR, WDB, Office of Public Research*

Recommendation	Lead	Partners
u. Incorporate meter-based analysis into potential studies to identify cost-effective savings potential. Customers with high baseload consumption, high temperature-to-load correlation and high summer peak usage, among other readily observable characteristics, likely offer cost-effective savings potential from interventions that are not cost-effective on average and are therefore currently assigned zero potential.	*CPUC/POUs*	*CEC, IOUs*
Goal 2: Removing Energy Efficiency Barriers in Low-Income and Disadvantaged Communities		
a. Supply technical assistance to utilities or program administrators seeking to create alternative energy efficiency financing programs.	*CEC*	*Utilities, PAs*
b. Create a perpetual funding source, outside of existing ratepayer funds, or resource, that multifamily building owners can use when retrofitting properties. This would take a legislative initiative. Such a source would streamline accessibility of energy efficiency services, a common need raised by multifamily building owners and developers.	*Legislature*	*CPUC, POUs, CEC, GO, MF building owners, Affordable housing advocates*
c. Expand direct-installation energy efficiency programs, outside of existing ratepayer funds, for rural, low-income, and hard-to-reach communities. Current programs have funds but lack the capacity or mandate to meet the needs of residents and businesses.	*Legislature, CPUC*	*CEC, GO, LGs*
d. Create a funding source, outside of existing ratepayer funds, for LGs to implement efficiency.	*Legislature, GO*	*CEC, LGs*
e. Implement California-wide tariffed on-bill repayment programs that open new financing mechanisms for low-income and disadvantaged communities that are not based on credit scores or income, such as the Pay-As-You-Save model.	*CPUC, Utilities, Legislature*	*CEC, CCAs, ESCOs, Investment Banks, Treasurer's Office*

Recommendation	Lead	Partners
Goal 3: Building Decarbonization		
a. Initiate a rulemaking proceeding using the load management standards authority to establish approaches that will enable and ease the rapid expansion of behind the meter resources dispatchable (DR) and predictable (EE) load shaping resources.	*CEC*	*CPUC, Utilities, CAISO, CALBO, Contractors, Western HVAC Performance Alliance*
b. Implement the findings of the AB 3232 report in 2020 to reach 40 percent below 1990 levels of building GHG emissions by 2030.	*CEC*	*CARB, CPUC, Building Decarbonization Coalition, CAISO, Clean energy stakeholders*
c. Develop demand flexibility standards to prepare electricity grid for growing demand as electrification expands.	*CEC*	*CPUC, Utilities, CAISO, CALBO, Contractors*
d. Demonstrate and evaluate the business case for demand flexible appliances. Highlight the appropriate technologies for each building sector.	*CEC*	*Appliance industry, CPUC, Contractors*
e. Implement Building Energy Efficiency Standards that accelerate the transition to zero carbon buildings in new construction, and retrofits by 2025.	*CEC*	*Utilities, CPUC, Building industry, CALBO, Contractors, Western HVAC Performance Alliance*
f. Develop building codes that require the installation of cost-effective, demand flexible, electric-ready infrastructure in preparation for all-electric buildings	*CEC*	*CSLB, Utilities, Building industry*
g. Develop a geographic map that includes utility districts, buildings, building classification, and building energy metrics to analyze the potential for building decarbonization through fuel substitution efforts, incorporating building benchmarking data where appropriate. Align this work with the CPUC's statewide "energy atlas".	*CEC*	*CARB, CPUC*
h. Evaluate the barriers and benefits to non-combustion measures in residential buildings. Determine effective program	*CEC, Building Decarbonization Coalition*	*CARB, CPUC, Utilities*

Recommendation	Lead	Partners
designs or delivery methods to increase adoption of these measures that are essential to building decarbonization.		
i. Co-fund electrification in buildings with flexible assets in order to optimize integration with DERs, DR, and load shifting capabilities.	*CEC, CPUC*	*CARB, POUs, CCAs, Building Decarbonization Coalition*
j. Develop a plan for the future of the natural gas network that reflects California's need to decarbonize its economy in an effective and least cost manner. This would take a legislative initiative. The goal is to adopt a pathway to reduce total source-to-site emissions from the network. In addition, explore increasing the levels of cleaner biofuel resources into the natural gas system (stakeholder comments during workshops).	*GO, Legislature*	*CPUC, CARB, CEC, Utilities, LGs, Building Decarbonization Coalition*
k. Establish a new policy goal of zero carbon buildings from the previous zero net energy policy.	*GO/ Legislature*	*CEC, CARB, CPUC, CAISO, other state agencies*
l. Create a financing tool or program designed to accelerate the clean energy transition. This would take a legislative initiative. The goal is to remove barriers that prevent bundling clean energy options (EE+EV+PV+storage) and flexibly integrating them with the grid.	*Legislature*	*Treasurer's Office, CEC, Renewable and transportation stakeholders, Building Decarbonization Coalition, CPUC, POUs*
m. Establish regional clearinghouses that combine taxpayer and ratepayer funding from health, energy, air and utility (infrastructure upgrade) entities to accelerate building electrification.	*Legislature, GO*	*CPUC, CEC, CARB, Department of Public Health, POUs, Clean energy stakeholders*
n. Identify, allocate, and appropriate funds to support new programs for building decarbonization and electrification, beyond the SB 1477 pilots, statewide or regionally, which also target natural gas equipment for early retirement. This would take a legislative initiative.	*Legislature, GO*	*CARB, CPUC, CEC, Building Decarbonization Coalition*

Recommendation	Lead	Partners
o. Adopt building decarbonization reach codes for all building types by 2022.	*LGs*	*CEC, CPUC, Utilities, Building Decarbonization Coalition*
p. Quantify methane emissions, from well head to end use. This allows for a complete accounting of the GHG savings from building decarbonization.	*CARB*	*CEC, Building Decarbonization Coalition*
q. Establish demand flexibility tariffs that support the use of zero-emission technologies that meet targeted GHG emission reductions.	*CPUC, POUs*	*CEC, PAs*
r. Increase focus on demand flexible assets and storage to ensure that targeted electrification programs do not adversely impact the electric grid.	*Utilities, CCAs*	*CAISO, CPUC, CEC*

CHAPTER 1: Introduction

Overview of 2019 California Energy Efficiency Action Plan

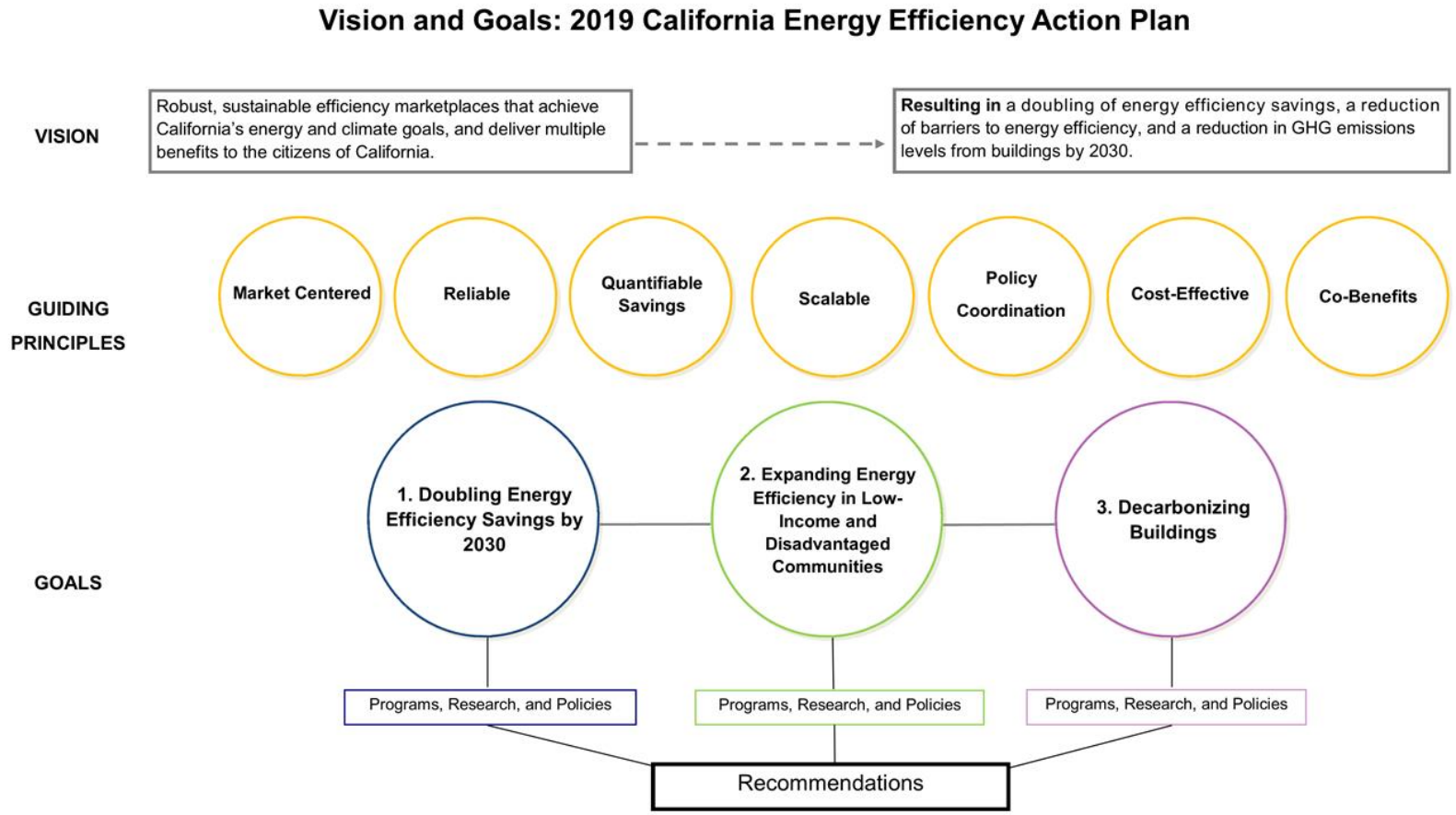
Under Assembly Bill 758 (AB 758; Skinner, Chapter 470, Statutes of 2009) and Senate Bill 350 (SB 350; De León, Chapter 574, Statutes of 2015), the California Energy Commission (CEC) is required to provide regular updates on the state's progress toward increasing energy efficiency in existing buildings and doubling energy efficiency savings from electricity and natural gas end uses by 2030. Energy efficiency is key to supporting California's efforts to lessen the impacts of climate change, reducing the economic burden of energy on low-income populations, and complementing numerous statewide sustainability efforts.

AB 758 directed the CEC to develop the *Existing Buildings Energy Efficiency Action Plan* (EBEE Action Plan), adopted in 2015 and updated in 2016, which provided a framework for state and local governments, building industries, and other stakeholders, to increase energy efficiency in existing residential, commercial, and public buildings.[1] SB 350 subsequently updated this legislation and, among other directives, mandated the state achieve a cumulative doubling of energy efficiency by 2030. The report *Senate Bill 350 Doubling of Energy Efficiency by 2030* (Doubling Report) expanded the focus from existing buildings to include agriculture, industry, newly constructed buildings, conservation voltage reduction,[2] and fuel substitution.[3]

As California turns its focus to a 100 percent clean energy future, the CEC has consolidated its action plans to form a comprehensive roadmap to achieving the state's energy efficiency and building decarbonization goals. This action plan incorporates key energy efficiency principles into a vision that through robust, sustainable efficiency marketplaces, California will achieve its energy and climate goals and deliver multiple benefits to California residents. The anticipated results are a doubling of energy efficiency savings by 2030, a reduction in the barriers facing customers wanting to participate in energy efficiency, and a reduction in the GHG emissions from buildings. Figure 1 brings together the vision, principles, and goals of the action plan.

1 California Energy Commission. Existing Buildings Energy Efficiency Action Plan, https://ww2.energy.ca.gov/efficiency/existing_buildings/16-EBP-01/.
2 More information about conservation voltage reduction is on page 93.
3 Jones, Melissa, Michael Jaske, Michael Kenney, Brian Samuelson, Cynthia Rogers, Elena Giyenko, and Manjit Ahuja. 2017. Senate Bill 350: Doubling Energy Efficiency Savings by 2030. California Energy Commission. Publication Number: CEC-400-2017-010-CMF.

Figure 1: Vision and Goals



Key Definitions

The action plan uses specific terms that require definition.

SB 350 Target—SB 350 directed the CEC to set targets resulting in a cumulative doubling of energy efficiency savings by 2030 relative to the expected savings in 2015. The targets consist of energy efficiency savings from programs operated by utilities, governments, and private entities.

Fuel Substitution—SB 350 language allows for fuel substitution, which the CEC defines as the substitution of one utility-supplied or interconnected energy source for another, such as electricity and natural gas. The CEC estimates the impacts of fuel substitution only if net source energy is reduced.

Electrification—When the uses in a building are converted to consume only electricity, then the building has undergone electrification. The most common path for electrification is through electrified heating, cooking, and clothes drying.

Building Decarbonization—Buildings produce GHGs emissions through the onsite use of fossil fuels and electricity produced from fossil sources, which contribute to ongoing climate change and result in unhealthy indoor air quality. "Building decarbonization" refers to eliminating GHG emissions from buildings and removing GHGs from electricity generation.

Ratepayer Programs—Refers to the broad category of programs funded through rates collected on a customer's utility bill. These programs are operated by investor-owned utilities (IOUs), publicly owned utilities (POUs), regional energy networks (RENs), and community choice aggregators.

Beyond-Ratepayer Programs—Refers to programs funded by tax and private dollars, as well as, by the California Cap-and-Trade Program. These programs are operated by state agencies, local governments, air districts, federal agencies, and private companies.

Cost-Effectiveness—Various metrics are used to determine the cost-effectiveness of energy efficiency programs and measures for inclusion in the SB 350 doubling targets, many of which are established by statute or regulation. The CEC relied on the cost-effectiveness calculations performed by program administrators. Therefore, the efficiency targets are savings summed from different cost tests.

Feasible—Feasibility includes how technically achievable the energy efficiency program is, how likely participation is in an energy efficiency program, and how realistic savings projections are, given economic, social, technological, and environmental constraints.

Adversely Impact Public Health and Safety—The CEC interprets the clause "will not adversely impact public health and safety" to mean primarily ensuring

reliability of electricity supply.[4] Energy efficiency savings are relied upon in the generation, transmission, and distribution system planning of utilities and state entities. If energy efficiency program savings do not materialize as expected, reliability could be adversely impacted. Furthermore, the CEC believes the term covers the need to reduce GHGs and other air pollutants, which can impact health and safety of the public.

Additional Achievable Energy Efficiency—Additional achievable energy efficiency (AAEE) savings are in addition to the committed energy efficiency savings embedded in the CEC demand forecast. AAEE is the incremental energy savings from the future market potential identified in utility potential studies not included in the baseline demand forecast but reasonably expected to occur, including future updates of building codes, appliance regulations, and new or expanded IOU or POU energy efficiency programs.[5]

Energy Efficiency Principles

The action plan brings forth important touchstones from the original EBEE Action Plan to ensure that strategies, initiatives, and objectives are in line with achieving the state's goals and align with stakeholder values. The following adopted principles from the EBEE Action Plan have been carried forth to this action plan.

Market-Centered—The market—consumers, property owners, tenants, and industry—constitutes the primary focus of the action plan. Associated requirements, interests, and objectives inform and direct the strategies.

Reliable—The plan supports pathways that balance risk to ensure that the reliability of the electricity and natural gas systems are not compromised. Energy efficiency savings are relied upon in the generation, transmission, and distribution system planning of utilities and state entities. If energy efficiency program savings do not materialize as expected, reliability could be adversely impacted.

Quantifiable Savings—To successfully set a path to achieve the state's energy and climate goals, the plan must have accurate data from which to calculate electricity, natural gas, and GHG savings. To the extent such data are available, they are leveraged in determining California's progress toward its goals. It will also be made explicitly clear when such data are lacking.

Cost-Effective—The plan considers energy savings that are deemed cost-effective for the entity responsible for delivering them. Any recommendations

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4 Public Resources Code Section 25300 asserts that "reliable supply of energy [be] consistent with protection of public health and safety"

5 California Energy Commission. 2015. 2015 Integrated Energy Policy Report. Pp. 138-139. Publication Number: CEC-100-2015-001-CMF. http://docketpublic.energy.ca.gov/PublicDocuments/15-IEPR-01/TN212017_20160629T154354_2015_Integrated_Energy_Policy_Report_Small_File_Size.pdf.

made to achieve additional energy efficiency are also considered through a cost-effectiveness lens.

Scalable—The strategies and activities of the plan must be developed to allow expansion and implementation at a large scale.

Policy Coordination—The plan will support and encourage ongoing coordination among state agencies—particularly the CEC, California Public Utilities Commission (CPUC), and California Air Resources Board (CARB)— as well as support and expand coordination of policy direction with federal, state, regional, and local governments.

Cobenefits—Energy efficiency and building decarbonization not only save money on customers' bills or ease the strain on the utility infrastructure, but result in added benefits like improved air quality, increased comfort, and better working conditions. These cobenefits must be considered when determining the value or impact of an efficiency and decarbonization program.

Feasible—Feasibility includes how technically achievable the energy efficiency program is, how likely participation is in an energy efficiency program, and how realistic savings projections are given economic, social, technological, and environmental constraints.

Historical Progress

California has been a national leader in energy efficiency since the late 1970s, with appliance and building standards saving consumers more than $100 billion in utility bills.[6] Today, energy efficiency is a tool to combat climate change by reducing demand from greenhouse gas-producing power plants.

In 2008, California targeted zero-net-energy use in all new homes by 2020 and commercial buildings by 2030. Compared to 2016 building standards, homes built to the 2019 standards will use roughly 53 percent less grid energy due to the solar requirement for new homes. Electricity produced for the grid is already cleaner than 10 years ago and will continue to be with new low-emissions building goals.

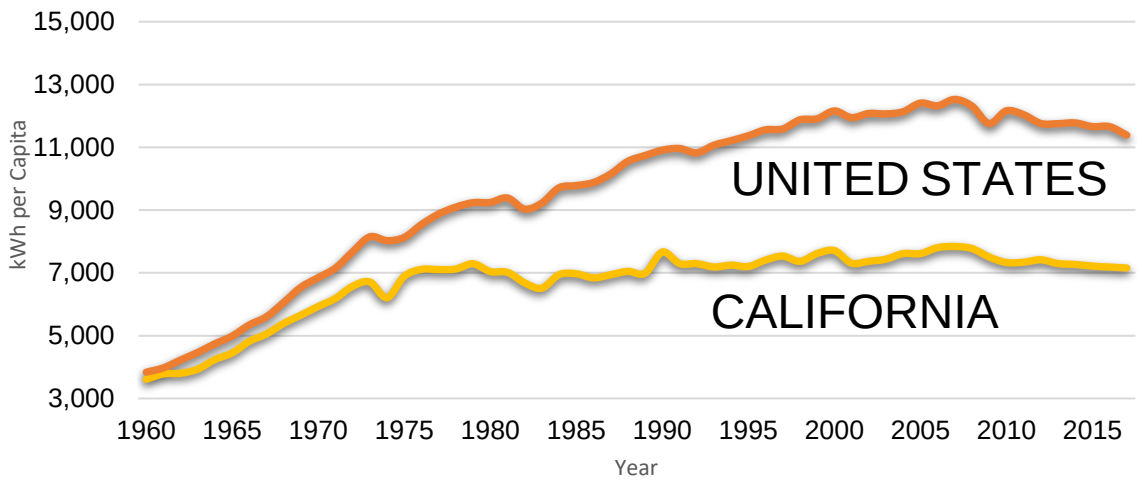
California's Appliance Efficiency Regulations (appliance standards) and federal appliance efficiency standards set minimum efficiency levels for energy and water consumption in products such as consumer electronics and household appliances to transition toward a cleaner market. In January 2018, the CEC adopted light bulb energy efficiency standards that require a minimum efficacy

6 "2018 Energy Efficiency Tracking Progress." California Energy Commission, https://www.energy.ca.gov/sites/default/files/2019-05/energy_efficiency.pdf

of 45 lumens per watt, making California the first state to mandate efficient light alternatives like light-emitting diode (LED) bulbs.[7] The state led the nation again at the end of 2018 in setting standards for computers, driving down energy consumption when the computer is idle.[8] The CEC continues to pursue water efficiency measures, such as sprinkler and irrigation controller efficiency, in light of the state's risk for extreme weather and drought.

As the nation's per-capita energy use has grown, California's expanding energy efficiency efforts have played a critical role in leveling growth. Despite ranking second in the United States for total energy consumption, California ranks 48th in consumption per capita (Figure 2).[9] Not only is California strong in energy efficiency, but it also striving to improve energy equity. In response to SB 350, the Commission recommended ways to increase energy efficiency accessibility in the *2016 Low-Income Barriers Study, Part A* (Barriers Study) and continues to expand on this conversation.[10]

Figure 2: Electricity Demand per Capita in United States and California



Source: CEC

Energy Savings and Emission Reductions

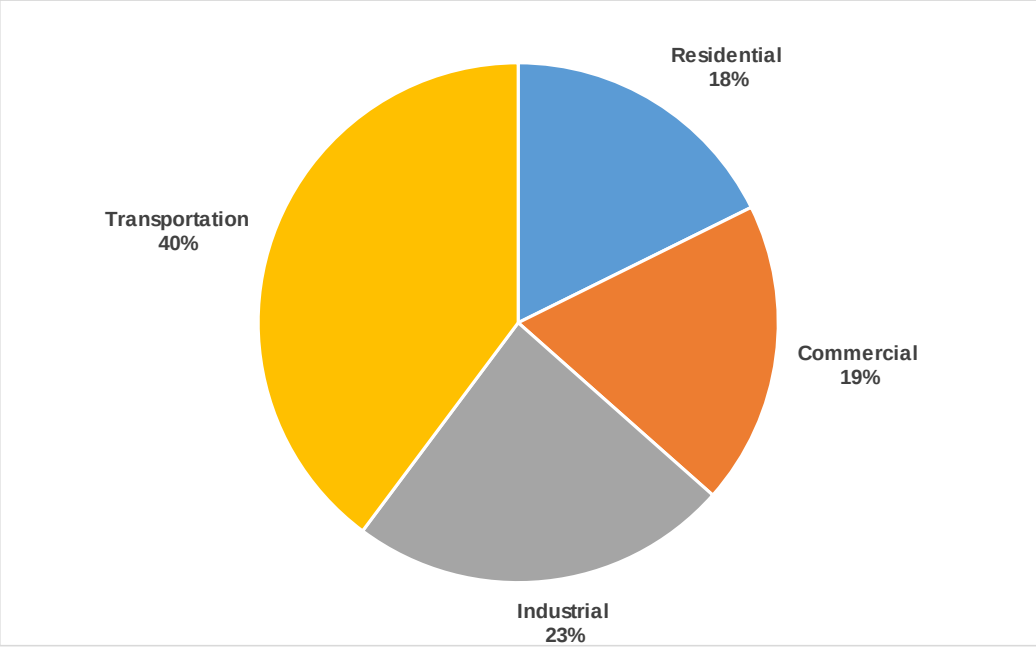
Energy Consumption Breakdown

The most recent California energy consumption statistics show the transportation sector as the highest energy user at 40 percent, annually (Figure 3). (This action

7 https://www.nrdc.org/sites/default/files/ca-efficient-lightbulbs-fs.pdf
8 Saxton, Patrick. 2019. Supplemental Staff Analysis for General Service Lamps (Expanded Scope). California Energy Commission. https://efiling.energy.ca.gov/GetDocument.aspx?tn=229471&DocumentContentId=60864.
9 https://www.eia.gov/state/data.php?sid=CA#ConsumptionExpenditures.
10 Scavo, Jordan, Suzanne Korosec, Estaban Guerrero, Bill Pennington, and Pamela Doughman. 2016. Low-Income Barriers Study, Part A: Overcoming Barriers to Energy Efficiency and Renewables for Low-income customers and Small Business Contracting Opportunities in Disadvantaged Communities. California Energy Commission. Publication Number: CEC-300-2016-009-CMF. https://efiling.energy.ca.gov/getdocument.aspx?tn=214830

plan does not address the transportation sector.) Homes and businesses represent about 37 percent. Industry rounds out use at 23 percent. Agriculture is included in commercial and industry end-uses by the Energy Information Administration (EIA). This action plan addresses more than half of the state's energy consumption.

Figure 3: Statewide Energy Consumption by Sector, 2016

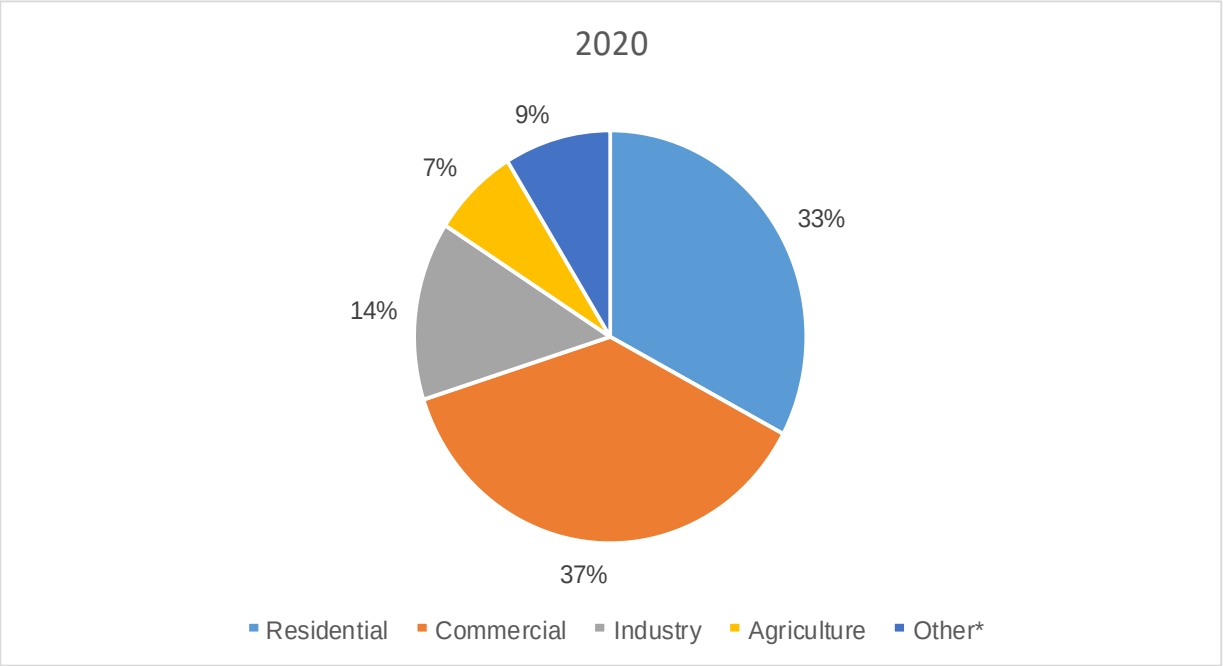


Source: Energy Information Administration 2016,
https://www.eia.gov/state/seds/data.php?incfile=/state/seds/sep_sum/html/sum_btu_1.html&sid=CA

Electricity Consumption

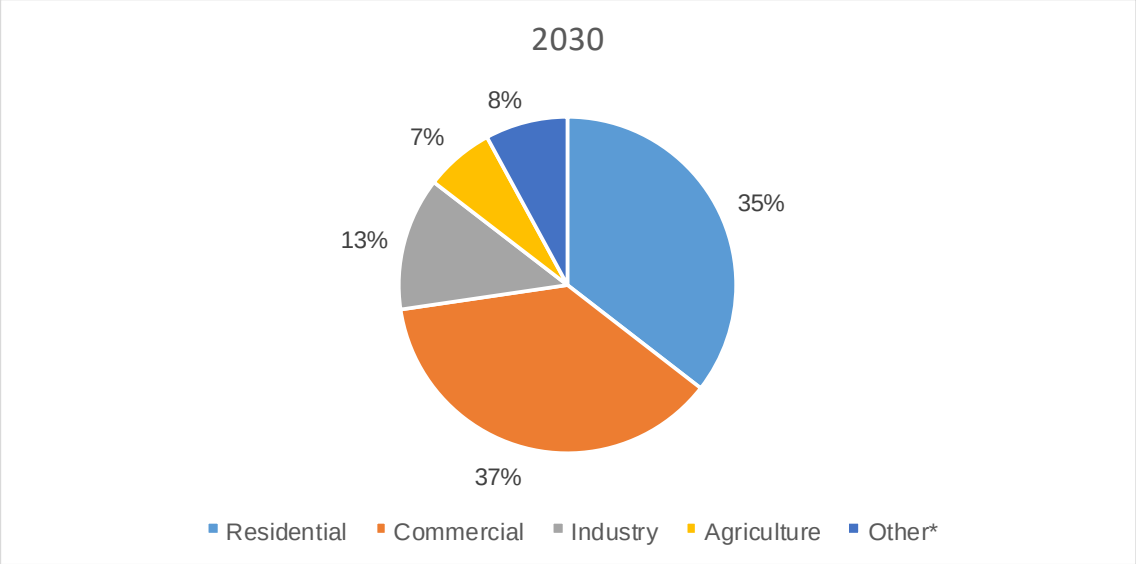
In 2020, the CEC expects commercial buildings to consume the most electricity, followed by homes (Figure 4). The portion of the figure labeled *other* includes mining, street lighting, transportation, communications, and utilities electricity consumption. The breakdown by 2030 is similar, with some growth expected in residential consumption and a decline in industry use (Figure 5), relative to statewide consumption, which is expected to grow by 15 percent between 2020 and 2030. Energy efficiency is key to managing that increased demand to avoid costly infrastructure investments.

Figure 4: Forecasted Electricity Consumption per Sector, 2020



Source: CEC

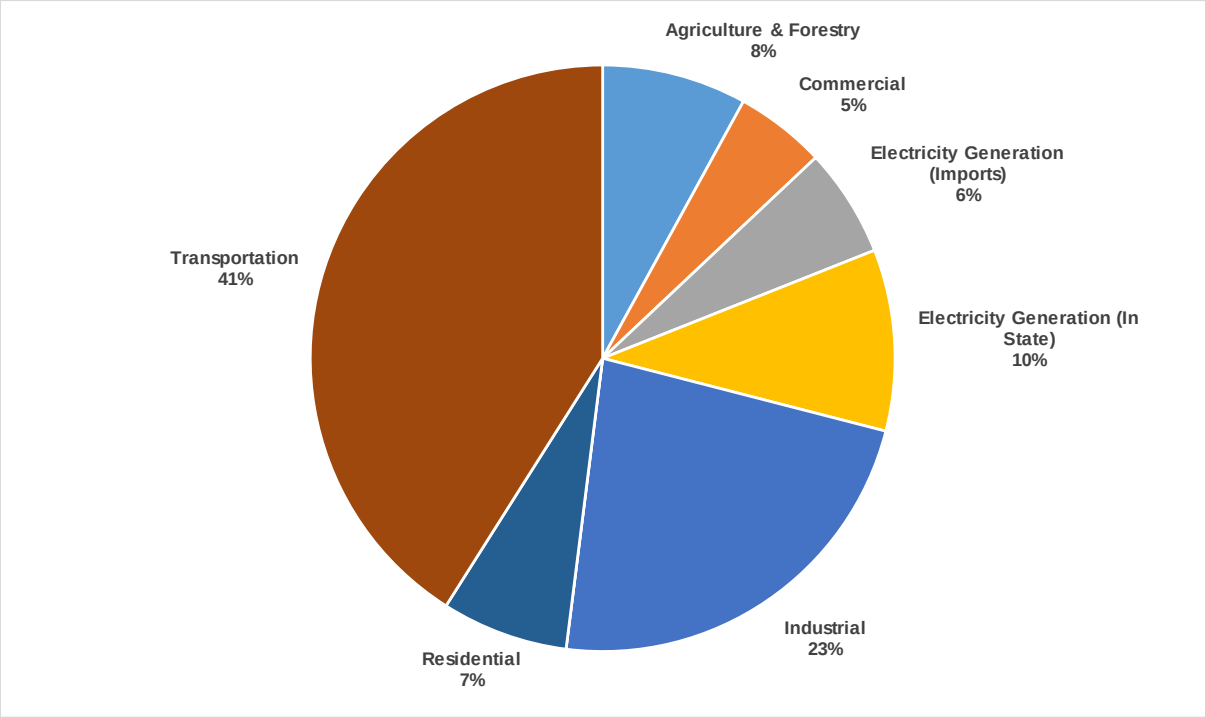
Figure 5: Forecasted Electricity Consumption per Sector, 2030



Source:CEC

In terms of GHG emissions, buildings represent about 12 percent of statewide emissions, primarily from direct natural gas combustion in the buildings for space- and water-heating. When the industrial, agricultural, and electricity sector emissions are included, this figure jumps to about 50 percent, assuming some portion of electricity generation is attributed to buildings (Figure 6).

Figure 6: GHG Emissions by Sector, 2016



Source: California Air Resources Board

Demand Flexibility

As California's electricity system transforms to achieve GHG emission reductions, transportation and building electrification are increasing the need for additional renewable energy resources - but also enable new opportunities. Maintaining system resiliency becomes ever more challenging in this scenario, calling for unprecedented demand flexibility to integrate supply resources with the grid, avoid curtailment and overbuild, allow the values and costs of the grid to flow more directly to the customer, and minimize the cost of renewable integration to the consumer. Distributed energy resources (DERs), including behind-the-meter solar generation, energy efficiency, demand response (DR), electricity storage, and electric vehicles (EVs), represent significant opportunities for demand flexibility, especially when coupled with advanced communications and automated controls.

Research into the ability of EVs to provide grid flexibility through DR features can help address this issue, as well as potentially assist during blackouts or in the aftermath of natural disasters. Conversely, how behind-the-meter batteries in micro-grids can provide DR during non-emergency periods.

Multiple tools can be pursued to drive demand flexibility via DERs, such as integrating DR with California Independent System Operator wholesale markets, more dynamic rates, and new load-shift-focused initiatives that are being explored. The CPUC's Load Shift Working Group report proposes six models

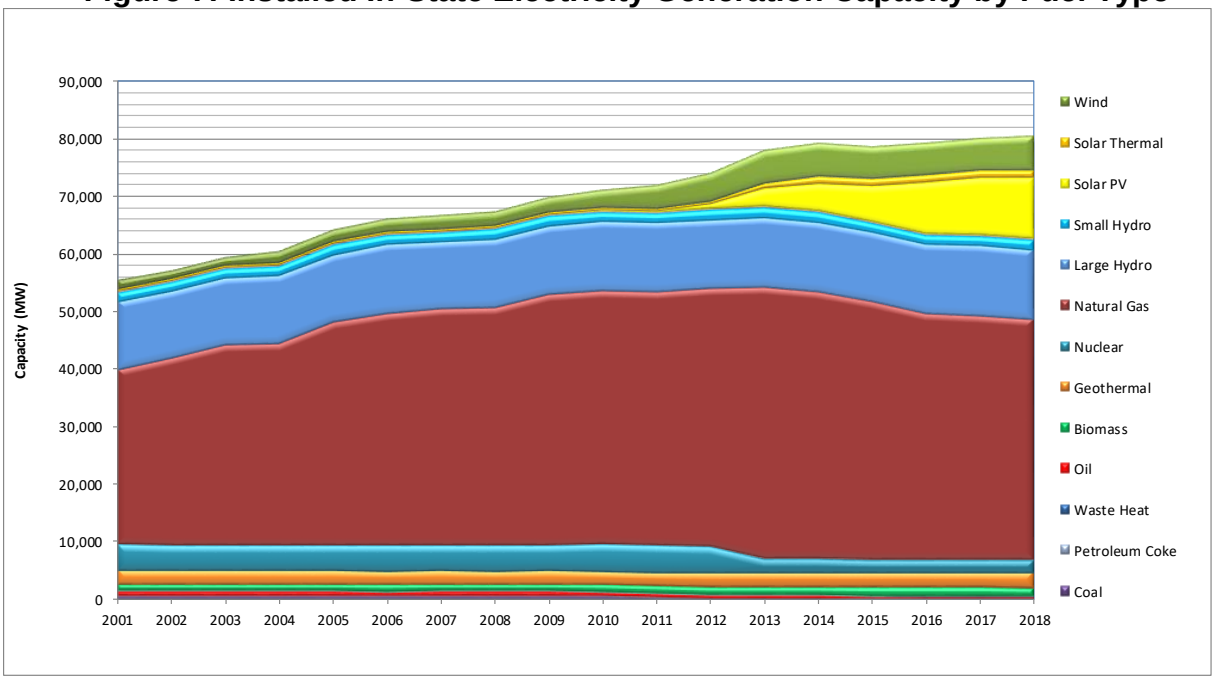
including both CAISO market-integrated approaches, and load modifying proposals to move load to periods of high renewable generation, low cost, and low emissions.[11]

The Lawrence Berkeley National Laboratory, in late 2019, will publish the results of its phase 3 modeling for the CPUC of the cost-based potential for residential, commercial and industrial end uses including EVs, and electric water and space heating, to shift load using advanced communications and automated controls. Finally, in late 2018, the investor owned utility third-party energy efficiency solicitations began seeking to procure more than $20 million per year in proposals that integrate energy efficiency lighting and HVAC systems with demand response controls to promote load flexibility.

Renewable Energy Curtailment and Integration

California's electric grid has been reshaped in the last decade as the amount of renewable energy capacity has grown (Figure 7). This energy is predominantly available in the middle of the day, leading to excess energy in the daytime that must be sold or curtailed. In addition, there is significant net demand ramp each afternoon/evening as solar energy production drops, and people move from their workplaces to their homes and turn on lights and appliances, creating the need for power from primarily natural gas power plants.[12]

Figure 7: Installed In-State Electricity Generation Capacity by Fuel Type



Source: CEC

11 https://gridworks.org/wp-content/uploads/2019/02/LoadShiftWorkingGroup_report-1.pdf
12 Net demand is the total electricity demand remaining after subtracting renewable energy.

Expansion of Electric Vehicles on the Grid

By 2030, electric vehicles (EVs) are expected to demand 400 percent more electric energy, more than 14,000 gigawatt-hours (GWh).[13] This added load will need to be met by new generation, offset by energy efficiency, or a combination. Research into the ability of EV to provide grid flexibility through DR features can help ensure grid reliability.

The CPUC plays a critical role in the state's transportation electrification efforts. As regulators of the state's electric investor-owned utilities, the CPUC has jurisdiction over electric rate design, electric system infrastructure deployment, grid management, and safety to accelerate transportation electrification. The CPUC's activities in this area fall into four main categories:

1. Electric rates and cost of fueling
2. Vehicle-grid integration policy and pilots
3. Charging infrastructure deployment and incentives
4. Program evaluation and interagency coordination

In December 2018, the CPUC launched a Rulemaking (R.18-12-006) to refocus its efforts related to transportation electrification, nearly a decade after opening its first Rulemaking related to alternative-fueled vehicles in 2009. The Rulemaking implements directives from the legislature and the Governor's office to develop investor-owned utility programs that accelerate transportation electrification.

To date, the CPUC has authorized approximately $1 billion of investment in transportation electrification, with approximately another $1 billion under review.

Energy Efficiency as a Resource

CPUC policies continue to assign value to energy efficiency as an energy resource. The keys to this objective are efforts to incorporate time and location value into energy efficiency goalsetting and portfolio development. Current cost-effectiveness tests incorporate certain elements, including peak-time values, to help determine the types of measures and programs that can most benefit ratepayers. Better understanding time-specific savings by measure will greatly improve program design and costs.

New methods to measure and verify energy savings will help track and value the contribution of energy efficiency as an energy resource. Increasing portions of the energy efficiency portfolio will use normalized metered energy consumption (NMEC) methods, which measure energy savings using actual

13 California Energy Commission. 2018 Integrated Energy Policy report Demand Forecast. 2018. https://ww2.energy.ca.gov/2018_energypolicy/documents/#cedu

consumption data from smart meters—providing better data on when and where energy savings are occurring.

