

CALIFORNIA STATE UNIVERSITY
OFFICE OF THE CHANCELLOR



**BUILDING DECARBONIZATION
POLICY REPORT**

Submitted by



ARC Alternatives
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Table of Contents

1. Introduction	2
2. Overall Policy Context	3
California State-Level Leadership	3
City and County Activities	4
Other California University Efforts.....	5
The University of California	5
Stanford University	7
3. Specific Regulatory Items	8
Title 24 Compliance	8
CPUC Building Decarbonization Proceeding	8
Appendix A – Policy Matrix	10

1. Introduction

The California State University system comprises 23 diverse campuses distributed throughout the state, 15 of which have signed a Carbon Neutrality Pledge. CSU has achieved its 2020 carbon emissions reductions ahead of schedule, primarily through the decarbonization of electric supplies. In order to meet its 2040 carbon emissions reduction goal of 80% below 1990 levels, CSU will need to significantly reduce emissions from natural gas combustion, and likely fully eliminate them by 2045 in order to meet new state goals. As part of a state government with overall climate and sustainability goals and policies, CSU is an important contributor, although it must move forward deliberately and carefully given fiscal constraints and its mission to remain affordable and inclusive for students.

This Building Decarbonization Policy Report is one element of CSU's initiative to develop a comprehensive Building Decarbonization Framework, enabling it to meet decarbonization goals with adequate planning and preparation. Additional elements of the framework, which are provided in separate documents and tools, include design and modelling guidelines, technology assessments, decarbonization strategies and a life cycle cost analysis tool.

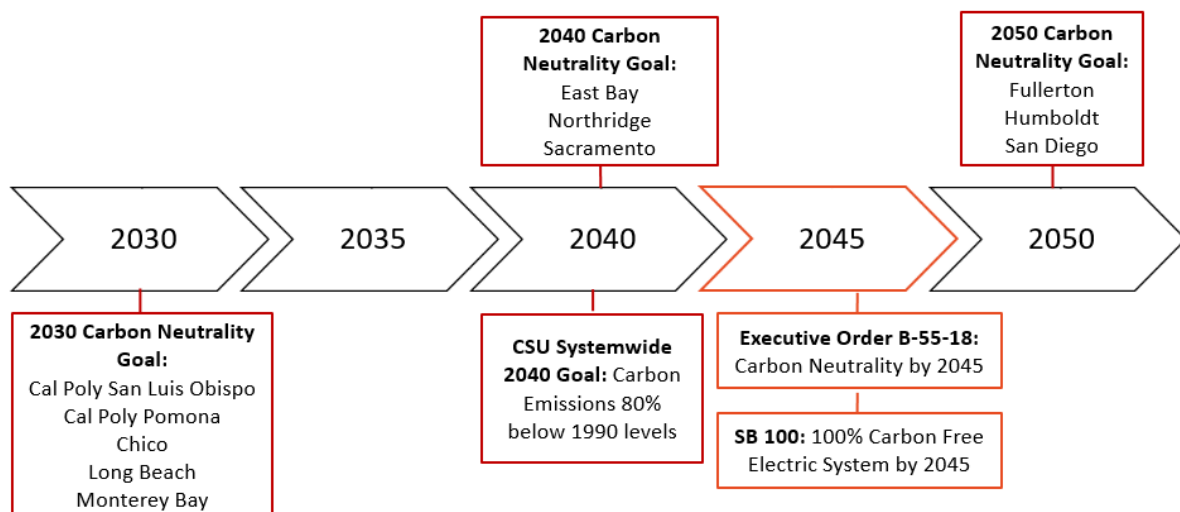
The Building Decarbonization Policy Report provides a brief discussion of the relevant policy landscape and highlights some specific items of particular importance to CSU, however its main purpose is to provide a compendium of policies from all levels of government, as well as other decarbonization resources, as summarized in the Policy Matrix in Appendix A.

2. Overall Policy Context

California State-Level Leadership

Like CSU, the overall state electricity sector also met the 2020 goal to reduce GHGs to 1990 levels ahead of schedule, achieving the milestone in 2017¹. Building on that success, in 2018 California enacted Senate Bill 100 (De León, Chapter 312, Statutes of 2018), which requires California's electricity system to become 100 percent zero-carbon by 2045. Separately, California Governor's Executive Order B-55-18 sets 2045 as the year to achieve statewide carbon neutrality.²

Exhibit 1 – Policy Milestones



With a decarbonized electricity system, California's Integrated Energy Policy Report (IEPR) recognizes that changes in buildings are critical to meeting overall GHG goals, stating:

*Leveraging the decarbonization of the electricity system by transitioning space and water heating in buildings toward highly efficient electric appliances, coupled with strategies to enable greater ability to shift when energy is consumed, will be key to reducing emissions from buildings.*³

Similarly, at a September 2019 workshop on the IEPR, California Energy Commission consultant E3 presented "Insights from 'Deep Decarbonization in a High Renewables Future' (CEC EPIC-14-

¹ California Energy Commission (CEC) staff. (2019). Draft 2019 Integrated Energy Policy Report (IPER). California Energy Commission. Publication Number: CEC-100-2019-001-CMD, page 1.