Wildfires, Resiliency, and Energy Efficiency

California is experiencing larger and longer wildfires from climate change. The climate change-driven fires in Sonoma and Napa Counties in 2017, followed by the devastating Camp Fire in Paradise in 2018, show that California needs to build and, in some cases, rebuild homes and businesses to be resilient to the impacts of climate change. This rebuilding includes better building materials, integrated renewable on-site energy, and better building envelopes. The building energy standards and ratepayer energy efficiency programs should play a significant role in preparing California's existing and new buildings for the new climate reality.

Market and Building Sector Characterization

Single Family

California's single-family residential sector consists of more than 10 million buildings. Nearly half of these homes were constructed before 1970, and about 80 percent were built before 1990.[14] Figures 8 through 11 show the energy consumed in single-family homes. Plug loads such as appliances, electronics, and lighting (Figure 8) use most of the energy. In single-family homes, 27 percent of energy is used for space heating, 60 percent of which is provided by natural gas (Figure 9). Similarly, water heating in single-family homes is 25 percent of usage, of which 85 percent is provided by natural gas (Figure 10). Air conditioning within single-family homes is growing as the climate warms; thus, the values in Figure 11 are likely to change in the next residential energy consumption survey in 2021.

Single-Family Sector (1-4 units)

Number of Buildings
9,185,660 attached and detached

1,132,562 two-unit to four-unit homes

Total: 10,318,222 (72 percent of residential buildings)

Source: CA Dept. of finance, ES File, May 2019

Annual Energy Use
18 percent of energy use in California

About 74 percent of all residential energy use

Source: EIA, Annual Electric Power Industry Report, 2017.

Key Building Industry Stakeholders

- Licensed general contractors
- Building performance contractors
- Home Energy Rating System Raters
- Specialty contractors including heating, ventilating, and air conditioning, weatherization, and remodeling
- Real estate brokers and agents
- Mortgage brokers and lenders

Opportunities in the Single-Family Market

Potential Savings: Building envelope and plug loads in existing buildings offer significant savings opportunities. While no single plug-load has major savings potential, in aggregate, the amount of energy consumed by plug-loads in homes creates large savings potential. Research into miscellaneous electrical loads in homes can reveal the scale of the potential.

Behavioral Programs: There is a growing market for utility programs that focus on behavioral changes of occupants. Early results show promise from the Home Energy Reports Program. A home energy report breaks down energy usage

14 https://www.eia.gov/consumption/residential/reports/2009/state_briefs/pdf/ca.pdf.

compared to similar buildings nearby, offers suggestions for improvements, and tracks usage from month to month to show improvements or changes.

Pay-for-Performance Programs: Homes offer a unique resource for program implementers to bundle customers into groups for retrofits. This bundling for retrofits can result in energy efficiency being a reliably procured resource.

Challenges in the Single-Family Market

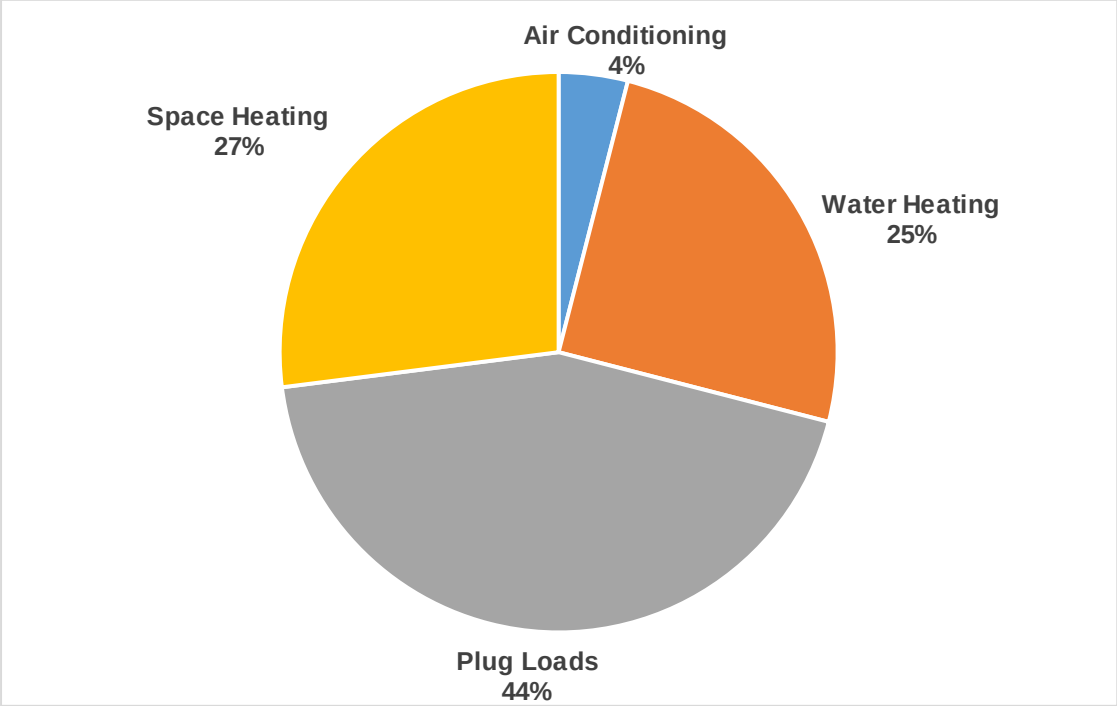
Benefits of Efficiency: It is not obvious to many homeowners how deep energy efficiency retrofits can pay back in bill savings and better indoor air quality, or what options are available to them to pursue deep retrofits. This issue is compounded in California's renter-heavy residential market.

Building Standards Compliance: While exact figures are lacking, compliance with building standards for residential heating, ventilation, air-conditioning (HVAC) permits is considered low.[15] Combined with resource-constrained building departments, there are potentially significant lost opportunities or unaccounted energy savings due to unpermitted work.

Efficiency Within Property Valuation: To real estate professionals, renters, and buyers, the value of efficiency in a home remains unclear. Expanding knowledge of the impacts efficiency measures have in homes must remain a priority.

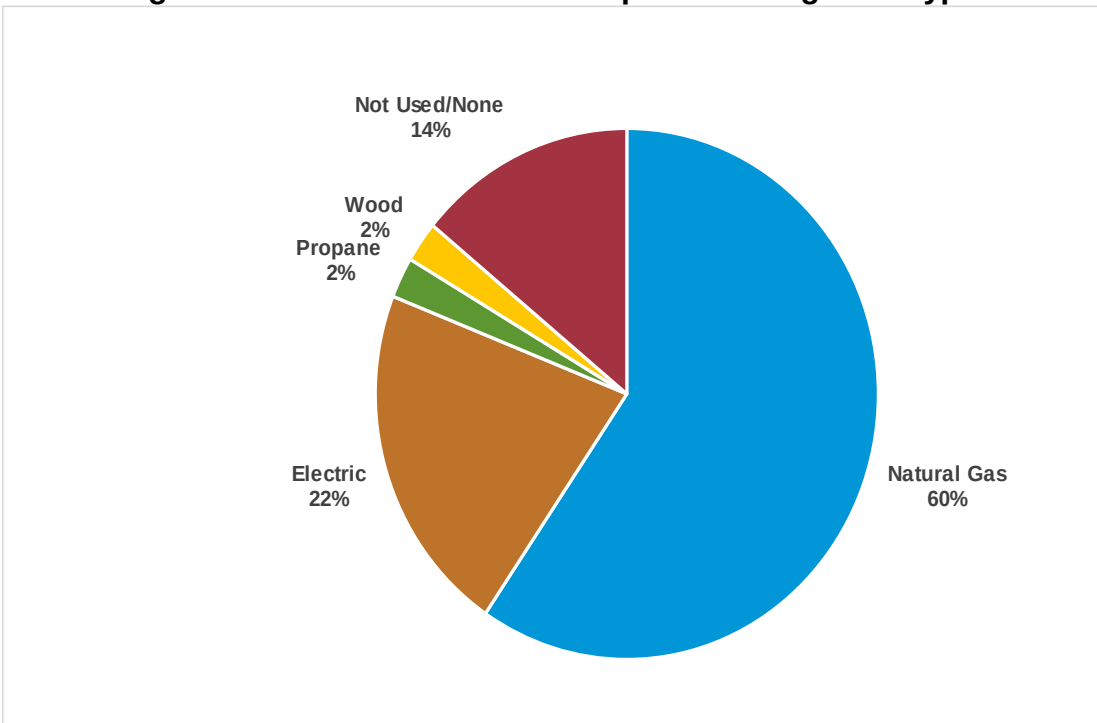
15 DNV-GL, Final Report: *2014-2016 HVAC Permit and Code Compliance Market Assessment Volume I*, Prepared for the CPUC, September 2017, calmac.org/publications/HVAC_WO6_FINAL_REPORT_VolumeI_22Sept2017.pdf.

Figure 8: California Residential End-Use Consumption



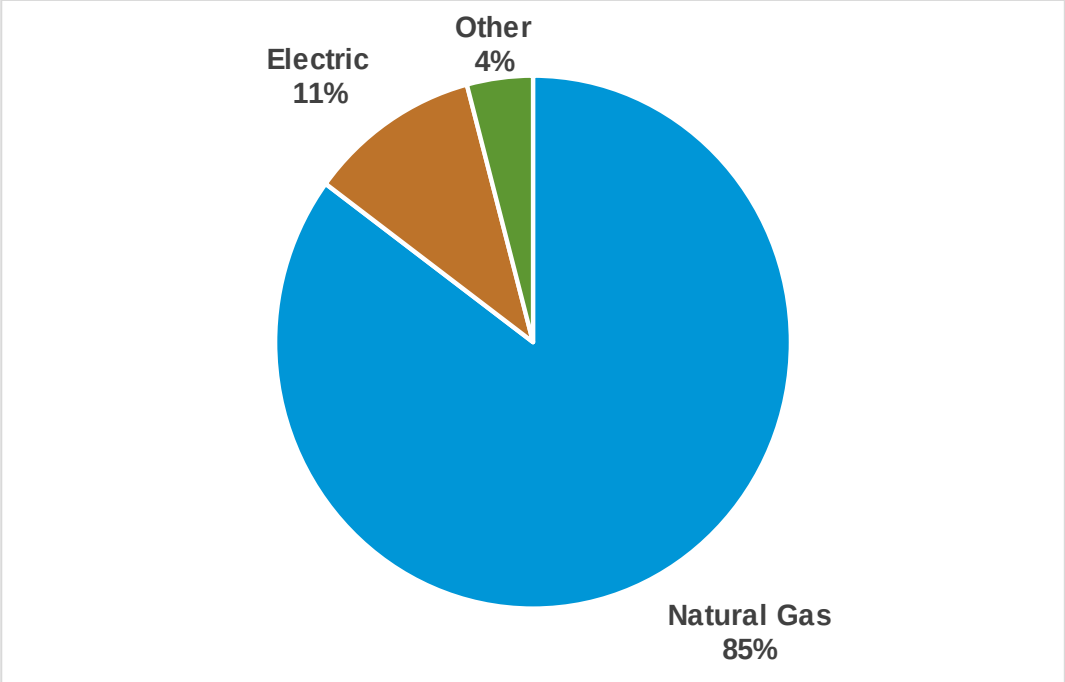
Source: EIA, 2009 Residential Energy Consumption Survey

Figure 9: California Residential Space Heating Fuel Type



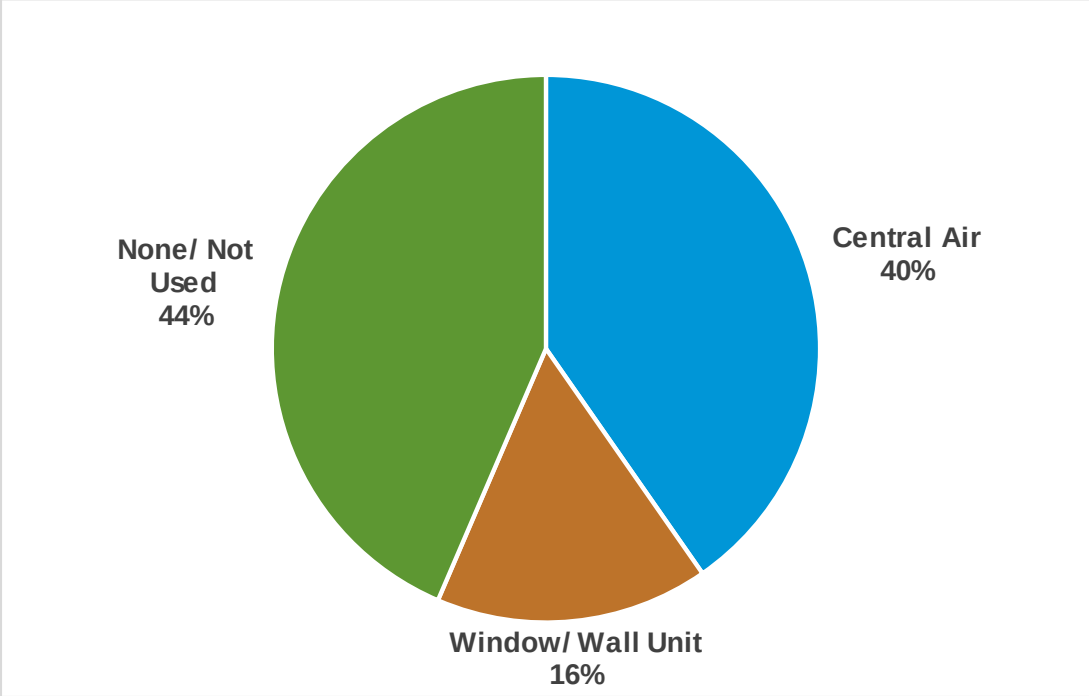
Source: EIA Office of Energy Consumption and Efficiency Statistics, Forms EIA-457 A and C of the 2009 Residential Energy Consumption Survey.

Figure 10: California Residential Water Heating Fuel Type



Source: EIA, Office of Energy Consumption and Efficiency Statistics, Forms EIA-457 A and C of the 2009 Residential Energy Consumption Survey.

Figure 11: California Residential Cooling Type



Source: EIA, Office of Energy Consumption and Efficiency Statistics, Forms EIA-457 A and C of the 2009 Residential Energy Consumption Survey.

Multifamily

The two- to four-unit multifamily sector experiences significantly different issues, opportunities, and energy consumption patterns (Figure 12) from single-family homes. The critical elements that set multifamily buildings apart include the size and complexity of buildings and systems, variability of ownership structure, split payment of utility costs between owners and tenants, limited financing products, and varied tenant sophistication and resources. The CLIMB Action Plan[16] delves further into the unique building and tenant characteristics of multifamily buildings.

Multifamily Sector (5+ units)

Number of Buildings
Total: 3,357,051 (24 percent of residential buildings)

Annual Energy Use
8 percent of building energy use (not including industrial)

Nearly 26 percent of all residential energy use

Vintage
More than **50 percent** of California's existing multifamily buildings were constructed before there were building energy efficiency standards (pre-1978).

Key Building Industry Stakeholders

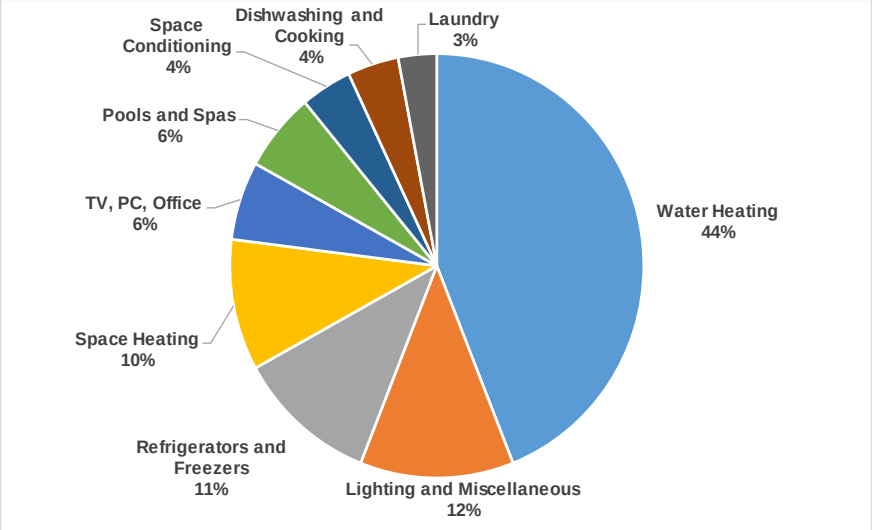
- Property owners
- Property managers
- Architects and engineers
- General contractors
- Real estate brokers
- Lenders, financial brokers, and underwriters

Types of Multifamily Buildings
Types include garden-style attached units, apartments, condominiums, mixed-use, senior housing/assisted living, special needs, single-room occupancy, co-op housing, and dormitories.

Sources: CA Department of Finance, E5 File, May 2019, EIA, Annual

16 Haramati, Mikhail, Eugene Lee, Tiffany Mateo, Brian McCollough, Shaun Ransom, Robert Ridgley, and Joseph Sit. 2018. *Clean Energy in Low-Income Multifamily Buildings Action Plan*. California Energy Commission. Publication Number: CEC-300-2018-005-SF. https://efiling.energy.ca.gov/GetDocument.aspx?tn=224513.

Figure 12: Multifamily Unit Electricity Usage by End Use



Source: EIA Office of Energy Consumption and Efficiency Statistics, Forms EIA-457 A and C of the 2009 Residential Energy Consumption Survey.

Challenges in Multifamily Market

Split Incentive: Because tenants are typically responsible for paying energy bills, the building owner does not directly benefit from performing energy efficiency upgrades. Common area upgrades are often performed, but the deeper savings are to be found within individual units.

Program Delivery: Renters rely on building owners to hire contractors who know about multifamily energy efficiency programs. If building owners employ contractors without this knowledge, then the building will not benefit from program participation. Better contractor outreach or different program delivery models that do not rely on contractors are needed.

Opportunities in the Multifamily Market

Trigger Events: There are specific times or "trigger events," like refinancing, during the life cycle of a multifamily building when major retrofits are possible. If these events are known in advance, programs can be tailored to engage the owners. Performing unit, envelope, roof, and other significant upgrades are most convenient and cost-effective during trigger events.

Alternative Financing: Traditional financing tools struggle to address the split incentive issue. Renters in multifamily buildings must rely on the building owner to upgrade the envelope, appliances, and more. Alternative financing tools, like on-bill tariffs, get around the split incentive by placing the cost on the utility billed paid by the tenant while avoiding tying the approval to credit metrics.

Commercial

The commercial building sector is variable and complex. Buildings may be used as offices, restaurants, hotels, retail, or mixed-use, and the associated energy demands, ownership, and occupancy may be just as disparate (Figure 13). The Commercial End-Use Survey, which provides data on California-specific commercial buildings, will be available in 2021. Current figures are from the 2004 survey. Electricity in commercial spaces is primarily consumed by lighting and space conditioning (Figure 14). Natural gas usage is dominated by space heating, water heating, and cooking.[17]

Commercial Sector

Number of Buildings

More than 7.5 billion sq. ft. of commercial floor space.

Annual Energy Use

19 percent of California energy use

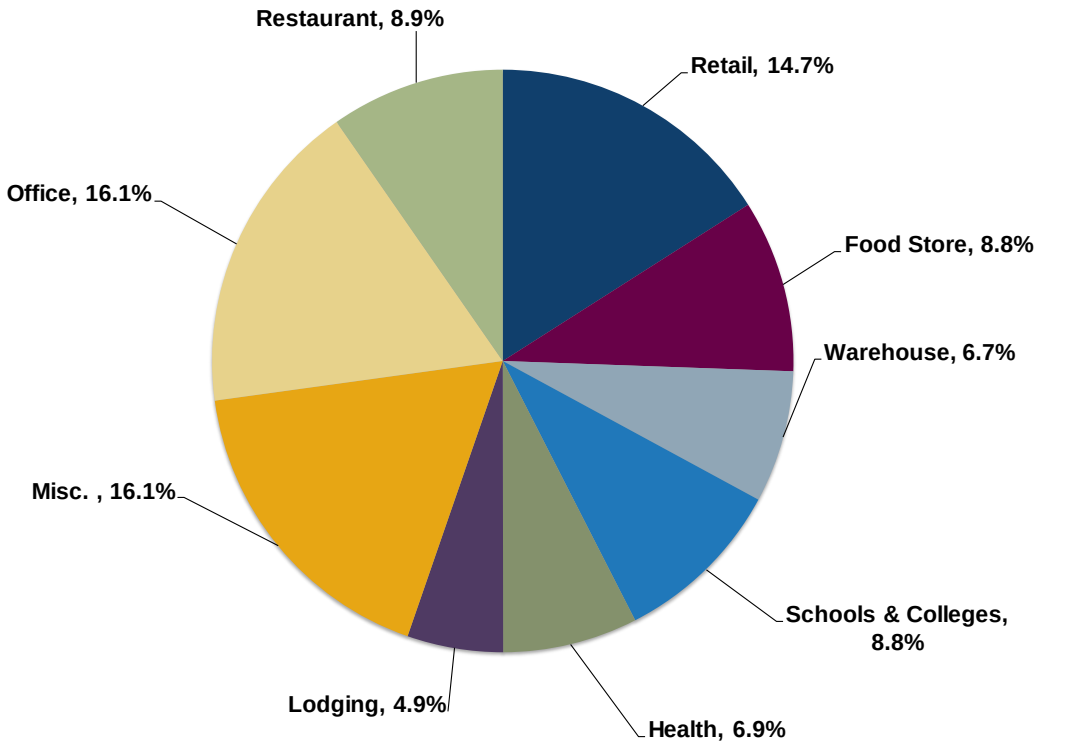
Key Building Industry Actors

- Building managers
- Large general contractor firms
- Small contractors firms
- Specialty contractors, including HVAC, weatherization, and remodeling
- Architecture and engineering firms
- Developers and real estate brokers
- Lenders, financial brokers, and underwriters

Source: *2017 Demand forecast, Integrated Energy Policy Report,* Energy Commission

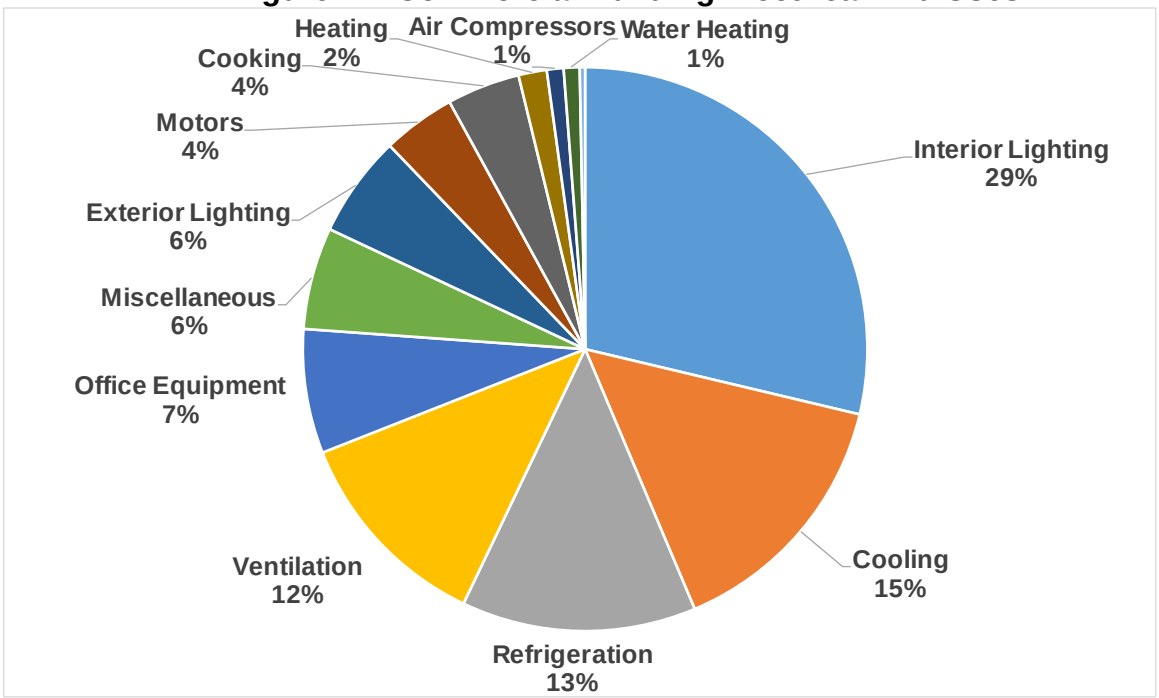
17 *California Commercial End-Use Survey.* California Energy Commission. 2004. https://ww2.energy.ca.gov/ceus/2006_enduse.html

Figure 13: Commercial Electrical Use by Building Type



Source: California Commercial End-Use Survey, 2004

Figure 14: Commercial Building Electrical End Uses



Source: California Commercial End-Use Survey, 2004

Challenges in Commercial Buildings

Awareness of Efficiency Value: A lack of awareness from building owners or commercial building operators result in stranded savings, savings that remain untapped but attainable.[18] Improved building energy asset scores[19] and outreach about benefits are necessary to close the gap between market and economic potential.

Building Owner-Tenant: Just as renters in residential buildings face a split incentive issue, so do renters of commercial spaces.

Opportunities in Commercial Buildings

High Savings Potential: The *2019 Energy Efficiency Potential and Goals Study* prepared for the CPUC indicates that HVAC and commercial refrigeration have the greatest electric savings potential (over 70 GWh per year depending on the selected scenario).[20] Water heating and food service measures are anticipated to save the most natural gas. Whole-building improvements are also expected to contribute to electric and natural gas savings.[21]

Industry and Agriculture Sectors

Agriculture Acreage
Over 24,000,000 acres of farm land.

Source: United States Department of Agriculture, 2017 Census.

Industrial Sites
Over 700 sites are required to report to CARB through the Cap-and-Trade Program.

Source: CARB, Mandatory GHG Reporting

Key Stakeholders

- Independent farmers and farming corporations
- Building managers
- Large general contractor firms
- Small contractors firms
- Specialty contractors, including HVAC, process heat, and pumping

Leadership in Energy and Environmental Design (LEED) /Green Buildings: California is home to the most LEED-certified buildings. As of 2018, more than 500 buildings met the requirements, which equates to more than 112 million gross square feet.[22] There is clearly a strong market-driven incentive in the state to design and operate buildings efficiently.

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18 Swearingen, Scott Van, Tracy Scott, and Kimberly Pray. 2012. *Reach for "Stranded Savings": The Challenges and Opportunities of Energy Efficiency in Affordable Multifamily*. ACEEE https://aceee.org/files/proceedings/2012/data/papers/0193-000125.pdf.
19 https://www.energy.gov/eere/buildings/building-energy-asset-score.
20 Navigant. 2019 Energy Efficiency Potential and Goals Study, pg. 89-92, Prepared for the California Public Utilities Commission. July 2019
21 Ibid
22 U.S Green Building Council. 2019. "Annual Top 10 States LEED, Green Certified". https://www.usgbc.org/articles/us-green-building-council-announces-annual-top-10-states-leed-green-building-2018

Agriculture and Industry

The state's agriculture and industries play a significant role in making California's economy the world's fifth largest. California is first in the nation in agricultural output, bringing in roughly $50 billion for a wide variety of products. California agriculture is driven primarily by the dairy, nut, and grape subsectors. Industry continues to drive energy consumption and revenue in California.[23] The state also ranked first in the nation in manufacturing gross domestic product in 2018.[24] California excels at technology manufacturing, like computer and electronic products.

California's industrial and agricultural sectors, combined, consume about a quarter of the total energy consumed in the state, of which 85 percent is consumed by the industrial sector, while the agricultural sector consumes the remaining 15 percent. For the industrial sector, about 70 percent of energy is in the form of natural gas. In contrast, for the agricultural sector about 85 percent energy is consumed in the form of electricity.[25] Overall, the industrial sector accounts for a quarter of the gas consumption in the state.[26]

Indoor Agriculture Subsector

Indoor agriculture or controlled environment agriculture is growing throughout the state, especially as cities look to source locally grown produce and communities strive to increase food security. In addition, recent California law has permitted commercial cannabis cultivation, which generally occurs indoors. Indoor cannabis growing is primarily taking place within retrofitted commercial spaces and warehouses. Standard indoor agriculture and cannabis cultivation are energy-intensive, requiring significant space conditioning, lighting, and ventilation.

End Uses

Agriculture: Electricity and natural gas are used in agriculture. Most of the direct energy use in U.S. farms is for machinery, which typically runs on diesel or gasoline, which are not in the scope of the action plan. Electricity use is dominated by heating and cooling livestock and dairy operations, as well as,

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23 California Department of Food and Agriculture. *California Agricultural Statistics Review 2017-2018*. https://www.cdfa.ca.gov/Statistics/PDFs/2017-18AgReport.pdf.

24 U.S. Energy Information Administration, https://www.eia.gov/state/data.php?sid=CA#ConsumptionExpenditures

25 California Energy Commission.,, Energy Consumption Data Management System, http://ecdms.energy.ca.gov/, Demand Analysis Office, Data Collection and Analysis Unit.

26 California Energy Commission. ", Supply and Demand of Natural Gas in California." http://www.energy.ca.gov/almanac/naturalgas_data/overview.html.

pumping water for irrigation.[27] In California, some farmers are switching to electric machinery and pumps, often offered incentives through air districts and CARB programs like the Carl Moyer Memorial Air Quality Standards Attainment Program.[28]

Industry: Uses within the industrial sector vary due to the numerous processes and products. However, most uses rely on natural gas. As noted above, about 70 percent of energy consumed in industry is from natural gas. Food processing, chemicals, refining, paper, and construction drive energy consumption. These subsectors often rely on uses that provide heat, like steam, justifying the significant need for natural gas.

Challenges in Agriculture and Industry

Disruption to Process: For the industrial sector, energy upgrades often necessitate shutting down industrial processes, thereby disrupting goods production. Such upgrades may be accomplished only in narrow periods, when the building or section of the building is shut down for maintenance. This narrow window means that the financing for upgrades must be in place well before. This period also applies in agricultural areas where pumping occurs regularly, during the growing season with limited windows of downtime to upgrade.

Nonstandardized Energy Efficiency Solutions: The varied uses, especially in industrial processes, mean that standard energy efficiency programs may not apply. Custom programs exist to resolve this, but barriers to defining a proper baseline or justifying the incentive often results in the window of opportunity passing by.

Expanding Cannabis Growth: As California sees a boom in cannabis cultivation, the result will be significant electric load increases. Utilities will need to work with indoor agriculture businesses on energy efficiency measures and become familiar with predictable load increases to prepare the local distribution and transmission system.

Opportunities in Agriculture and Industry

Strategic Energy Management (SEM): SEM is a growing program design that targets industry and agriculture energy use. SEM programs focus on supporting customers to implement ongoing behavioral, retrocommissioning, energy

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27 United States Department of Agriculture. May 2013.، *Agriculture's Supply and Demand for Energy and Energy Products.* https://www.ers.usda.gov/webdocs/publications/43756/37427_eib112.pdf?v=0.

28 California Air Resources Board. "، Carl Moyer Program." https://ww2.arb.ca.gov/our-work/programs/carl-moyer-memorial-air-quality-standards-attainment-program.

efficiency, and operational savings measures.[29] The IOUs identified SEM as a key strategy to reduce energy consumption and increase efficiency savings.[3031] Through this program, a utility or third-party implementer provides the processes and systems needed to incorporate energy considerations and energy management into daily operations.[32] The key is to continuously monitor and evaluate ways to improve efficiency and upgrade assets.

GHG Reduction Programs: Another pathway for industry and agriculture to reduce energy use is through GHG reduction programs like those funded by the Greenhouse Gas Reduction Fund (GGRF). In these programs, GHGs serve as the metric to reduce energy use as opposed to measuring kilowatt-hours (kWh) or therms reductions. Because these sectors, especially industry, are GHG-intensive, they are often the target of state programs aimed at combating climate change, such as the Cap-and-Trade Program.[33]

Large Energy Consumers: The extensive amount of energy consumed by the industrial sector provides opportunities for increased energy efficiency savings. For example, stakeholders from the California Large Energy Consumers Association (CLECA) described to staff 10 projects representing a partial list of the energy efficiency projects under consideration by CLECA members. For the 10 projects discussed, CLECA members planned to invest (or had committed) more than $10 million in project costs, and the anticipated energy savings were expected to be more than 23 million kWh and total demand savings of 3.1 megawatts (MW).

29 SEM engagements last from one to three years to realize the deepest levels of savings at participating customer facilities. AESC and Cascade Energy Bring Strategic Energy Management to Southern California, http://www.aesc-inc.com/aesc-cascade-energy-bring-strategic-energy-management-southern-california/./

30 Breitenstein, Colleen. Doubling Energy Efficiency Savings: Industrial & Agricultural Sector. IEPR Commissioner Workshop on Doubling Energy Efficiency Savings. June 7, 2018

31 Brooks Erin, Agricultural and Industrial Energy Efficiency. IEPR Commissioner Workshop on Doubling Energy Efficiency Savings. June 7, 2018 http://www.energy.ca.gov/2018_energypolicy/documents/2018-06-07_workshop/2018-06-07_presentations.php.

32 U.S. Department of Energy. "Data Driven, Strategic Energy Management." https://www.energy.gov/eere/slsc/data-driven-strategic-energy-management.

33 California Air Resources Board. "Cap and Trade." https://ww2.arb.ca.gov/our-work/programs/mandatory-greenhouse-gas-emissions-reporting.

Industrial Assessment Centers: The U.S. Department of Energy's Industrial Assessment Centers at San Francisco State University and San Diego State University provide no-cost energy audits to medium and small industrial plants.[34] Industrial Assessment Centers (IACs) have been conducting industrial assessments since 1976.

Public Buildings

The action plan separates public sector buildings, those owned by local, state, and federal governments, from other commercial buildings. These buildings play a unique role, especially in California, to showcase energy efficiency possibilities while saving on operating costs. To date, California state buildings have been used to demonstrate the feasibility of zero-net-energy design. Moving forward, public buildings can be the living labs for zero-carbon buildings.

Challenges in Public Buildings

Financial Constraints: Many local governments lack the capital to upgrade buildings or do not view it as a priority. Moreover, any cost savings from implemented upgrades may go to the general operating fund, not reinvested back into building upgrades.

Expert Knowledge: Many local governments lack the capacity to hire clean energy staff. This constraint limits the municipalities' ability to identify upgrades beyond standard

Public Buildings

Number of Buildings

State Buildings

Department of General Services (DGS) reports about 25,000 state-leased or -owned structures with a total of more than 230 million square feet of floor space.

Local Government Buildings

Definitive data are not available for the number of local government buildings in California, though they are estimated at 35,000 to 40,000.

Schools

- K-12: About 12,800 schools; more than 714 million square feet.
- California Community Colleges: 112 campuses; 5,281 buildings; 75.6 million square feet.
- California State Universities: More than 2,000 buildings; 90 million square feet.
- University of California System: 5,775 buildings; 129 million square feet.

Key Building Industry Stakeholders

- Department of General Services
- Local government agencies
- Local government IOU partnerships
- Energy services companies

Sources: EIA, Energy Commission, Department of Finance
Based on 2010 data

34 U.S. Department of Energy, Office of Energy Efficiency & Renewable Energy. ", Locations of Industrial Assessment Centers.". https://www.energy.gov/eere/amo/locations-industrial-assessment-centers.

maintenance. Becoming reliant on technical assistance may not be a long-term solution for small local governments with limited capital.

Opportunities in Public Buildings

Models for Success: Governments can direct upgrades to their building stock to showcase energy efficiency and clean energy. Through demonstration, policy makers can show the broader cost savings and benefits to upgrades. The CEC offers funding for energy efficiency upgrades via the Energy Conservation Assistance Act loans and the Proposition 39 competitive grant program.

Purchasing Power: Just as policy makers can require upgrades to government buildings, they can direct resources to purchase clean energy measures. The buying power of governments, especially California, should unlock lower costs for more efficient uses. It may be possible for smaller governments to purchase new equipment or bundle building upgrades jointly to lower costs.

Updated Milestones and Outcomes

The following updated implementation timeline, based on the 2016 EBEE Plan Update, includes goals and outcomes summarizing progress. These are the primary milestones implementers will use to assess and adapt the plan over the next 10 years. Plain text indicates the outcome or milestone with no reportable progress, bold bullets are those that have been accomplished, and italicized bullets are in progress. Changes since the 2016 EBEE Action Plan Update are in brackets.

- **By 2016, all California utilities provide whole-building energy use data to building owners and their agents upon request**. [The CEC enacted regulations to require building benchmarking for commercial and multifamily buildings with plans to disclose commercial building benchmarks in 2019 and multifamily building benchmarks in 2020.]
- *By 2018 to 2019, the energy agencies use analytical tools containing granular, statewide data on energy usage and building characteristics to track the evolution of energy usage, identify market trends, understand compliance with state and local codes, and update policies and programs to maintain and enhance effectiveness*. [This work is ongoing at the CEC and the CPUC.]
- *By 2017, building owners and occupants have easy access (directly or via their chosen service providers) to detailed energy usage data. By 2017, they routinely use this information to inform their decisions*. [The data are available to building owners, but it is unclear how often it is used to drive decision making.]
- **By 2018, a time-certain benchmarking program is in place for nonresidential buildings more than 50,000 square feet**. [The CEC implemented this benchmarking program for commercial buildings on June 1, 2018, and for multifamily buildings on June 1, 2019.]
- *By 2017, energy and cost savings information for state and school building retrofits is publicly available. [*Energy and cost savings are available to the public in the Citizens Oversight Board reports.[35]]
- **Every two years, starting in 2017, the CEC, in conjunction with the partners identified in the EBEE Action Plan and 2016 Plan Update, evaluates plan progress and reports findings in the *Integrated Energy Policy Report (IEPR)*.** [The *2019 IEPR* contains an update on progress.]

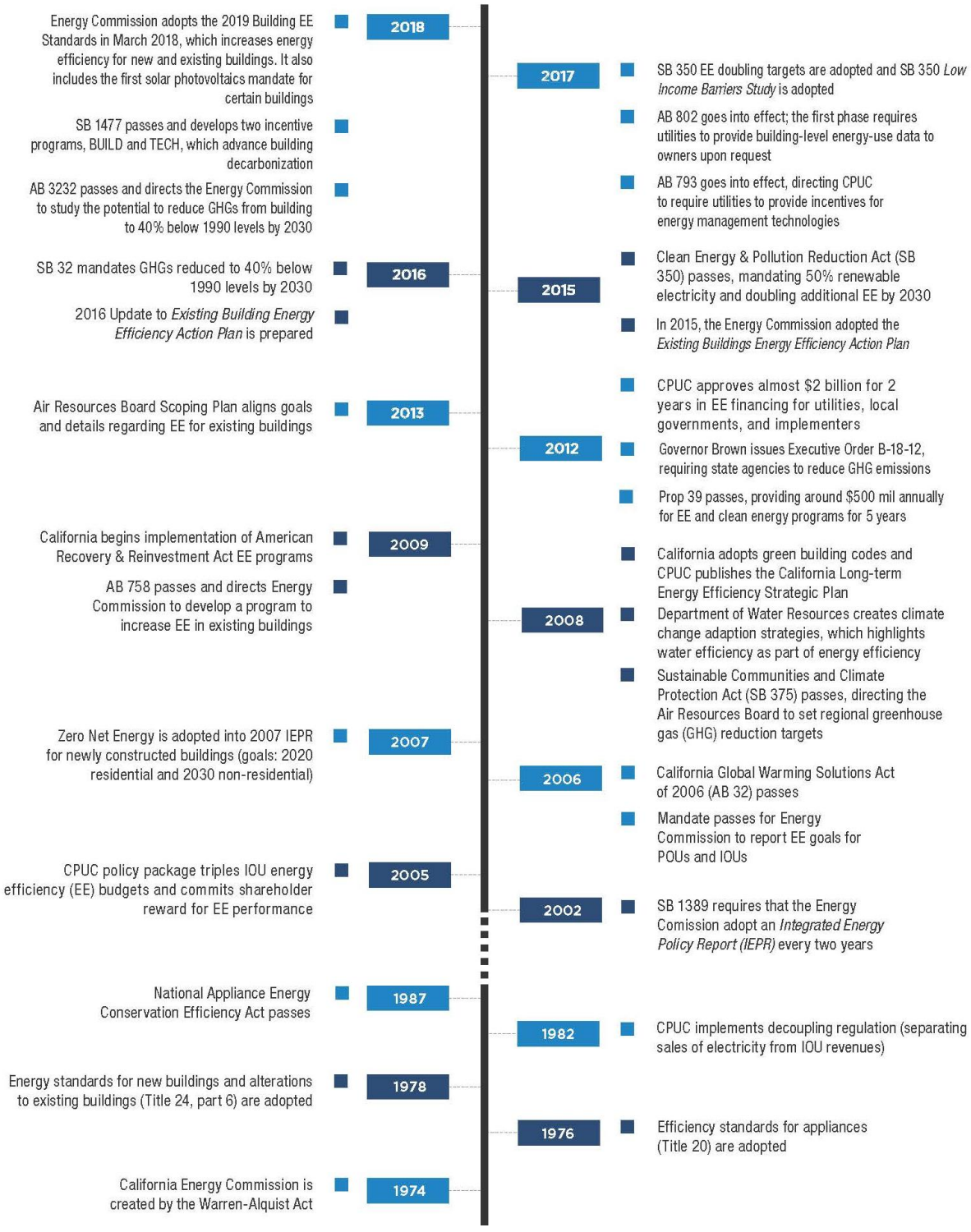
35 The Citizens Oversight Board is a public board that oversees the progress of the Proposition 39 energy efficiency grant program.

- *By 2018 to 2019, energy asset ratings are considered in real estate appraisals and included in property listings*. [To date, no significant progress has been made on this milestone.]
- *By 2018, establish baseline code compliance rate for residential HVAC replacements. By 2021, improve compliance to 80 percent*. [The CEC is developing a plan under Senate Bill 1414 (Wolk, Chapter 678, Statutes of 2016) to improve compliance for air-conditioner and heat-pump installations.]
- **The *2019 Building Energy Efficiency Standards* provide directed guidance and simplified approaches for compliance and enforcement of code requirements for existing building alterations.** [The 2019 Standards took steps to simplify and guide approaches for compliance with existing buildings alterations. Future iterations will continue to simplify compliance.]
- *By 2020, retrofit project compliance with the Building Energy Efficiency Standards is at 90 percent and is achieved at lower cost.* [Compliance rates are still poorly understood. The CEC is taking steps to better understand specific compliance problems with the standards.]
- By 2020, brokers and underwriters routinely consider asset ratings and other energy performance indicators when determining housing expense-to-income and commercial debt service coverage ratios. Asset ratings are not widely used in California, at this time. CEC will continue to seek pathways for asset ratings and other clean energy performance tools.
- By 2020, the financial value of energy savings drives private investment in energy efficiency and supports development of alternative, innovative business models to satisfy and drive market demand. This is improving, but the CEC foresees additional work to succeed.
- *By 2020, industry quality assurance is a routine job completion practice. Work is ongoing to meet this goal.*
- *By 2020, a certified, high-performing workforce is enabled to support California's energy efficiency industry. Work is ongoing to meet this goal.*
- *By 2020, utility resource procurement programs play an increased role in achieving energy savings. Work is ongoing to deliver efficiency as a procurable resource.*
- The *2022 Building Energy Efficiency Standards* provide pathways to building decarbonization and approaches to improve energy efficiency within multifamily buildings. *The 2019 Energy Code provided pathways to electrification for new single-family homes, while the 2022 Energy Code will investigate decarbonization pathways in multifamily and nonresidential buildings.*

- *By 2030, California has doubled energy efficiency savings as mandated under Senate Bill 350. Progress reported in the action plan.*
- *By 2030, renewable energy resources supply 60 percent of the retail sales of electricity in California. California is on track to achieve this goal. As of 2018, more than 30 percent of electricity came from renewable sources.*
- *By 2030, California must reduce GHG emissions 40 percent below 1990 levels. Assessment is due January 2021. Next steps will follow.*
- *By 2045, California achieves carbon neutrality across all sectors. Former Governor Edmund G. Brown Jr. directed state agencies to put the State on path to achieve net-zero-carbon emissions by 2045 and negative greenhouse gas emissions thereafter. The CEC is leading implementation of Senate Bill 100 (De León, Chapter 312, Statutes of 2018) to plan for a 100 percent clean energy electricity sector by 2045.*
- *By December 31, 2045, renewable energy resources and zero-carbon resources supply 100 percent of retail sales of electricity to California customers and 100 percent of electricity procured to serve all state agencies. The CEC is leading implementation of Senate Bill 100 (De León, Chapter 312, Statutes of 2018) to plan for a 100 percent clean energy electricity sector by 2045.*

CHAPTER 2:
Policy Updates

Timeline of Major Energy Efficiency Policy Measures



Policy and Action Drivers

California has driven energy efficiency, building decarbonization, and energy equity in California through both legislation and executive orders signaling the state's priorities for GHG reductions. These policy and legislative drivers are detailed below.

Assembly Bill 758

AB 758 (Skinner, Chapter 470, Statutes of 2009) required the development of the Existing Buildings Program, which resulted in the triennial EBEE Action Plan, which is now incorporated into this biennial action plan. Specifically, AB 758 required the CEC to consider the following to achieve greater savings in the state's existing residential and nonresidential building stock:

- The amount of annual and peak energy savings, GHG reductions, and projected customer utility bill savings that will accrue from the program.
- The most cost-effective means and reasonable time frames to achieve the goals of the program.
- The various climate zones within the state.
- An appropriate method to inform and educate the public about the need for, benefits of, and environmental impacts of the comprehensive energy efficiency program.
- The most effective way to report building energy assessment results and the corresponding energy efficiency improvements to the owner of the residential or nonresidential building.
- Existing statutory and regulatory requirements to achieve energy savings and GHG emission reductions.
- A broad range of implementation approaches, including both utility and nonutility administration of energy efficiency programs.

Senate Bill 350

The Clean Energy and Pollution Reduction Act of 2015 (SB 350, De León, Chapter 547, Statutes of 2015) continues, enhances, and expands the existing building energy efficiency program established by AB 758, providing new direction, including periodic updating of the program to achieve a doubling of the state's energy efficiency savings potential. SB 350 contains five energy efficiency mandates, most of which are in progress or have been completed:

1. The CEC, in collaboration with the CPUC and local POUs, will establish annual targets for statewide energy efficiency and demand reduction to achieve a cumulative doubling of statewide "energy efficiency savings in

electricity and natural gas final end uses of retail customers" by January 1, 2030.[36] *Ongoing*.

2. The CEC, on or before January 1, 2017, and at least every three years thereafter, will update this plan to achieve a cumulative doubling of statewide energy efficiency savings by 2030. The first report was completed, and this action plan incorporates updates. *Ongoing*.
3. The CEC will adopt, implement, and enforce responsible contractor policies to ensure that retrofits meet high-quality performance standards and reduce energy savings lost or forgone due to poor-quality workmanship, and establish consumer protection guidelines for energy efficiency products and services. *In process*.
4. The CEC develop and publish the Low-Income Barriers Study. *Completed*.
5. Authorizes the CPUC to pursue market transformation programs to achieve deeper energy efficiency savings and pay for performance programs that link incentives directly to measured energy savings. *Ongoing*.

Furthermore, SB 350 directs the Existing Buildings Program to promote greater penetration of specific energy efficiency programs in disadvantaged communities, considering a broad range of implementation approaches, including workforce development and job training. SB 350 also directs maximization of savings in disadvantaged communities to be integral with the energy savings target setting and progress monitoring to achieve the state's goal of doubling energy savings by 2030. *Ongoing*.

Assembly Bill 802

Assembly Bill 802 (AB 802; Williams, Chapter 590, Statutes of 2015) requires utilities to maintain energy usage records for all buildings to which they provide service, and to provide energy usage data to the owner, owner's agent, or operator of a covered building upon request. The bill also directed the CEC to adopt regulations providing for the collection and public disclosure of building energy benchmarking information. The regulations enacting the benchmarking and public disclosure program went into effect June 1, 2018, with the first batch of commercial buildings reporting. June 1, 2019, saw the first reporting deadline for covered multifamily buildings.

36 Jones, Melissa, Michael Jaske, Michael Kenney, Brian Samuelson, Cynthia Rogers, Elena Giyenko, and Manjit Ahuja. 2017. *Senate Bill 350: Doubling Energy Efficiency Savings by 2030.* California Energy Commission. Publication Number: CEC-400-2017-010-CMD.

AB 802 directed the CPUC to include operational, behavioral, and retrocommissioning programs[37] within the portfolio of efficiency programs, and permitted utilities to develop meter-based savings programs.

Senate Bill 1414

Senate Bill 1414 (SB 1414; Wolk, Chapter 678, Statutes of 2016) requires the CEC to develop and approve a plan that promotes air-conditioner and heat-pump installations that comply with the *Building Energy Efficiency Standards*. SB 1414 authorizes the CEC to adopt regulations to support this plan, and requires the CEC to evaluate the best available technological and economic information to ensure that data collection and related use are feasible and achievable at a reasonable cost to government, industry, and homeowners.

Senate Bill 1477

Senate Bill 1477 (SB 1477; Stern, Chapter 378, Statutes of 2018) requires the CPUC to develop two new incentive programs for customers of gas corporations. These programs would provide incentives for low-emission space- and water-heating equipment for new homes and for near-zero-emission building technologies in new and existing residential buildings to reduce GHG emissions.

Assembly Bill 3232

Assembly Bill 3232 (AB 3232; Friedman, Chapter 373, Statutes of 2018) requires the CEC, by 2021, to assess the potential to reduce GHGs from the state's residential and commercial building stock by at least 40 percent below 1990 levels by January 1, 2030. It requires the CEC to include a section in each *IEPR*, starting in 2021, describing the GHG emissions associated with the supply of energy to buildings.

Senate Bill 1013

Senate Bill 1013 (Lara, Chapter 375, Statutes of 2018) directs the CPUC to develop a strategy for increasing the use of low-global-warming potential refrigerants as part of the EE portfolio. This bill requires the CEC to "identify opportunities to assess" the energy efficiency of low-global warming potential alternatives that could be used in fluorine-based appliances and equipment.

Senate Bill 1131

Senate Bill 1131 (Hertzberg, Chapter 562, Statutes of 2018) requires the CPUC to authorize IOU incentives for customized industrial, agricultural, commercial, residential, and public sector energy efficiency projects based on nationally

37 Often shortened to BROs, operational, behavioral, and retrocommissioning programs, are efficiency programs that target improperly used equipment, occupant behavior improvements, and incorrectly installed or maintenance, respectively.

recognized measurement and verification standards. The bill also establishes new requirements and timelines for the CPUC's review of these projects.

Senate Bill 100

Senate Bill 100 (De León, Chapter 312, Statutes of 2018) increases the Renewables Portfolio Standard (RPS) to 60 percent by 2030. Moreover, the bill sets a policy that eligible renewable resources and zero carbon resources supply 100 percent of retail sales of electricity to end-use customers and 100 percent of electricity procured to serve all state agencies by December 31, 2045. In addition, it requires the CEC, CPUC, CARB and all other state agencies incorporate this policy into all relevant planning. Also, the CEC, CPUC and CARB are required to prepare a report addressing the implementation of the policy focused on technologies, forecasts, existing transmission, maintaining safety, environmental protection, affordability, and system and local reliability to the Legislature in 2021 and every four years thereafter.

CHAPTER 3:
Statewide Energy Reduction Goals

Overview

The core outcomes and recommendations of the action plan revolve around three goals:

1. To double energy efficiency savings by 2030
2. To remove barriers to energy efficiency participation within low-income households, disadvantaged communities, and rural regions
3. To reduce the GHG emissions from buildings

Together, these goals drive California to a clean energy and equitable future while aligning with the principles established for increasing energy efficiency in existing buildings. This chapter delves into these goals and incorporates public feedback from the series of workshops CEC staff held during spring 2019 to inform development of the action plan.

Goal 1: Double Energy Efficiency Savings by 2030

In 2015, California set an ambitious goal to achieve a statewide cumulative doubling of energy efficiency savings and demand reductions in electricity and natural gas end uses by January 1, 2030. SB 350 directed the CEC to set annual targets that achieve this goal. The state will need to harness emerging technologies, progressive program designs, and innovative market solutions as part of this effort. Getting projects in motion will require better alignment of energy efficiency supply and implementation chains. The state can assist through efficiency policies, regulations, and codes. Although there are limitations to government intervention that other pathways can leverage. It is increasingly important to encourage and work with the private marketplace to prevent hindering the transformation underway. Leveraging private capital will be important to meeting the doubling targets.

The following components discuss the areas of energy efficiency savings that the CEC analyzed to develop and update the annual targets. This first goal also explores the various research and market transformation efforts underway, or feasible, to spur additional savings.

Component 1: Ratepayer Programs and Policies

Ratepayer energy efficiency programs comprise the bulk of the continuous funding and projected energy efficiency savings. IOUs and POUs, as well as more recently consumer choice aggregators, deliver programs. In many

instances, third parties may carry out the administration and implementation. Historical savings are reported by the CPUC for IOU programs, while POUs report savings through public reports made available by the California Municipal Utility Association (CMUA). These same groups are responsible for producing forecasts of efficiency savings.

Publicly Owned Utilities Energy Efficiency Programs

California POUs are vertically integrated energy providers regulated by local governing boards and vary by size, customer base, and resource portfolios. There are over 40 POUs in 13 of the state's 16 climate zones. POU electricity savings programs provide subsidies and incentives for energy efficiency to end users. POU incentive programs range from cash rebates for the purchase of higher-efficiency products and home energy upgrades to customized financial incentives and awareness and education campaigns that improve customer energy use behavior. POUs also administer load management programs that provide technical assistance and customer incentives to install automated DR equipment,[38] undertake voluntarily scheduled load reduction, and manage peak-day and time-of-use consumption patterns.

Historical Energy Efficiency Savings

Each year POUs must report the following information to customers and to the CEC:

1. Investments in energy efficiency and demand reduction programs
2. Descriptions of each energy efficiency and demand reduction program, program expenditures, cost-effectiveness of each program, and expected and actual energy efficiency savings and demand reduction results
3. Sources for funding of energy efficiency and demand reduction programs
4. Methods and input assumptions used to determine cost-effectiveness of programs
5. A comparison of the POUs' annual energy efficiency targets and the POUs' reported electricity efficiency savings and demand reductions

This collaborative report compiles the required data from the POUs into a comprehensive document in compliance with Public Utilities Code Section 9505.

38 Automated demand response measures will react automatically to utility price signals and reduce energy consumption.

Recently, the POUs developed a new cost-effectiveness tool and reporting platform with the CEC. This platform improves the tracking and evaluation of energy efficiency programs. Using this new tool, POUs can analyze individual efficiency measures or full programs to determine the potential savings and cost-effectiveness before implementation.[39] POUs are able to create unique programs and measures for their utility and may choose to share them with other POUs collaboratively. The model also allows each POU to be able to specify many key inputs, including:

- Retail rates.
- Hourly load shapes.
- Hourly GHG emissions curves.
- Hourly avoided cost.
- Overhead allocations by measure, programs, portfolio, sector, or use, or a combination thereof.

The new tool will allow POUs to manage reference libraries of measures, avoided costs, load shapes, and GHG emissions, allowing useful tracking and comparative scenario analyses for integrated planning.

During the 2018 reporting cycle, POUs spent more than $218 million on energy efficiency programs, resulting in more than 638 GWh of net annual energy savings (Table 1).[40] Table 2 summarizes energy efficiency program savings for all POUs. Los Angeles Department of Water and Power (LADWP) alone represents more than half (54.2 percent) of the total annual energy savings for public power. Together with Sacramento Municipal Utility District (SMUD), the two largest POUs represent 71.6 percent of the total annual energy savings achieved by POUs last year. The 16 POUs subject to the integrated resource plan requirements provided 97.8 percent of public power's annual energy savings, which slightly exceeds these utilities' share of total POU customer electricity consumption (94.1 percent).[41] Most reported savings are from lighting measures, followed distantly by any other grouping of upgrades (Figure 15).

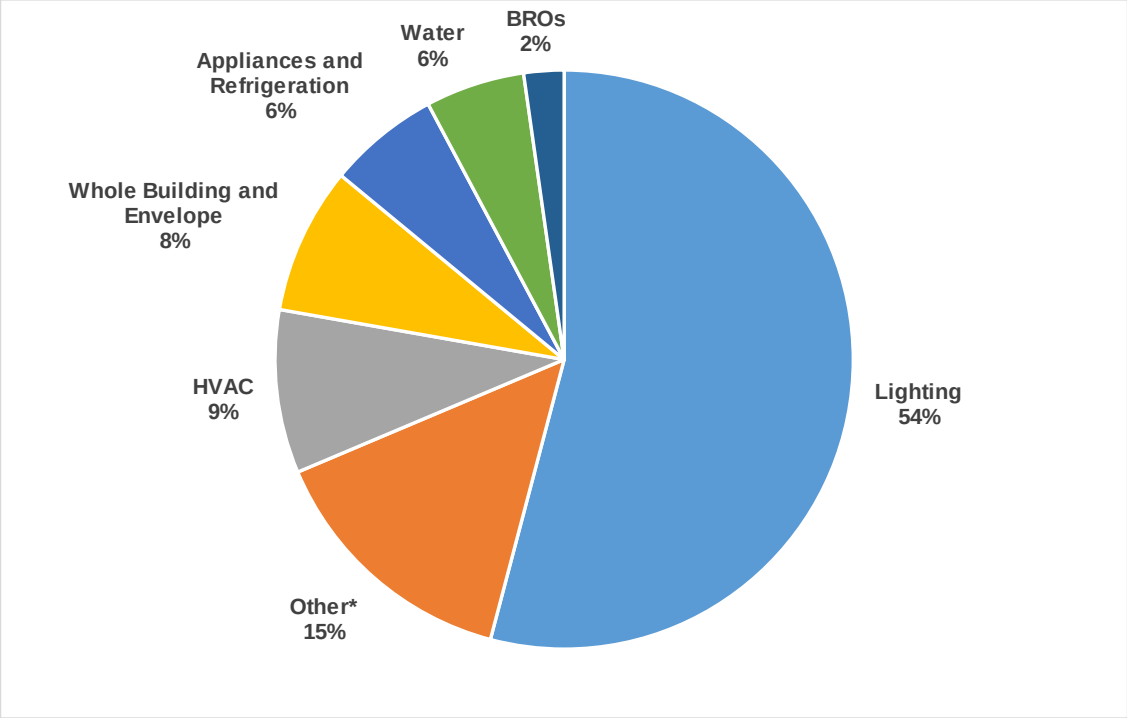
39 2019 Energy Efficiency in California's Public Power Sector Report, 13th Edition, https://www.ncpa.com/policy/reports/energy-efficiency/
40 Expenditures and savings table, pg. 4, *2019 POU EE Report*, https://www.ncpa.com/policy/reports/energy-efficiency/
41 Savings by utility, pg. 6, *2019 POU EE Report*, https://www.ncpa.com/policy/reports/energy-efficiency/

Table 1: POU Electricity Savings and Expenditures

Year	Net Peak Savings (kW)	Net Annual Savings (MWh)	Net Lifecycle Savings (MWh)	Total Utility Expenditures ($)
FY05/06	52,552	169,303	2,249,214	$54,412,728
FY06/07	56,772	254,332	3,062,361	$63,151,647
FY07/09	82,730	401,919	4,473,801	$103,907,266
FY08/09	117,435	644,260	6,749,912	$146,093,107
FY09/10	93,712	522,929	5,586,299	$123,433,250
FY10/11	81,121	459,459	4,604,364	$132,372,795
FY11/12	82,561	439,710	4,638,521	$126,936,631
FY12/13	89,305	521,478	5,722,100	$134,475,230
FY13/14	110,437	625,187	6,413,468	$169,901,735
FY14/15	124,807	644,703	7,836,316	$162,896,993
FY15/16	107,925	771,592	10,253,633	$154,796,668
FY16/17	113,549	861,942	11,991,602	$226,386,251
FY17/18	129,244	638,656	8,267,536	$218,730,235
TOTAL	**1,242,149**	**6,955,469**	**81,849,127**	**$1,817,494,536**

Source: Northern California Power Agency (NCPA), 2019 POU Energy Efficiency Report

Figure 15: Percentage 2018 POU Electricity Savings by Use



Source: NCPA, 2019 POU Energy Efficiency Report

Table 2: POU Savings 2018

Summary by Utility	Resource Savings Summary							Cost Summary	Cost Test Ratios		
Utility	Gross Peak Savings (kW)	Gross Annual Energy Savings (kWh)	Gross Lifecycle Energy Savings (kWH)	Net Peak Savings (kW)	Net Annual Energy Savings (kWh)	Net Lifecycle Energy Savings (kWh)	Net Lifecycle GHG Reductions (Tons)	Total Utility Cost	PAC	TRC	Utility ($/kWh)
Alameda	180	1,471,579	20,741,534	162	1,362,479	19,242,186	7,687	$875,637	1.95	1.18	$0.060
Anaheim	4,361	20,136,148	233,959,277	4,361	20,136,148	233,959,277	88,626	$4,914,824	4.56	7.10	$0.027
Azusa	654	3,036,347	33,783,387	637	2,872,363	32,002,410	12,625	$731,703	4.10	5.94	$0.030
Banning	1,144	150,301	1,610,310	911	124,871	1,354,002	550	$207,194	0.81	1.20	$0.191
Biggs	-	51,216	256,080	-	46,094	230,472	117	$20,936	0.94	0.94	$0.099
Burbank	4,253	14,451,356	123,765,099	4,212	14,312,559	122,344,415	47,777	$3,635,878	3.62	1.25	$0.036
Colton	315	2,001,970	20,909,142	253	1,508,946	15,796,947	6,692	$1,413,864	27.64	29.37	$0.113
Glendale	4,455	10,201,043	39,748,649	4,414	10,133,699	38,645,052	16,032	$1,843,996	2.32	2.17	$0.061
Gridley	29	104,348	1,276,213	20	86,724	982,417	412	$92,378	1.32	0.89	$0.118
Healdsburg	102	687,772	8,255,258	85	581,351	6,966,033	2,728	$257,685	2.82	0.83	$0.038
Imperial	7,403	18,626,472	250,671,076	6,151	15,432,152	209,038,646	97,703	$5,298,497	4.15	7.01	$0.037
Lassen	35	262,065	2,935,758	27	220,118	2,450,699	976	$102,815	2.24	1.61	$0.052
Lodi	371	3,190,405	38,444,771	272	2,487,074	29,641,708	12,154	$792,018	3.67	2.11	$0.033
Lompoc	40	306,406	4,483,302	28	207,818	3,040,544	1,127	$108,541	2.78	1.68	$0.041
Los Angeles	52,710	346,408,005	5,052,753,288	52,704	346,379,055	5,052,405,888	292,162	$131,042,086	1.72	0.85	$0.034
Merced	-	2,037,395	20,405,526	-	1,624,970	16,264,098	6,549	$1,068,008	1.35	1.53	$0.081
Modesto	1,285	6,719,789	74,927,724	1,045	5,523,033	61,468,862	24,892	$2,426,614	3.16	1.43	$0.040
Moreno Valley	628	4,716,930	47,271,023	563	4,236,312	42,420,820	16,721	$183,523	22.54	22.63	$0.005
Needles	1	5,875	83,542	1	4,875	71,052	28	$148,370	0.04	0.97	$2.851
Palo Alto	415	8,988,048	100,491,731	232	5,956,736	63,217,786	21,436	$3,080,534	1.74	0.65	$0.056
Pasedena	1,536	13,526,452	81,800,786	1,504	13,353,078	79,581,441	31,029	$4,042,594	2.26	2.26	$0.059
Plumas-Sierra	33	82,921	1,116,146	24	57,730	806,337	346	$124,828	0.73	0.46	$0.208
Port of Oakland	-	648,755	7,785,060	-	519,004	6,228,048	3,042	$45,829	13.51	1.24	$0.009
Rancho Cucamonga	171	480,554	7,688,864	171	480,554	7,688,864	2,760	$87,879	7.78	21.37	$0.016
Redding	1,109	7,028,979	54,926,085	861	5,518,363	42,010,053	18,871	$2,654,740	1.91	1.15	$0.072
Riverside	3,416	23,555,710	309,433,140	2,930	22,240,608	276,855,125	110,446	$5,974,465	5.29	19.97	$0.029
Roseville	1,829	15,873,872	99,313,187	1,608	14,957,621	89,520,947	39,505	$4,001,169	1.26	1.27	$0.055
Sacramento	36,823	131,521,260	1,567,460,963	28,825	110,819,702	1,333,705,655	88,853	$30,976,348	1.15	0.26	$0.028
San Fracisco	126	4,262,300	63,934,500	126	4,262,300	63,934,500	29,487	$5,054,602	1.52	1.45	$0.106
Shasta Lake	40	166,772	2,223,528	22	130,745	1,661,188	672	$135,744	1.42	1.14	$0.105
Silicon Valley Power	1,943	15,620,586	212,107,277	1,660	13,515,623	182,846,581	68,650	$4,313,248	3.87	2.53	$0.031
Trinity	7	2,588	35,480	6	1,937	27,048	13	$128,825	0.03	0.10	$6.268
Truckee Donner	28	261,699	2,636,803	22	202,089	1,982,231	828	$411,587	0.61	0.89	$0.273
Turlock	2,726	13,802,965	159,746,452	2,691	13,599,570	157,066,969	59,345	$1,984,134	7.47	2.37	$0.016
Ukiah	17	135,780	1,711,500	13	102,789	1,267,873	549	$87,137	1.66	1.07	$0.087
Vernon	948	5,383,804	66,720,063	948	5,383,804	66,720,063	25,093	$473,988	12.57	10.89	$0.009
Victorville	110	340,831	5,112,465	88	272,665	4,089,972	1,516	$43,896	7.58	1.61	$0.015
TOTAL	**129,244**	**676,249,299**	**8,720,524,989**	**117,578**	**638,655,559**	**8,267,536,209**	**1,137,999**	**$218,786,114**	**1.99**	**0.95**	**$0.036**

POU Program Activity

The CEC established ambitious annual targets to achieve a statewide doubling of cumulative energy efficiency savings. Achieving these targets will require the collective efforts of many entities, including state and local governments, utilities, program administrators and implementers, private lenders, market

participants, builders, equipment manufacturers, suppliers, and installers, as well as customers. As an example, the City of Palo Alto Utilities (CPAU) has been implementing a variety of energy efficiency programs since the 1970s. In 1998, CPAU created the Electric Public Benefits Program and increased the program budget to 2.85 percent of projected annual revenue to fund energy efficiency programs. CPAU's electric efficiency program budget can be supplemented with supply-side funds to meet state requirements that publicly owned electric utilities, in procuring energy, first acquire all available energy efficiency and demand reduction resources that are cost-effective, reliable, and feasible.[42]

Another example, SMUD, launched an online marketplace, the SMUD Energy Store, which provides ready access to energy-saving equipment. Also, at the April 8, 2019, joint agency workshop, SMUD presented Table 3 detailing its electrification program, including incentives it launched in March 2018. SMUD also reported progress on builders' commitment to electrify new construction buildings, as shown in Table 4, which includes forecast figures.

Table 3: SMUD Electrification Program Offerings

	Launch Date	Total Possible Incentive	Base Incentive	HP-HVAC	HPWH	Induction	Bonus
Single-Family New Construction	March 2018	$5,000	$4,000			$1,000	X
Multifamily New Construction	March 2018	$1,750	$1,250			$500	X
Single-Family Existing	May 2018	$10,500	n/a	$4,500	$3,000	$500	$2,500
HPWH Equipment Efficiency	June 2018	$3,000	$2,000	n/a		n/a	$1,000
HPWH Midstream Incentive	November 2018	$1,000	n/a	n/a		n/a	X
Multifamily Existing	December 2018	$2,500	n/a	$1,000	$1,000	$500	X
HP-HVAC Equipment Efficiency	1st Quarter 2019	$4,500	$1,500	$2,500	n/a	n/a	$500
HPWH Direct-Install Program	2nd Quarter 2019	$3,000	n/a	n/a		n/a	X

Source: Sacramento Municipal Utility District

42 Energy Efficiency in California's Public Power Sector: 12th Edition — 2018, https://www.ncpa.com/policy/reports/energy-efficiency/

Table 4: SMUD Electrification Program Uptake

	2018 (7 Months)	2019 (Forecast)	
Single-Family New Construction	79	194	Commitments from 4 of the top 25 builders in Sacramento, much more interest in 2019, 230 commitments 2020-2021
Multifamily New Construction	0	18	Main issues are lead time for multifamily and central HPWH systems that are challenging to electrify
HP-HVAC Equipment	134	500	Predominantly HPP so far, launching Equipment Efficiency in June
HPWH Equipment	142	654	Delivery through HPP and Equip Eff, seeing some organization around HPWH
Induction Cooking	10	20	Multiple challenges -- emotional choice for consumers, delivery method of program as well
Multifamily Existing	88	300	Aided by our internal low-income programs as well as external low income programs (multiple funding sources)

Source: Sacramento Municipal Utility District

POU Energy Efficiency Potential and Goals Studies

Every four years, POUs must identify all feasible and cost-effective energy efficiency savings and establish 10-year annual goals.[43] In addition, they must provide to their customers and the CEC the results of evaluation studies that measure and verify claimed demand reduction and energy savings. CMUA, in partnership with NCPA and the Southern California Public Power Agency, collaborated to develop 10-year electricity savings projections to establish electricity savings goals.[44]

The POUs' 2017 report on energy efficiency potential and goals (POU Potential and Goals Study) was submitted in March 2017.[45] The next iteration is due in spring 2021. The POU Potential and Goals Study presents a base set of projections of electricity savings and demand reduction as a function of projected electricity sales. Each POU then modified estimates using alternative assumptions, or other changes, for its own portion of the overall POU savings projection. The POU Potential and Goals Study contains the results of the adjustments to the base analysis identified by each POU, so the study does not

43 Assembly Bill 2021 (Levine, Chapter 734, Statutes of 2006) required 10-year efficiency targets to be set every three years. Assembly Bill 2227 (Bradford, Chapter 606, Statutes of 2012) changed the frequency of target setting to every four years.

44 Energy Efficiency in California's Public Power Sector: 12th Edition. 2018.

45 CMUA. March 2017. *POU Potential and Goals Study,* http://docketpublic.energy.ca.gov/PublicDocuments/17-IEPR-06/TN217680_20170522T124015_Energy_Efficiency_in_California's_Public_Power_Sector_11th_Edit.pdf.

contain a uniform set of assumptions common to all POUs nor any alternative scenarios. The 2017 Doubling Report details how the CEC adjusted the goals for use in the initial target-setting process.[46]

California Public Utilities Commission

Energy Efficiency Rolling Portfolio

Before 2015, the CPUC approved energy efficiency portfolios on three-year program cycles. However, the timing and nature of regulatory oversight and portfolio approval often delayed CPUC approval of the next program cycle(s), which contributed to market uncertainty and a start-stop dynamic in energy efficiency funding. In 2014, the CPUC took the first step in eliminating these three-year funding "cliffs" and adopted annual energy efficiency program funding of nearly $1 billion for 2015-2025.

Marked as the first year of the "rolling portfolio," in 2015, the CPUC directed the energy efficiency program administrators to file high-level business plans that provided an overview of sector-level strategies as well as estimated budget forecasts and energy savings. Program administrators file annual program-level specifics, including program-level budgets, energy savings forecasts, and new or closing programs, with the CPUC each September and request specific funding amounts for the next program year within the funding cap authorized by the CPUC.[47]

The energy efficiency portfolio faces challenges related to cost-effectiveness, as program administrators strive for deeper energy savings at lower cost. Consequently, the CPUC and stakeholders, via the California Energy Efficiency Coordinating Committee (CAEECC), are exploring ways to better realize the intent of the rolling portfolio, ensure proper oversight and cost-effectiveness, and streamline the budget request process.

Integrated Resource Planning

In 2018, CPUC Energy Division staff drafted a white paper outlining options for closer integration of energy efficiency into the integrated resource plan (IRP) process. The white paper discusses the potential benefits from increased energy efficiency and IRP integration as well as some of the challenges and tasks that would come with integration. Stakeholders provided initial feedback on the white paper via an informal round of comments. As the Energy Division works toward future rounds of energy efficiency potentials analysis and goal setting, as well as integrated resource planning, CPUC will assess potential avenues for

46 Jones, Melissa, Michael Jaske, Michael Kenney, Brian Samuelson, Cynthia Rogers, Elena Giyenko, and Manjit Ahuja. 2017. *Senate Bill 350: Doubling Energy Efficiency Savings by 2030.* pg. 33-39.California Energy Commission. Publication Number: CEC-400-2017-010-CMD,

47 CPUC Decision (D.) 18-05-041 (2018) describes the current funding cap. http://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M215/K706/215706139.PDF.

increased integration. Energy efficiency can be a resource that is contracted just like renewable energy, and natural gas; however, the value and reliability of efficiency must be clearly defined.

Normalized Metered Energy Consumption Approaches

SB 350 directed CPUC to measure progress toward energy efficiency goals, "taking into consideration the overall reduction in normalized metered electricity and natural gas consumption where these measurement techniques are feasible and cost effective."[48] The CPUC also approved high-opportunity projects and programs that leverage normalized metered energy consumption (NMEC) and have ranged from two rounds of a "pay-for-performance" residential procurement by Pacific Gas and Electric (PG&E) to site-level programs targeting large commercial and government buildings. The CPUC expects the first sets of NMEC savings reported by program administrators in Q4 2019 or Q1 2020.

Meanwhile, the CPUC has begun laying the foundation for expanded use of NMEC across the ratepayer-funded energy efficiency portfolio. In March 2018, Energy Division staff issued a draft rulebook for programs using "site-level NMEC," meant for large buildings that use a building-specific approach to determining savings. A January 31, 2019, ruling directed staff to update the site-level rules and develop rules for programs using population-level NMEC, which aggregates buildings. The CPUC launched an NMEC Working Group in May 2019 to solicit feedback from stakeholders on population-level NMEC rules.

Expanded use of NMEC has the potential to bring benefits to California's IOU energy efficiency portfolio:

- Program implementers and administrators can focus on achieving results measured at the meter.
- Implementers can have more flexibility to innovate program design and delivery without shifting additional risk to ratepayers.
- The use of metered savings can help make the CPUC program evaluation more efficient.

Third-Party Energy Efficiency Implementation

In August 2016, the CPUC adopted D. 16-08-019, which defined a "third-party program" as a program designed, implemented, and delivered by nonutility personnel under contract to a utility program administrator. D.18-05-041 required the four California IOUs—PG&E, Southern California Edison Company (SCE), Southern California Gas Company (SoCalGas), and San Diego Gas & Electric

48 Public Resources Code 25310(c)(1)

Company (SDG&E)—to contract at least 60 percent of its portfolio to third parties by the end of 2022 (Table 5).

Table 5: Program Administration Third-Party Requirements

Date	Third-Party Portfolio Percentage Minimum
December 19, 2019	25 percent
December 31, 2020	40 percent
December 31, 2022	60 percent

Source: CPUC

This new policy reflects the CPUC's view that the IOUs should focus more on portfolio design and less on individual program design and implementation. With the new definition, third-party implementers will be able to offer more cost-effective and innovative programs, garner significantly higher portion of savings than in the past, and support the SB 350 concept for pay-for-performance and meter-based energy savings evaluation.

In January 2018, the CPUC addressed the process for third-party solicitations and the risks associated with such a process in D.18-01-004. The CPUC required the IOUs to develop a set of standard and modifiable contract terms and conditions for third-party programs, use procurement reviews groups to design and conduct solicitations, hire a pool of independent evaluators with energy efficiency expertise to monitor and review utility solicitations, and implement a two-stage solicitation process, which begins with the request for abstracts followed by the request for proposals.

Market Transformation

The CPUC issued a market transformation staff proposal[49] in August 2018, outlining a new framework for setting longer-term program goals and recognizing accomplishments in terms of market metrics and transformation indicators. An important feature of the contemplated framework is the assessment of cost-effectiveness, which would occur over a longer time horizon (the projected life cycle of the Market Transformation Initiative) rather than year-over-year, as is required for the energy efficiency resource program portfolio. Two public workshops were held to discuss stakeholder comments and perspectives. The discussions led to the formation of a stakeholder working group and, ultimately, to a joint stakeholder market transformation report[50] that was released for public comment in March 2019.

49 http://docs.cpuc.ca.gov/SearchRes.aspx?DocFormat=ALL&DocID=225059924
50 http://docs.cpuc.ca.gov/SearchRes.aspx?DocFormat=ALL&DocID=281395459

It is important for the CPUC to study the pathways for market transformation through the ratepayer programs. New program designs, cost-effectiveness inputs or tests, or new technologies should play into the long-term plans of the program portfolio.

On-Bill Finance

D. 09-09-047 approved an on-bill financing (OBF) program as part of the energy efficiency funding for all four major energy utilities. The OBF program offers eligible nonresidential customers a way to pay for energy efficiency upgrades without incurring upfront costs. Under the program, a utility provides eligible customers with funded unsecured loans covering 100 percent of the energy efficiency equipment and installation costs (net of rebates and other incentives) with zero percent interest. Customers then repay the loans through charges added to their regular utility bills. Loan capital is raised through utility rates and the energy efficiency budget covers defaults and pays for program administration. The payment schedule for energy improvements allows the OBF amount to match cash savings on utility bills, to repay the cost of the improvements. The convenient access to capital and the cash flow profile is expected to boost the levels of efficiency adoption and increase energy savings.

PG&E filed its petition for modification of D. 09-09-047 on September 7, 2018. PG&E proposed to increase the OBF loan caps and terms. In the petition for modification, PG&E explains that it is motivated to help meet the state's increased energy efficiency goals to double energy efficiency savings by 2030 by increasing access to affordable capital for energy efficiency investments. PG&E believes that expansion of the OBF program can increase implementation of energy efficiency projects by raising maximum loan caps and terms.

On March 20, 2019, the CPUC issued D.19-03-001 approving the PFM and, among other things, increasing PG&E's OBF loan limit to $250,000 per application, with a maximum 10-year loan term for all eligible nonresidential customers, as requested in the petition. The CPUC also increased the exception limit for standard OBF loans from $2 million to $4 million for all eligible nonresidential customers where unique energy savings opportunities are identified. Further, the decision allowed all four of the major IOUs to request future changes to their OBF loan tariffs by filing a Tier 2 advice letter. On August 6, 2019, Southern California Edison Company (SCE) submitted for approval an advice letter to the CPUC to increase the loan caps for SCE's On Bill Financing (OBF) Program similar to PG&E.

Investor-Owned Utility Programs

The IOU programs are funded by a small portion of electricity and gas rates included in customer bills, which provides about $700 million per year to fund IOU energy efficiency programs.