² <https://www.ca.gov/archive/gov39/wp-content/uploads/2018/09/9.10.18-Executive-Order.pdf>

³ CEC staff. (2019). Draft 2019 IPER., page 3.

069) & other recent E3 analyses” which concluded that efficiency and electrification are low-cost and low-risk pillars of energy decarbonization, limited biofuels should be targeted towards high-value uses that are difficult to electrify or substitute, and electricity serves as the lynchpin for decarbonizing the energy system, via electrification.”⁴

Another factor at play related to the decarbonization of the grid is changing time-of-use (TOU) periods for electricity rates in 2019 and 2020. The new peak time-of-use, from 4:00PM to 9:00PM, is when electricity is most expensive due to solar generation falling off in the late afternoon and evening and traditional generation quickly ramping up. Conversely, before 4:00PM, when solar production is abundant, there are off-peak and super-off-peak rates where electricity is the cheapest and cleanest. CSU typically uses the most energy during the day to keep classrooms cool, peaking in the early afternoon and decreasing in the evening. As a result, increased electrification will further leverage CSU’s use of electricity during these less expensive periods, making it more cost effective than under previous TOU rate structures.

CSU is among many leading organizations analyzing and adopting decarbonization policies throughout the state, including cities, counties and other universities, whose activities are highlighted in the following sections.

City and County Activities

As of May 2020, 30 cities and counties throughout California had adopted electrification related ordinances that employ a range of approaches, including: incentivizing specific measures, requiring all electric buildings, enacting emissions limits and prohibiting new natural gas hookups. An additional four cities and counties are also currently considering adopting such policies. While much of the focus is on residential and municipal segments, at a broader level, these efforts demonstrate a local commitment to decarbonize and many CSU campuses are located within or near these cities and counties as summarized in Exhibit 2 – Local Ordinances.

⁴ Subin, A. Zachary, E3. September 23, 2019. The Role of Electricity in Decarbonizing CA’s Energy System, page 11

Exhibit 2 – Local Ordinances

Other California University Efforts

The University of California (UC) and Stanford University both have existing policies and well-developed programs aimed at decarbonization.

The University of California

In 2013, UC launched the Carbon Neutrality Initiative, pledging the University to eliminate Scope 1 and Scope 2 GHG emissions by 2025. Since then, UC has worked toward that goal with many policies, studies and initiatives. Specifically concerning electrification, the UC Policy on Sustainable Practices states that no new building or major renovation approved after June 30, 2019 shall use onsite fossil fuel combustion (e.g., natural gas) for space or water heating.⁵

In February 2018, UC published the “University of California Strategies for Decarbonization: Replacing Natural Gas” report funded by the TomKat Foundation. Many of the key findings are directly relevant to CSU’s decarbonization efforts. It finds that “... a cost-effective exit strategy for conventional natural gas is vital to achieving the carbon neutrality goal.” Furthermore, “Although natural gas emits less during combustion than other fossil fuels, it still emits CO₂, making its continued widespread use inconsistent with deep decarbonization of the energy sector. Finding alternatives to natural gas must be at the center of any strategy for achieving deep decarbonization.” The report presents and analyzes “three complementary approaches for transitioning away from natural gas: (1) reducing energy demand via improved energy efficiency, (2) substitution of renewable gas (i.e., biogas and hydrogen produced without GHG emissions) for natural gas, and (3) electrification of end uses.”⁶

The first strategy is well established and CSU has a long history and continued emphasis on energy efficiency.

The second strategy, involving biogas, while potentially a direct substitution for natural gas, particularly for campuses with combined heating and cooling plants (CHP), raises concerns of scalability, availability and cost. The TomKat study reports that “...UC Office of the President has determined that sufficient additional biogas resources are available to meet UC’s needs. Therefore, the UC system should be able to offset its natural gas consumption and emissions using biogas in the short term, once appropriate pricing is negotiated. But is this a scalable

⁵ University of California, Policy on Sustainable Practices, Section III.A.3.