2018 Programs

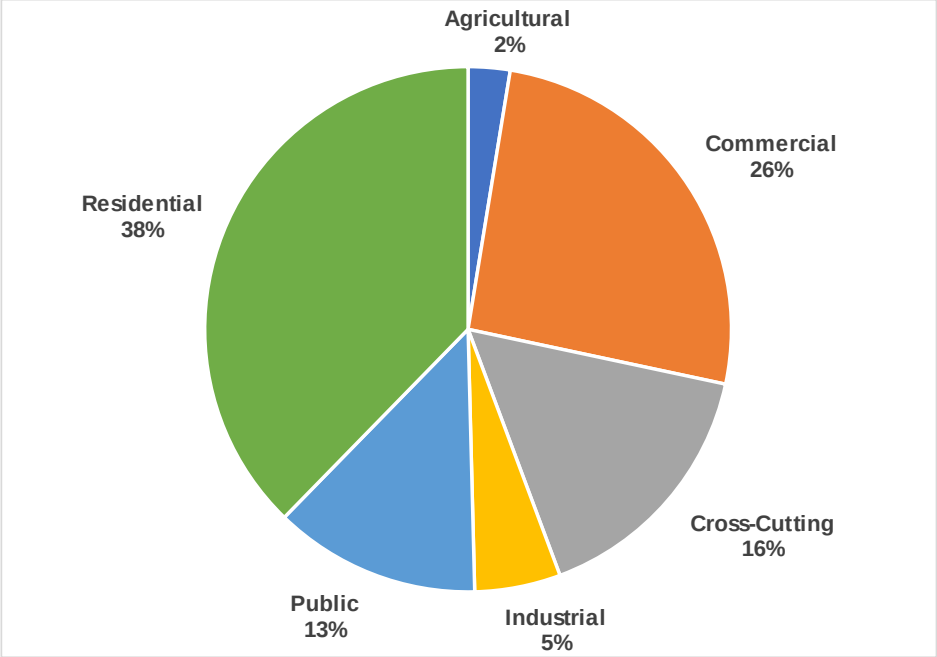
In 2018, IOUs, RENs, and Marin Clean Energy (MCE) spent nearly $700 million on programs (Table 6). The spending focused predominately on the residential and commercial sectors, which account for 64 percent of energy efficiency spending combined (Figure 16). Advocacy and research for new codes and standards, done in partnership with the CEC, make up most of the cross-cutting savings. Overall, the savings coming from the IOU portfolio are increasingly coming from codes and standards as low-hanging fruit, like lighting programs, are depleted (Figure 17).

Table 6: 2018 IOU Program Spending by Sector (Claimed)

Program Administrator	Agricultural	Commercial	Cross-Cutting	Industrial	Public	Residential
SCE	$ 2,688,429	$ 56,498,857	$ 28,260,946	$8,341,369	$ 21,577,994	$ 80,039,410
SDG&E	$ 543,998	$ 24,085,220	$ 29,161,804	$ 1,875,053	$ 7,831,203	$ 19,323,683
PG&E	$12,445,043	$ 79,524,652	$ 43,339,687	$21,407,084	$47,818,680	$ 90,064,483
SoCalGas	$ 2,117,078	$ 17,525,325	$ 7,251,583	$4,921,453	$ 3,117,782	$ 52,421,025
BayREN		$ 148,602	$ 2,034,844			$ 14,666,465
SoCalRen		$ 184,390	$ 546,219		$ 7,597,674	$ 3,966,779
MCE		$ 617,207	$ 35,114			$ 695,467

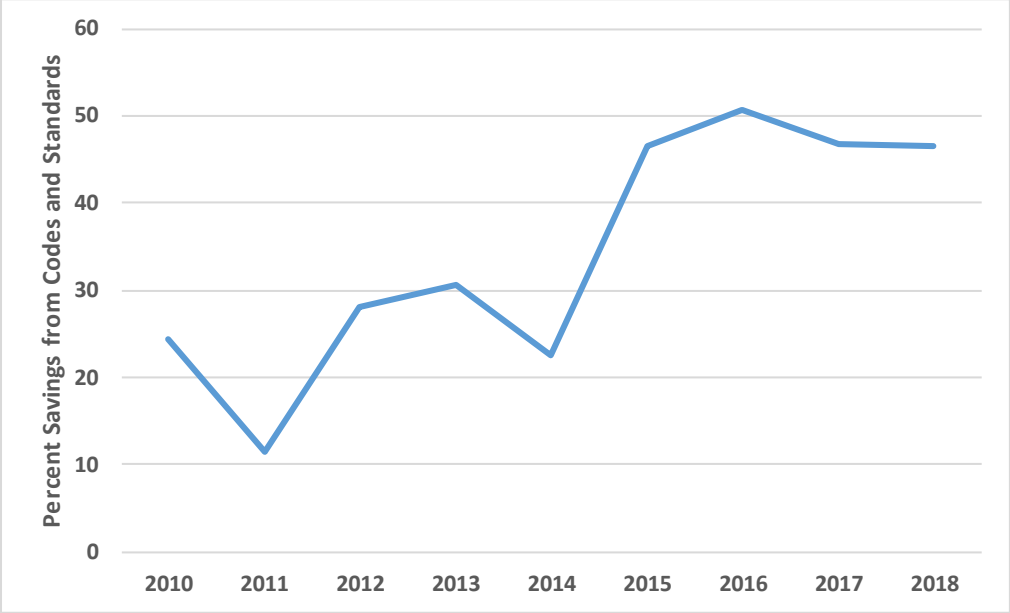
Source: CPUC

Figure 16: Percentage Spending Per Sector in 2018



Source: CPUC

Figure 17: IOU Savings, Percentage From Codes and Standards (2010-2018)



Source: CPUC, EEStats, and CEDARS

Regional Energy Networks Energy Efficiency Programs

In D. 12-11-015 the CPUC approved the applications of the Bay Area Regional Energy Network (BayREN) and the Southern California Regional Energy Network (SoCalREN) to receive ratepayer funds to offer energy efficiency offerings. The CPUC directed RENs to undertake:

1. Activities that utilities cannot or do not intend to undertake.
2. Pilot activities where there is no current utility program offering and where there is potential for scalability to a broader geographic reach, if successful.
3. Pilot activities in hard-to-reach markets, whether there is a current utility program that may overlap.

In D.18-05-041, the CPUC approved the 2018-2025 business plans of the two existing RENs and a new REN called the Tri-County REN made up of Santa Barbara, Ventura, and San Luis Obispo Counties. The decision approved SoCalREN's budget for this period at $173.6 million. SoCalREN's core programs were approved, including its public sector, residential, workforce education and training, and finance, though its request to add a codes and standards advocacy program was rejected. BayREN's approved budget for 2018-2025 is $193 million. The CPUC adopted BayREN's request to significantly ramp-up its commercial programs, but most of its approved budget is devoted to the residential sector. The Tri-County REN's approved budget is $48.3 million, and its approved programs include codes and standards advocacy, workforce training, and a residential middle-income direct-install program that focuses on multifamily tenants and Spanish-speaking occupants.

On March 27, 2019, the CPUC administrative law judge sought input on whether the policy currently in place for existing and new RENs is appropriate in light of current trends in energy efficiency policy and program administration.

Savings From Potential and Goals Study

Starting in 2006 with the passage of Senate Bill 1037 (Kehoe, Chapter 366, Statutes of 2005), the CPUC, in consultation with the CEC, has been required to identify all potentially achievable cost-effective energy efficiency savings and establish energy efficiency goals every other year for IOU electrical and gas corporations. These studies estimate all the potential energy savings available through different technologies, program measures, codes and standards, and, behavioral, retro commissioning, and operational measures and market transformation programs that the IOUs can use in their energy efficiency portfolios. Potential and goals studies typically identify energy efficiency savings based on technical, economic, and market potential. "Technical potential" is the amount of energy savings that would be possible if the highest level of efficiency for all technically applicable opportunities to improve energy efficiency were taken, including retrofit measures, replace-on-burnout measures, and new construction measures. "Economic potential" is the total energy efficiency potential available when limited to only cost-effective measures, as determined by the cost-effectiveness metrics. "Market potential" is a subset of economic potential that includes assumptions about stock turnover rates, participation, and incentives. The potential and goals study examines the

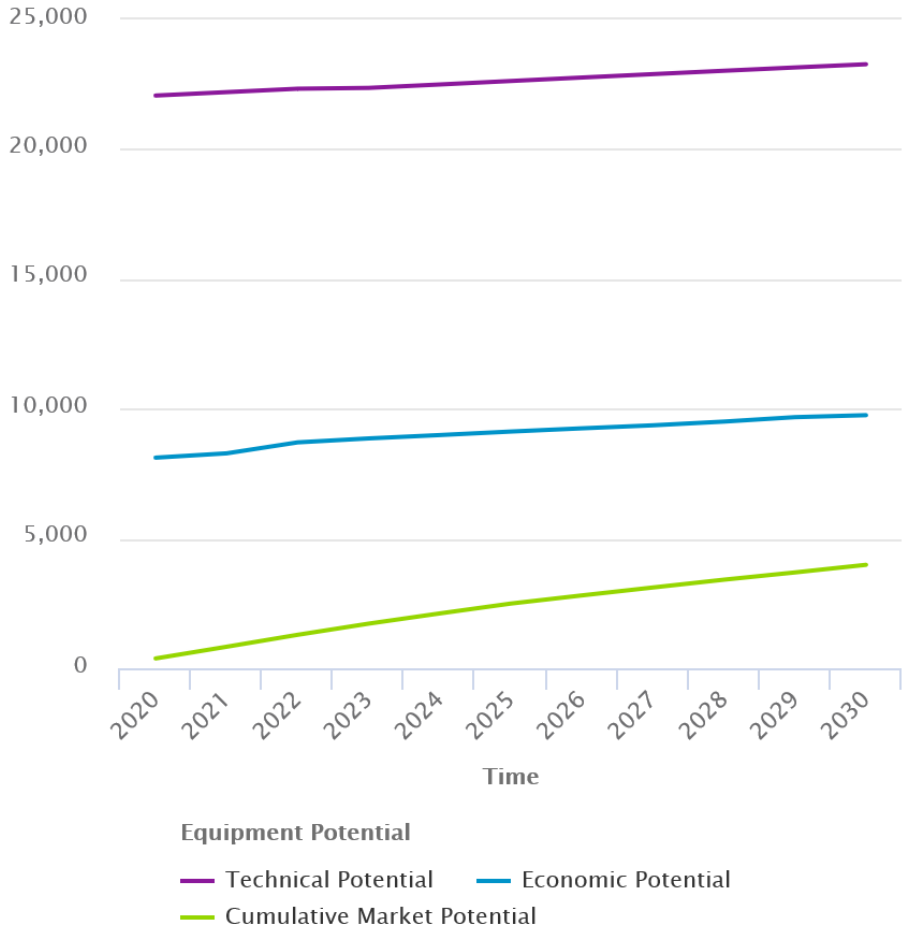
savings from street lighting, mining, and additional savings from low-income households, beyond the traditional sectors: residential, commercial, agriculture, and industry.[51]

2019 Energy Efficiency Potential and Goals

The 2019 Potential and Goals Study offers two market potentials: an incremental savings value and a cumulative savings value. The CPUC sets annual efficiency goals for the investor owned utilities based on the incremental market potential found by the study. The goals from the study are then used to update the SB 350 targets and the demand forecast. Upon adoption by the CPUC, the ratepayer program proposals must work to achieve the annual incremental goals. Figure 18 breaks down the differences among the technical, economic, and market potential for electricity savings. The market potential from the chosen savings scenario is broken up by sector and service territory (Figure 19). The savings from the reference scenario indicate that the most savings are expected to come from codes and standards for the next several years, followed closely by residential and commercial sector savings. Overall, the savings expected has dropped from the 2017 study due to the widespread adoption of LED lighting that removed the need for incentives, and an overall improving baseline for lighting measures.

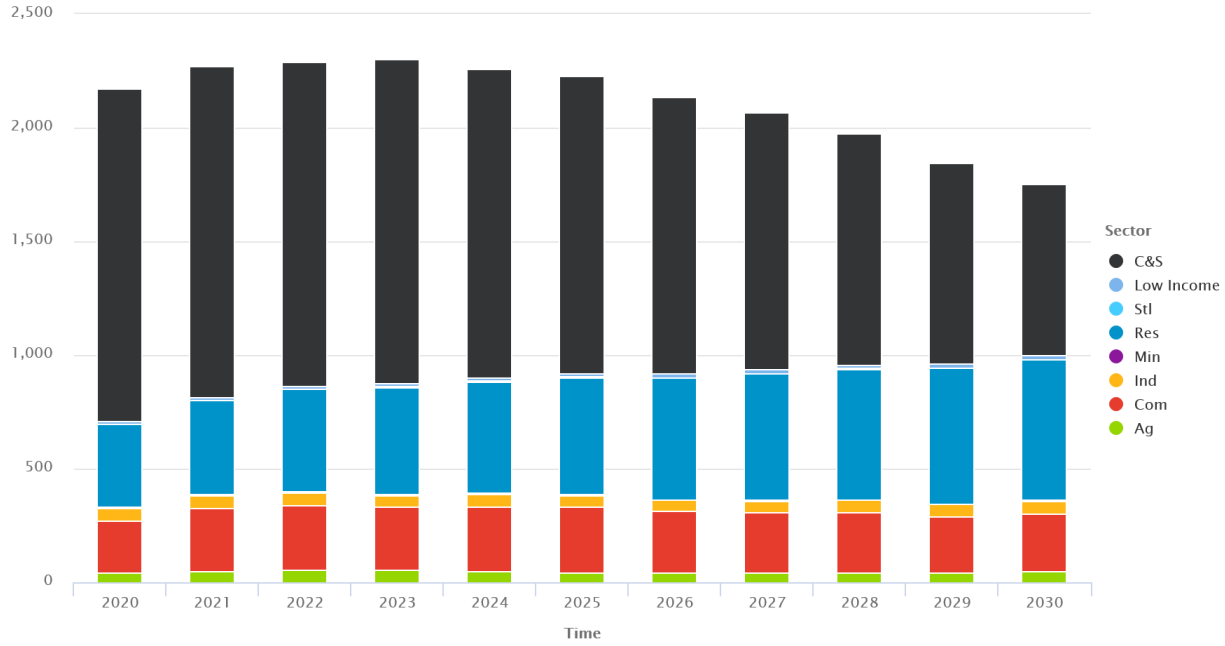
51 Added sectors are abbreviated Min (Mining); Stl (Street Lighting) by Navigant.

Figure 18: Electric Equipment Potential Savings (GWh)



Source: Navigant, 2019 Potential and Goals Study

Figure 19: Statewide Electric Savings Market Potential (MWh)



Source: Navigant, 2019 Potential and Goals Study

Community Choice Aggregators Energy Efficiency Programs

Community choice aggregators are local power purchasing entities created by local governments. These local governments could be any city, county, or combination thereof in California that is within an IOU territory. Community choice aggregators pool together a local government's electricity load to purchase or develop power projects on behalf of residents, businesses, and municipalities. As of May 2019, California has 19 active community choice aggregators, serving customer sizes ranging from just over 7,000 (Solana Energy Alliance) to 972,500 (Clean Power Alliance).[52]

The current operational model for community choice aggregators involves the community choice aggregator purchasing the electricity and using the IOU distribution infrastructure to deliver the energy and maintain the grid. IOUs still own and read the electric meter, send monthly bills, and provide the same maintenance and other repair services they always have. Advocates liken the community choice aggregator to an "energy democracy." That is, the local community choice aggregators can provide the choice of electricity resources its constituents support. The community choice aggregators can use the revenue generated by electricity sales to reinvest in the local community through programs and grants for EVs, energy efficiency retrofits, and rooftop solar.

52 CalCCA, https://cal-cca.org/about/

To date, two community choice aggregators run programs using ratepayer dollars collected and distributed by the CPUC. These are Marin Clean Energy (MCE), which operates a full suite of programs, and Lancaster Clean Energy, which is approved for the first time this year to pursue nonresource programs.[53] MCE programs saved nearly 3 GWh and 0.11 MM therms between 2016 and 2018, as reported to the CPUC.[54] In addition to these community choice aggregators filing as program administrators with the CPUC, others, such as Sonoma Clean Power, are able to offer programs independently. Independent CCA programs tend to focus more on GHG reductions and electrification than purely efficiency.

Advanced Energy Rebuild Program

A collaboration among Sonoma Clean Power (SCP), PG&E, and Bay Area Air Quality Management District (BAAQMD) was formed in 2017 in response to the October 2017 firestorms that devastated the region. The program combines funding and knowledge from the three sources to encourage homeowners to rebuild their homes energy efficiently and sustainably, including a pathway to rebuild as all-electric homes. Sixty-six homes enrolled in the program in the first year.

Sonoma Clean Power- Advanced Energy Rebuild
https://sonomacleanpower.org/programs/advanced-energy-rebuild

Community choice aggregation electrification programs encourage decarbonization in buildings. Community choice aggregator's coordination with the utilities managing their local grid will be necessary so electrification proceeds safely and without disrupting reliability.

In public workshops held to gather information for this action plan, stakeholders reported that a potential benefit of more community choice aggregator-run programs is the ability to fill gaps in areas that typical ratepayer programs cannot cover. Since the community choice aggregators can leverage modified cost tests, they are able to offer incentives for different retrofits.[55] However, stakeholders caution that the current EE market lacks clarity on who is responsible for the governance of and compliance with community choice aggregator programs. They stress that regulators need to make determinations on what are program and contract requirements for community choice aggregators, how community choice aggregators should partner with IOUs to

53 Non-resource program: an energy efficiency program that has no directly attributed energy saving but the programs supports the energy efficiency portfolio through activities such as marketing or improved access to training and education
54 California Energy Data and Reporting System, Monthly Reports, https://cedars.sound-data.com/monthly-reports/statewide-dashboard/
55 CCAs do not need to follow the total resource cost tests mandated by the CPUC as long as they run programs with internal funds.

achieve the state's goals, and how community choice aggregators will apply for energy efficiency funds with the CPUC.

Component 2: Beyond-ratepayer Programs and Policies

California state agencies, the federal government, local governments, and private industries all operate energy efficiency programs. The programs result in energy savings, reduced energy costs to consumers, efficiency market transformation, and improved living and working conditions. This section details those programs and discusses the related effects.

CEC Energy Efficiency Programs

CEC operates a multitude of programs. The following provides concise descriptions of CEC programs.

Proposition 39 Clean Energy Jobs Act

The CEC administers three components of the California Clean Energy Jobs Act: a grant program (Proposition 39 K-12 Program), a revolving loan program (Energy Conservation Assistance Act, ECAA—Education Subaccount Financing Program), and a technical assistance program (Bright Schools Program).

The Proposition 39 Program provides grant funds for energy projects—energy efficiency measures and clean energy generation—at schools within a local educational agency (LEA), which include public school districts, charter schools, county offices of education, and state special schools. LEAs submit energy expenditure plans (EEPs) to the CEC. Once the EEPs are approved by the CEC, the California Department of Education distributes funding to the LEAs from the Clean Energy Jobs Creation Fund.

Each approved EEP can represent multiple eligible energy measures—energy efficiency or clean energy generation measures—at multiple school sites within an LEA. Completed EEPs have resulted in the installation of thousands of energy efficiency and clean energy generation measures throughout the state. More than 50 percent of the approved measures are lighting-related; more than 20 percent fall into the category of lighting and HVAC control measures; 10 percent are HVAC; 8 percent are other efficiency measures that include plug loads, pumps, motors, building envelope, domestic hot water, and so forth; and 3 percent are attributed to photovoltaic (PV) generation.

As of July 2018, more than 23,000 energy measures have been identified by LEAs. These energy measures are expected to reduce annual electricity usage by 520 GWh and annual natural gas usage by 2 million therms. These reductions correspond to annual energy cost savings of $105 million.

Energy measures implemented through the Proposition 39 K-12 Grant Program may have a number of cobenefits, such as health, safety, enhanced comfort,

better indoor air quality, and improvements to the learning environment. A cobenefit credit was included in the "savings to investment" determination of all identified measures, however, specific cobenefits of measures were not identified as part of the Proposition 39 K-12 Grant Program.

The Proposition 39 K-12 Grant Program provides benefits to California's workforce by providing funding for energy projects that create local jobs. The CEC has not directly quantified the number of jobs created; however, the California Workforce Development Board (CWDB) did provide a report estimating direct, indirect, and induced jobs created through the Proposition 39 K-12 Grant Program. Based on this report, the CWDB estimates 18,571 total jobs created through 2017.

Senate Bill 110[56] created two additional grant programs from the Proposition 39 program for loans and technical assistance. The bill states that $75 million of the remaining Proposition 39 funds will be used to fund a clean school bus grant program, and up to $100 million in remaining Proposition 39 funds will be used to fund a competitive ECAA loan program. Anything left beyond those allocations would go to a revamped competitive Proposition 39 program. However, due to the higher participation in the Proposition 39 program than anticipated, only $117 million remained when the program closed. Therefore, the School Bus Replacement Program was fully funded, the ECAA-Ed Competitive Loan Program received roughly $42 million, and the Proposition 39 Competitive Grant Program was not funded.

SB 110 changed the prior ECAA-Ed Loan Program from first-come, first-served basis to a competitive basis. The interest rate will remain at zero percent, and the new program is structured to encourage greater participation by allocating funding based on region, size of school, and student eligibility for the free and reduced price meal program, further benefitting disadvantaged communities.

In comments to the CEC, the School Energy Coalition noted the SB 110 extension to the Proposition 39 program does not guarantee funding to K-14 grants. The School Energy Coalition also requested that the State continue to leverage the incoming funding stream to provide grant funding to K-14 school energy projects. The continuation of funds should coincide with an expanded goal to reduce GHG emissions from schools and to make them more resilient community centers and, perhaps, test beds for microgrids.

Energy Conservation Assistance Act

The ECAA Financing Program was established in 1979 and designed to reduce energy use and cost throughout California. All funded projects must demonstrate energy savings. The CEC provides ECAA loans to local

56 Budget and Fiscal Review, Chapter 55, Statutes of 2017.

governments and public education institutions to fund energy efficiency and renewable energy projects. Typical measures are upgraded lighting systems, pumps and motors, streetlights, energy management systems and equipment controls, building insulation, energy generation including renewable and combined heat and power projects, HVAC, water and wastewater treatment equipment, and load-shifting projects such as thermal energy storage.

Table 7: Historical ECAA Energy Savings Data From March 1, 2000 to December 31, 2017

Total Number of Approved Loans:	332
Total Approved Loan Amount:	$349,497,866
Total Annual Energy Cost Savings:	$38,659,086
Total Annual Electric Savings (kWh):	362,311,130
Total Annual Demand Savings (kW):	44,249
Total Annual CO_2 reductions (tons):	126,466

Source: CEC, https://www.energy.ca.gov/efficiency/financing/calmap/county/counties/energy_savings_data.pdf.

The ECAA statute requires that the costs of the project be recovered through energy cost savings during the loan repayment period. The ECAA statute also requires that the repayment period not exceed the useful life of the equipment and that repayment not exceed 20 years. Loans are funded from ECAA appropriations or bond proceeds from tax-exempt revenue bonds. The loan interest rates are 1 percent for local governments and zero percent for public educational institutions.

The ECAA funding available for public education institutions is now competitive. CEC staff designed the program and published the program opportunity notice at the beginning of 2019.[57] Up to $36 million is available in the funding cycle for energy projects. ECAA funding for local governments will remain on a first-come, first-served basis.

Table 8: Historical ECAA Loans From 1979 to 2017

Summary by Recipient Type	Total Number of Loans Awarded	Total Loan Amount Awarded
Local Government Loans	343	$234,683,139
K-12 School Loans	359	$99,580,928
College Loans	78	$38,798,900
Special District Loans	19	$15,706,078

57 ECAA Loan, Program Opportunity Notice, February 2019, https://www.energy.ca.gov/solicitations/2019-02/pon-18-101-energy-conservation-assistance-act-education-subaccount-ecaa-ed.

Public Care & Hospital Loans	63	$25,341,483
Grand Total:	**862**	**$414,110,528**

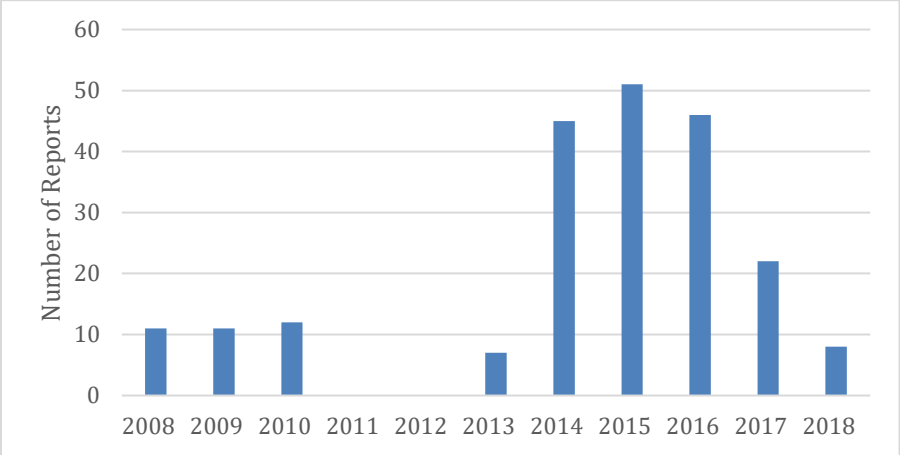
Source: CEC, https://www.energy.ca.gov/efficiency/financing/calmap/county/

Bright Schools and Energy Partnership Program

The Bright Schools Program (BSP), under the ECAA financing programs established in 1979, provides public K-12 schools assistance in identifying energy-saving opportunities in existing and planned facilities. The program started in 1988 and has historically provided a wide range of technical assistance services, including energy audits, third-party proposal reviews, and professional engineering support services. The Energy Partnership Program (EPP) provides the same type of assistance that the BSP provides, only to local governments (cities/counties), special districts, public colleges, and public hospitals/care centers.

The majority of effort is providing technical assistance in the form of American Society of Heating, Refrigeration, and Air-conditioning Engineers (ASHRAE) Level 2 energy audits, with the objective to identify all energy efficiency measures appropriate for buildings in concert with detailed financial analysis to justify project implementation, to lead to reduced energy use. Energy audit reports with recommendations of lighting and HVAC retrofits are expected to improve lighting quality, indoor air quality, and occupant comfort. Energy reductions will save customers energy operating costs. Figure 20 below shows the number of final reports the BSP produced since 2008.

Figure 20: Bright Schools Program Final Reports From 2008-2018



Source: CEC

The American Recovery and Reinvestment Act

The American Recovery and Reinvestment Act of 2009 (ARRA) awarded California nearly $5 billion to foster energy efficiency, modernize the electric transmission grid, and increase the use of alternative transportation fuels and vehicles. The CEC was awarded $226.1 million in stimulus funds to administer the

State Energy Program (SEP). The CEC invested the funds in innovative market transformation pilot programs, including promoting the "whole-building" approach to energy efficiency upgrades for existing buildings. These funds were offered through competitive solicitations to local jurisdictions and other organizations to preserve and create jobs, increase energy efficiency, and reduce reliance on imported energy. Although closed on April 30, 2012, the SEP benefits of the pilot programs will be realized for decades to come. The CEC continues to oversee four revolving loan funds (RLF): Energy Efficient State Property Revolving Fund Loan Program (discussed in the DGS section), Moderate Income Sustainable Technology (MIST) Program, Los Angeles County Public Building Revolving Loan Fund, and SoCalREN Public Building Revolving Loan Fund. The MIST program, sponsored by the California Homebuyers Fund, was designed to implement a comprehensive whole-house energy efficiency retrofits program for low-to-moderate-income single-family homes. The MIST program has exceeded expectations by providing financial assistance to more than 1,050 homeowners making energy-efficient home improvements. The average size of these loans was $25,531 with a program size totaling $25,585,350. The retrofits resulted with average cost savings per home of 34 percent, with the program savings totaling 100 MM Btus. All interest reflows to the CEC, per legislative authority, have been used to fund additional programs such as the Local Government Challenge.

The CEC awarded Los Angeles County $11 million to support existing energy efficiency retrofit financing programs and to create a new benchmarking program. Los Angeles County is using the ARRA funds to operate and support the following programs.

Los Angeles County Public Building Revolving Loan Fund— The Public Building Revolving loan fund uses $5.3 million to fund audits and energy efficiency retrofits for county municipal buildings. Since the creation of the fund, it has been used for 35 audits and 27 building retrofits. About $1.3 million dollars was shifted from this RLF to fund the new SoCalREN RLF.

SoCalREN Public Building Revolving Loan Fund— The SoCalREN RLF is a new program for 2019 with anticipated loan sizes on the average of $350,000 to $400,000. The anticipated payback time frame will be 18-24 months. These bridge loans will be used by SoCalREN territory public agencies to fund energy efficiency retrofits in their building stock.

Santa Barbara County Benchmarking— Santa Barbara County is directing $828,000 dollars of ARRA funds to implement a voluntary auditing, benchmarking, and technical assistance program for commercial property owners in all sectors. Activities will include analyzing commercial building stock, conducting benchmarking and auditing, and providing technical assistance and support.

Los Angeles County Benchmarking— The Los Angeles County Benchmarking program will administer $1 million to develop tools and analyze buildings that are owned and operated by public agencies within Los Angeles County. By the end of 2020, county officials anticipate directly offering these services to 120 public agencies.

Local Government Challenge

The Local Government Challenge (LGC) program, funded by ARRA interest payments, aims to increase building efficiency and provide opportunities to small local governments, as well as disadvantaged communities in California. The LGC is helping spawn innovative, practical solutions for these communities. In 2017, nearly $10.2 million in ARRA grant funds were awarded by the CEC to 13 local governments under the Energy Innovation Challenge, and the Small Government Leadership Challenge. The Energy Innovation Challenge committed $6.7 million to four local government agencies. These grants are providing opportunities to focus on innovative energy efficiency deployment that would not happen otherwise. The Small Government Leadership Challenge committed $3.5 million of grant funding to nine local governments with populations of fewer than 150,000 people. The focus of these small grants is on helping local governments develop climate action plans, conduct energy efficiency planning, and perform building retrofits.

Building Energy Efficiency Standards

The CEC's Building Energy Efficiency Standards (BEES) set energy and water design standards for residential and nonresidential buildings. The BEES include cost-effective energy efficiency requirements for newly constructed buildings, additions to existing buildings, and alterations to existing buildings. These standards are part of the California Building Codes, which are updated triennially.

2019 Building Energy Efficiency Standards— Effective on January 1, 2020, the 2019 BEES:

- Improve envelope efficiency, which refers to improving the insulation windows, exterior walls, floors, and roof of a building.
- Create all-electric pathways for new homes.
- Require appropriately sized solar photovoltaics on new homes.
- Promote grid harmonization strategies that maximize self-utilization of photovoltaic output and limit exports to the grid.

It is projected that these new standards will reduce 700,000 tons of CO_2 emissions over three years, which is equivalent to taking 115,000 gas cars off the road.

2022 Building Energy Efficiency Standards and Beyond— Looking forward to 2022, in addition to addressing building efficiency, the BEES will look to simplifying the code and adding flexibility for building decarbonization. Future BEES aim to use an improved GHG-based metric to properly value the avoidance of GHG emissions in buildings. The CEC will also look to move away from equal hourly netting to support grid flexibility. This recognizes that not all hours of the day are equal on the electrical grid, and saving energy during certain peak times is more valuable than at other times when renewable generation sources are ample. Zero-net-energy homes or buildings may not interact with the grid in the most beneficial ways if the accounting ignores when energy is generated and consumed on site. The next BEES cycle will also consider improving efficiency in nonresidential and multifamily buildings, for example, by improving envelope, indoor air quality, mechanical systems, and lighting. These building types have not been the primary focus of previous iterations of the BEES but contribute to a substantial portion of the energy used in buildings.

Numerous suggestions were made by stakeholders during staff workshops about changes to BEES. The CEC in the 2016 code cycle updated forms to be dynamic and easily accessible and streamlined forms to reduce the number of forms required. Another area of suggested improvement from stakeholders is a request for additional guidance on performance path compliance. This matter is especially important in regions with fewer resources or staff to assist builders or homeowners. The Natural Resources Defense Council (NRDC) suggests the CEC investigate the role of mandatory standards in existing buildings as part of a full market transformation strategy to help achieve California's climate and clear air goals.

Standards Compliance

Acceptance Test Technician Certification Program— "Acceptance testing" is the process by which a field technician verifies the installation and operation of newly installed equipment or construction elements of a nonresidential building. Since 2005, the BEES have required acceptance testing for nonresidential buildings. Acceptance testing ensures that installed equipment, controls, and systems in nonresidential buildings operate as required by the BEES, and that the building owner and occupants receive the desired energy efficiency benefits. Acceptance testing is required for a wide range of installations, including envelope, lighting controls, mechanical systems, and covered processes (that is, escalators, elevators, refrigerated warehouses, and so forth).

Home Energy Rating System Program— The Home Energy Rating System (HERS) program verifies the installation and operation of certain appliances and construction elements in homes. HERS Raters ensure that installed appliances, controls, and systems in homes operate as required by the BEES so that homeowners receive the intended energy efficiency benefits. HERS Raters are

certified by HERS Providers, who are approved triennially by the CEC to train, certify, and oversee HERS Raters and document compliance with the BEES.

SB 1414— The CEC is developing a plan to improve BEES compliance for air-conditioner and heat-pump installations in homes. The plan will highlight the various compliance issues and effect on energy efficiency and make recommendations to resolve those compliance issues. The CEC hosted several stakeholder workshops to obtain input on potential recommendations for improving air-conditioner and heat-pump energy efficiency compliance. Parties suggest the CEC explore an HVAC tracking system to improve compliance. Another party suggested that prior to sale, major unpermitted building retrofits be brought up to code or be required to obtain a permit. Providing forms online and in multiple languages would also lead to better compliance rates.

Ongoing Compliance Concerns— BayREN has found within its territory that only 16 percent of permits are error-free, and more than half of reviewed projects had errors that would result in worse energy performance than expected. BayREN found that installed measures were often less efficient than the documented measures, and designs were often changed during construction without updating the energy efficiency portion of the design to match. To make matters worse, building departments have noted that soon most of their officials will retire, and departments lack knowledgeable staff to replace them or acquire their institutional knowledge. Several parties noted that the frequency of changes to the residential and nonresidential code, and the lack of enforcement capabilities, leads to lower compliance.

Title 20: Appliance Efficiency Regulations

Another major responsibility of the CEC is to adopt and enforce appliance efficiency standards to reduce the wasteful, uneconomic, inefficient, or unnecessary consumption of energy or water (Public Resources Code Section 25402). The appliance standards set minimum efficiency levels for energy and water consumption in many types of products, including consumer electronics, such as computers, televisions, and monitors; household appliances, such as refrigerators and clothes washers; and plumbing equipment, such as showerheads, toilets, and kitchen and lavatory faucets. The goal of these standards is to shift the marketplace toward more efficient products, providing significant, cost-effective energy savings to California consumers without affecting the usefulness or functionality of the products. Many standards have been adopted by the U.S. Department of Energy (DOE) for national standards and by other states looking to follow California's path.

Recent regulations apply to computers, monitors, signage displays, small-diameter directional lamps, general purpose LEDs, portable electric spas, portable air conditioners, and compressors. The changes to computers and monitors and to LEDs are expected to save 2,332 GWh per year and 3,794 GWh

per year, respectively. These small changes to residential and commercial loads collectively result in massive bill savings, lower GHG emissions, and less strain on the electricity grid.

Many appliances are now covered under federal efficiency standards that apply nationwide. One of the most significant regulations applies to general purpose light bulbs, requiring these light bulbs to be LEDs beginning in 2020. However, the U.S. Department of Energy is considering repealing the types of light bulbs subject to the efficiency standards, which could cost Californians between $736 million and $2.4 billion.[58] As a result, the CEC is taking action to backstop the standards to ensure that these savings still accrue to California.

Meanwhile, the CEC continues to evaluate improvements in the energy and water efficiency of nonfederally regulated appliances, such as sprinklers, commercial-size fans, gas fireplaces, and certain types of linear tube lights.

Food Production Investment Program

The Food Production Investment Program (FPIP) was established by Assembly Bill 109 (Ting, Chapter 249, Statutes of 2017). FPIP provides grants to food processing plants installing energy technologies that reduce GHG emissions. Funding is provided through California's Cap-and-Trade Program and administered through California Climate Investments.[59] Current program funding is about $124 million.

The program goals are to accelerate adoption of advanced energy efficiency and renewable energy technologies at food processing plants. The technologies are required to show promise to demonstrate reliability and effectiveness and help food processors work toward a low-carbon future. The funded technologies will support energy cost reductions. All FPIP projects must also reduce GHG emissions.

Whole-Building Energy Use Data Access, Benchmarking, and Public Disclosure

In October 2017, the CEC approved regulations implementing the whole-building energy use data access, benchmarking, and public disclosure provisions of Public Resources Code Section 25402.10. The regulations require the owners of commercial buildings larger than 50,000 square feet to report building characteristics, energy use data, and building usage information to the CEC by June 1, annually, beginning in 2018. The regulations require the owners of residential buildings larger than 50,000 square feet to do the same beginning in 2019. The regulations state that the CEC will make building-level information

58 Saxton, Patrick. 2018. Analysis of General Service Lamps (Expanded Scope). California Energy Commission. Publication Number: CEC-400-2018-015-SD.

59 California Climate Investments is a statewide initiative that administers cap-and-trade funding though programs administered by various state agencies. For more information, visit http://www.caclimateinvestments.ca.gov/.

publicly available beginning in 2019 for commercial buildings and in 2020 for residential buildings.

In 2018, the CEC received reports for roughly 10,800 commercial buildings, including about 3,300 buildings in jurisdictions with their own benchmarking and public disclosure programs. In 2019, as of August 2, 2019, the CEC received about 8,400 commercial and 3,045 multifamily building reports. The submissions for 2019 are not final, CEC will continue to evaluate submissions.

In late 2019, the CEC's public disclosure website will launch. The website will include energy performance information for reported buildings and provide resources for owners to learn more about potential building improvements, as well as options for financing those improvements.

Property-Level Data Access— AB 802 was limited in that it did not provide energy use data to the owner of a property containing multiple buildings with fewer than five utility accounts each, regardless of the number of such buildings on the property. (A notable example of this is a complex of residential four-unit buildings.) In September 2018, the Legislature passed Senate Bill 782 (Skinner, Chapter 684, Statutes of 2018) to address this. Effective January 1, 2019, utilities were required to begin providing combined data for multiple buildings containing, collectively, five or more utility accounts upon the request of the property owner. Senate Bill 782 also gives the CEC the authority to amend its regulations accordingly.

Other California State Agency Programs

This section discusses programs operated by other California state agencies.

Department of General Services

DGS operates the Energy Efficient State Property Revolving Fund. The fund provides loans to state agencies to fund energy efficiency projects at their buildings. Original funding for the program came from ARRA in 2009 through the CEC. The revolving fund was created by and operates under the terms of Public Resources Code Chapter 5.7 Section 25472. Under the terms of program, projects that receive funding must use them for projects that "will improve long-term energy efficiency and increase energy use savings." In addition, loan-funded projects must generate enough energy cost savings to repay the loan amount within the life of the energy-saving equipment. Reduced electricity and natural gas use results in reduced GHG emissions.

From 2014 to 2018, DGS loaned more than $88 million to upgrade state agency buildings. There are several more applications awaiting loans. Altogether, these completed and proposed projects will result in electricity reductions of more than 70 GWh per year and 370,000 therms per year. These reductions will save the state nearly $10 million dollars on energy costs annually.

California Air Resources Board

CARB operates an enforceable California Cap-and-Trade Program that meets the requirements of Assembly Bill 32 (Núñez, Chapter 488, Statutes of 2006). Proceeds from the Cap-and-Trade Program support a wide range of programs called California Climate Investments. The programs aim to reduce GHG emissions and deliver major economic, environmental, and public health benefits for Californians, including meaningful benefits to the most disadvantaged communities, low-income communities, and low-income households.

Funds received from the Cap-and-Trade Program are deposited into the Greenhouse Gas Reduction Fund (GGRF) and appropriated by the California Legislature. The GGRF funds many important programs, and initiatives that are split into three categories: transportation and sustainable communities, natural resources and waste diversion, and clean energy and energy efficiency. For the clean energy and energy efficiency initiatives, the programs are administered by several state agencies, including the CEC.

The programs that directly support the goals laid out in the action plan include the Woodsmoke Reduction Program and the Funding Agricultural Replacement Measures for Emission Reductions (FARMER) Program, both administered by CARB; the Low-Income Weatherization Program (LIWP) administered by the California Department of Community Services and Development; the Water-Energy Grant administered by the Department of Water Resources; the State Water Efficiency Enhancement Program administered by the California Department of Food and Agriculture; and the Food Production Investment Program, administered by the CEC. These programs help fill the gap in meeting SB 350 doubling targets, improving conditions in low-income or disadvantaged communities, and decarbonizing buildings.