⁶ Meier, A., et al. (2018). University of California Strategies for Decarbonization: Replacing Natural Gas. UC TomKat Carbon Neutrality Project. <http://doi.org/10.17605/OSF.IO/HNPUJ>, pages 1-2.

solution beyond UC?”⁷ Scalability and cost are key questions for CSU, particularly with UC, and perhaps others, already moving to secure limited near-term supplies and longer-term supplies remaining uncertain. A solution that is not scalable beyond first-movers provides little long-term benefit if it simply results in dividing up the same resource between more parties.

The third strategy, electrification, emerges as a comprehensive near- and long-term solution. The report develops several key insights related to electrification, summarized in Exhibit 3 – TomKat Key Conclusions About Electrification.

Exhibit 3 – TomKat Key Conclusions About Electrification

**Strategies for Decarbonization: Replacing Natural Gas Report
Key Conclusions About Electrification⁸**

A critical issue for electrification of heating is the temperature required for the end use. The maximum temperature provided by heat pumps is limited and may not be sufficient for some applications. Higher temperature heat pumps are beginning to emerge on the market, but are not yet widely available.

New buildings are typically the easiest to make all electric. A recent cost study conducted for UC assesses first costs for all-electric construction to be generally neutral relative to gas-based construction—within the uncertainty of the cost estimation process (16). We envision and recommend a shift to all-electric designs for new building construction that cannot be connected to a CHP plant, an option that is consistent with the UC Finance and Management Task Force’s recommendations.

Electrification should be evaluated for new buildings that are connectable to CHP plants, in the context of integrated campus planning for future buildings, energy efficiency, and carbon neutrality.

Existing stand-alone buildings are generally more cost-effective to decarbonize through electrification than existing buildings connected to central heating loops based upon combined heat and power.

Gradually disconnecting buildings on the periphery of the central heating distribution system — “pruning” — is a good strategy, particularly for central systems that are at or near capacity.

The different techniques available to address high-temperature applications served by undersized heat exchangers or to address orphan loads (e.g., cage washers, sterilizers) should be evaluated and compared. High-temperature heat pumps should be included in such an evaluation.

⁷ Ibid, page 9.

⁸ Ibid, pages 13-14.

As dependence on renewables has grown, so have concerns about reliability of electricity delivery. Increased use of storage technologies, including batteries, can help address those concerns. Battery costs have declined substantially and are expected to continue to do so in coming decades.

Some of the TomKat study findings help to inform the strategies more targeted to CSU's infrastructure and operating environment and are developed in other portions of the Decarbonization Framework, particularly Task 5.

Stanford University

At Stanford, the recent Stanford Energy System Innovations (SESI) project, which resulted in massive GHG reductions, was driven by both policy and practical need. An existing cogeneration plant was approaching the end of its useful life, so options for its replacement were evaluated. A GHG reduction options report was prepared in 2008, with the selected approach finally approved and funded in 2011. The result was Stanford's new, electrically-powered district heating and cooling system completed in 2015. As the next step in their transition to carbon neutrality, Stanford will add a solar generating facility in 2021 to their existing majority renewable mix, bringing their electrical supply up to 100% renewable.⁹

⁹ <https://sustainable.stanford.edu/campus-action/stanford-energy-system-innovations-sesi>

3. Specific Regulatory Items

Title 24 Compliance

New all-electric buildings pose a significant compliance challenge with the current performance benchmarking requirements in Title-24. Title-24 relies on a Time Dependent Valuation (TDV) of energy in modeling. The concept behind TDV is that energy efficiency measure savings should be valued differently depending on which hours of the year the savings occur to better reflect the actual costs of energy to consumers, to the utility system, and to society. TDV therefore encourages building designs that perform better during periods of high energy cost. However, if your goal is carbon reduction, the TDV metric is misaligned. Not only is TDV a weak signal of the energy's carbon content, it advantages lower cost natural gas in those systems for which baselines are gas consuming, such as heating. As a result, Title-24 TDV analysis penalizes all-electric buildings causing them to fail Title-24 compliance requirements in some notable cases.

This issue is widely recognized and many stakeholder groups are working with the CEC to address it for the 2022 code cycle and mid-cycle of the 2019 code. We understand that for central heat pump water heater designs, both a prescriptive exemption for specific designs and a project specific exemption for a performance credit are being considered.

Outcome Based Energy Codes

A topic that often arises when discussing the challenges of current Title-24 requirements is the potential to shift to an Outcome Based Energy Code (OBC). OBC relies on actual measured energy use instead of estimates based on calculations or modeling. Building energy use is monitored, post-occupancy, to demonstrate code compliance. California currently has no such compliance pathway. However, an organization called the California Energy Alliance (CEA) launched an OBC initiative in late 2018 with a goal of creating an OBC compliance approach for California.¹⁰ Given CSU's experience with meter-based approaches and energy information systems, an OBC approach could be a natural fit and an opportunity for CSU to explore.

CPUC Building Decarbonization Proceeding

CPUC proceeding R.19-01-011 has four phases, the first of which deals with the implementation of SB1477 (Stern, 2018) and is focused on implementing two programs, Building Initiative for Low Emissions Development (BUILD) and Technology and Equipment for Clean Heating (TECH). Other phases include a pilot program for post-fire rebuilding of all-electric homes, building and appliance codes and standards that maximize GHG reductions, and developing a comprehensive building decarbonization policy framework. We highlight this proceeding here because although its title sounds promising and there is much activity associated with it, the direct impact to CSU

¹⁰ <https://caenergyalliance.org/outcomebased-energy-code>

is likely limited in the near-term due to the program target markets and funding levels. That said, CSU should monitor the proceeding, particularly the first phase, for any approaches or technologies applicable to CSU campuses.

Appendix A – Policy Matrix

The Policy Matrix was compiled over the course of several months and contains many relevant policies, though it is not an exhaustive list and is current through mid-May 2020 when the report was finalized.

Policy Matrix provided separately as an Excel file:

CSU Bldg Decarb Policy Matrix-Append A.xls

State & Federal Policies Related to Building Decarbonization

Date	Organization	Policy	Status	Link/Source	Description
1/1/2020	CEC	Title 24, 2019	New code to promote pathways for all-electric buildings	https://www.energy.ca.gov/publications/pdfs/titles24_2019.pdf	<p>"The CEC's 2019 Title 24 building energy efficiency standards, which are effective starting in 2020, provide another example of the increasing statewide policy focus on building decarbonization. With the 2019 standards, CEC has begun to shift from a goal of minimizing building energy use to the more specific goal of minimizing building GHG emissions. Several of the changes in the 2019 standards help pave the way for reducing GHG emissions in buildings. One prominent example is the establishment of a new prescriptive pathway that makes it easier for builders to develop all-electric buildings that comply with the building code." (quote from R.19-01-011)</p> <p>Energy Commission adopted and the California Building Standards Commission in December approved the first in the nation building standards that require solar on new homes starting in 2020</p>
8/1/2019	CPUC	R.13-11-005 Decision Modifying the EE three-prong test related to fuel substitution	Approved by CPUC 8/1/19	https://arcalty.com/wp-content/uploads/2019/08/R13-11-005-EE-Test-Modifications-Final-Order.pdf	<p>Energy efficiency funds can be spent on energy efficiency measures that change from one regulated fuel type to another regulated. Non-CPUC regulated utilities or fuel types are not eligible for funds, and rules will be developed under the Building Decarbonization Proceeding (R.19-01-011).</p> <p>Measures cannot increase source energy consumption or greenhouse gas emissions compared to a measure or custom baseline to qualify for funding.</p>
7/16/2019	CPUC	R.19-01-011 Order Instituting Rulemaking Regarding Building Decarbonization	Instituted by the CPUC in Jan 2019	https://arcalty.com/wp-content/uploads/2019/07/R19-01-011-Building-Decarbonization-Proceeding-Final-Order.pdf	<p>The proposed scope of the rulemaking includes: 1) implementing SB 1477; 2) potential pilot programs to address new construction in areas damaged by wildfires; 3) coordinating CPUC policies with Title 24 Building Energy Efficiency Standards and Title 20 Appliance Efficiency Standards developed at the Energy Commission; and 4) establishing a building decarbonization policy framework</p> <p>The CPUC is considering using funds generated by the Self-Generation Incentive Program to promote heat pump water heaters as an energy storage method. (R.12-11-005)</p>
2/22/2019	State of CA	Net Zero Carbon Buildings Commitment (World Green Building Council)	Joined 2/22/19	https://www.wgbc.org/resources/net-zero-carbon-buildings-commitment/	In 2018, California joined the Net Zero Carbon Buildings Commitment, administered by the World Green Building Council for the Global Climate Action Summit. The commitment calls on signatories to enact regulations and planning policies to ensure that all new buildings operate at net zero carbon emissions by 2030 and for all buildings to do so by 2050.
9/23/2018	State of CA	SB 1440, Hueso. Energy: biomethane: biomethane procurement.	Approved by Governor 9/23/18	https://leginfo.ca.gov/pub/09_2018/bills_1401_1499/bill_1440_1499_00_.htm	Requires the CPUC, in consultation with CARB, to consider adopting "specific biomethane procurement targets or goals for each gas corporation."
9/19/2018	State of CA	SB-1369: Energy: green electrolytic hydrogen.	Approved by Governor 9/19/18	https://leginfo.ca.gov/pub/09_2018/bills_1301_1399/bill_1369_1399_00_.htm	SoCalGas also suggests that Senate Bill 1369 (Skinner, Chapter 567, Statutes of 2018) may help with "increasing the volumes of renewable hydrogen gas available to assist in decarbonizing the building sector."
9/18/2018	State of CA	SB-1383: Short-lived climate pollutants: methane emissions: dairy and livestock: organic waste: landfills.	Approved by Governor 9/18/18	https://leginfo.ca.gov/pub/09_2018/bills_1301_1399/bill_1383_1399_00_.htm	Set a goal that California reduce methane and hydrofluorocarbon (HFC) refrigerants to 40 percent below 2013 levels by 2030