Through the FARMER program, funding is available to the agricultural community for upgrading agricultural pump engines. The FARMER program may reduce electricity (depending on how the funding is used); however, it would reduce total energy consumption and help with the state's objective of decarbonizing. Funding eligibility is detailed in the Carl Moyer Program Guidelines, 2017 Revisions, Chapter 5, Off-Road Equipment.[60] Similarly, the Woodsmoke Reduction Program does not reduce electricity and natural gas use; it reduces total energy consumption and helps with the State's objective of decarbonizing buildings. Senate Bill 563 (Lara, Chapter 671, Statutes of 2017) established the Woodsmoke Reduction Program to promote the voluntary replacement of old wood-burning stoves with cleaner and more efficient alternatives. The

60 *The Carl Moyer Program Guidelines; 2017 Revisions*; Chapter 5, Off-Road Equipment https://www.arb.ca.gov/msprog/moyer/guidelines/2017gl/2017_gl_chapter_5.pdf.

Legislature committed $5 million in the 2016-2017 budget and $3 million in the 2018-2019 budget. The Woodsmoke Reduction Program is being implemented by the California Air Pollution Control Officers Association (CAPCOA) in coordination with local air pollution control districts or air quality management districts (air districts). CAPCOA determines how much funding is available to each district participating in the Woodsmoke Reduction Program.

Department of Water Resources

The Department of Water Resources (DWR) receives funding from the GGRF to run the Water-Energy Grant Program. As of February 2019, the program has received $50 million to perform water and energy efficiency upgrades. It is open to applicants from the residential and nonresidential sectors. Grants are used to finance upgrades that improve water efficiency, reduce GHG emissions, and reduce energy use. Energy savings are captured primarily by installing measures to reduce hot water use, resulting in water and energy reduction.[61] Examples include replacing high-water use fixtures with WaterSense-approved fixtures,[62] installing low-flow irrigation units, directly installing efficient clothes washers and dryers in disadvantaged communities, and providing additional rebates for energy-efficient dishwashers.

California Department of Food and Agriculture

The State Water Efficiency and Enhancement Program (SWEEP)[63] is administered by California Department of Food and Agriculture (CDFA) and provides financial assistance in the form of grants to implement irrigation systems that reduce GHGs and save water on California agricultural operations. As of February 2018, the program has received more than $66 million to implement measures. Eligible system components include soil moisture monitoring, drip systems, switching to low-pressure irrigation systems, pump retrofits, variable-frequency drives, and installation of renewable energy to reduce on-farm water use and energy. A second program, SWEEP—DWR (Prop. 1), is a joint project that CDFA administers with the DWR. Through this competitive grant program, CDFA and DWR intend to demonstrate the potential benefits of conveyance enhancements combined with on-farm agricultural water use efficiency improvements and GHG reductions.[64]

California Department of Community Services and Development

The LIWP is a statewide program administered by the California Department of Community Services and Development (CSD) that promotes the use of energy-

61 California Climate Investments Using Cap-and-Trade Auction Proceeds, Annual Report 2017. pp. 82.
62 WaterSense fixtures are water efficiency products that meet the U.S. EPAs criteria for efficiency and performance, https://www.epa.gov/watersense/about-watersense
63 "State Water Efficiency an Enhancement Program." California Department of Food and Agriculture, https://www.cdfa.ca.gov/oefi/sweep/.
64 "Agriculture Water Use Efficiency California Department and Food and Agriculture and Department of Water Resources." https://water.ca.gov/Work-With-Us/Grants-And-Loans/Agriculture-Water-Use-Efficiency-CDFA-DWR.

efficient upgrades (for example, building envelope improvements, lighting upgrades, more efficient appliances, and HVAC improvements) to reduce energy demand in low-income housing. Along with energy upgrades, LIWP also promotes the installation of PV to offset the remaining energy consumption.

The LIWP provided no-cost funding for the installation of energy efficiency measures and solar PV for low-income single-family homes that were within disadvantaged communities. This portion of the LIWP ended in March 2019. From 2015 to 2019, the program affected more than 11,000 single- and multifamily dwellings.[65] In lieu of the residential program, a new LIWP component is the Farmworker Housing, which will target low-income single-family and low-income multifamily farmworker housing. This component will focus on the installation of energy efficiency measures and PV in the 12 counties that have the highest concentration of farmworker housing. Another portion of the LIWP provides incentives and technical assistance for energy efficiency measures and PV for low-income multifamily buildings that are in disadvantaged communities.

The intent of this program is to improve energy equity by using cap-and-trade funds to help low-income and disadvantaged communities perform energy-efficient upgrades for owners who would not have been able to afford them on their own. The non-energy benefits associated with reducing energy consumption is a reduced energy bill for the recipient, lower operating costs for multifamily building owners, reduced GHG emissions, reduced air pollution where the conventional power was produced, improved indoor air quality and comfort, and improved energy equity in disadvantaged communities. This type of direct-installation program has proven very successful in low-income communities, rural areas, and hard-to-reach customers.

California Department of Housing and Community Development

The Affordable Housing and Sustainable Communities Program (AHSC) is administered by the Strategic Growth Council and implemented by the California Department of Housing and Community Development (HCD). AHSC is a California Climate Investments program that integrates affordable homes and sustainable transportation.[66]

AHSC works to increase the supply of affordable places to live near jobs, stores, transit, and other daily needs. AHSC funds the building of affordable housing and transportation options that encourage residents to walk, bike, and use public transportation. Through the AHSC program, $440 million has been invested across the state, providing more than 6,050 affordable homes to

65 Community Services and Development. Low Income Weatherization Year End Reports, 2017, 2018

66 California Climate Investments is a statewide initiative that puts billions of cap-and-trade dollars to work reducing greenhouse gas emissions, strengthening the economy, and improving public health and the environment, particularly in low-income and disadvantaged communities.

families in need and covering 60 sustainable projects that will reduce 1.58 million tons of GHGs over the operating lives. Historically, most AHSC applicants have been developers of affordable and mixed-income housing, local governments, regional transportation agencies, and public transit providers. Other eligible applicants include K-12 school, college, and university districts and federally recognized indigenous tribes. Green buildings and renewable energy are included as elements of an application that score the most points.

HCD also plays a role in building standards. HCD protects the health and safety of Californians by enforcing standards for housing construction, maintenance of farmworker housing, and manufactured homes. HCD also proposes amendments to California's residential building standards for new construction to the California Building Standards Commission and creates specialized standards for CALGreen, the nation's first mandated green-building code. HCD also adopts amendments to the CALGreen code to improve building water efficiency.

California Department of Public Health

The California Department of Public Health[67] (CDPH) protects and improves the health of all Californians and helps shape positive health outcomes for individuals, families, and communities. As an example, CDPH supported a pilot project in Contra Costa County to document the collaborative partnership between the county's home visitation nurse/health program and disseminating information about and providing referrals to LIWP and Low Income Home Energy Assistance Program (LIHEAP) services for eligible households. From this pilot, a weatherization and energy efficiency pilot project guidance document was developed, *Energy Efficiency and Health: A Guide for Public Health and Health Care Professionals on Connecting Vulnerable Residents With Energy Efficiency Services.*[68]

Housing conditions play a significant role in health. Health care professionals can help residents and communities have healthier housing by connecting them with free weatherization and energy efficiency programs. The guidance document addresses why health professional should connect residents with energy efficiency programs and how to make that connection. This strategy is included in the CLIMB Action Plan. CDPH was a partner agency to the CEC and

67 California Department of Public Health, https://www.cdph.ca.gov/
68 Energy Efficiency and Health: A Guide for Public Health and Health Care Professionals on Connecting Vulnerable Residents with Energy Efficiency Services. 2018 http://www.rampasthma.org/D:Web%20Siteswww.rampasthma.orgwp-contentuploads/2018/12/Energy-Efficiency-and-Health-Guide-for-Public-Health-and-Health-Care-Professionals.pdf.

other state agencies on developing the CLIMB Action Plan. There is great value in its continued involvement as a partner in the implementation of the plan.

California Building Resilience Against Climate Effects— The California Building Resilience Against Climate Effects[69] (CalBRACE) project aims to enhance CDPH's capability to plan for and reduce health risks associated with climate change. The program provides resources and technical assistance for the state and local public health departments to build climate adaptation capacity and enhance resilience at the local and regional levels. The CalBRACE project focuses on preparing for three of the major climate impacts facing California: increasing temperature/extreme heat, wildfires, and sea-level rise, including flooding. As temperatures rise and more communities experience extreme heat, building insulation and energy efficiency will become increasingly important in saving energy and reducing GHG emissions. Additional climate action strategies include reducing building energy use through weatherization, cool roofs/green roofs, and water conservation. Reducing building energy use will reduce energy costs, promote healthy living environments, promote cooler communities, create local green jobs, and improve climate resilience.

California Strategic Growth Council

In addition to administering the Affordable Housing and Sustainable Communities Program, the Strategic Growth Council funds the Transformative Climate Communities (TCC) program.[70] The TCC awards funds to community-led development and infrastructure projects that achieve environmental, health, and economic benefits for disadvantaged communities. The TCC program used GGRF funds for two different solicitations. The first round resulted in $132 million awarded to three locations: City of Fresno, Watts, and City of Ontario.[71] The second round of funding awarded $46 million between the City of Sacramento and the Pacoima neighborhood in Los Angeles.[72] Examples of projects are affordable and sustainable housing developments, bicycle and car share programs, urban greening, and residential weatherization.

California Alternative Energy and Advanced Transportation Financing Authority

The California Alternative Energy and Advanced Transportation Financing Authority (CAEATFA) is part of the California State Treasurer's Office. It is designed to advance the state's goals of reducing GHG emissions, increasing sustainable and renewable energy sources, implementing energy efficiency measures, creating green sector jobs, and reducing California's dependence

69 "CalBRACE." California Department of Public Health, https://www.cdph.ca.gov/Programs/OHE/Pages/CalBRACE.aspx#.
70 "Transformative Climate Communities." Strategic Growth Council, http://www.sgc.ca.gov/programs/tcc/
71 "Transformative Climate Communities, Previous Awardees." Strategic Growth Council, http://www.sgc.ca.gov/programs/tcc/resources/previous-awardees.html.
72 "Transformative Climate Communities, 2018 Awardees." Strategic Growth Council, http://www.sgc.ca.gov/programs/tcc/resources/2018-awardees.html.

on fossil fuels. CAEATFA accomplishes these goals by bringing together public funds and private capital investments to spur increased market transformation.

California Hub for Energy Efficiency Financing — CAEATFA serves as the manager of the California Hub for Energy Efficiency Financing (CHEEF), in collaboration with the CPUC and the IOUs. The program develops financing pilots that bring together private lending and investments with ratepayer dollars. These pilots can take the form of loan loss reserves, debt service reserve funds, on-bill financing, and more. It gives customers access to lower-cost financing products while offering lenders less risk. The CPUC evaluates the proposed pilots to determine whether they are scalable, have leveraged private capital to install energy efficiency upgrades, improved conditions for underserved Californians, and resulted in measurable energy savings. The current budget for the various pilots totals $65.9 million. This budget is shared among approved pilot programs: Residential Energy Efficiency Loan Assistance (REEL), Small Business Energy Efficiency Finance (SBF), Affordable Multifamily Program (AMF), and nonresidential. GoGreen Financing is the public-facing website for these pilot programs.[73]

REEL offers loans to owners and renters of existing residential properties who select from a large list of energy efficiency measures to implement on their property. The property owner or renter must receive electricity or gas service from an IOU. The lenders receive a credit-enhancement of 11 percent of the claimed eligible amount, or 20 percent if the applicant is considered underserved. The credit-enhancement leads to better financing terms for the loan recipient resulting in increased maximum loan amounts and longer repayment terms, which mean deeper retrofits are possible. At the end of 2018, REEL had seven participating lenders and more than 290 contractors.[74] Since the launch, REEL financed more than $5.8 million in energy efficiency measures, primarily for air conditioning, duct work, windows, and insulation. More than half of the home improvements occurred in low- to moderate-income census tracts.

The SBF program has goals for small businesses. It aims to remove barriers for small business to receive loans, especially loans with better terms than would otherwise be available without the credit enhancement, and permit deeper retrofits in spaces that would likely never receive them. The program also permits repayment through the utility bill. CAEATFA enrolled the first lenders and retrofit contractors into the program in Q1 2019 and is beginning to enroll participants. Concurrently, CAEATFA staff is working with its vendors to develop a user interface to expedite transactions in the broader rollout of the program.

73 GoGreen, www.gogreenfinancing.com.
74 California Alternative Energy and Advanced Transportation Financing Authority 2018 Annual Report. March 2019, https://www.treasurer.ca.gov/CAEATFA/annual/2018.pdf.

The AMF is designed to match the SBF program in many ways. A key efficiency of the AMF program design is integration with existing AMF programs across the state, specifically the LIWP administered by CSD and the Solar On Multifamily Affordable Homes program, administered by CPUC, via a competitively selected team of nonprofit organizations. Similarly, the AMF program will fund any energy efficiency or demand response measure approved for rebate and incentive by any IOU, REN, or community choice aggregator, as well as any measure from the energy savings measures list. There is no minimum or maximum loan size, although only the first $1 million of the loan is credit-enhanced. To be eligible, the multifamily property must have five or more units with at least 50 percent of the units being income-restricted to 80 percent of the area median income.

The nonresidential program is designed for entities that do not qualify as small business, both for-profit and nonprofit, and for public entities. The program, currently in development, will not offer a credit enhancement; instead repayment will come through the utility bill. The current timetable for program development is uncertain, as resources are flowing to the SBF and AMF programs.

Property Assessed Clean Energy Loan Loss Reserve— The PACE Loan Loss Reserve Program was authorized in 2013 to address the concerns raised by the mortgage industry over residential single-family PACE financings.[75] Senate Bill 96 (Committee on Budget and Fiscal Review, Chapter 356, Statutes of 2013) allocated $10 million to CAEATFA to set up a loan loss reserve. This reserve would cover the first mortgage holder on a property should PACE payments be required while the lender is in possession of a property. The reserve would also cover any losses to the lender up to the amount of the outstanding PACE assessment in a forced sale for unpaid taxes or special assessments. PACE administrators may participate in the program by applying to CAEATFA and demonstrating that they meet the minimum underwriting criteria of the program as established in statute and regulation.

To date, the loan loss reserve covers 156,375 PACE loans, with a total principal value of more than $3.6 billion. Semiannual activity reports indicate a dramatic reduction in enrollment since mid-2016. To date, no claim has been made on the reserve. CAEATFA is analyzing the potential long-term liability and longevity of the reserve based on loan activity. CAEATFA staff initially estimated that the $10 million reserve would last 8 to 12 years. In 2018, CAEATFA staff elected a firm and began performing a risk analysis of the $10 million loss reserve to help inform future efforts.

75 Broader description of PACE financing is on page 91.

Clean Energy Bond Financing— CAEATFA acts as California's primary alternative energy bond issuer and has issued more than $212 million in bond financing since the 1980s. The program has slowed in recent history, with only two outstanding bonds on the books for 2018.

Local and Tribal Government Energy Efficiency Programs

This section describes energy efficiency program operated by local governments, Native American tribes, and other special districts.

Tribal Governments

Native American tribes face numerous barriers to energy efficiency program participation, including local knowledge, cost-effectiveness, program qualification, and distance from program administrators (PAs). The CEC has a tribal consultation policy that encourages cooperation with California Native American tribes and staff dedicated to working with tribes.[76] California Native American tribes provide input on the development of regulations, rules, policies, plans, and activities that may affect them. The CEC is developing funding and assistance resources for California Native American tribes. In recent workshops, the CEC outlined a two-year plan to provide grant money for tribal energy projects and perform a statewide gap analysis to better understand the barriers and opportunities within tribal governments.[77]

Tribal Government Challenge - [Placeholder heading until program details released]

Air Quality Management and Air Pollution Control Districts

California law has established 35 local air pollution control districts (APCD) or air quality management districts (AQMD) in the state.[78] These range from small, single-county districts such as Lassen to multicounty agencies such as the South Coast Air Quality Management District (SCAQMD), Bay Area Air Quality Management Districts (BAAQMD), and San Joaquin Valley Air Pollution Control District (SJVAPCD). Districts provide local expertise and knowledge of local conditions to deal with local problems. The three largest districts—the SCAQMD, and BAAQMD, and the SJVAPCD—have initiated or submitted plans to reduce energy consumption, thereby also reducing GHG emissions.

Bay Area Air Quality Mitigation District— In June 2018, BAAQMD approved spending $4.5 million to fund projects at 15 regional public agencies to reduce GHG emissions from existing buildings or develop strategies for the long-term reduction of GHG emissions or a combination. All projects conform to

76 California Energy Commission. "Tribal Consultation Policy,"https://www.energy.ca.gov/programs-and-topics/programs/tribal-program/tribal-consultation-policy.
77 California Energy Commission, "Tribal Government Workshop," May 14, 2019, https://efiling.energy.ca.gov/GetDocument.aspx?tn=228339&DocumentContentId=59521.
78 California Air Pollution Control Act, 1947.

BAAQMD's clean air plan and accelerate the reduction of criteria air pollutants, like nitrous oxide (NO_x), as well as GHG emissions. The funded projects that will reduce GHG emissions include implementation of effective energy saving programs on a regional level that will develop a program to use electric hot water heat pumps instead of traditional natural gas water heating tanks; refrigeration upgrades in corner markets; market transformation for electric heat pump water heaters; a commercial building ordinance to reduce energy use; PV generation for critical facilities, like hospitals; replacement of diesel generators with battery storage in data centers; and replacement of wall furnaces with electric heat pumps.

BAAQMD typically offers $250,000 in grants each fiscal year to Bay Area nonprofit organizations and school communities. There are two grant opportunities under this grant program: the School Community Grants and the James Cary Smith Community Grants. The BAAQMD offers $50,000 to school communities for projects that increase knowledge about the science of air quality, the relationship between air quality and public health, and the impact of air pollution on the global climate. Grants of up to $2,500 will be awarded for K-12 schools, teachers, student leaders, or parent leaders to implement air quality-related projects. In addition, under the James Cary Smith Community Grants funding program, the air district will offer $225,000 for air quality-related education and engagement projects, local air pollution mitigation projects, and community-based participatory research projects. Grants of up to $25,000 per project are awarded.

BAAQMD is collaborating with PG&E and SCP on the Advanced Energy Rebuild Program that offers incentives to fire victims in Sonoma and Mendocino Counties.[79] This program was launched in May 2018. For customers who choose to rebuild their homes as all-electric, combined incentives can amount to $12,500. PG&E is providing building design assistance to build beyond the building standards, while SCP and BAAQMD are providing incentives for electric appliances, solar panels, and EV charging stations. PG&E is using its existing California Advanced Home Program funds to support the above code design assistance offered to Sonoma and Mendocino Counties for fire rebuild efforts.

South Coast Air Quality Management District— SCAQMD funded the Coachella Valley Project, which was highlighted in the *2016 Existing Building Energy Efficiency Action Plan*. In 2015 and 2016, SCAQMD funded a basic energy efficiency retrofit for 2,100 homes in the Coachella Valley area of eastern Riverside County. This was not a low-income program but was focused on those homeowners and renters in disadvantaged communities. The retrofits focused on the building envelope. The SCAQMD Coachella Valley project was

79 See program blurb on page 50 in the community choice aggregators section.

completed by the end of 2016. The average cost per home was $1,950, and the average time to complete each home was under three hours in a day.

While actual energy savings results from the two utilities that serve the Coachella Valley (SCE and Imperial Irrigation District) are still being analyzed, initial modeling with EnergyPro software anticipated that each home would save, on average, 1,560 kWh per year (10 percent site savings) and 3,275,000 kWh per year for all homes. On the gas side, each home was modeled to save 35 therms per year and 73,500 therms total per year for the project. In terms of bill savings, the average annual savings in the SCE territory was quantified at $310 per home and a total of $650,000. Applying U.S. Environmental Protection Agency-approved attribution methods to the modeled energy savings, the program should achieve annual emissions reductions of 1,750 tons of GHGs. SCAQMD considered these emissions reductions so important that it adopted the Coachella Valley Project as an official pollution reduction measure: Control Measure No. ECC-02.

SCAQMD is developing a net emissions analysis tool and working group to assess the cost-effectiveness of technologies and life-cycle emissions. The tool includes several control measures that seek emission reductions with zero and near-zero NO_x appliances in commercial and residential applications and integrate energy efficiency enhancements with criteria pollutant (such as NO_x) cobenefits. To this end, the emissions tool estimates changes in criteria and GHG emissions and costs associated with upgrades in commercial and residential appliances in conjunction with installation of zero- and near-zero emission technologies.

In January 2019, the SCAQMD Board approved funding of more than $20 million for 10 projects to reduce energy consumption and GHG emissions in residential and commercial buildings. These projects are:

- Multifamily Affordable Housing Electrification Project.
- Zero-NO_x Water Heating; Space Heating, Cooking and Laundry Systems.
- Residential Energy Efficiency Retrofit Project (San Fernando Valley).
- Midstream Commercial Water Heating Incentive Program.
- Residential Fuel Cell Demonstration With PV and Storage.
- Residential Energy Efficiency Retrofit Project (Coachella Valley).
- Rialto Bioenergy Facility RNG Upgrading and Interconnection Project.
- Aquarium of the Pacific 1,320 kW Fuel Cell Power Generation System.
- Riverside Flare Reduction Project: Producing Renewable Hydrogen and Power and Avoiding NO_x and Volatile Organic Compounds.

- Fuel Cells Integrated With Energy Storage on College of the Canyons Campus.
- Microgrid System at University of Redlands.

San Joaquin Valley Air Pollution Control District— The SJVAPCD consists of eight counties, all primarily driven by the agricultural industry. As a result, most of the program activity supported by the SJVAPCD focuses on reducing emissions from the agricultural sector. While the emission reduction programs typically focus on farm equipment like tractors, the SJVAPCD also offers incentives for agricultural pump changes.[80] The pumps are switched from either diesel to more efficient diesel, or diesel to electric. The latter switch is important for decarbonizing the agricultural sector. In 2010, the SJVAPCD adopted regional energy efficiency strategies to advance energy conservation and efficiency activity that would also reduce emissions and improve air quality. SJVAPCD does not offer an energy efficiency programs or grants like those described in the BAAQMD or SCAQMD. It has historically offered such programs but more recently has leveraged education campaigns. For example, in late 2018 the SJVAPCD approved continued funding for the "Green Team" programs.[81]

Next Steps— Going forward, the CEC can leverage the activities of these and other local districts to reach the industrial and agricultural sectors and obtain additional energy efficiency savings critical to meeting the objectives of the SB 350. Though the industrial sector consumes more than 20 percent of the overall energy consumption in California, the established SB 350 targets projected minimal energy savings for the industrial and agricultural sector. The CEC can work with CAPCOA, which represents the state's 35 local air districts, to reach and educate various industrial and agricultural organizations. These efforts can initiate energy savings that may reduce costs, lead to increased business profitability, benefit local districts by reducing criteria pollutants, increase efficiency savings, and reduce GHG emissions. Initiating a statewide education, marketing, and outreach program by working with CAPCOA, CARB, the air districts, and other various energy-user associations may lead to substantial energy and GHG emissions reductions, which may not be obtained otherwise.

Local Benchmarking Programs

Beyond the commercial and multifamily building benchmarking program run by the state, several local jurisdictions have passed compliant benchmarking programs that cover a smaller or a broader range of buildings. Cities with their own local benchmarking program are San Francisco, Los Angeles, San Diego, San Jose, and Berkeley.[82] Building owners in these jurisdictions report their energy

80 "SJVAPCD Grants, Ag Pump Program," http://valleyair.org/grants/agpump.htm.
81 "SJVAPCD Governing Board Meeting Minutes," December 2018, http://www.valleyair.org/Board_meetings/GB/agenda_minutes/Agenda/2018/December/final/11.pdf.
82 Local Benchmarking and Public Disclosure Ordinances, https://www.energy.ca.gov/benchmarking/

use directly to their local program, which then reports data from qualifying buildings to the CEC. Some local benchmarking programs have broader reporting requirements that the state program, such as requiring buildings under the state's 50,000 sq. ft. threshold to report, or requiring energy audits and retrocommissioning.

Building Energy Efficiency Reach Codes, CALGreen

Jurisdictions can develop their own local code ordinance or can conduct an analysis to adopt Title 24, Part 11 California Green Building Standards Code (CALGreen), which includes voluntary green building standards that become mandatory where adopted.[83] Local jurisdictions wishing to enforce locally adopted energy standards must submit an application with the following materials to the CEC: (1) the proposed energy standards, (2) the local jurisdiction's findings and supporting analyses on the energy savings and cost-effectiveness of the proposed energy standards, (3) a statement or finding by the local jurisdiction that the local energy standards will require buildings to be designed to consume no more energy than permitted by BEES, and (4) any findings, determinations, declarations or reports, including any negative declaration or environmental impact report, required under the California Environmental Quality Act.[84]

Throughout the 2016 BEES cycle, several local governments adopted aggressive energy efficiency and solar requirements. Some of the local jurisdictions include Santa Monica, San Mateo, Palo Alto, Los Angeles County, Marin County, Arcata, and Davis.[85] Common code adoptions featured cool roofs, solar PV, solar thermal, or a requirement to meet a certain efficiency percentage above code baseline.

Energy Upgrade California

Energy Upgrade California® (EUC) is a statewide marketing, education, and outreach initiative. The multilingual campaign educates Californians on issues from energy efficiency to time-of-use rates. The EUC focus on marketing, education, and outreach was initiated in 2013 by CPUC Decision 12-05-015, which directed the program to serve as the primary statewide campaign to help residential and small business customers initiate energy management concepts and programs. EUC is supported by an alliance of the CPUC, the CEC, utilities, RENs, local governments, community choice aggregators, businesses, and nonprofit organizations to assist communities in meeting state and local

83 California Building Standards Commission. "California Green Building Standards Code (Part 11 of Title 24, California Code of Regulations)." Access in May 2019. Available online at: http://www.bsc.ca.gov/Home/CALGreen.aspx.
84 Public Resources Code section 25402.1(h)2 and section 10-106, outline the local ordinance procedure
85 "Local Ordinances Exceeding the 2016 Building Energy Efficiency Standards." Accessed in May 2019, https://www.energy.ca.gov/title24/2016standards/ordinances/

energy and climate action goals. Funding comes from surcharges to investor-owned energy utility customers.

Federal Energy Efficiency Programs

Below are descriptions of programs funded by the federal government. The verification of savings from these programs is challenging due to the lack of available public data. Nevertheless, these programs result in energy savings and positive socioeconomic impacts.

U.S. Department of Energy Appliance Standards

The U.S. DOE sets standards for common household, commercial, and industrial appliances. These are designed to save consumers money and protect them from inferior products. DOE is required to review standards and test procedures periodically for more than 60 products, representing about 90 percent of home energy use, 60 percent of commercial building energy use, and 30 percent of industrial energy use.[86] Common appliances covered by these standards include refrigerators, air conditioners, dishwashers, clothes washers, and furnaces.

Better Buildings Initiative- Through the Better Buildings Initiative, DOE partners with leaders in the public and private sectors to make the nation's homes, commercial buildings, and industrial plants more energy-efficient by accelerating investment and sharing successful best practices. There are several efforts that DOE leads under this umbrella, some including:

- Better Buildings Challenge.
- Better Buildings Accelerators.
- Better Communities Alliance.
- Better Plants Program.
- Better Buildings Alliance.
- Better Buildings Workforce.

As of 2018, nationwide, the Better Buildings Initiative has resulted in 1.38 quad Btus of energy savings, $8.4 billion saved, and 82 million tons of CO_2 emissions avoided. The initiative has partnered with more than 900 entities.[87] The CEC partners with DOE on several better buildings initiatives and supports the continuation of these efforts.

Weatherization Assistance Program- The Weatherization Assistance Program, founded more than 40 years ago, offers incentives for mechanical, building envelope, electric, water, and health and safety weatherization measures.

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86 "Appliance Efficiency Standards." U.S. Department of Energy, https://www.energy.gov/sites/prod/files/2017/01/f34/Appliance%20and%20Equipment%20Standards%20Fact%20Sheet-011917_0.pdf.

87 Better Buildings Program, 2019 Progress Report. U.S. Department of Energy, https://betterbuildingssolutioncenter.energy.gov/sites/default/files/program/DOE_BBI_2019_Progress_Report.pdf.

These measures help reduce the costs associated with fixing, replacing, and installing upgrades for low-income families. The mechanical weatherization measures include cleaning, repairing, or replacing HVAC units, and repairing, replacing, or installing water heaters and pipe insulation. Building shell weatherization measures include repairing roof or wall leaks, improving attic and wall insulation, repairing or replacing windows and doors, and installing awnings and solar screens. Electric and water weatherization measures include installing energy-efficient lights and low-flow shower heads and replacing old refrigerators with new energy-efficient models. Health and safety weatherization measures include installing ventilation to ensure good indoor air quality, installing smoke and carbon monoxide alarms, and evaluating mold and moisture hazards. The non-energy benefits associated with weatherization measures is a reduced energy bill for the recipient, reduced GHG emissions, improved indoor comfort, improved health and safety, and improved energy equity for the homeowner. The intent with this program is to increase energy efficiency of homes while improving the recipient's health, safety, and energy equity. This program supports 8,500 jobs and improves about 35,000 homes nationwide annually.

U.S. Department of Health and Human Services- Low-Income Home Energy Assistance Program (LIHEAP)

LIHEAP provides financial assistance and weatherization to households. The funds are allocated to each state for implementation. In California, CSD administers the funds. In 2018, more than $200 million were allocated to California to run the Home Energy Assistance Program, Energy Crisis Intervention Program, and LIHEAP Weatherization.[88] The first two programs provide direct financial assistance with paying utility bills, while the third program provides free energy efficiency upgrades to reduce monthly utility bills and improve the health and safety of the occupants.[89]

U. S. Department of Housing and Urban Development

The United States Department of Housing and Urban Development (HUD) funds energy efficiency through various programs. It recognizes that utility costs can burden households, especially low-income ones. HUD also sees the benefit of reducing its own energy costs through efficiency. HUD spends funds on heating, cooling, and lighting efficiency improvements for its portfolio of public and assisted housing, and Section 8 vouchers. Furthermore, reducing the energy

88 "2019 Funding Release of LIHEAP Block Grant Funds." https://liheapch.acf.hhs.gov/Funding/funding.htm.
89 California Department of Community Services and Development, LIHEAP, https://www.csd.ca.gov/Services/HelpPayingUtilityBills.aspx

burden strengthens local economies; thus, these programs act as investments in a community's future.

HUD offers energy efficiency funds and support through numerous programs, including:

- Community Development Block Grants.[90]
- Choice Neighborhoods Planning Grants Program.[91]
- HOME Investment Partnership.[92]
- Public Housing Environmental and Conservation Clearinghouse.[93]
- Veterans Housing Rehabilitation and Modification Pilot Program.[94]

These programs benefit low-income, disabled, disadvantaged, rural, and urban communities. Often, they leverage private funds with public money to expand the scope of a project. These funds play an essential role in financing affordable housing, improving low-income communities, and redeveloping neighborhoods that have suffered economic downturns.

Private Market Energy Efficiency Program

Residential and Commercial Property Assessed Clean Energy

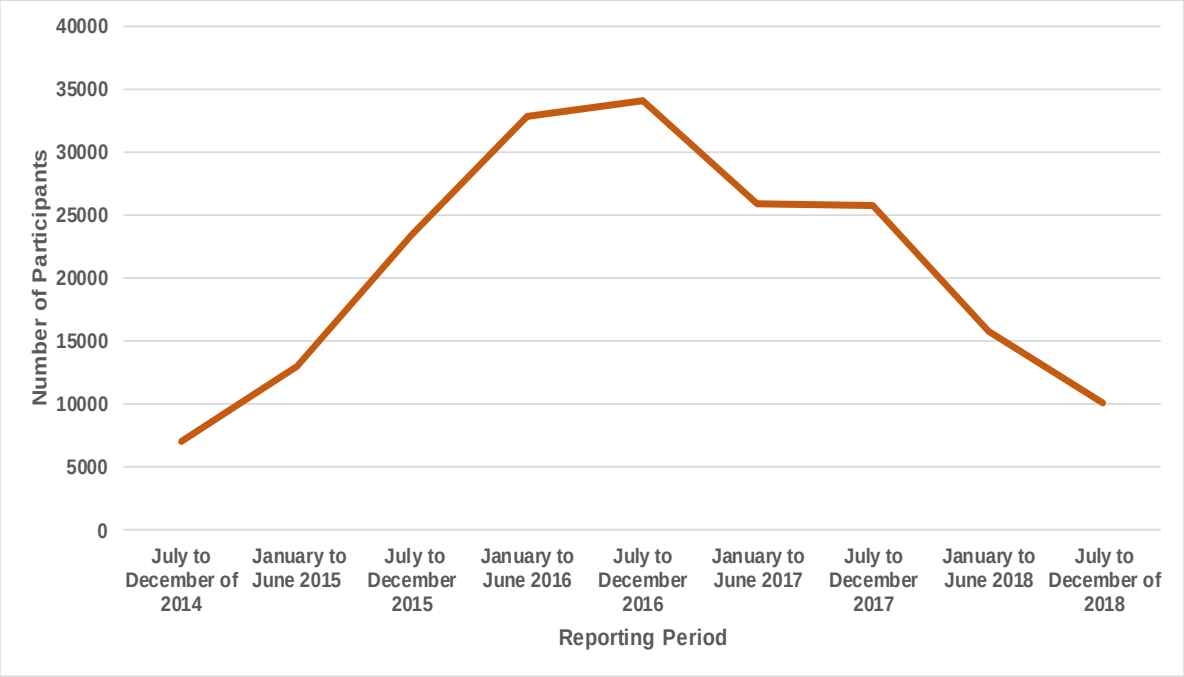
Since 2008,[95] California law has permitted PACE programs. Twelve PACE providers offer loans in California. Residential PACE loans make up most financings. PACE loans rely on the existing framework of residential property taxes by allowing property owners to repay the entire loan for a project through a special tax assessment made on the property. This arrangement limits PACE providers' field of operation only to those jurisdictions that passed laws permitting the special tax assessment. The loan is used to pay for property-affixed energy efficiency measures such as building insulation, HVAC, envelope improvements, windows, lighting controls, and other equipment controls. It may also pay for rooftop PV and seismic retrofits. The initiation of these programs did not substantially gain momentum until the opening of the PACE loan loss reserve (addressed on page 83 of this report). The commercial market has seen slow but continued growth. California is the largest PACE market in the country,

90 "Community Development Block Grants" U.S. Department of Housing and Urban Development, https://www.hudexchange.info/programs/cdbg./
91 "2019 Grant Programs." U.S. Department of Housing and Urban Development, https://www.hud.gov/program_offices/spm/gmomgmt/grantsinfo/fundingopps/fy19cnpg.
92 https://www.hudexchange.info/programs/home/
93 "Public Housing Environmental and Conservation Clearinghouse." U.S. Department of Housing and Urban Development, https://www.hud.gov/program_offices/public_indian_housing/programs/ph/phecc.
94 "Veterans Housing Rehabilitation and Modification Pilot Program." U.S. Department of Housing and Urban Development https://www.hudexchange.info/programs/rural/veterans-housing-rehabilitation-and-modification-pilot-program/.
95 California Assembly Bill 811 (Levine and Beall, Chapter 159, Statutes of 2008).

accounting for more than 80 percent of national PACE financing and representing nearly $5 billion in clean energy capital investment. This capital is spread over nearly 200,000 clean energy projects with hundreds of local government partners.[96]

Recently, the number of PACE loans has declined (Figure 21). This trend began in 2017 and has continued through 2018. It is unclear if the drop is due solely to legislation passed in 2017,[97] or if other market factors, such as saturation, are to blame. According to comments filed by Ygrene, "[Assembly Bill 1284, Chapter 475, Statutes of 2017] …significantly constricted the growth of the California PACE market, which dropped by approximately 40 percent after the legislation took effect. Without proper support from state leadership, government agencies, and local communities, PACE will not achieve the impacts it is capable of creating."[98] Assembly Bill 1284 addresses the perception that unscrupulous contractors were harming consumers by abusing the PACE program qualifications.

Figure 21: PACE Participation July 2014–December 2018



Source: CAEATFA, PACE Loan Loss Reserve Program

PACE plays a major role in the SB 350 target-setting process, as it is the largest beyond utility program in the state. The CEC needs more insight into the costs

96 Ygrene Energy Fund. "Ygrene Energy Fund Comments on the 2019 California Energy Efficiency Action Plan,", https://efiling.energy.ca.gov/GetDocument.aspx?tn=228290&DocumentContentId=59468.
97 Assembly Bill 1284, Chapter 475, Statutes of 2017.
98 Ygrene Energy Fund. "Ygrene Energy Fund Comments on the 2019 California Energy Efficiency Action Plan,", https://efiling.energy.ca.gov/GetDocument.aspx?tn=228290&DocumentContentId=59468.

and savings of these projects to more accurately account for the contributions of the costs and savings to the doubling targets.

Conservation Voltage Reduction

Conservation voltage reduction (CVR) is a proven technology for reducing energy use and peak demand. CVR improves the efficiency of the distribution system by optimizing voltage. The key principle of CVR operation is that the standard voltage band between 114 and 126 volts can be compressed using regulation to the lower half (114–120 volts) instead of the upper half (120–126 volts),[99] producing considerable energy savings at low cost without harm to consumer appliances.[100] Sensors detect distribution voltages, and when voltages exceed preset limits, voltage regulation equipment is triggered.

To date, pilots on implementing CVR have been run by smaller POUs such as Glendale and Palo Alto. Larger-scale adoption has not occurred in California. The benefits from reduced energy consumption (metered end-user usage and distribution losses) and avoided equipment damage through time must exceed the investment and operating costs for CVR to make sense economically. While CVR is a proven technology, it is difficult to calculate cost-effectiveness unless the utility is vertically integrated, meaning the utility owns the electricity supply, transmission, and distribution system. More work is needed to determine a societally cost-effective method so that the energy savings from this technology can be properly captured.

Fuel Substitution

The CEC defines "fuel substitution" as replacing one end-use, utility-provided fuel for another. This substitution is most commonly a switch between natural gas and electricity. SB 350 legislation called on fuel substitution as a means to double energy efficiency.[101] This topic overlaps with building decarbonization (discussed in Chapter 4).[102] Building decarbonization programs will result in a net energy decrease and fewer GHG emissions. Beyond-ratepayer programs (such as LIWP) offer this type of efficiency upgrade. Electrification is the primary path for fuel substitution, and it is being pursued by POUs and community choice aggregators, which are generally electric-only providers and have an interest in increasing their customer base.

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99 In the United States, regulations require that voltage be made available to consumers at 120 volts (V) plus or minus 5 percent, yielding a range of 126V to 114V.

100 Electrical equipment including air conditioning, refrigeration, appliances, and lighting is designed to operate most efficiently at 114V. Power delivered at higher voltage wastes energy as heat.

101 Public Resources Code Section 25310(d)(10).

102 See page 118 in Goal 3 of Chapter 1

Three-Prong Test— As a result of joint motion party led by NRDC in June 2017, the CPUC issued a proposed decision in June 2019 to modify the three-prong test and address the questions raised by parties.[103] The proposed decision renames the three-prong test to the fuel substitution test and reduces the prongs to two. The updated test requires that the measure tested must not increase total source energy consumption when compared with the baseline measure of the original fuel. The remaining prong of the test requires that the measure not adversely impact the environment (as currently measured by GHG emissions). The prong requiring the measure to pass a cost-effectiveness test is removed.[104] This permits fuel substitution measures to compete within the program portfolio alongside traditional measures.

Component 3: Energy Efficiency Market Transformation

The final section of the first goal consists of efforts intended to result in future energy savings. These efforts include research and development, expansion of financing tools, new program designs, and expanded access to data for state agencies, local governments, and energy decision makers.

Energy Efficiency Research and Development

This section highlights the areas where the state is investing funding dollars into energy research and technology development and deployment.

Electric Program Investment Charge

The CPUC established the Electric Program Investment Charge (EPIC) through Decision 12-05-037 under Rulemaking 11-10-003, on May 24, 2012. Senate Bill 96 guides the administration of EPIC. The program funds roughly $162 million annually in clean energy research, demonstration, and deployment projects that support California's energy policy goals and promote greater electricity reliability, lower costs, and increased safety.

EPIC's proposed 2018-2020[105] Triennial Investment Plan[106] focuses on improving existing building energy efficiency and reducing GHG emissions in the following areas of opportunity:

- Accelerating product development and market acceptance of solid-state lighting technologies and designs
- Developing and launching next-generation windows and envelope technologies

103 Proposed Decision, Decision Modifying the Energy Efficiency Three-Prong Test Related to Fuel Substitution, R.13-11-005, June 2019.
104 Ibid, pg. 2-3.
105 The EPIC investment plan can be found here: https://www.energy.ca.gov/research/epic/17-EPIC-01/
106 *EPIC Proposed 2018-2020 Triennial Investment Plan*. California Energy Commission. April 2017. CEC-500-2017-023-CMF Chapters 2 and 3.

- Satisfying existing buildings demand for energy-efficient HVAC and refrigeration systems that have low GHG emissions and use refrigerants with low global warming potential
- Enabling integration of building and equipment controls and automation
- Increasing plug loads and consumer electronics efficiency
- Transitioning to direct current-powered buildings
- Developing and using cost-effective decarbonization strategies in California's industrial sector
- Scaling up cost-effective and sustainable retrofits to highly energy-efficient buildings, including zero-net-energy retrofits, where technically and economically feasible

The current authorization for EPIC will expire at the end of 2020. The CPUC has indicated, in an October 2018 Decision (D.18-10-052), that it intends to open a new rulemaking proceeding in 2019 to examine the future of the program.

Natural Gas Research and Development Program

In 2000, California enacted legislation to enable the Natural Gas Research and Development (R&D) Program under Assembly Bill 1002.[107] AB 1002 directed the CPUC to impose a surcharge on all natural gas consumed in California to fund research and development specific to natural gas. The CPUC created the Natural Gas R&D Program in August 2004. That same year, the CPUC designated the CEC as the administrator of program research funds under Decision 04-08-010. The CPUC allocates $24 million per year to the Natural Gas R&D Program; program funding has not increased since 2009.

The Natural Gas R&D program also prioritizes research focused on strengthening the integrity and safety of natural gas infrastructure. In recent years, the program has funded research and development aimed at GHG reduction, production of renewable gas, climate adaptation, and resiliency for the natural gas system. One example of this is the Demonstrating Innovative Solutions to Convert California's Forest Biomass Resources Into Renewable Gas (GFO-18-501) solicitation. This solicitation will fund research and development aimed at achieving GHG reduction, reducing the increasing risk of wildfires, and developing renewable sources of gas.

State Leadership Opportunities

The following section discusses the various committees, forums, and groups in which the CEC and others participate to advance energy efficiency.

107 Wright, Chapter 932, Statutes of 2000.

California Energy Efficiency Coordinating Committee

The CAEECC was authorized by CPUC Decision 15-10-028 and launched in January 2016. The Coordinating Committee (CC) is made up of representatives from the PAs, the CEC, Workers' Unions, NRDC, the Public Advocates Office, the Local Government Sustainable Energy Coalition, the Efficiency Council, consultants, trade groups, and local government representatives.

The goals of the CC are to:

- Support the development and expansion of energy efficiency programs that reduce GHG emissions in line with state climate and energy goals while responding to customer needs and market dynamics.
- Provide input to the PAs in developing and implementing their energy efficiency business plans.
- Improve collaboration and communication among committee members and with the CPUC on energy efficiency matters.
- Resolve disagreements among stakeholders whenever possible to reduce the number of matters that need to be litigated before the CPUC.

Moving forward, CAEECC will act as a venue for stakeholders to provide input on related A.17-01-013 et al. matters and R.13-11-005 issues.[108] However, CAEECC is not a decision-making body. Policy decision authority remains with the CPUC, and final portfolio decisions are made by the PAs.

Recent quarterly CC meetings have dealt with workforce contract requirements, expansion of third-party EE program implementation, market transformation strategies, and IOU budget advice letters.[109] Ad hoc meetings have covered the Database for Energy Efficiency Resources peak demand definitions, local government partnerships, and PA energy efficiency implementation plans.[110]

California Technical Forum

The California Technical Forum (CalTF) is a collaborative of experts who use independent professional judgment and a clear process to review and provide technical information pertaining to California's demand-side management portfolio. It consists a policy advisory committee, a technical forum, and permanent staff. The CalTF has completed reviews and updates to the deemed

108 A.17-01-013: PA business plans, https://apps.cpuc.ca.gov/apex/f?p=401:56:0::NO:RP,57,RIR:P5_PROCEEDING_SELECT:A1701013, R.13-11-005: Establishes a proceeding in which to fund the current energy efficiency portfolios through 2015, implement energy efficiency "rolling portfolios," and address various related policy, https://apps.cpuc.ca.gov/apex/f?p=401:56:0::NO.

109 Quarterly Meetings, California Energy Efficiency Coordinating Committee, https://www.caeecc.org/coordinating-comm-meetings.

110 Ad-Hoc Meetings, California Energy Efficiency Coordinating Committee, https://www.caeecc.org/ad-hoc-meetings.

measures used in utility programs, developed an electronic technical reference manual, and begun advancing a consistent building energy model approach.

Market Transformation Data Efforts

While ongoing energy efficiency work is crucial to meeting the 2030 doubling goal, there is additional data, market, and workforce development to be done. This section goes into the big data needed for proper efficiency valuation, the tools in development or newly available to analyze efficiency, and workforce development and training improvements that are necessary for the success of all programs.

CEC Enterprisewide Data Effort

The CEC is in the early stages of a multiyear enterprisewide data modernization effort. The primary driver for this effort is the collection of customer-level interval-meter-data (IMD) from the six largest utilities in California.[111] IMD provides high-resolution, hourly and subhourly energy billing, and consumption information compared to the monthly billing data that the CEC has. As these data contain customer-level information, there is a need to protect and secure the data to ensure privacy and confidentiality in line with CEC information security policies. This need, along with the large volume of data, warrants the use of big-data cloud services. Once implemented as part of the modernization, the service will allow CEC staff to use a highly scalable and secure storage infrastructure to analyze and model IMD to meet CEC needs for demand forecasting and analysis of energy efficiency program impacts. The IMD project is estimated to be completed by June 2020.

Leverage Energy Consumption Data to Create Hourly and Locational Energy Efficiency Projections

The CEC has the opportunity, once it begins collecting and analyzing consumption data across the state, to prepare aggregated datasets. These datasets can be designed for local government use, PAs, and other stakeholders. The goal of such an effort is to reduce the unknowns commonly associated with implementing energy efficiency, especially as it is needed to reach specific locations at specific times.

Secure, nondiscoverable datasets for use within state agencies can also improve the outreach and design of efficiency programs. Tools like the Energy Equity Indicator (discussed in Goal 2, Component 3) and the Energy Data Atlas (discussed in the next section) can combine consumption data and building information with socioeconomic data, to reveal where efficiency is not being

111 Cal. Code Regs., tit. 20, § 1353.

implemented, reveal potentially why not, and could make solutions easier to develop.

Open-Source Energy Solutions— California has led in the development and use of open-source energy measurement and verification tools. Stakeholders initiated a process in 2012 to develop transparent, empirically tested methods for tracking demand change at the utility meter. The process, known as CalTRACK Methods, is now part of the Energy Market Methods Consortium (Details in box on page 98), and brings together multiple state representatives, government agencies, and private sector stakeholders.

The CEC supplied initial funding to develop the open-source OpenEEmeter software. The software engine implements the CalTRACK methods to quantify monthly, daily, and hourly changes in energy consumption from utility meters.

Energy Market Methods Consortium

Under the umbrella of the Linux Foundation Energy Projects, the Energy Market Methods Consortium is the home for industry stakeholders to collaborate on methods to reduce the costs of scaling up demand-side energy programs and procurement. The consortium is split in three sections: CalTRACK, GRID, and SEAT. CalTRACK is the working group developing methods to standardize the way normalized meter-based changes in energy consumption are measured and reported. GRID is working to extend the CalTRACK site-based savings methods to account for grid impacts, apply population level adjustments, standardize adjustments for non-routine events and decay of savings, and to facilitate investment in non-wires alternatives. The SEAT working group deals with technical and methodological barriers to secure data sharing and privacy concerns that support demand-side energy programs and non-wires alternatives. Together this effort is spearheading the work to properly place value on energy efficiency as a resource.

Linux Foundation-https://www.lfenergy.org/projects/
Energy Market Methods-
https://www.energymarketmethods.org/
CalTRACK- https://www.caltrack.org
GRID- https://www.energymarketmethods.org/grid.html
SEAT- https://www.energymarketmethods.org/seat.html

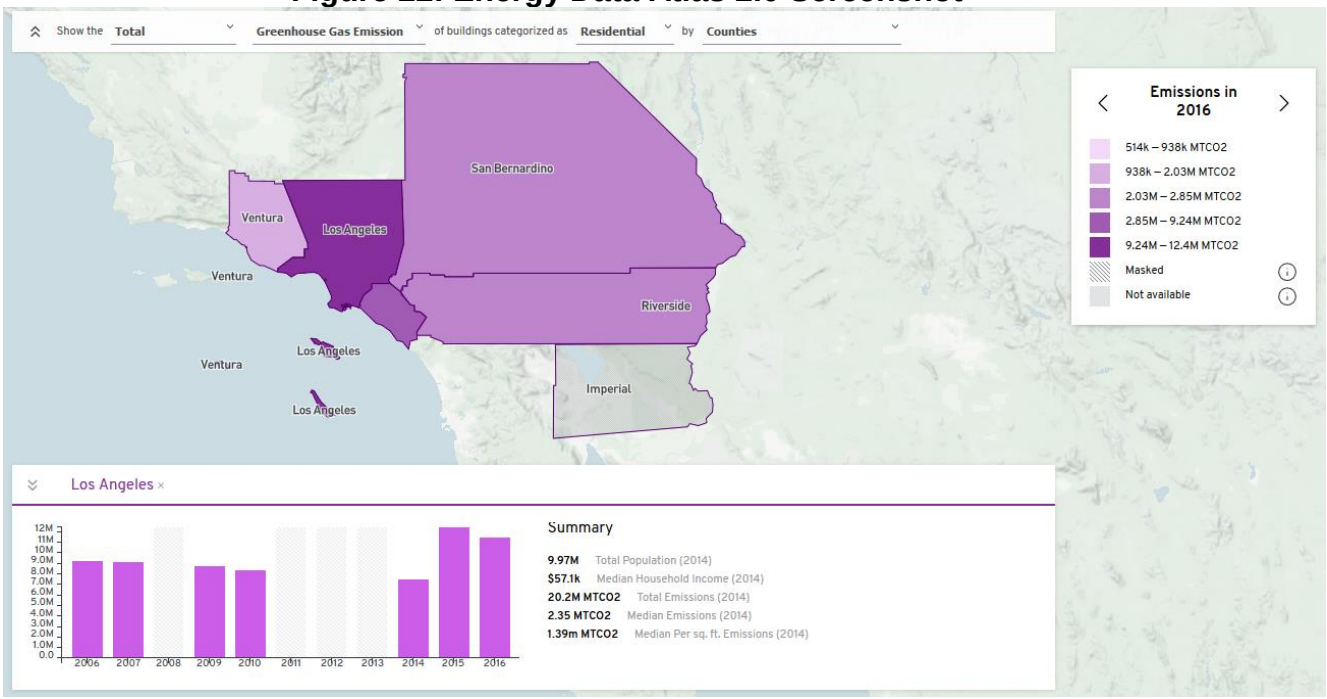
Energy Data Atlas and Beyond

Energy Atlas is a proprietary tool developed by the California Center for Sustainable Communities at UCLA through funding by Strategic Growth Council, CEC EPIC grant and ratepayer funds. The purpose is to analyze actual (not modeled or estimated) energy consumption by building type, age, type of energy, and GHG emissions in Los Angeles County and most of Southern

California (example of atlas in Figure 22). Before public disclosure, data are aggregated to protect individual customer privacy in accordance with CPUC guidelines. In D 18-05-041, the CPUC ordered the IOUs to expand access to actuarial energy use data statewide (akin to Energy Atlas in Southern California). Leveraging the CEC enterprise systems described above, the statewide tool would map and analyze customer actuarial energy consumption data aggregated to meet privacy and confidentiality protections required under current laws and regulations. Local governments, governmental agencies, and energy efficiency PAs would be the targeted users of the tool. The statewide tool is expected to be launched by end of 2020.

Analytics and mapping of aggregated actuarial energy use come with several benefits, such as providing an energy consumption baseline from which program implementers can track progress; helping policy makers understand how well a particular policy is working; assisting local governments with developing, implementing, and tracking climate action plans; and helping stakeholders understand how the built environment contributes to GHG emissions. The CEC expects to leverage big data efforts like these with the respective enterprise platform and energy consumption datasets. Coordination with the CPUC is essential to developing a statewide tool that can result in the benefits described above.

Figure 22: Energy Data Atlas 2.0 Screenshot



Source: UCLA Energy Data Atlas 2.0

Behavioral Program Expansion

As utilities increasingly look for cost-effective energy efficiency measures, AB 802 opened the door to offer more behavior improvement-based programs. These new program opportunities are occurring as more granular data about energy consumption are becoming available, which make verifying behavioral savings possible. Utilities have had success recently with offering home energy reports. They compare a customer's energy use to that of their neighbors, with the expectation of motivating changes by high-usage consumers. This purely behavioral approach produces savings ranging, on average, from less than 1 percent up to 3 percent per household.[112] In the most recent CPUC potentials and goals study, behavioral programs like these will soon represent a large portion of savings.[113]

The initial SB 350 targets for behavioral and market transformation programs accounted for about 2 percent of the total projected electricity savings and 7 percent of natural gas savings in 2030. In establishing the SB 350 targets, the CEC used the best available data and methods to project savings from behavior and market transformation while recognizing that these programs and measures are still being designed and developed for widespread implementation. Because many of these are nascent programs, uncertainty remains about whether the CEC's projections capture all possible behavioral-based strategies and what is the amount of confidence to place in current methods to count potential savings.[114]

Unique Building Identifiers

Managing data for physical buildings is challenging, due to the various addresses that can be associated with a building. A complex logic check needs to be completed to understand if multiple addresses refer to the same building. The creation of a statewide building identification number can remedy this. The CEC has partnered with the DOE through the Better Buildings Program Accelerator—Building Energy Data Analysis to develop, test, and implement unique building identifiers (UBIDs).[115] Initial testing is being done on the buildings reported through the statewide benchmarking program. The UBIDs are then attached to energy and building information from other sources, with the UBID acting as the bridge. The CEC will be part of the partnership through 2020 as it advances UBID improvements. The CEC is still developing UBIDs for California

112 CPUC. (May 2018). *Energy Efficiency Portfolio Report,* pg. .28. Retrieved from http://www.cpuc.ca.gov/uploadedFiles/CPUCWebsite/Content/About_Us/Organization/Divisions/Office_of_Governmental_Affairs/Legislation/2018/13-15%20Energy%20Efficiency%20Report_Final.pdf.

113 *2019 Potential and Goals Study*. Prepared by Navigant on behalf of the CPUC, pg. 5.

114 "Behavioral and Market Transformation," *2018 IEPR Update,* pg. 72, https://ww2.energy.ca.gov/2018publications/CEC-100-2018-001/CEC-100-2018-001-V2-CMF.pdf.

115 U.S. DOE Better Buildings Program, Accelerator. ", Building Energy Data Analysis," https://betterbuildingsinitiative.energy.gov/accelerators/building-energy-data-analysis.

and will determine the best path forward for use, whether for public reporting or internal use. The development of a UBID is important to not only the CEC, but potentially to stakeholders across the nation. The UBID is more accurate than connecting data through a street address. The DOE will post a method and tool for the public to use once tested and verified.

Building Asset Scores

The EBEE Action Plan calls for standardized energy asset ratings for residential and nonresidential buildings. An "asset rating" is a method of quantifying the efficiency potential of a building, independent of the number of occupants and their behavioral choices. By including an asset rating as part of real estate listings or information for a building owner, one can factor the behavior-independent energy costs of a building into his or her decisions and amend behavior to achieve the full potential energy efficiency. The factors affecting underlying efficiency potential include the envelope, heating, cooling, ventilation, and hot water systems of the building, along with the installed lighting and major appliances and any offsetting electrical power produced by on-site renewable systems. Energy savings that can be directly attributed to an energy asset rating are behavioral, whereas any measures implemented due to knowing and acting on the rating is attributable to that specific program.[116]

Home Energy Rating System

The 2009 update to the Home Energy Rating System (HERS) Regulations instituted Phase II of the HERS program.[117] This update involves rating the energy efficiency of a building on a scale from 0 to 250, relative to a reference home that just meets the prescriptive requirements of the BEES. A 0 rating home is best and 250 rating the worst. This whole-house HERS rating applies to new and existing single-family homes and multifamily buildings up to three stories. This program is intended to provide reliable asset ratings that the real estate industry can use to compare the built-in energy features of buildings and, by extension, inform Realtors®, lenders, and buyers of potential operating costs. This is an important step toward market valuation of building energy efficiency.

For example, homes with lower (better) ratings could qualify for an energy-efficient mortgage, in which expected utility savings translate to a higher loan amount. It would also create value propositions for homeowners to ensure compliance with codes. The CEC has approved one California HERS provider to deliver HERS ratings, and collectively, completes about 100 ratings per year.

116 Jones, Melissa, Michael Jaske, Michael Kenney, Brian Samuelson, Cynthia Rogers, Elena Giyenko, and Manjit Ahuja. 2017. *Senate Bill 350: Doubling Energy Efficiency Savings by 2030*. California Energy Commission. Publication Number: CEC-400-2017-010-CMF.

117 Public Resources Code Section 25942.

Nonresidential Building Energy Asset Ratings

The EBEE Action Plan recommended the CEC study the applicability of nonresidential asset scores to California. The CEC studied and identified the possible specifications for such a tool to work in California but did not proceed with implementation. In 2018, the CEC and a contractor reviewed the DOE commercial energy asset rating tool and compared it to draft specifications developed by the CEC. The assessment found that the DOE tool is applicable to California nonresidential buildings but would require modification.

Workforce Alignment and Development

The Workforce Education and Training (WE&T) Program represents a portfolio of education and training activities aimed at supporting the achievement of IOU energy savings targets, as well as the workforce objectives set forth in the California Long-Term Energy Efficiency Strategic Plan.[118]

The WE&T program has a similar overall structure across the IOUs and is organized into three subprograms:

> The **Centergies** subprogram receives most of the WE&T program funding and organizes training around technology categories and building type and focuses on promoting education and training in energy efficiency, and integrated demand-side management.
>
> The **Connections** subprogram focuses on forging collaborations with external education institutions to promote coordinated energy-related careers and training.
>
> The **Planning** subprogram develops the statewide framework for planning, coordinating, and implementing WE&T activities, stakeholder engagement meetings, and partnerships.

In D. 18-10-008, the CPUC ordered specific workforce standards be applied by all energy efficiency PA business plan portfolios for HVAC and lighting programs that meet certain criteria. These workforce requirements are intended as a starting point for requirements in the future, in coordination with the evaluation and the CEC adoption of a "responsible contractor policy" as set forth by SB 350.

Specifically, the workforce standards are required to be included in the first round of third-party solicitations. All downstream or midstream HVAC energy efficiency measures with incentives of $3,000 or more installed, subsidized, or paid for out of ratepayer energy efficiency program portfolios are to be installed by Journeymen 2 with five or more years of experience or apprentices enrolled in or having completed a federal or California state apprenticeship program. All

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118 *California Long-Term Energy Efficiency Strategic Plan*., CPUC, https://www.cpuc.ca.gov/uploadedfiles/cpucwebsite/content/about_us/organization/divisions/office_of_governmental_affairs/legislation/2018/13-15%20energy%20efficiency%20report_final.pdf.

downstream and midstream advanced lighting control installation, modification, or maintenance measures with incentives of $2,000 or more installed, subsidized, or paid for under a program administrator's energy efficiency portfolio are to be installed by workers that have been certified by an ATTCP.

Other California Programs

The Employment Training Panel (ETP) was created in 1982 by the California Legislature and is funded by California employers through a special payroll tax. The ETP provides funding to employers to assist in upgrading the skills of their workers through training that leads to good-paying, long-term jobs. ETP concentrates its outreach to industries identified during the panel's strategic planning; one of those priorities is for ETP-funded training for job creation and economic revitalization throughout Green/Clean Technology. The benefits of the ETP warrant continued coordination with state agencies to further align workforce goals.

The Employment Development Department offers a variety of comprehensive services and programs, at no cost, designed to benefit all job seekers, including laid-off workers, youth, workers looking for better opportunities, veterans, and individuals with disabilities. The Employment Development Department provides individuals with job search and resume workshops, training, referrals, and more. It offers guidance on green/clean technology job requirements and available training and education programs.

Financing Opportunities

Traditional finance mechanisms (for example, home improvements loans, consumer credit cards, small business loans and leases) have mobilized only a small fraction of the cost-effective potential for energy efficiency. There is a need for alternative financing mechanisms that avoid the typical financing barriers that systematically disqualify prospective participants by applying criteria directly dependent on income, credit score, and owner/renter status.

On-Bill Tariff Financing

The Barriers Study identified the need for alternative financings tools and, after reviewing numerous possible options, proposed on-bill tariffs as its primary recommendation.[119] An "on-bill tariff" is a financing tool that funds an energy efficiency measure through the customer's utility bill. The basis for receiving the funds depends on a good utility payment history, not a credit score or income level. The measure is tied to the bill at the physical address where the upgrade is performed similar to the way PACE attaches the financing to the property, not the owner. In a recent E3 publication sponsored by SMUD, LADWP, and SCE on the preferred pathways to decarbonize homes, one major finding was that on-bill tariffs would allow the type of capital deployment necessary to achieve effective decarbonization.[120] The CEC supports this tool and has offered technical assistance to

On-Bill Tariff Details

To date, there are seventeen on-bill tariff programs around the country, providing energy efficiency upgrades to rural communities, low and moderate income households, and commercial building owners. The model is accessible to any utility structure, municipal, investor-owned, and cooperative.

Barriers to traditional energy efficiency program participation, like upfront costs, split-incentives, and credit-worthiness, are avoided in on-bill tariff programs. Low- and middle-income households can easily participate without issue, as well as, households that are debt constrained, live on a fixed income, and rent.

Successful on-bill tariff programs, like the Pay As You Save model, estimate savings to exceed charges on an annual and lifecycle basis, tie payments to location not customer, repayments occur through utility bill, offer rebates if applicable, use only proven technologies, and utilities treat uncollectable payments just as they would any other uncollectable payment.[1]

1 Hummel, Holmes, Harlan Lachman, What is inclusive financing for energy efficiency, and why are some of the largest states in the country calling for it now?, ACEEE Summer Study, 2018.

119 Scavo, Jordan, Suzanne Korosec, Estaban Guerrero, Bill Pennington, and Pamela Doughman. 2016. Low-Income Barriers Study, Part A: Overcoming Barriers to Energy Efficiency and Renewables for Low-Income customers and Small Business Contracting Opportunities in Disadvantaged Communities. California Energy Commission. Publication Number: CEC-300-2016-009-CMF. https://efiling.energy.ca.gov/getdocument.aspx?tn=214830.

120 Residential Building Decarbonization in California: Consumer Economics, Greenhouse Gases, and Grid Impacts, Energy Economics Environment. 2018. https://www.ethree.com/wp-content/uploads/2019/04/E3_Residential_Building_Electrification_in_California_April_2019.pdf.

public utilities seeking to implement it.

Green Banks

Green banks are set up to secure low-cost capital for large clean energy projects. They can be set up by state or local governments. Active examples of green banks nationwide are Connecticut Green Bank, New York Green Bank, California Lending for Energy and Environmental Needs, Rhode Island Infrastructure Bank, Montgomery County Green Bank, and Hawaii Green Energy Market Securitization. California Lending for Energy and Environmental Needs (CLEEN) is part of the California Infrastructure and Economic Development Bank.[121] CLEEN offers direct public financing to municipalities, universities, schools, and hospitals to reduce GHG emissions, conserve water, and save energy. It rolls money out through two programs: the Statewide Energy Efficiency Program and the LED Street Lighting Program. Financing is available as a direct loan or through publicly offered tax-exempt bonds. An applicant can apply for financing between $500,000 and $30 million. In the last few years, only a single jurisdiction has leveraged the CLEEN.[122] It is unclear what barriers are preventing more entities from using this financing tool.

Green Leases

A "green lease" is a tool available to tenants and landlords for capturing additional energy efficiency. It creates an agreement in which the tenants are receive incentives to participate in water and energy efficiency programs. Example terms for green leases are available online and can be implemented in several building sectors. They are more complicated to negotiate than a traditional lease but offer benefits such as higher occupant productivity and health, reduced energy bills, higher future rent and occupancy rates, and improved marketability.[123]

Increase Energy Efficiency Appraisals

Leading up to the 2015 EBEE Action Plan, working groups and studies, funded through the Statewide Codes and Standards Program, highlighted the potential for increasing awareness of, and creating market demand for, energy efficiency during real estate transactions. The preliminary results of a survey conducted by Build It Green in collaboration with the Oakland-Berkeley Association of Realtors and the California Regional Multiple Listing Service revealed that 70 percent of Realtors are interested in using energy efficiency or green features as a selling point. The survey results also identified a lack of understanding of home

121 California Lending for Energy and Environmental Needs, http://www.ibank.ca.gov/cleen-center/.
122 http://www.ibank.ca.gov/wp-content/Documents/CLEEN/CLEENCenter2016-18ProjectProfiles1.23.18.pdf.
123 Green Leasing, Green Building Alliance, https://www.go-gba.org/resources/green-building-methods/green-leasing/.

performance and difficulty in confirming seller's claims as the top challenges facing the market for green homes.[124] The CEC recognizes the value of integrating energy efficiency into property appraisals and supports including energy efficiency attributes in real estate appraisals.

Goal 2: Low-Income and Disadvantaged Community Energy Equity

The second goal of the action plan addresses the need for equitable application of energy efficiency upgrades for low-income customers and those who live in disadvantaged, and rural communities. The complex and variable barriers preventing energy efficiency uptake in these communities are well understood, and actions are being taken to address them. This goal is broken into three components to highlight the ongoing work and recommendations.

Component 1: Low Income and Disadvantaged Community Barriers

The first component of this goal addresses low-income and disadvantaged communities. There is agreement among stakeholders that several barriers prevent clean energy investments in low-income and disadvantaged communities. SB 350 takes steps to ensure California's clean energy transformation includes a strong focus on equity to ensure benefits are realized by all Californians, especially those in the most vulnerable communities. SB 350 directed the CEC to study the barriers to implementing energy efficiency upgrades and weatherization investments for low-income customers, including those in disadvantaged communities, and to make recommendations on how to increase access to these investments for low-income customers. This direction and others related to clean energy investments led to the Barriers Study.

Senate Bill 350 Low-Income Barriers Study

The Barriers Study highlights several structural challenges. Other barriers stem from policy and program decisions that can be overcome through new policy development or program refinements.

Structural barriers identified in the report include:

- Low home ownership rates.
- Complex needs, ownership, and financial arrangements for low-income, multifamily housing.
- Insufficient access to capital.
- Building age.

124 Build It Green, 2016. "Statewide Realtor Survey." Discussion at Green Real Estate Working Group. Meeting Summary via email. September 15, 2016. Facilitator: StopWaste.org.

- Remote or underserved communities.

The policy and program barriers identified include:

- Insufficient market delivery and outreach.
- Lack of program integration or coordination.
- Data limitations.
- Unrecognized non-energy benefits.

The Barriers Study offers key recommendations (Table 9) to address barriers to clean energy access.

Table 9: CEC Low-Income Barriers Study Recommendations

#	Recommendation
1	Organizing a multiagency task force to promote coordination across state-administered programs
2	Enabling community solar offerings for low-income customers
3	Formulating a statewide clean energy labor and workforce development strategy.
4	Developing new financing pilot programs to encourage investment for low-income customers.
5	Establishing common metrics and encouraging data sharing across agencies and programs.
6	Expanding funding for photovoltaic and solar thermal offerings for low-income customers.
7	Enhancing housing tax credits for projects to include energy upgrades during rehabilitation.
8	Establishing regional outreach and technical assistance one-stop shop pilots.
9	Investigating consumer protection issues for low-income customers and small businesses in disadvantaged communities.
10	Encouraging collaboration with community-based organizations in new and existing programs.
11	Funding research and development to enable targeted benefits for low-income customers and disadvantaged communities.
12	Conducting a follow-up study for increasing contracting opportunities for small businesses in disadvantaged communities.

Source: CEC

Progress Since Barriers Study

Since publication of the Barriers Study in 2016, progress has been made on several recommendations. In 2018, the Disadvantaged Communities Advisory Group (advisory group) met for the first time. Under Public Utilities Code Section 400 (g), the advisory group advises the CPUC and the CEC regarding the development, implementation, and effects of proposed programs related to SB 350 in disadvantaged communities. In its first year of meetings, the advisory group took the following actions related to energy efficiency:

- Identified the Energy Equity Indicators (tool and report) as critical and set out further development of the indicators as a priority (See Goal 2, Component 3)
- Adopted an equity framework
- Provided recommendations for the CPUC proceeding R.15-03-010, examining affordable energy options in San Joaquin Valley communities

The equity framework seeks energy policies and programs that apply health and safety impacts, provide access and education, and give financial benefits, economic development, and consumer protection.[125] More information on the recommendations from the equity framework can be found in the most recent advisory group annual report.[126]

Clean Energy in Low-Income Multifamily Buildings Action Plan

Another recommendation of the Barriers Study called for the development of a "comprehensive action plan to improve opportunities for energy efficiency, renewable energy, demand response, energy storage, and electric vehicle infrastructure for multifamily housing, with attention to pilot programs for multifamily rental properties in low-income and disadvantaged communities" (Barriers Study, p. 5). To address this recommendation, the CEC, with the direction of the Governor's Office and in coordination with other state agencies, developed the CLIMB Action Plan.[127] Adopted in November 2018, the final CLIMB Action Plan identifies current programs and policies, remaining challenges, and concrete actions that the state can take to accelerate the launch of distributed energy resources within California's multifamily housing stock. With a significant portion of low-income Californians living in multifamily buildings, these buildings offer an opportunity, and a challenge, to accelerating the state's clean energy progress and ensuring energy equity.

Many of the CLIMB strategies support and align with goals and strategies in the EBEE Action Plan.[128] For instance, CLIMB strategies to develop a cohesive understanding of the multifamily market support EBEE Action Plan strategies to ensure data-driven decision making. In addition, CLIMB strategies to identify additional resources and deployment opportunities support EBEE Action Plan

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125 *Disadvantaged Communities Advisory Group 2018 Annual Report*, https://efiling.energy.ca.gov/getdocument.aspx?tn=227473.
126 Disadvantaged Communities Advisory Group Web page-https://www.energy.ca.gov/sb350/DCAG/.
127 Haramati, Mikhail, Eugene Lee, Tiffany Mateo, Brian McCollough, Shaun Ransom, Robert Ridgley, and Joseph Sit. 2018. *Clean Energy in Low-Income Multifamily Buildings Action Plan*. California Energy Commission. Publication Number: CEC-300-2018-005-SF. https://efiling.energy.ca.gov/GetDocument.aspx?tn=224513.
128 California Energy Commission. 2016. *Existing Buildings Energy Efficiency Action Plan: 2016 Plan Update*. Publication Number: CEC-400-2016-023SD.

goals for affordable and accessible energy efficiency solutions. Also included in the CLIMB Action Plan are strategies to ensure consumer protection, one of the energy efficiency mandates of SB 350.[129] Furthermore, strategies in the CLIMB Action Plan address recommendations in the Doubling Report, such as expanding funding for LIWP and ensuring adequate reporting of energy efficiency impacts in disadvantaged communities.

Energy Savings Assistance Program

The Energy Savings Assistance (ESA) program provides no-cost home weatherization services, energy efficiency measures, and energy education to help eligible low-income households conserve energy, reduce monthly bills, and improve health, comfort, and safety. Since 2007, the ESA Program has worked toward a 2020 goal to ensure that all eligible low-income electricity and gas customers have the opportunity to participate in low-income energy efficiency programs (Public Utility Code 382.c). From 2007 to 2018, first-time ESA program participants numbered more than 3.1 million households (ESA-CARE Annual Reports). By 2020, IOUs' ESA goal is to increase the 3.1 million household first-time participant count to roughly 3.7 million households statewide. ESA's free services for California's lowest-income families improve daily life with efficiency measures like high-efficiency clothes washers and attic insulation.

The four large IOUs administer the ESA Program—PG&E, SDG&E, SoCalGas, and SCE. Households with total annual incomes at or below 200 percent of the federal poverty guidelines qualify for the ESA program. Participants can be owners or renters in single-family homes, multifamily residences, mobile homes, or certain group homes. In multifamily properties, if 80 percent of tenant households are income-qualified, then the whole property is ESA-eligible. For deed-restricted multifamily properties, if 65 percent of tenant households are income-qualified, then common areas are ESA-eligible.

Environmental and Social Justice Action Plan

In early 2019, the CPUC published the Environmental and Social Justice Action Plan (ESJ Action Plan)[130]. The CPUC is responsible for programs and policies that directly impact environmental and social justice communities via affordable clean energy, among other regulatory issues. The ESJ Action Plan is intended to

129 California Energy Commission. 2016. *Existing Buildings Energy Efficiency Action Plan: 2016 Plan Update*. Publication Number: CEC-400-2016-023SD. Page 4.
130 California Public Utilities Commission, *Environmental and Social Justice Action Plan*. 2019. https://www.cpuc.ca.gov/CPUCNewsDetail.aspx?id=6442461331

provide a broad look at communities long underserved. The ESJ communities are designated as those that are:

- Predominantly communities of color or low-income.
- Underrepresented in setting policies or making decisions.
- Subject to a disproportionate impact from one or more environmental hazards.
- Likely to experience disparate implementation of environmental regulations and socioeconomic investments in their communities.[131]

ESJ communities also include those identified in the top 25 percent of California EPA's CalEnviroScreen,[132] all tribal lands, low-income households,[133] and low-income census tracts.[134]

The CPUC can use the ESJ Action Plan as a roadmap to ensure that it provides resources equitably across California. The goals of the ESJ action plan are to:

- Consistently integrate equity and access considerations throughout CPUC regulatory activities.
- Increase investment in clean energy resources to benefit ESJ communities, especially to improve local air quality and public health.
- Strive to improve access to high-quality water, communications, and transportation services for ESJ communities.
- Increase climate resiliency in ESJ communities.
- Enhance outreach and public participation opportunities for ESJ communities to participate meaningfully in the CPUC's decision-making process and benefit from CPUC programs.
- Enhance enforcement to ensure safety and consumer protection for all, especially for ESJ communities.
- Promote economic and workforce development opportunities in ESJ communities.
- Improve training and staff development related to environmental and social justice issues within the CPUC's jurisdiction.
- Monitor the CPUC's environmental and social justice efforts to evaluate how they are achieving its objectives.

Details for these goals can be found within the ESJ Action Plan.[135] The previously discussed advisory group also provided input to this plan, and recommendations reflecting its inputs are included in the final document.

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131 Government Code Section 65040.12.e.
132 CalEnviroScreen Tool, https://oehha.ca.gov/calenviroscreen/report/calenviroscreen-30.
133 Household incomes below 80 percent of the area median income.
134 Census tracts with household incomes less than 80 percent area or state median income.
135 *CPUC Environmental and Social Justice Action Plan.* 2018, https://www.cpuc.ca.gov/uploadedFiles/CPUCWebsite/Content/About_Us/Organization/Commissioners/Martha_Guzman_Aceves/Env%20and%20Social%20Justice%20ActionPlan_%202019-02-21.docx.pdf.

San Joaquin Valley Proceeding

The CPUC is implementing pilot programs to increase access to affordable energy across several disadvantaged communities in the San Joaquin Valley. Assembly Bill 2672 (Perea, Chapter 616, Statutes of 2015) led the CPUC to initiate proceeding R.15-03-010 to identify communities in need of support in the San Joaquin Valley. The CPUC selected 11 communities as pilot project sites with $56 million in funding. The approved pilots are the following:

- More than 900 homes in Alpaugh, Fairmead, Lanare, La Vina, and Le Grand will be eligible for an electrification project with community solar discount components by a to-be-selected third-party project administrator with a $25,754,613 investment.
- More than 300 homes in Allensworth, Cantua Creek, and Seville will be eligible for an electrification project with community solar discount components to be administered by Pacific Gas and Electric Company with a $9,655,835 investment.
- Nearly 450 homes in California City, Ducor, and West Goshen will be eligible for an electrification project with community solar discount components to be administered by Southern California Edison with a $15,411,008 investment.
- An additional 224 homes in California City will be eligible for a natural gas project including gas line extensions and appliance replacements, to be administered by Southern California Gas Company with a $5,591,100 investment.

Implementation and final planning of the pilots are underway with expected completion by 2021. During implementation, the CPUC will evaluate progress, collect data, and determine next steps.

Stakeholder Feedback

During the five workshops to inform this action plan, and in response to questions in the workshop notice, stakeholders had considerable feedback regarding low-income and disadvantaged community issues. Several workshop panels focused on breaking down barriers in the multifamily energy efficiency market, which specifically affect low-income and disadvantaged communities. Panelists pointed to the need for more affordable housing funding, for continuation of incentives so developers can rely on them throughout various retrofits, and for improved alignment of funding requirements. Also, stakeholders praised technical assistance, like that offered by the LIWP program. Several panelists pointed to the success of the LIWP program and stated that the framework of the program allowed them to go after deeper retrofits than a traditional efficiency program. SCE pointed out in comments that direct installation programs have shown the best success when trying to target low-income or disadvantaged communities. SCE representatives point out that the San

Joaquin Valley proceeding (discussed in Component 2, Goal 2) can teach a lot about the best pathways to improve conditions in low-income, disadvantaged communities.

Component 2: Rural and Hard-to-Reach Barriers

Rural and hard-to-reach communities face similar, yet unique, barriers to those in low-income or disadvantaged communities. The CPUC Energy Efficiency Policy Manual[136] defines hard-to-reach residential customers as "those customers who do not have easy access to program information or generally do not participate in energy efficiency programs due to a language, income, housing type, geographic, or home ownership (split incentives) barrier." This definition is joined by 15 other definitions the federal government used to define rural communities.[137] The CPUC uses its authority to direct resources to rural areas through the IOUs' abilities to claim a higher net-to-gross ratio for serving hard-to-reach customers. This policy helps utilities meet their efficiency goals. Another actor in this effort is California's Rural Hard-to-Reach Local Government Partnership, a working group that convenes quarterly to discuss practices for delivering efficiency to less-densely populated regions.

CPUC Identified Rural and Hard-to-Reach Barriers

When people think of rural communities, they often only include geography. But California faces a diverse set of issues when reaching rural communities. The CPUC has outlined the primary barriers it sees to reaching rural and hard-to-reach communities.

- Geographic—Businesses or homes in areas other than the United States Office of Management and Budget Combined Statistical Areas of the San Francisco Bay Area, the Greater Los Angeles Area and the Greater Sacramento Area, or the Office of Management and Budget metropolitan statistical areas of San Diego County
- Language—Households where the primary language spoken is other than English
- Income—Those customers who qualify for the California Alternative Rates for Energy or the Family Electric Rate Assistance Program
- Housing Type—Multifamily and mobile home tenants (rent and lease)

136 *CPUC Energy Efficiency Policy Manual*,https://www.cpuc.ca.gov/uploadedFiles/CPUC_Public_Website/Content/Utilities_and_Industries/Energy_-_Electricity_and_Natural_Gas/EEPolicyManualV5forPDF.pdf.
137 *Reaching Rural Communities With Energy Efficiency Programs,* pg.2, ACEEE, 2018, https://aceee.org/sites/default/files/publications/researchreports/u1807.pdf.