9/13/2018	State of CA	AB-3232: Zero-emissions buildings and sources of heat energy	Approved by Governor 9/13/18	https://leginfo.ca.gov/pub/09_2018/bills_3201_3299/bill_3232_3299_00_.htm	Requires the California Energy Commission by January 1, 2021, to assess the potential for the state to reduce the emissions of greenhouse gases from the state's residential and commercial building stock by at least 40% below 1990 levels by January 1, 2030.
9/13/2018	State of CA	AB-2195: Natural gas: out-of-state sources: greenhouse gases.	Approved by Governor 9/13/18	https://leginfo.ca.gov/pub/09_2018/bills_2101_2199/bill_2195_2199_00_.htm	Assembly Bill 2195 helps determine the emissions from imported natural gas so we can better assess the climate benefits of using less gas.
9/10/2018	State of CA	SB-100: California Renewables Portfolio Standard Program: emissions of greenhouse gases	Approved by Governor 9/10/18	https://leginfo.ca.gov/pub/09_2018/bills_1001_1099/bill_1001_1099_00_.htm	The electricity system is required by SB 100 to reduce emissions to near zero by 2045. No comparable policy exists for the natural gas system to reduce GHG emissions. (. requires a 60% renewable portfolio standard (RPS) by 2030 and 100% of retail sales to be served by zero carbon electricity by 2045.)
9/10/2018	State of CA	Executive Order B-55-18	Issued by Governor 9/10/18	https://www.sos.ca.gov/eo/B-55-18	Established a carbon neutrality target for 2045, which is more strict than 80 x 50. ("80 x 50" refers to the state's existing goal of an 80% reduction in GHG emissions below 1990 levels by 2050.) The executive order covers all sectors of the economy and includes consideration of carbon sequestration in natural and working lands.
9/1/2018	State of CA	SB-1477: Low-emissions buildings and sources of heat energy	Approved by Governor 9/13/18	https://leginfo.ca.gov/pub/09_2018/bills_1401_1499/bill_1477_1499_00_.htm	Calls on the California Public Utilities Commission (CPUC), in consultation with the California Energy Commission (Energy Commission), to develop two programs with a combined annual budget of \$50 million per year focused on reducing direct greenhouse gas emissions from buildings: the Building Initiative for Low-Emissions Development (BUILD) program and the Technology and Equipment for Clean Heating (TECH) program.
6/1/2017	United States	Paris Climate Agreement	Joined December 2015 Intent to withdraw 6/1/17	https://ec.europa.eu/clima/policies/paris_en	Does not include specific decarbonization targets, but states the need for global emissions to peak as soon as possible. The U.S. plan submitted to the UNFCCC in advance of Paris in 2015 is to reduce emissions by 26–28% below 2005 levels by 2025. This translates to a reduction of 13–15% below 1990 levels by 2025.
9/8/2016	State of CA	SB-32 California Global Warming Solutions Act of 2006: emissions limit.	Approved by Governor 9/8/16	https://leginfo.ca.gov/pub/09_2016/bills_3001_3099/bill_3032_3099_00_.htm	Set a statewide requirement to reduce California's GHG emissions 40 percent below 1990 levels by 2030, building on the Assembly Bill 32 (Núñez, Chapter 488, Statutes of 2006) requirement to reduce GHG emissions to 1990 levels by 2020
9/8/2016	State of CA	AB-197: State Air Resources Board: greenhouse gases: regulations.	Approved by Governor 9/8/16	https://leginfo.ca.gov/pub/09_2016/bills_101_199/bill_0197_0199_00_.htm	emphasized equitably implementing state climate change policies such that the benefits reach disadvantaged communities
12/23/2015	CPUC	D.14-12-040 Greenhouse Gas Balancing Account (GHGBA)	Effective 12/23/15	https://www.cpuc.ca.gov/Energy-and-Gas/Greenhouse-Gas-Balancing-Account-(GHGBA)	Adopts a settlement agreement between Pacific Gas and Electric Company, the Office of Ratepayer Advocates, Southern California Gas Company, San Diego Gas & Electric Company, and Southwest Gas Company regarding policies, programs, rules, and tariffs necessary for natural gas utilities to comply with the Cap-and-Trade Program.
10/7/2015	State of CA	SB-350: Clean Energy and Pollution Reduction Act	Approved by Governor 10/7/15	https://leginfo.ca.gov/pub/10_2015/bills_3001_3099/bill_3501_3599_00_.htm	Requires California to achieve 50 percent renewable electricity by 2030. It also calls for the doubling of energy efficiency savings in electricity and natural gas through efficiency and conservation
11/8/2012	CPUC	SB-700; R.12-11-005 Order Instituting Rulemaking Regarding Policies, Procedures and Rules for the California Solar Initiative, the Self-Generation Incentive Program and Other Distributed Generation Issues	Filed 11/8/2012	https://arcalty.com/wp-content/uploads/2012/11/SB700-Rule-Making-Process-Updated-7-16-19.pdf	There are 21 Decisions under this Rule Making (beginning in 2001) concerning all issues related to the Self Generation Incentive Program (SGIP)
1/1/2012	ARB	Cap-and-Trade (under AB-32) - Extended AB-398	Approved 1/1/2012, Extended 2017	https://www.arb.ca.gov/2012capandtrade.htm	California's Cap-and-Trade Program for greenhouse gases helps to fight climate change by limiting greenhouse gas pollution and placing a steadily increasing price on carbon emissions. The Cap-and-Trade Program was designed by the California Air Resources Board (ARB) to achieve the goals of the Global Warming Solutions Act of 2006 (AB 32)
9/27/2006	State of CA	AB-32 Air pollution: greenhouse gases: California Global Warming Solutions Act of 2006.	Approved by Governor 9/27/06	https://leginfo.ca.gov/pub/09_2006/bills_3001_3099/bill_3032_3099_00_.htm	Established an economywide goal of reducing GHG emissions to 1990 levels by 2020 and charged the state with adopting policies and regulations to achieve the maximum technologically feasible and cost-effective GHG reduction strategies

Through mid-May 2020, not an exhaustive list

City & County Ordinances Related to Decarbonization

Date	Organization	Policy	Status	Link/Source	Description
5/14/2020	City of Hayward	Electrification Reach Code	Approved by City Council 3/3/20, Submitted to CEC for approval 5/14/20	https://haywardca.gov/ceccommittees/energy/2020/05/14/2020-05-14-CEC-Item-10-Residential-Electrification-Reach-Code	All new residential buildings are required to be all-electric and nonresidential and high-rise residential buildings are electric preferred. Mixed-fuel buildings must install solar panels, and the energy budget must be 10 percent better than code.
4/29/2020	City of Los Altos	All Electric Reach Code Ordinance	First Reading 4/29/20	https://www.ci.losaltos.ca.us/DocumentCenter/View/11111	The City of Los Altos is in the process of adopting an all-electric Reach Code Ordinance for newly constructed buildings in 2020.
3/24/2020	City of Santa Cruz	All-Electric Reach Code for New Construction	Draft Code Reviewed by City Council 3/24, Pending Approval	http://www.ci.santacruz.ca.us/DocumentCenter/View/11111	Requires all-electric new construction with exemptions for projects that are deemed to be in the public interest and for restaurant cooking.
3/16/2020	City of Richmond	Electrification Reach Code	Submitted to CEC for approval 3/16/20	https://arcalt.com/	Requires new residential buildings over three stories to have prewiring for electric readiness and to support all-electric clothes dryers and space and water heating. Allows gas to power stoves and fireplaces. Requires all buildings under three stories to build all-electric and install a minimum amount of on-site solar based on square footage.
2/20/2020	City of Santa Rosa	All-Electric Reach Code for New Construction	Passed by City 11/19/19, Approved by CEC 2/20/2020	https://srcity.com/	On November 19, 2019, the City of Santa Rosa passed a reach code that would require all new residential construction of 3-stories and below in the City have to be all electric.
2/20/2020	City of Windsor	All- Electric Reach Code Adoption	City Approved Sept 2019, Approved by CEC 2/20/2020	https://arcalt.com/	Voted 4-0 to adopt a reach code in September 2019 that mandates all-electric new construction for all new low-rise residential buildings. This includes single-family homes, multi-family below four stories, and detached accessory dwelling units (ADUs). Attached ADUs are exempt. The reach code is required to be implemented at the time of building permit submittal, and once approved by the CEC, will be effective January 1, 2020.
2/20/2020	City of Healdsburg	Building Electrification Reach Code	Passed by City 12/2/19, Approved by CEC 2/20/2020	http://healdsburgca.gov/DocumentCenter/View/11111	Recently passed a strong building electrification reach code for new construction. The code requires electrification for most appliances, but grants an exemption from electrification for gas cooking and fireplaces.
2/20/2020	City of Brisbane	Electrification Reach Code	Passed by City 11/21/19, Approved by CEC 2/20/2020	http://brisbanecity.org.au/DocumentCenter/View/11111	Recently passed a mandatory all electric reach code for new construction. There are exemptions for cooking appliances, but the code requires pre wiring throughout the building so a transition from gas to electric in the future is possible.
2/20/2020	City of Los Gatos	Electrification Reach Code	Passed by City 12/3/19, Approved by CEC 2/20/2020	https://arcalt.com/	Recently passed an all electric reach code for new construction. Los Gatos' code requires electrification for all appliances, with one exception for gas cooking.
2/11/2020	San Mateo County	All Electric Reach Code	Approved by county 2/11/2020	https://sanmateo.org/DocumentCenter/View/11111	The ordinance requires that no "natural" gas or propane plumbing is installed in new buildings, and that electricity be used as the energy source for water heating, space heating, cooking, and clothes drying appliances.
2/4/2020	City of Campbell	All Electric Reach Code	Approved by city council 2/4/2020	https://arcalt.com/	Campbell's reach code requires all-electric space and water heating in new residential buildings, ADUs, and major remodels.
2/3/2020	Santa Clara County	Building Electrification Reach Code	In Development	https://www.sccgov.org/DocumentCenter/View/11111	The County of Santa Clara is currently engaging community stakeholders to develop a Building Electrification Reach Code
1/17/2020	San Francisco	Electrification Ordinance	Approved by Mayor 1/17/20	https://sf.gov	Ordinance amending the Environment Code to require new construction and major renovations of municipal buildings to exclude natural gas and include exclusively all-electric energy sources; and affirming the Planning Department's determination under the California Environmental Quality Act.
1/16/2020	City of Los Altos Hills	Electrification Reach Code	Approved by city council 1/16/2020	https://arcalt.com/	Requires electric space and water heating in new low rise residential buildings
12/17/2019	City of Cupertino	Electrification Reach Code	First Reading 12/17	https://cupertino.org/DocumentCenter/View/11111	Considering adopting an all-electric reach code for new construction. All major building types, including residential and non-residential buildings, are required to be electric under the ordinance. Outdoor pools, spas, and barbecues are included within the definition of an all-electric building. Electrification requirements also apply to stand alone Accessory Dwelling Units (ADUs).