ACEEE Report—Reaching Rural Communities With Energy Efficiency Programs

In 2018, American Council Energy Efficient Economy (ACEEE) released a report documenting the barriers and highlighting successes to implementing energy efficiency in rural communities.[138] The report defines "rural communities" as those with fewer than 50,000 inhabitants. The infrastructure, fuel mix, and climates often vary in rural areas relative to metropolitan regions, making one-size-fits-all utility program offerings more challenging. The households also tend to have higher energy burdens than the median for their region. ACEEE identified the main challenges to implementing efficiency as:

- Low population density.
- Lack of broadband access.
- Customer reluctance.
- Shortage of qualified local energy efficiency workers.
- Financial constraints.
- High program delivery costs.
- Insufficient data collection.
- Efforts among state agencies.

Nationwide, rural housing is made up of older and geographically dispersed homes. Nearly one-third of rural households experience energy insecurity.[139] Moreover, these homes tend to rely on heating fuels such as fuel oil, propane, and wood burning, which can come with higher costs and poor indoor air quality. In California, these areas may also be more prone to wildfires and electrical blackouts. Energy efficiency and resiliency measures are crucial to keeping rural households safe and free of energy burden.

As an example, the Sierra Nevada Energy Watch, a local government partnership program implemented by PG&E and the Sierra Business Council, was called out by ACEEE as an effective tool in the state.[140] As the lead local partner, the Sierra Business Council oversaw direct-installation efficiency projects and conducted outreach to local government agencies and small businesses. PG&E provided technical assistance and identified energy efficiency measures for program participants. The program offered small businesses direct-install measures, building benchmarking, climate action plan development, funding of

138 *Reaching Rural Communities With Energy Efficiency Programs*. ACEEE. 2018, https://aceee.org/sites/default/files/publications/researchreports/u1807.pdf.
139 One in three U.S. households faced challenges in paying energy bills in 2015. US EIA, https://www.eia.gov/consumption/residential/reports/2015/energybills/.
140 *Reaching Rural Communities With Energy Efficiency Programs*, pg.20-22. ACEEE. 2018, https://aceee.org/sites/default/files/publications/researchreports/u1807.pdf.

local government energy and climate meetings, and education.[141] The Sierra Nevada Business Council faced many challenges running the program, such as staff availability and retention in local governments, travel to cover the large territory, and customer skepticism. These issues and other policy decisions have pushed the program to be non-cost-effective. Therefore, the Sierra Nevada Business Council will no longer offer the direct installation part of the partnership.[142] However, the program model is good for regional direct-installation working groups to address rural issues, division of labor among partners, and a dual focus on saving energy and building capacity for local governments. This program model could effectively be leveraged by other state agencies or utilities in rural areas.

The ACEEE report recommends states do the following to improve efficiency uptake in rural regions:

- Offer incentives to utilities to deliver energy efficiency in rural areas
    - Leverage public dollars to lower the costs for program implementers to work in these areas
    - Continue to fund entities designed to implement efficiency in rural and hard-to-reach areas
- Create programs that combine state with federal funding
    - For example, leverage LIHEAP and the U.S. Department of Agriculture's (USDA's) Rural Energy for America Program resources in conjunction with the CSD-led farm worker housing or CPUCs ESA programs
- Partner with local implementers who know the needs of the community
- Have programs work with local contracting firms and use local marketing strategies
- Have programs keep communitywide economic development impacts in mind
- Support local workforce through programs
- Combine programs and funding, for example, water conservation and renewable energy resources
- When possible, try to bundle measures and install at households or businesses near one another to lower costs

Stakeholder Feedback on Rural Communities

The CEC received comments from rural community stakeholders at regional workshops and in the docket. The Sierra Business Council suggested that direct-installation programs are best suited for rural regions where customers have

141 Reaching Rural Communities With Energy Efficiency Programs, pg.20. ACEEE. 2018, https://aceee.org/sites/default/files/publications/researchreports/u1807.pdf.
142 2019 California Energy Efficiency Action Plan Workshop-Redding transcript. https://efiling.energy.ca.gov/getdocument.aspx?tn=228059j.

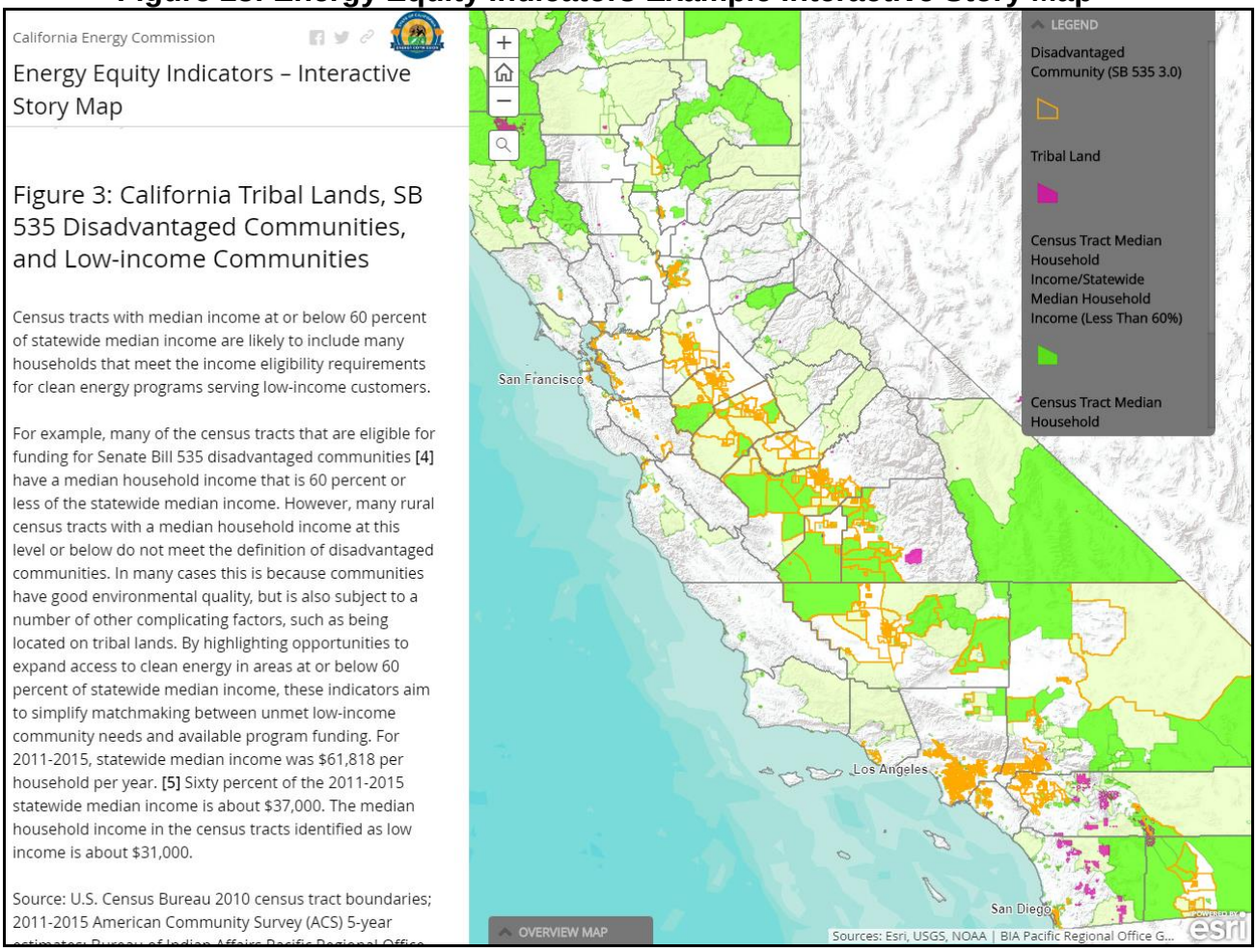
limited broadband access and may be less trusting of government programs. Education on energy options is a major barrier to success in rural regions, and local governments are best suited to deliver the outreach and education needed to be successful. Stakeholders stressed that rural regions cannot be cut off just because the cost-effectiveness criteria don't pencil out. The cobenefits of working in these regions, which are largely not quantifiable, make efficiency programs worthwhile. Stakeholders also raised the importance of local communities taking control of energy efficiency dollars in their region to ensure the programs work everywhere, including rural regions. It was suggested by the Sierra Business Council to make more data available to local governments, especially in rural communities where strategic planning is even more important to maintain cost-effectiveness.

Component 3: Tracking Equity

In June 2018, the CEC published the *Energy Equity Indicators Tracking Progress* Report[143] (Equity Indicators Report) to advance implementation of the Barriers Study recommendations. The Equity Indicators Report outlines a set of energy equity metrics to better track progress toward achieving the Barriers Study recommendations. The report includes nine indicators relating to clean energy access, investment, and resilience in California's low-income and disadvantaged communities. The report is accompanied by an interactive map,[144] which highlights key opportunities to advance clean energy in low-income and disadvantaged communities (Figure 23). The map allows stakeholders to focus on metrics and locations for their own analyses. The California Air Resources Board (CARB) is working closely with the CEC to identify metrics to ensure increased access to clean transportation programs. CEC staff will annually update the Equity Indicators Report.

143 "Energy Equity Indicators Tracking Progress Report." California Energy Commission, June 2018, https://efiling.energy.ca.gov/GetDocument.aspx?tn=223922.
144 "Energy Equity Indicators." California Energy Commission, https://www.energy.ca.gov/sb350/barriers_report/equity-indicators.html.

Figure 23: Energy Equity Indicators Example Interactive Story Map



Source: CEC

The energy equity indicators tool allows the user to overlay data sets to identify areas of need. For example, in the 2018 update, the map was used to show where low levels of energy efficiency participation overlap with low levels of energy efficiency investment near low-income areas, especially where older homes exist. These areas had on average 8 households per 1,000 participating in energy efficiency programs.[145] The tool identified locations where opportunities for launching additional regional services exist to improve program delivery. This tool can also be used by local governments to understand where vulnerable populations exist and where to direct funding for clean energy initiatives.

Energy Savings in Low-Income and Disadvantaged Communities

The updated SB 350 targets allow for disaggregation, or breakdown, of savings attributed to disadvantaged communities and low-income households. Values

145 Energy Equity Indicators Report, pg. 18. June 2018, https://efiling.energy.ca.gov/GetDocument.aspx?tn=223922.

are disaggregated based on the proportion of disadvantaged communities reported in the CalEnviroScreen 3.0 tool and the percentage of low-income households from the area's median income data (Table 10).

Table 10: Estimated Savings Attributed to Low-Income and Disadvantaged Communities

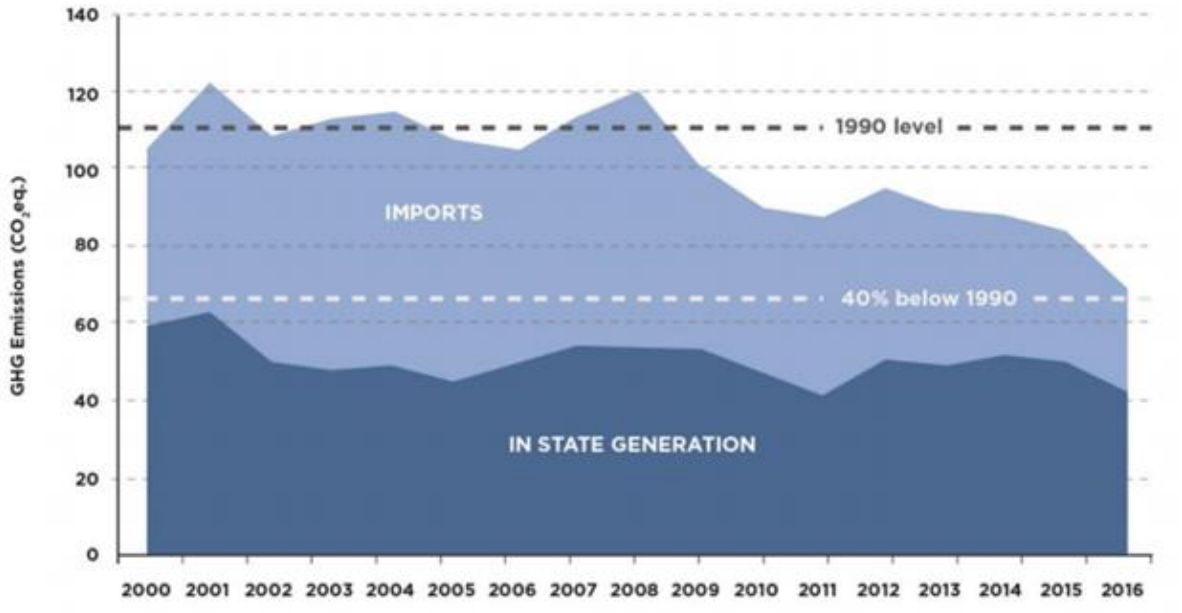
[Data for tables is still in development]

Goal 3: Reducing Greenhouse Gas Emissions From Buildings

Overview

For California to achieve its ambitious goals to combat climate change, the state must decarbonize its buildings. California continues to be a national leader in energy efficiency and renewable energy, yet the state's buildings rely heavily on fossil fuels for water and space heating, and for cooking. California's electric grid can provide the backbone for building decarbonization through building electrification, with the electricity sector leading the state in emissions reductions by achieving GHG emissions 37.6 percent lower than 1990 levels in 2016 (Figure 24). Even as the state creates a pathway to electrify new homes, existing homes and businesses will remain a challenge. Other challenges exist to build low-carbon commercial and industrial buildings and reliably satisfy greater demand resulting from electrifying transportation, space heating, and water heating. Buildings must be transformed from contributors of carbon emissions into clean distributed energy resources for the state via effective policies, creative financing, and new technologies.

Figure 24: GHG Emissions from California's Electricity Sector Continue to Decline (Million Metric Tons)



Source: California Independent System Operator

California's GHG emission reduction strategies are driven by Senate Bill 32 (SB 32; Pavley, Chapter 249, Statutes of 2016) and Assembly Bill 32 (AB 32; Núñez, Chapter 488, Statues of 2006). In 2016, SB 32 set a statewide requirement to reduce California's GHG emissions 40 percent below 1990 levels by 2030, building on the AB 32 requirement to reduce GHG emissions to 1990 levels by 2020. The state is on track to exceed its AB 32 goal next year. The state has subsequently updated its emissions goals, seeking to reduce GHG emissions 80 percent below 1990 levels by 2050 and to achieve economywide carbon neutrality by 2045. Senate Bill 100 (De León, Chapter 312, Statutes of 2018) sets a planning target of having renewable resources and zero-carbon electricity resources serve 100 percent of California's electricity use by 2045 and increases the 2030 Renewables Portfolio Standard target from 50 percent to 60 percent (See IEPR 2018, Chapter 3 for further discussion).

Assembly Bill 3232 (Friedman, Chapter 373, Statutes of 2018) and Senate Bill 1477 (Stern, Chapter 378, Statutes of 2018) directly address GHG emissions from the building sector. AB 3232 directs the CEC to assess the potential for buildings to reach a 40 percent reduction in GHG emissions, relative to 1990, by 2030. SB 1477 sets the stage for market transformation to zero-emission space- and water-heating equipment in buildings. In conjunction with the goal of doubling energy

efficiency by 2030 as mandated by SB 350, AB 3232 and SB 1477 lay out a clear vision for establishing a building sector that has a reduced reliance on natural gas and uses electricity more efficiently.

There is a growing consensus that building electrification is the most viable and least-cost path to zero-emission buildings. With natural gas comprising half of the energy consumed by California's buildings, complete electrification can greatly reduce buildings' GHG emissions, including the methane emissions associated with natural gas use. Carbon dioxide (CO_2) reductions will accelerate as the electricity system becomes cleaner with large increases in renewable resources (See IEPR 2018, Chapter 3). Renewable gas can be a part of the solution to reduce GHG emissions from buildings, but the role is likely to be constrained by limitations on its availability, cost, and leakage concerns.

University of California and California State University Decarbonization Pilots

The University of California (UC) and California State University (CSU) systems have partnered with SCE to pilot a performance-based, GHG reduction program, known as the Clean Energy Optimization Pilot. The four-year, $20 million program provides financial incentives to university systems to identify and install clean energy technologies. Incentive levels are based on actual metered results. The program is not limited to a prescriptive approach but allows for energy and cogeneration efficiency measures, on-site renewable energy, clean transportation, and energy storage.

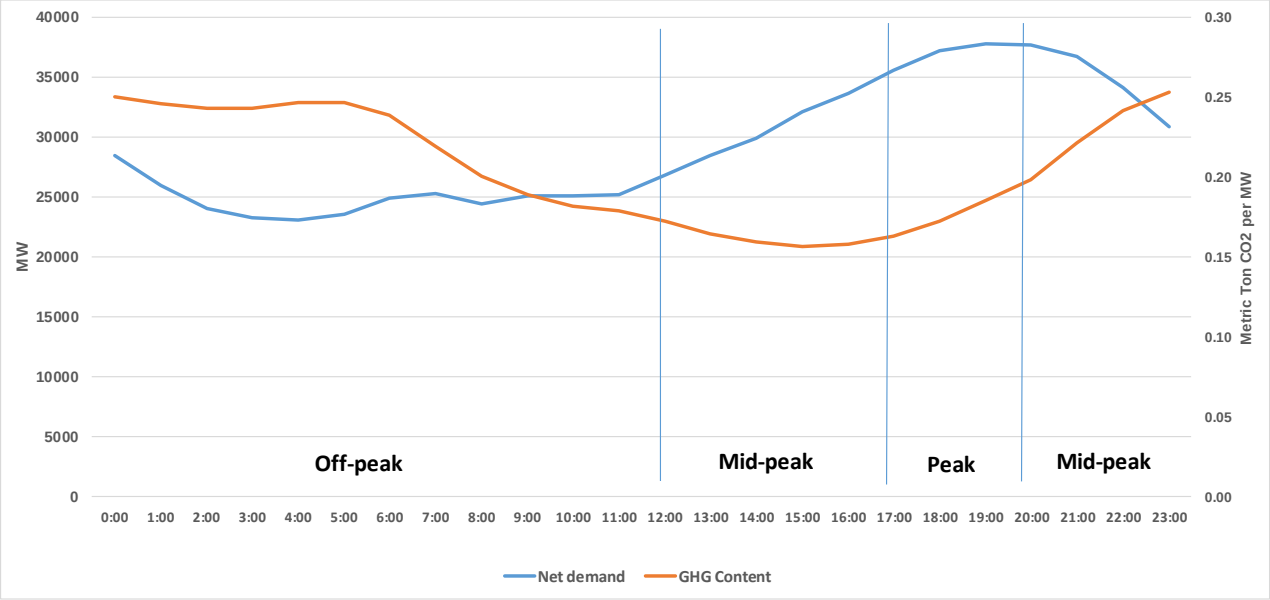
Seven sites across the two university systems have been selected to participate: UC Davis Veterinary Lab, UC Irvine Medical Center, UC Irvine, UCLA Medical Center, UC Santa Barbara, CSU- Pomona, and CSU-Dominguez Hills.

1: https://energized.edison.com/stories/fighting-climate-change-through-higher-education

In particular, electrification of space and water heating with highly efficient technologies, coupled with strategies to shift energy consumption in real-time, are key to reducing emissions from buildings. For example, time-of-use rates and demand response can shift the timing of energy consumption in buildings to coincide with peak solar production during midafternoon, when emissions are lowest (Figure 25). Replacing carbon-intensive power generation with renewable power will cut emissions for all end uses, including buildings. The expected shift in the GHG content of the electricity grid between 2019 and 2030

from added renewable generation is illustrated in Figures 26 and 27.[146] Strategies employed must also encourage the use of refrigerants with low global warming potentials and otherwise reduce GHG emissions associated with refrigerants. Effective statewide building decarbonization efforts will seek to increase the share of renewable generation on the electricity grid, lower barriers to building electrification, and increase energy efficiency, all while coordinating efforts to reduce electricity consumption when the GHG intensity of electricity is highest.

Figure 25: Net Demand Versus GHG Content of Electricity During Time of Use



Source: CEC and SMUD

Tools for advancing building decarbonization efforts include legislation, codes and standards, better financing models and integration of building decarbonization into energy efficiency programs and independent local action. In July 2019, the CPUC voted to permit the use of ratepayer energy efficiency program funds for building decarbonization fuel substitution.[147] Additionally, local governments across California are adopting reach building codes or using local police powers to further electrification efforts in their cities. In June 2019, Berkeley, CA, became the first city in the United States to ban natural gas in new construction using its police powers.[148] Envisioning zero-carbon buildings also requires better integration of enhanced building performance policies with local land use decision-making to promote walkable and transit-oriented

146 Emissions intensities are shaded from green to red; green is the lowest GHG content periods and red is the greatest GHG content periods. Periods of lowest-GHG intensity electricity coincide with high solar PV generation.
147 CPUC Decision 19-08-009, Modifying the Energy Efficiency Three-Prong Test Related to Fuel Substitution.
148 Ordinance NO. 7,672-N.S, City of Berkeley, City Council July 23, 2019 Meeting, https://www.cityofberkeley.info/Clerk/City_Council/2019/07_Jul/City_Council__07-23-2019_-_Regular_Meeting_Agenda.aspx

development that will pave the way for higher-performing and healthier buildings and communities for all.

Figure 26: 2019 System Average Metric Ton CO_2 per MW

Month	January	February	March	April	May	June	July	August	September	October	November	December
Hour 1	0.24	0.23	0.21	0.20	0.20	0.20	0.25	0.27	0.27	0.26	0.26	0.26
Hour 2	0.24	0.23	0.21	0.20	0.20	0.20	0.25	0.26	0.27	0.26	0.26	0.26
Hour 3	0.24	0.22	0.21	0.20	0.20	0.20	0.24	0.26	0.27	0.26	0.26	0.26
Hour 4	0.24	0.22	0.21	0.20	0.20	0.20	0.24	0.26	0.27	0.26	0.26	0.26
Hour 5	0.24	0.22	0.20	0.18	0.19	0.20	0.25	0.27	0.27	0.26	0.26	0.26
Hour 6	0.23	0.22	0.19	0.18	0.18	0.19	0.25	0.27	0.27	0.25	0.26	0.25
Hour 7	0.22	0.21	0.19	0.18	0.18	0.18	0.24	0.26	0.27	0.25	0.25	0.25
Hour 8	0.22	0.21	0.19	0.17	0.17	0.17	0.22	0.25	0.26	0.25	0.24	0.24
Hour 9	0.21	0.18	0.16	0.15	0.15	0.15	0.20	0.21	0.22	0.21	0.21	0.21
Hour 10	0.18	0.15	0.14	0.13	0.14	0.14	0.19	0.19	0.21	0.19	0.19	0.19
Hour 11	0.18	0.14	0.13	0.13	0.13	0.13	0.18	0.19	0.20	0.18	0.19	0.17
Hour 12	0.17	0.14	0.13	0.13	0.13	0.13	0.18	0.19	0.19	0.17	0.19	0.17
Hour 13	0.17	0.14	0.13	0.13	0.13	0.13	0.17	0.19	0.20	0.17	0.19	0.18
Hour 14	0.18	0.15	0.13	0.13	0.13	0.13	0.16	0.18	0.20	0.18	0.19	0.18
Hour 15	0.19	0.16	0.14	0.13	0.13	0.13	0.16	0.18	0.20	0.19	0.21	0.20
Hour 16	0.22	0.18	0.15	0.14	0.13	0.13	0.16	0.17	0.19	0.20	0.23	0.23
Hour 17	0.21	0.21	0.17	0.15	0.13	0.13	0.16	0.17	0.20	0.21	0.22	0.22
Hour 18	0.20	0.19	0.17	0.15	0.13	0.13	0.16	0.18	0.20	0.20	0.22	0.22
Hour 19	0.21	0.19	0.17	0.14	0.14	0.13	0.17	0.19	0.21	0.21	0.22	0.22
Hour 20	0.21	0.20	0.17	0.15	0.14	0.14	0.18	0.20	0.23	0.22	0.23	0.22
Hour 21	0.22	0.21	0.18	0.16	0.15	0.15	0.20	0.22	0.25	0.24	0.24	0.24
Hour 22	0.24	0.22	0.20	0.17	0.16	0.16	0.22	0.25	0.27	0.26	0.25	0.25
Hour 23	0.25	0.23	0.20	0.18	0.18	0.17	0.24	0.27	0.28	0.27	0.27	0.26
Hour 24	0.25	0.23	0.21	0.19	0.19	0.19	0.25	0.27	0.27	0.26	0.27	0.26

Source: CEC

Figure 27: 2030 System Average Metric Ton CO_2 per MW

Month	January	February	March	April	May	June	July	August	September	October	November	December
Hour 1	0.22	0.22	0.19	0.16	0.14	0.14	0.21	0.25	0.25	0.23	0.22	0.23
Hour 2	0.22	0.22	0.19	0.16	0.15	0.14	0.22	0.25	0.25	0.23	0.22	0.23
Hour 3	0.22	0.21	0.19	0.16	0.15	0.15	0.22	0.25	0.25	0.23	0.22	0.23
Hour 4	0.21	0.21	0.19	0.16	0.14	0.14	0.22	0.25	0.25	0.23	0.22	0.22
Hour 5	0.21	0.21	0.18	0.14	0.14	0.14	0.21	0.24	0.24	0.22	0.22	0.22
Hour 6	0.20	0.19	0.17	0.14	0.13	0.14	0.21	0.24	0.24	0.22	0.21	0.21
Hour 7	0.19	0.19	0.17	0.14	0.14	0.14	0.20	0.23	0.24	0.22	0.20	0.21
Hour 8	0.19	0.18	0.16	0.11	0.09	0.09	0.14	0.16	0.20	0.20	0.18	0.20
Hour 9	0.13	0.11	0.10	0.09	0.08	0.08	0.11	0.13	0.13	0.12	0.11	0.13
Hour 10	0.11	0.09	0.09	0.08	0.08	0.08	0.10	0.11	0.12	0.10	0.10	0.11
Hour 11	0.10	0.09	0.09	0.08	0.08	0.08	0.10	0.11	0.11	0.10	0.10	0.11
Hour 12	0.10	0.09	0.09	0.08	0.08	0.08	0.10	0.11	0.11	0.10	0.10	0.10
Hour 13	0.10	0.09	0.09	0.08	0.08	0.08	0.10	0.11	0.11	0.10	0.10	0.11
Hour 14	0.10	0.09	0.08	0.08	0.08	0.08	0.11	0.12	0.12	0.10	0.10	0.11
Hour 15	0.11	0.09	0.08	0.08	0.07	0.07	0.12	0.13	0.13	0.10	0.11	0.12
Hour 16	0.16	0.11	0.09	0.08	0.08	0.08	0.13	0.15	0.15	0.13	0.17	0.18
Hour 17	0.19	0.18	0.13	0.09	0.09	0.09	0.14	0.16	0.17	0.16	0.18	0.19
Hour 18	0.17	0.17	0.15	0.12	0.10	0.10	0.14	0.16	0.17	0.16	0.17	0.17
Hour 19	0.17	0.16	0.14	0.11	0.10	0.10	0.15	0.17	0.18	0.16	0.17	0.18
Hour 20	0.18	0.16	0.14	0.12	0.11	0.11	0.16	0.17	0.19	0.17	0.18	0.18
Hour 21	0.18	0.17	0.15	0.12	0.11	0.11	0.17	0.19	0.20	0.19	0.18	0.19
Hour 22	0.20	0.19	0.16	0.13	0.11	0.11	0.17	0.20	0.22	0.21	0.20	0.21
Hour 23	0.22	0.21	0.18	0.14	0.12	0.12	0.18	0.22	0.24	0.23	0.21	0.22
Hour 24	0.22	0.21	0.19	0.15	0.13	0.13	0.20	0.24	0.25	0.23	0.22	0.23

Source: CEC

SB 1477 and AB 3232 Implementation

Before 2018, decarbonization efforts were limited to fuel-switching to zero-emission options in the fossil fuel-dominated transportation sector. SB 1477 and AB 3232 widened the decarbonization scope to include reducing the carbon footprint of buildings, moving beyond advancing energy efficiency and zero-emission buildings. Altogether, buildings produce 12 percent of statewide GHG

emissions.[149] However, this figure consists only of on-site emissions; total GHG emissions attributable to buildings drastically increase when factoring in upstream emissions due to the transportation, storage, and delivery of the natural gas used in those buildings.

SB 1477 authorizes two incentive programs to spur market development for clean, near-zero-emission building equipment. To support that technical goal, the bill directs $50 million per year, through 2023, to the Building Initiative for Low-Emissions Development (BUILD) and the Technology and Equipment for Clean Heating (TECH) programs. The programs promote retirement and replacement of conventional appliances, such as gas water heaters and gas space heaters, with low-, or zero-emissions electric equipment.

The CPUC opened the proceeding for SB 1477 in January 2019. The rulemaking is dubbed Building Decarbonization and is filed under R.19-01-011.[150] The proposed scope includes four issues:

- Implementing BUILD and TECH as spelled out in SB 1477
- Launching programs to address new construction in areas damaged by wildfires
- Coordinating CPUC policies with Title 24 building energy efficiency standards and Title 20 appliance efficiency standards
- Establishing a building decarbonization policy framework

AB 3232 directs the CEC to assess the potential for reducing building GHG emissions 40 percent below 1990 levels by 2030. Assessment findings are due to the Legislature in January 2021. To start the assessment, the CEC is reviewing data on GHG emissions to inform an effective baseline that will clarify which emissions to include or exclude, from site to source.

Building Decarbonization Technology and Research

Energy research, development, and demonstration (RD&D) that supports and advances technologies to improve reliability, affordability, and public health and safety is vital to achieving California's energy and climate goals. The CEC is researching low- and no-carbon alternatives for space heating, water heating, and cooking in buildings.[151] The goal is to obtain technical and economic data needed to verify the benefits of installation. In addition, real-world feedback is collected from consumers on the use of these technologies.

149 CARB, GHG inventory, 2016, https://ww3.arb.ca.gov/cc/inventory/data/data.htm.
150 CPUC opened the order instituting rulemaking regarding building in November 2018, R.19-01-011.
151 Energy Commission research projects are available to review at http://innovation.energy.ca.gov/SearchHome.aspx?ti=636942212481590669

The following research projects focus on innovative approaches that reduce the carbon intensity of space-conditioning in buildings:

- Testing HVAC supporting technologies and analyzing integration into a single system. Technologies analyzed included a variable-capacity compressor, variable-speed blower, automated DR, intelligent dual-fuel heating, and zonal controls. The project includes testing a single-family residential heat pump conditioning system optimized for California climates.[152]
- Evaluating operational performance issues and market barriers of heat pump technology.[153] This work will assess barriers to further adoption of heat pumps across markets to support electrification goals.
- Reviewing cost-effective and integrated demand-side retrofits in multifamily buildings.[154] Example measures include smart thermostats, plug-load controls, and central system heat pump water heating. The project will focus on solutions to maximize building decarbonization in retrofit markets.

The CEC is also researching fuel substitution and energy efficiency in commercial food service to identify opportunities to reduce the industry's energy intensity while maintaining the ability to meet customer desires:

- Test data show that plug-in commercial food service equipment has a wide range of energy intensity. Research is testing an electric cooktop that may be more efficient than induction cooktops. The conduction-cooking system has specialized double-walled, vacuum-sealed pots. Research includes determining energy savings, cooking times, and other parameters of interest to food service operators. Energy savings are claimed to be 250 percent versus comparable electric cooktops.[155]
- A commercial kitchen project is assessing the potential reduction of electricity of commercial plug loads from food service equipment. It also demonstrates the potential for reduced energy consumption through the use of innovative pre-commercial appliance technologies and control technologies.[156]

152 Grant EPC-14-021, Development and Testing of the Next Generation Residential Space Conditioning System for California, http://innovation.energy.ca.gov/SearchResultProject.aspx?p=30005&tks=636963103836691770.
153 Work Authorization NAV-15-007, Heat Pump Technology Performance and Barriers and Recommendations for EPIC Research, Development, and Demonstration Activities.
154 Grant EPC-15-053, Customer-Centric Approach to Scaling Integrated Demand Side Management Retrofits, http://innovation.energy.ca.gov/SearchResultProject.aspx?p=30924&tks=636963114547718447
155 Grant EPC-15-027, Electric Plug Load Savings Potential of Commercial Foodservice Equipment http://innovation.energy.ca.gov/SearchResultProject.aspx?p=30957&tks=636966615302804813
156 EPIC Grant EPC-15-027

Pathway for Building Electrification within Energy Code

Building electrification is achievable with current building science and technology, and has become an accessible path for local jurisdictions seeking to adopt reach building codes that support their climate plans. The City of Berkeley represents a leading locality in building electrification, having passed a ban on natural gas in new low-rise residential buildings, effective January 2020. Space heating and water heating remain two of the largest energy loads in buildings, and natural gas is the dominate source for both these end-uses. Recent Energy Code updates for new home construction have included critical changes to ensure the code does not prevent electrifying these heating loads. Future code updates will need to continue this work for newly constructed commercial buildings and facilities.

The 2019 BEES update took two steps towards electrification:

1. It removed language that required gas appliances in new residential dwellings, allowing all-electric buildings that can avoid gas-piping installation costs.
2. It established an all-electric prescriptive compliance path for residential buildings.[157]

The 2019 BEES take effect January 1, 2020. The benefits provided by electrification include many direct benefits to homeowners and tenants. Reductions in on-site combustion, particularly for cooking, directly improves indoor air quality and reduces concentrations of criteria pollutants.

In the 2022 BEES update, the CEC plans to focus on energy efficiency in multifamily buildings. This update will address additional barriers to building electrification, ensuring that all-electric pathways are available to all types of multifamily construction.

For commercial buildings, the CEC must first establish an all-electric baseline, starting with the most common building types. Commercial buildings have much more varied designs than residential dwellings, and electric equivalents to commercial gas equipment are not available for some applications. There is also a need to integrate demand responsive technologies to support a communicating energy grid that can cost-effectively integrate renewable generation.

Grid Interactivity and Renewable Energy Support

Heat pump water and space heating can support renewable energy integration and serve as an energy storage resource. Making small adjustments

157 The "prescriptive compliance path" in the Energy Code is the default baseline design defined in the code. The alternative is the optional "performance compliance path" which requires modeling the proposed project, and showing it just as or more energy efficient as the prescriptive path.

in space conditioning schedules and using heat pump hot water heaters as thermal storage are effective strategies for absorbing excess renewable generation from solar during the middle of the day and shifting it to meet late afternoon peak loads that occur after the sun sets. With the right automation, grid-level signals can allow devices to minimize their impact on the distribution grid while maintaining or improving their ability to meet customer needs.

The greater the penetration of these systems into the built environment, the greater their potential to absorb excess capacity and reduce grid stress from intermittent renewable generation, such as wind and solar. Optimizing demand flexibility will pave the way for deployment of additional renewable resources and the eventual transition to a zero-carbon grid while reducing the potential impacts of rapid electrification on California's electricity distribution infrastructure.

Energy Efficiency Savings from Goals

SB 350 directed the CEC, in consultation with stakeholders, to set annual energy efficiency targets that result in a cumulative doubling of energy efficiency savings by 2030, and then to identify all possible cost-effective, feasible, and reliable energy efficiency savings. The initial savings identified in 2017, included savings from ratepayer and beyond-ratepayer programs, as well as, possible market transformation efforts. Projected energy efficiency savings from ratepayer programs come from IOU and POU historical and forecast reports. Beyond-ratepayer energy efficiency savings come from multiple sources including state agencies, PACE, and codes and standards. The initial target setting effort revealed the scale of savings needed in order to meet the goal. Staff and contractors projected energy efficiency savings for electricity in gigawatt-hours (GWh) and for natural gas in millions of therms (MM therms or 1 million therms). The combined energy savings projections from electricity and natural gas are also represented in British thermal units (BTUs).

Updated SB 350 Doubling Targets [DRAFT- Incomplete Data]

Since the initial target setting process[158], the CEC has moved several methodology improvements forward. CEC staff improved and created new tools to track individual beyond-ratepayer program contributions. This includes estimating end-use impacts in programs, estimating the share of savings between utility territories, and improving savings decay estimates based on effective useful life of measures installed. The targets now include improved agricultural and industrial savings forecasts beyond those offered in ratepayer portfolios and conservation voltage reduction estimates. CEC staff updated

158 For the complete initial target setting process, please see Chapter 2 and Attachments in the Senate Bill 350 Doubling Energy Efficiency by 2030 Report, https://ww2.energy.ca.gov/sb350/doubling_efficiency_savings/

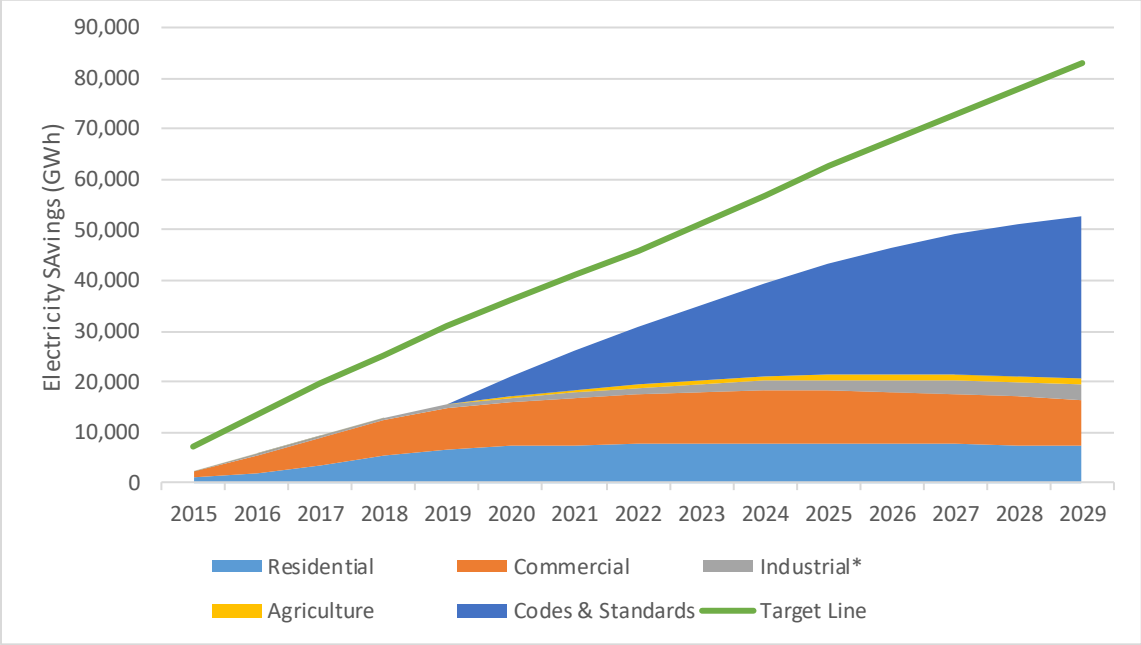
data for several programs including: Proposition 39, ECAA, BEES, appliance standards, PACE, and LIWP. Many other programs received minor updates or small forecasting improvements. A full report of the changes made is available in Attachment 1 (Navigant report to CEC). Individual program workbooks and the master target spreadsheet are also available.

[Note for the draft action plan SB 350 targets- codes and standards are based on IOU historical values and the 2019 Potential and Goals Study, which have been extrapolated to cover total, statewide codes and standards savings. This only includes savings up to the 2022 code cycle, not future code cycles. The building standards, appliance standards, or federal appliances beyond-ratepayer savings are not included as targets are still in development. Those will be included in the final draft. Codes and standards impacts are available for disadvantaged communities, but not low-income households, as staff prepare sector disaggregation.]