12/11/2019	City of San Jose	Building Electrification Ordinance	Approved 9/17/19, Updated 10/29/19, CEC Approved 12/11/19	https://sanjoseca.gov/DocumentCenter/View/11111	San Jose's reach code is one of the most aggressive. It encourages all-electric construction by requiring any new building with gas to achieve higher energy-efficiency savings (Cal Green Tier 1 compliance) and be "electrification ready." It will soon require all-electric new construction for new municipal buildings and new low-rise residential buildings, and the city will consider expanding this electrification requirement for mid-rise (4-7 stories) residential buildings next year. The code also requires greater access to electric vehicle charging for new construction. October 29th update: San Jose further strengthened their electrification policy by prohibiting new gas hook-ups for new low-rise residential buildings and new municipal buildings. One of the first ordinances to be approved by the CEC on 12/11/19.
12/11/2019	City of Santa Monica	Electrification Reach Code	City Approved Approved 9/10/19, CEC Approved 12/11/19	http://santamonica.org/DocumentCenter/View/11111	On September 10, the city council voted unanimously for a strong building electrification code for all new construction (residential and commercial). The ordinance does not require all-electric new construction, but encourages it by requiring additional energy efficiency measures for new buildings with gas.
12/11/2019	City of Menlo Park	Electrification Reach Code	Approved 9/10/19, CEC Approved 12/11/19	https://www.menlopark.org/DocumentCenter/View/11111	Voted to adopt a strong reach code that requires all-electric new construction for all residential buildings (single-family and multifamily, including high-rise) as well as new commercial buildings. For low-rise residential (under four stories), the city will allow gas for cooking. The ordinance is one of the first to have been approved by the CEC and will go into effect January 1, 2020.
12/11/2019	Marin County	Green Building Ordinance	Approved Sept 2019, Approved by CEC 12/11/19, Effective 1/1/2020	http://www.marincounty.org/DocumentCenter/View/11111	The updated county code which was voted on in September, 2019 offers 3 updated compliance pathways: one for all electric construction, one for limited mixed fuel (gas stoves) construction, and mixed fuel construction. The mixed fuel pathway requires the most strict compliance with Cal Green Tier 1 and electrification readiness requirements. The limited mixed fuel pathway has fewer efficiency requirements because this pathway uses less gas, and the most affordable pathway remains all electric with no additional energy efficiency requirements. One of the first ordinances to be approved by the CEC on 12/11/19.
12/4/2019	City of Saratoga	Electrification Ordinance Reach Code	Passed by City 12/4/19	https://legistar.com/DocumentCenter/View/11111	Passed a strong electrification ordinance that mixes mandatory electrification requirements for some buildings and electrification incentives for others. Saratoga's reach code is similar to Menlo Park's.
12/3/2019	City of Monte Sereno	Electrification Reach Code	Passed by City 12/3/20	https://montesereno.org/DocumentCenter/View/11111	Monte Sereno passed a code that encourages the reduction of gas use in new construction. The community's preference for choice and resiliency led to passing code amendments to include pre-wiring for future electric appliances, as well as pre-wiring for battery storage. Both measures reduce the cost of any future adoption of batteries, induction stoves and electric heat pumps, and may encourage some builders to build all-electric homes today.
12/3/2019	City of Berkeley	City of Berkeley: Natural Gas Ban & Electrification Reach Code	Gas Ban Approved by City Council 7/16/19, effective 1/1/2020 Electrification Reach Code City Approved 12/3/19	https://www.berkeleyca.gov/DocumentCenter/View/11111	Berkeley voted unanimously to adopt a "first in the nation" ordinance in July 2019 that prohibited gas in all new construction. Berkeley's gas ordinance was unique because it did not go through the traditional reach code route, which requires approval from the California Energy Commission (CEC). Instead, Berkeley used its city police powers to prohibit new gas hookups on the grounds of public health and safety. The ordinance was widely supported by the community, including PG&E, East Bay Clean Energy, environmental and climate organizations, and green builders. The city of Berkeley recently passed a building electrification reach code to supplement the gas ban it passed earlier this year. Berkeley decided to pass this additional reach code to ensure that the small fraction of buildings that were not affected by the full gas ban would still have incentives to be built with all electric wiring and appliances. This reach code extends requirements for solar to nonresidential buildings, high-rise residential buildings, and hotel/motels and places additional energy efficiency requirements for mixed fuel buildings.