SB 350 Doubling Efficiency Targets- Electricity

The statewide cumulative savings target for electricity is updated in Figure 28. The majority of savings are expected to come from codes and standards. Expected savings are still below the 2030 electricity goal and have changed X percent from the initial target setting.[159]

Figure 28: SB 350 Electricity Efficiency Savings (GWh)



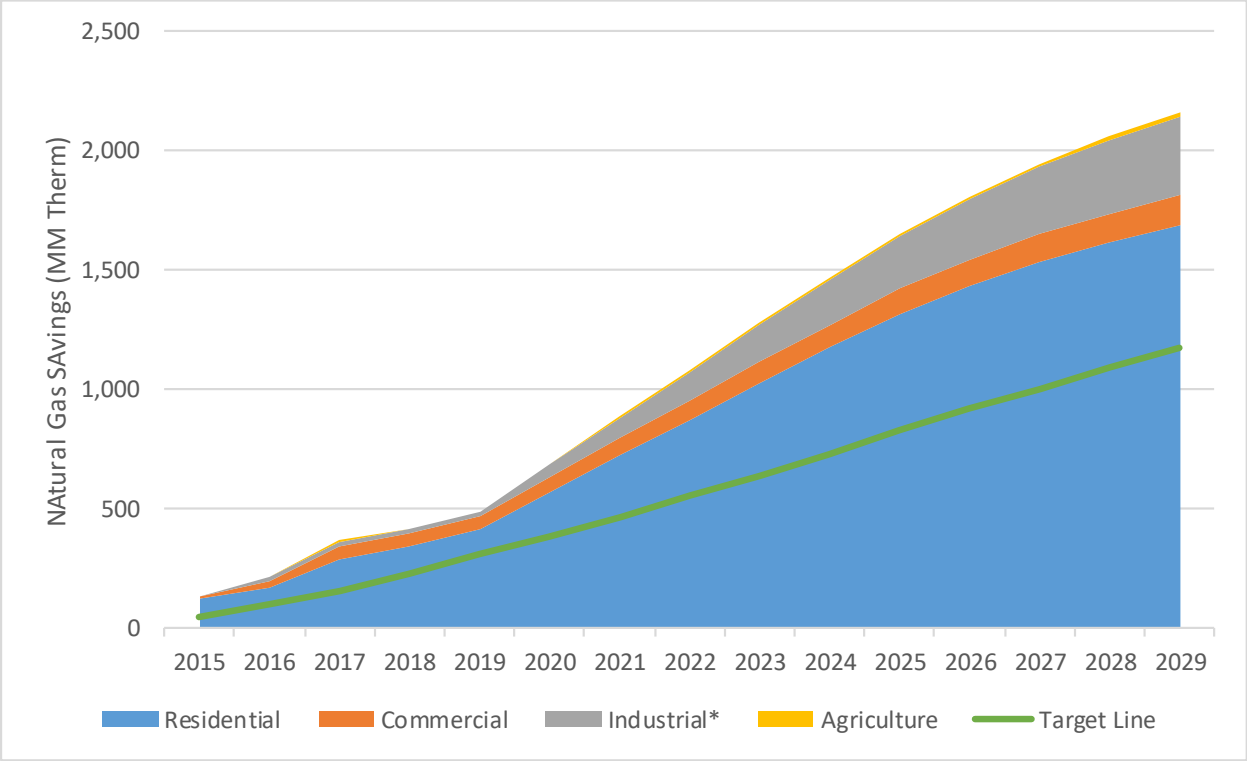
Source: CEC

159 * Savings from industrial sector include street lighting and mining programs.

SB 350 Doubling Efficiency Targets- Natural Gas

The statewide cumulative savings target for natural gas is updated in Figure 29. The majority of savings come from the residential sector. The savings in that sector are driven primarily by codes and standards. The CEC expects the state to surpass the 2030 goal, for natural gas only, about seven years early. The cumulative savings changed X percent from the initial target setting.

Figure 29: SB 350 Natural Gas Efficiency Savings (MM therm)

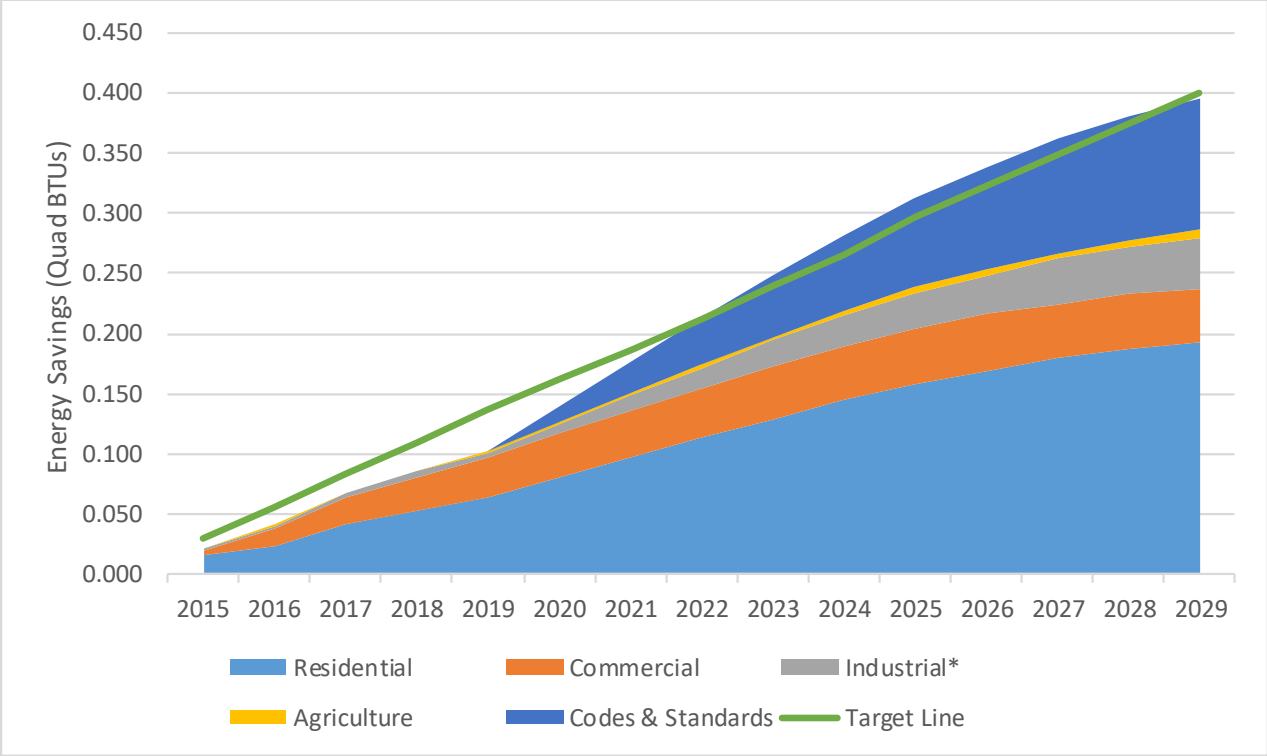


Source: CEC

SB 350 Doubling Efficiency Targets- Combined

The updated combined electricity and natural savings indicate California will just meet the 2030 goal (Figure 30). The savings are driven by the residential sector, and codes and standards. The overall savings changed by X percent from the initial target setting.

Figure 30: SB 350 Combined Energy Efficiency Savings (Quad BTUs)



Source: CEC

While the targets indicate the state can meet the 2030 goal, it is imperative that significant market transformation occurs and that the market also begins to look at GHG emissions just as crucially as energy savings.

Conversion of Efficiency Savings to Avoided Greenhouse Gas Emissions

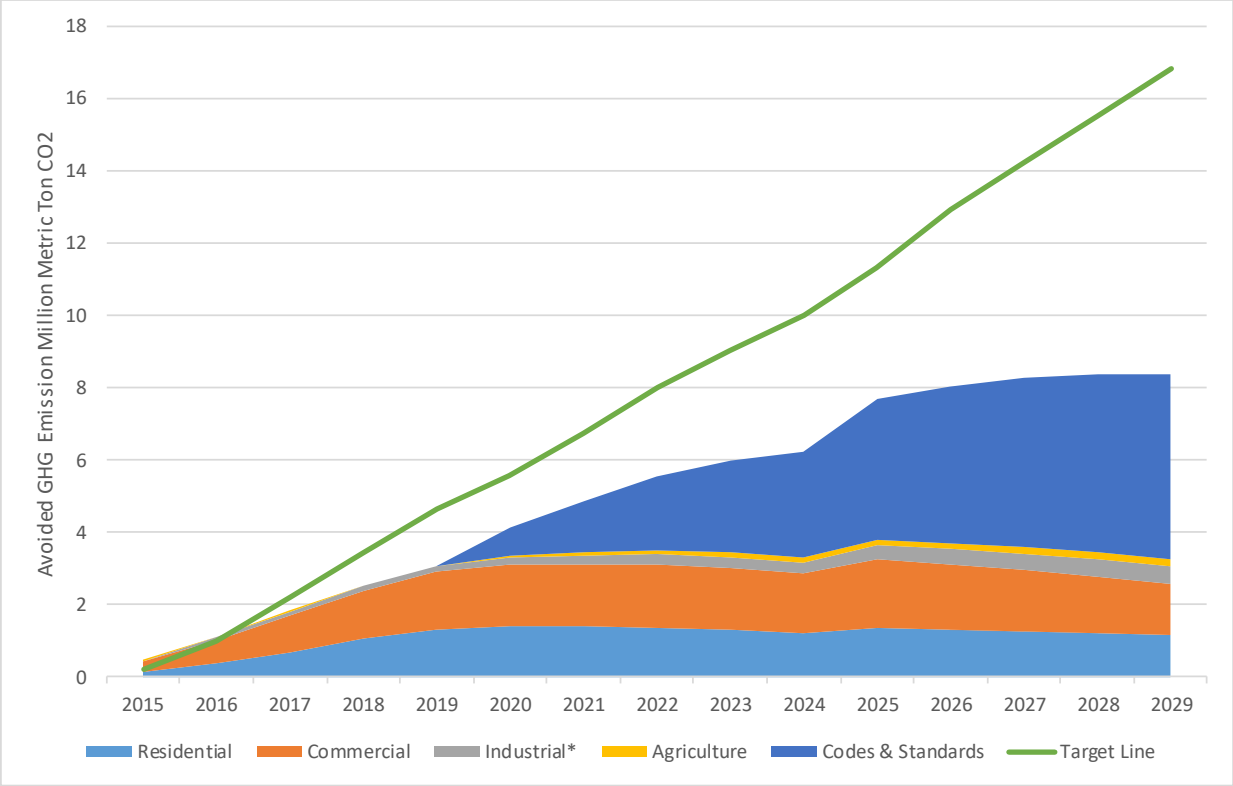
While the target of reducing electricity and natural gas use in buildings is a primary goal of the CEC, it is also becoming equally important to reduce GHG emissions through energy efficiency. As described in greater detail in Goal 3, GHG emissions from energy use vary by the time of day and season. At this time, the CEC has produced annual average GHG content of electricity so that the annual estimated electricity savings may be converted to avoided GHG emissions. While hourly values for the GHG content of electricity exist, the CEC currently lacks the same granular information about energy efficiency. For details on the calculation of annual and hourly GHG emissions from electricity, refer to the 2018 IEPR Update.[160]

160 2018 Integrated energy Policy Report, Chapter 2, pg. 80-82, California Energy Commission, https://ww2.energy.ca.gov/2018publications/CEC-100-2018-001/CEC-100-2018-001-V2-CMF.pdf

The conversion of natural gas efficiency to avoided GHG emissions is much simpler, assuming only the building end-use is considered. The CEC used the U.S. EPA value for the GHG content of natural gas combustion.[161] As mentioned in Goal 3, there are other GHG sources that could be included in calculation of natural gas savings in buildings, but for the conversion shown here, staff have only multiplied by the accepted value.

The SB 350 targets are converted into avoided GHG emissions in Figure 31. This forecasts that the state will miss the 2030 goal. The state's policy is increasingly looking towards GHG emission reductions, and the lack of progress from efficiency programs speaks to the way programs have historically been designed. A new paradigm is needed that targets energy savings during specific hours of the day when GHG emissions are highest, as illustrated by Figures 26 and 27 (Goal 3).

Figure 31: Avoided GHG Emissions from SB 350 Targets



Source: CEC

Additional Achievable Energy Efficiency and Senate Bill 350 Targets

Adjustments made to the demand forecast by efficiency efforts are termed additional achievable energy efficiency (AAEE).The beyond-ratepayer and

161 0.0053 million metric ton CO2per million therms, United States Environmental Protection Agency, Energy and the Environment, https://www.epa.gov/energy/greenhouse-gases-equivalencies-calculator-calculations-and-references

ratepayer energy efficiency savings in this report are used to adjust the state's demand forecast. AAEE in the forecast has historically included new savings from utility programs and codes and standards. However, SB 350 identified a number of other sources of savings that reduce statewide demand, so beginning with the initial SB 350 target setting process in 2017, the CEC has worked to improve estimations of the savings outside utility efforts and standards, so that they may also receive recognition in AAEE. These "beyond-ratepayer and standards" savings from sources discussed throughout this report are now included in the AAEE adjustments to the state's demand forecast, though the estimates are adjusted due to the conservative nature of the demand forecast. Each program has a multiplier between zero and one applied based on the confidence the program can or has achieved its stated energy efficiency. Scenarios of savings are developed in the updated forecasting workbooks, which are also incorporated into the different iterations of the demand forecast and AAEE.

CHAPTER 4:
Recommendations and Next Steps

Recommendations

Recommendations for action are presented under the goal with which they most closely aligns. There is overlap with between goals, thus the recommendations also cross goals. Each recommendation has a lead, who is the party the CEC identifies with the authority or ability to implement the recommendation. Each recommendation also has one or multiple partners. They are additional actors who can play a role in implementation.

Recommendation	Lead	Partners
Goal 1: Double Energy Efficiency Savings by 2030		
a. Develop non-portfolio funds for efforts that move markets toward energy efficiency and carbon free technologies and practices.	*CEC*	*CARB, CPUC, Local Governments, Legislature*
b. Develop hourly and locational aggregated energy consumption datasets and privacy protected analytics for PAs, LGs, and others, for policy, planning, and research purposes.	*CEC*	*CPUC, LGs, PAs, Academics & Researchers*
c. Develop hourly energy efficiency savings estimates from interval meter data to verify and forecast SB 350 targets.	*CEC*	*CPUC, ISO*
d. Develop metrics to value the co-benefits of energy efficiency that enable consumers, the energy efficiency industry, and policy makers to better understand and integrate the benefits of energy efficiency into decision-making processes.	*CEC*	*Department of Public Health, CPUC, CARB, CSD, LGs*
e. Improve building standards compliance, for example, by implementing the findings from the Senate Bill 1414 plan upon its completion.	*CEC*	*CSLB, CPUC, Trade Unions, ESCOs, Western HVAC Performance Alliance, CALBO*
f. Develop and implement energy efficiency programs, outside of existing ratepayer funds, to support small, medium, and large industries to overcome barriers to improving energy efficiency and decarbonization.	*CEC, CARB, Legislature*	*Air Districts, Industry stakeholders, CPUC, International partners*

Recommendation	Lead	Partners
g. State agencies should collaborate on and accelerate the use of hourly (electric) and daily (gas) modern energy data analytics assets to inform policy decisions and identify cost-effective savings opportunities. All data warehouses and energy modeling methods should be shared across state agencies and made available to private energy market actors through systems that while ensuring the privacy of individual customer personal information keeping consumer-specific data privacy is maintained confidential.	*CEC, CPUC*	*GovOps, Department of Technology, CARB*
h. Publish best practices for commercial building energy audit tools. These tools are essential to properly valuing and addressing energy retrofits in nonresidential buildings.	*CEC, DOE*	*Appraisal industry, Commercial leasing agents, Contractors, Acceptance Test Technicians*
i. For IOUs, work with CPUC integrated resources planning (IRP) process to develop the ability to incorporate aggregations of energy efficiency and DR programs into long term planning	*CEC/CPUC*	*Utilities, CAISO, Program Implementers*
j. For POUs, develop methods to integrate aggregations of energy efficiency and DR projects into IRPs. Work with POUs to establish minimum thresholds of cost effective energy efficiency and DR that must be included in IRPs.	*CEC/POUs*	*CAISO, Program Implementers*
k. Continue to design and implement strategies that link water and energy efficiency, such as pairing water use assessments with energy audits, and including water efficiency measures in direct-install programs.	*HCD/ CEC*	*DWR, State Water Board*
l. Encourage pay-for-performance approaches and technology innovations beyond ratepayer-funded portfolio. This is enabled through aggregated NMEC measurement methods and shifts performance risk away from customers, does not risk public funds, enables markets and leverages private investment.	*Legislature*	*GO, CPUC, CEC, CAISO*

Recommendation	Lead	Partners
m. Create a one-stop shop for building energy efficiency and decarbonization programs and financing. This entails providing technical support to all building sectors, including industry and agriculture, and application information for local utility, state, and privately funded programs. Legislative direction is needed to coordinate the involved parties and assign funding for this structural change in program delivery.	*Legislature*	*CPUC, CARB, CEC, Utilities, Local governments (LGs)*
n. Fund new energy efficiency grant programs for schools. This would take a legislative initiative.	*Legislature*	*GO, CEC, CCCO*
o. Develop a new program to require retrofits in poorly-scored buildings under the benchmarking and disclosure program, similar to recently approved program in New York City (Local Law 97 of 2019). This would take a legislative initiative.	*Legislature, LGs*	*CEC, Building Owners, ESCOs*
p. Fund new energy efficiency grant programs for schools. This would take a legislative initiative.	*Legislature*	*GO, CEC, CCCO*
q. Improve building and appliance code compliance through additional locally-lead technical assistance, outreach, and education programs.	*LGs*	*California Building Officials (CALBO), CPUC, CEC, CSLB, Trade Unions, Utilities, ESCOs*
r. Integrate green leases and energy efficiency disclosures into the building purchase process so that efficiency is properly valued in buildings and considered during mortgage qualification.	*MLS, Realtor groups, Mortgage industry*	*CEC*
s. Expand use of the California Infrastructure and Economic Development Bank (Infrastructure bank) to provide another resource to LGs for financing energy efficiency and clean energy projects.	*Treasurer's Office/ Infrastructure bank*	*CEC, LGs*

Recommendation	Lead	Partners
t. Develop energy efficiency program designs that air districts can offer to reduce residential, commercial, agricultural, and industrial site emissions associated with energy. Programs at Bay Area AQMD and South Coast AQMD could inform the designs.	*CAPCOA*	*CEC, CPUC, CARB*
u. Develop an energy efficiency/clean energy workforce education and training implementation plan. Collaborate with community colleges, vocational schools, and workforce development agencies and programs, like the Employment Training Panel and Employment Development Department, to create an action plan that aligns training and education curriculums to clean energy goals. Coordinate the effort with the Office of Public Research's "Just Transition" work.	*CEC, EDD*	*Employers, Community colleges, Trade schools, PAs, OPR, WDB, Office of Public Research, CPUC*
v. Expand the use of meter-based savings programs across the state, both for incentive-based energy efficiency programs and for energy resource procurement.	*CPUC/ CEC*	*Utilities, Program Administrators (PAs)*
w. Incorporate meter-based analysis into potential studies to identify cost-effective savings potential. Customers with high baseload consumption, high temperature-to-load correlation and high summer peak usage, among other readily observable characteristics, likely offer cost-effective savings potential from interventions that are not cost-effective on average and are therefore currently assigned zero potential.	*CPUC/POUs*	*CEC, IOUs*
Goal 2: Removing Energy Efficiency Barriers in Low-Income and Disadvantaged Communities		
a. Supply technical assistance to utilities or program administrators seeking to create alternative energy efficiency financing programs.	*CEC*	*Utilities, PAs*

Recommendation	Lead	Partners
b. Create a perpetual funding source, outside of existing ratepayer programs, or resource, that multifamily building owners can use when retrofitting properties. This would take a legislative initiative. Such a source would streamline accessibility of energy efficiency services, a common need raised by multifamily building owners and developers.	*Legislature*	*CPUC, POUs, CEC, GO, MF building owners, Affordable housing advocates*
c. Expand direct-installation energy efficiency programs, outside of existing ratepayer funds, for rural, low-income, and hard-to-reach communities. Current programs have funds but lack the capacity or mandate to meet the needs of residents and businesses.	*Legislature, CPUC*	*CEC, GO, LGs*
d. Create a funding source, outside of existing ratepayer funds, for LGs to implement efficiency.	*Legislature, GO*	*CEC, LGs*
e. Implement California-wide tariffed on-bill repayment programs that open new financing mechanisms for low-income and disadvantaged communities that are not based on credit scores or income, such as the Pay-As-You-Save model.	*CPUC, Utilities, Legislature*	*CEC, CCAs, ESCOs, Investment Banks, Treasurer's Office*
Goal 3: Building Decarbonization		
a. Initiate a rulemaking proceeding using the load management standards authority to establish approaches that will enable and ease the rapid expansion of behind the meter resources dispatchable (DR) and predictable (EE) load shaping resources.	*CEC*	*CPUC, Utilities, CAISO, CALBO, Contractors, Western HVAC Performance Alliance*
b. Implement the findings of the AB 3232 report in 2020 to reach 40 percent below 1990 levels of building GHG emissions by 2030.	*CEC*	*CARB, CPUC, Building Decarbonization Coalition, CAISO, Clean energy stakeholders*
c. Develop demand flexibility standards to prepare electricity grid for growing demand as electrification expands.	*CEC*	*CPUC, Utilities, CAISO, CALBO, Contractors*

Recommendation	Lead	Partners
d. Demonstrate and evaluate the business case for demand flexible appliances. Highlight the appropriate technologies for each building sector.	*CEC*	*Appliance industry, CPUC, Contractors*
e. Implement Building Energy Efficiency Standards that accelerate the transition to zero carbon buildings in new construction, and retrofits by 2025.	*CEC*	*Utilities, CPUC, Building industry, CALBO, Contractors, Western HVAC Performance Alliance*
f. Develop building codes that require the installation of cost-effective, demand flexible, electric-ready infrastructure in preparation for all-electric buildings	*CEC*	*CSLB, Utilities, Building industry*
g. Develop a geographic map that includes utility districts, buildings, building classification, and building energy metrics to analyze the potential for building decarbonization through fuel substitution efforts, incorporating building benchmarking data where appropriate. Align this work with the CPUC's statewide "energy atlas".	*CEC*	*CARB, CPUC*
h. Evaluate the barriers and benefits to non-combustion measures in residential buildings. Determine effective program designs or delivery methods to increase adoption of these measures that are essential to building decarbonization.	*CEC, Building Decarbonization Coalition*	*CARB, CPUC, Utilities*
i. Co-fund electrification in buildings with flexible assets in order to optimize integration with DERs, DR, and load shifting capabilities.	*CEC, CPUC*	*CARB, POUs, CCAs, Building Decarbonization Coalition*
j. Develop a plan for the future of the natural gas network that reflects California's need to decarbonize its economy in an effective and least cost manner. This would take a legislative initiative. The goal is to adopt a pathway to reduce total source-to-site emissions from the network. In addition, explore increasing the levels of cleaner biofuel resources into the natural gas system (stakeholder comments during workshops).	*GO, Legislature*	*CPUC, CARB, CEC, Utilities, LGs, Building Decarbonization Coalition*

Recommendation	Lead	Partners
k. Establish a new policy goal of zero carbon buildings from the previous zero net energy policy.	*GO/ Legislature*	*CEC, CARB, CPUC, CAISO, other state agencies*
l. Create a financing tool or program designed to accelerate the clean energy transition. This would take a legislative initiative. The goal is to remove barriers that prevent bundling clean energy options (EE+EV+PV+storage) and flexibly integrating them with the grid.	*Legislature*	*Treasurer's Office, CEC, Renewable and transportation stakeholders, Building Decarbonization Coalition, CPUC, POUs*
m. Establish regional clearinghouses that combine taxpayer and ratepayer funding from health, energy, air and utility (infrastructure upgrade) entities to accelerate building electrification.	*Legislature, GO*	*CPUC, CEC, CARB, Department of Public Health, POUs, Clean energy stakeholders*
n. Identify, allocate, and appropriate funds to support new programs for building decarbonization and electrification beyond the SB 1477 pilots, statewide or regionally, which also target natural gas equipment for early retirement. This would take a legislative initiative.	*Legislature, GO*	*CARB, CPUC, CEC, Building Decarbonization Coalition*
o. Adopt building decarbonization reach codes by 2022	*LGs*	*CEC, CPUC, Utilities, Building Decarbonization Coalition*
p. Quantify methane emissions, from well head to end use. This allows for a complete accounting of the GHG savings from building decarbonization.	*CARB*	*CEC, Building Decarbonization Coalition*
q. Establish demand flexibility tariffs that support the use of zero-emission technologies that meet targeted GHG emission reductions.	*CPUC, POUs*	*CEC, PAs*
r. Increase focus on demand flexible assets and storage to ensure that targeted electrification programs do not adversely impact the electric grid.	*Utilities, CCAs*	*CAISO, CPUC, CEC*

Next Steps

The Action Plan is the first step in collecting the state's energy reduction goals into a single document. Based on the wealth of information and the recommendations brought together, state agencies and other stakeholders have actionable tasks to help California achieve its ambitious energy and climate goals. The Action Plan and SB 350 targets will be updated every two years. The CEC anticipates pursuing all recommendations where it is identified as lead in the Action Plan, and looks forward to partnering with other state agencies, LGs, utilities, and the larger stakeholder community to further all of the recommendations.

Glossary

AAEE	Additional achievable energy efficiency - Incremental savings from the future market potential identified in utility potential studies not included in the baseline demand forecast, but reasonably expected to occur, including future updates of building codes, appliance regulations, and new or expanded investor-owned utility or publicly owned utility efficiency programs.
AB 758	Assembly Bill 758 - Skinner, Chapter 470, Statutes of 2009
ACEEE	American Council Energy Efficient Economy – A nonprofit organization that acts as a catalyst to advance energy efficiency policies, programs, technologies, investments, and behaviors.
Action plan	2019 California Energy Efficiency Action Plan - covers issues, opportunities, and savings estimates pertaining to energy efficiency and building decarbonization in California's built environment.
Advisory group	Disadvantaged Communities Advisory Group – State-supported group that reviews and provides advice on proposed clean energy and pollution reduction programs and determine whether those proposed programs will be effective and useful in disadvantaged communities.
AHSC	Affordable Housing and Sustainable Communities Program – California funded program to support infill and compact development that reduce greenhouse gas emissions.
Air Districts	Air pollution control districts and air quality management districts – For definition see APCD and AQMD.
AMF	Affordable Multifamily Program – Program run by CAEATFAA to assist the new construction, rehabilitation and preservation of permanent and transitional rental housing for lower income households.
APCD	Air pollution control districts – Agencies responsible for regional air quality planning, monitoring, and stationary source and facility permitting.
Appliance standards	Appliance Efficiency Regulations - California appliance regulations, combined with federal standards, set minimum efficiency levels for energy and water consumption in

	products, such as consumer electronics, household appliances, and plumbing equipment.
AQMD	Air quality management districts - Agencies that are county or regional governing authorities that have primary responsibility for controlling air pollution from stationary sources.
ARRA	American Recovery and Reinvestment Act of 2009 –Federal act that promotes economic recovery and growth, and includes measures to modernize our nation's infrastructure, enhance energy independence, expand educational opportunities, preserve and improve affordable health care, provide tax relief, and protect those in greatest need
ASHRAE	American Society of Heating, Refrigeration, and Air-conditioning Engineers - Professional association seeking to advance heating, ventilation, air conditioning and refrigeration systems design and construction.
BAAQMD	Bay Area Air Quality Management District – Air district that oversees policies and adopts regulations for the control of air pollution in the nine counties that surround the San Francisco Bay.
Barriers Study	2016 Low-Income Barriers Study – Study published by the CEC, mandated by SB 350 (2015), to explore the barriers to and opportunities for expanding low-income customers' access to energy efficiency, weatherization, and renewable energy investments. It also examines barriers and opportunities related to contracting with small businesses located in disadvantaged communities.
BayREN	Bay Area Regional Energy Network - Collaboration of the nine counties that make up the San Francisco Bay Area and provides regional-scale energy efficiency programs, services, and resources.
BEES	Building Energy Efficiency Standards – California energy standards for new construction of, and additions and alterations to, residential and nonresidential buildings.
BSP	Bright Schools Program – California program that offers services to help schools identify the most cost-effective energy saving opportunities.
BUILD	Building Initiative for Low-Emissions Development – State program mandated by SB 1477 (2018) to provide incentives for California's builders to find innovative and low-cost ways to

	make clean heating technologies common practice in new construction.
CAEATFA	California Alternative Energy and Advanced Transportation Financing Authority – Authority under the California Treasurer's Office to provide innovative and effective financing solutions for California's industries, assisting in reducing the state's greenhouse gas emissions by increasing the development and deployment of renewable energy sources, energy efficiency, and advanced transportation and manufacturing technologies to reduce air pollution, conserve energy, and promote economic development and jobs.
CAEECC	California Energy Efficiency Coordinating Committee – CPUC-sponsored venue for stakeholders to discuss energy efficiency matters while ensuring transparent access to information and opportunities to get involve.
CalBRACE	California Building Resilience Against Climate Effects - California Department of Public Health program that provides resources and technical assistance for the state and local public health departments to build climate adaptation capacity and enhance resilience at the local and regional levels.
CALGreen	California Green Building Standards Code – First-in-the-nation mandatory green building standards code that result in GHG emissions.
CalTF	California Technical Forum – Collaborative of experts who use independent professional judgment and a transparent, technically robust process to review and issue technical information related to California's integrated demand side management portfolio.
CAPCOA	California Air Pollution Control Officers Association - An association of air pollution control and air quality management district's representing all thirty-five local air quality agencies throughout California.
CARB	California Air Resources Board – Dedicated to protecting the public from the harmful effects of air pollution and developing programs and actions to fight climate change.
CC	Coordinating Committee – See CAEECC definition above.
CCAs	Community Choice Aggregators - Lets local jurisdictions aggregate, or combine, their electricity load to purchase power on behalf of their residents. In California, CCAs are

	legally defined by state law as electric service providers and work together with the region's existing utility, which continues to provide customer services.
CDFA	California Department of Food and Agriculture – State agency responsible for protecting and promoting agricultural industry.
CDPH	California Department of Public Health – State agency dedicated to optimizing the health and well-being of the people in California.
CHEEF	California Hub for Energy Efficiency Financing – Set of pilot programs overseen by CAEATFA as part of a public-private partnership among state agencies and investor owned utilities.
CLECA	California Large Energy Consumers Association – Ad hoc group of large industrial electric customers of PG&E and Edison, active on electric rate and service issues.
CLIMB	Clean Energy in Low-Income Multifamily Buildings – CEC report which sets forth early actions to implement energy and water efficiency, demand response, on-site renewable energy, electric vehicle infrastructure installation, and energy storage for multifamily housing in California.
CPAU	City of Palo Alto Utilities – Municipal utility for the city of Palo Alto.
CPUC	California Public Utilities Commission – State agency responsible for regulating services and utilities, protecting consumers, safeguarding the environment, and assuring Californians' access to safe and reliable utility infrastructure and services.
CSD	California Department of Community Services and Development - Reduce poverty for Californians by leading the development and coordination of effective and innovative programs for low-income individuals, families, and their communities.
CVR	Conservation voltage reduction – Technologies which allow utilities to provide electricity to customers at lower voltages (~114 v) resulting in energy and demand reductions.
CWDB	California Workforce Development Board - Responsible for the oversight and continuous improvement of the workforce system in California, which encompasses a wide array of work, including: policy development; workforce support and

	innovation; and performance assessment, measurement and reporting.
DERs	Distributed energy resources – electricity-producing or controllable loads that are directly connected to a local distribution system. They include DR, energy efficiency, and storage.
DGS	Department of General Services (DGS) – State agency that offers a diverse to state government, from managing construction projects to procuring vital equipment to overseeing a statewide vehicle fleet.
Doubling Report	Senate Bill 350 Doubling of Energy Efficiency by 2030 – Report mandated by SB 350 (2015) by the CEC. It established energy efficiency targets towards a statewide, cumulative doubling of energy efficiency savings in electricity and natural gas final end uses by 2030
DR	Demand response – Changes in electric usage by the end user in response to price signals or incentive payments.
DWR	Department of Water Resources – State agency that protects, conserves, develops, and manages much of California's water supply. This includes the State Water Project, the nation's largest state-built water conveyance program.
EBEE Action Plan	Existing Buildings Energy Efficiency Action Plan – CEC report which acts as the state's roadmap energy efficiency in existing buildings mandated by AB 758 (2009).
ECAA	Energy Conservation Assistance Act – CEC clean energy financing program.
EEPs	Energy expenditure plans - The application a local educational agencies uses to request Proposition 39 program award funds to implement proposed eligible energy projects.
CEC	California Energy Commission - As the state's primary energy policy and planning agency, the CEC is committed to reducing energy costs, curtailing greenhouse gas emissions, and ensuring a safe, resilient, and reliable supply of energy.
EPIC	Electric Program Investment Charge – CEC electricity program that invests in scientific and technological research to accelerate the transformation of the electricity sector to meet the state's energy and climate goals.

EPP	Energy Partnership Program – CEC program that offers services to help identify the most cost-effective, energy-saving opportunities for buildings and new construction.
ESA	Energy Savings Assistance - No-cost weatherization services to low-income households who meet the California Alternate Rates for Energy income guidelines.
ESJ Action Plan	Environmental and social Justice Action Plan - Roadmap to expand public inclusion in California Public Utilities Commission decision-making and improve services to targeted communities across California.
ETP	Employment Training Panel – State panel that provides funding to employers to assist in upgrading the skills of their workers through training that leads to good paying, long-term jobs.
EUC	Energy Upgrade California - Created to motivate and educate California residents and small businesses about energy management.
EVs	Electric Vehicles – Vehicles operated by electricity.
FARMER	Funding Agricultural Replacement Measures for Emission Reductions – CARB-run program that provides funding through local air districts for agricultural harvesting equipment, heavy-duty trucks, agricultural pump engines, tractors, and other equipment used in agricultural operations.
FPIP	Food Production Investment Program – CEC program that provides grants to help producers replace high-energy-consuming equipment and systems with market-ready and advanced technologies and equipment.
GGRF	Greenhouse Gas Reduction fund – State-run fund made up of California Cap-and-Trade auction proceeds.
GHG	Greenhouse gas - Gases in Earth's atmosphere that trap heat.
GWh	Gigawatt hour - Unit of energy representing one billion (1,000,000,000) watt hours and is equivalent to one million kilowatt hours.
HCD	California Department of Housing and Community Development – State department that promotes safe, affordable homes and strong vibrant communities throughout California.
HERS	Home Energy Rating System (HERS) – CEC program that tests and rates the energy performance of a home.

HP	Heat Pump – A device that transfers heat energy. Heat pumps in buildings use electricity to move heat from a cool space to a warm space.
HUD	United States Department of Housing and Urban Development – Federal department that administers programs providing housing and community development assistance.
HVAC	Heating, ventilation, air-conditioning - Mechanical systems that provide thermal comfort and air quality to indoor spaces.
IACs	Industrial Assessment Centers – Federally-funded centers hosted at universities that conduct the energy audits to identify opportunities to improve productivity and competitiveness, reduce waste, and save energy
IEPR	Integrated Energy Policy Report – CEC biennial report on major energy trends and issues facing California's electricity, natural gas, and transportation fuel sectors. It contains policy recommendations to address issues.
IMD	Interval-meter-data - Record of energy consumption from a utility meter, with readings made at regular intervals throughout the day.
IOUs	Investor-owned utilities (IOUs) – Private electricity and natural gas providers.
IRP	Integrated Resource Planning - outlines an electric utility's resource needs in order to meet expected electricity demand over a long-term planning horizon.
kWh	Kilo-watt hour - Energy unit used in measuring electrical power, the work done by one kilowatt acting for one hour
LADWP	Los Angeles Department of Water and Power - Municipal utility covering the city of Los Angeles.
LEA	Local educational agency - A county office of education, school district, charter school, or state special school.
LED	Light-Emitting Diode - Light source which uses semiconductors and electroluminescence to create light.
LGC	Local Government Challenge – CEC grant program for local governments.
LIHEAP	Low Income Home energy Assistance Program - Federally funded program that assists eligible low-income households with their heating and cooling energy costs, bill payment

	assistance, energy crisis assistance, weatherization and energy-related home repairs.
LIWP	Low-Income Weatherization Program – State program run by CSD that helps low-income families to reduce their energy bills by making their homes more energy efficient. The program reduces greenhouse gas emissions and household energy costs by saving energy and generating clean renewable power.
MCE	Marin Clean Energy - Community choice aggregator for Marin County and adjacent participating local governments.
MIST	Moderate Income Sustainable Technology – ARRA-funded revolving loan fund run by Los Angeles County.
MW	Megawatt - A unit of power equal to one million watts, especially as a measure of the output of a power station.
NMEC	Normalized metered energy consumption - Energy savings calculation based on energy usage data observed at the meter, and normalized to local weather.
NOx	Nitrous oxide- A greenhouse has and common air pollutant.
NRDC	Natural Resource Defense Council - Non-profit international environmental advocacy group.
OBF	On-bill financing – Alternative energy financing tool that allows a utility to recover the cost of an upgrade on the utility bill.
PACE	Property Assessed Clean Energy – Private financing program for home and business owners, which is repaid through a special assessment on their property tax over a period of years.
PAs	Program administrators - Operate formal energy efficiency programs and play important roles in advancing new building codes and improving the savings from existing codes at the federal, state, and local levels.
POUs	Publicly-owned utilities– non-profit public entity managed by locally elected officials or public employees. Subject to local public control and regulation. POUs are organized in various forms including municipal district, city department, irrigation districts, or rural cooperatives.
PV	Photovoltaic - A system designed to convert sunlight to electricity using semiconducting materials.

R&D	Research and Development – Supports and advances technologies to improve reliability, affordability, and public health and safety is vital to achieving California's energy and climate goals.
REEL	Residential Energy Efficiency Loan Assistance – Loan program run by CAEATFA to help homeowners and renters access lower cost financing for energy efficiency projects by reducing risk to participating lenders.
RENs	Regional energy networks -Provides regional-scale energy efficiency programs, services, and resources using ratepayer funds.
RLF	Revolving loan funds - Pools of capital from which loans can be made for clean energy projects, as loans are repaid, the capital is then re-loaned for another project.
SB 350	Senate Bill 350– Requires the California CEC to establish annual targets that will achieve a cumulative doubling of statewide energy efficiency savings and demand reductions in electricity and natural gas final end uses by 2030.
SBF	Small Business Energy Efficiency Finance – CAEATFA-run finance program with the goal of helping small businesses access better financing terms for energy efficiency retrofits. Program features a credit enhancement to help financing companies mitigate risk.
SEM	Strategic Energy Management– A growing program design that targets industry and agriculture energy use. SEM programs focus on supporting customers to implement ongoing behavioral, retrocommissioning, energy efficiency, and operational savings measures
SEP	State Energy Program– Federal program that provides funding and technical assistance to states, territories or use in efficiency, renewable, and alternative energy demonstration activities.
SMUD	Sacramento Municipal Utility District– Community-owned electric utility. SMUD provides reliable, affordable electricity to most of Sacramento County and a portion of Placer County.
SoCalREN	Southern California Regional Energy Network– Administered by the County of Los Angeles, SoCalREN provides regional-scale energy efficiency programs, services, and resources.

SWEEP	State Water Efficiency and Enhancement Program – State program operated by CDFA that provides financial assistance in the form of grants to implement irrigation systems that reduce greenhouse gases and save water on California agricultural operations.
TCC	Transformative Climate Communities – Strategic Growth Council program that awards funds to community-led development and infrastructure projects to achieve environmental, health, and economic benefits for disadvantaged communities
TECH	Technology and Equipment for Clean Heating – Program mandated by SB 1477 to promote retirement and replacement of conventional appliances, such as gas water heaters and gas space heaters, with clean, low-, or zero-emissions electric equipment.
WE&T	Workforce Education and Training - Education and training activities aimed at supporting the achievement of energy savings targets.

Attachments

To Be Posted with Final Report

Navigant Report- SB 350 Target Setting Update

Target Setting Workbooks