City & County Ordinances Related to Decarbonization (Continued)

Date	Organization	Policy	Status	Link/Source	Description
12/2/2019	City of Mill Valley	Electrification Preference Ordinance for New Construction	Passed by City 12/2/19	https://cityofmillvalley.org/ordinances	Recently passed a strong electrification preference ordinance for new construction. Mill Valley's reach code closely resembles Marin County's recently passed reach code.
11/12/2019	City of Pacifica	Electrification Ordinance Reach Code	Passed on 11/12/19	https://pacificacity.org/ordinances	Recently voted for an electrification ordinance for new construction that has electrification requirements for some appliances and exceptions for others. In new residential buildings, Pacifica's reach code requires electric fuel sources for space heating, water heating, and clothes drying, though gas can be used (if desired) for cooking appliances and fire places. In new non-residential buildings, there are a slightly different set of standards; space and water heating/cooling, cooking appliances, fireplaces, and clothes dryers must be all electric, but there is a gas exemption for emergency services public agencies and nonresidential kitchens (such as for-profit restaurants).
11/5/2019	City of Milpitas	Electrification Preference Ordinance for New Construction	City Approved 11/5/19	https://mcpa.org/ordinances	Recently voted in favor of an electrification preference ordinance for new construction. Milpitas' reach code has higher energy efficiency requirements for mixed fuel buildings and has an electrification readiness provisions for a future transition off gas to all electric. While Milpitas' code does not require all electric new construction, it will steer developers towards electrification via the costs savings that will be achieved with all electric appliances, wiring, and piping.
11/4/2019	City of Palo Alto	Energy Reach Code for Building Construction	City Approved 11/4/19	https://www.paloalto.gov/ordinances	Voted unanimously to adopt a reach code encouraging all-electric construction. Additionally, the Council directed city staff to begin working on multiple ordinances prohibiting natural gas infrastructure in new buildings that should take effect in 2020.
10/23/2019	City of Morgan Hill	Prohibition of Natural Gas Infrastructure in New Buildings Ordinance	Approved 10/23/19	http://morganhill.org/ordinances	Morgan Hill's gas ban is similar to Berkeley's in that it uses the city's police powers to ban gas on health and safety grounds, but it goes a step further by immediately impacting more buildings.
10/22/2019	City of Mountain View	Reach Code	City Approved 10/22/19	https://mountainview.org/ordinances	Voted unanimously in support of a reach code that requires electrification for new residential and commercial buildings. Mountain View's ordinance is robust; there are no exemptions for gas stoves, fireplaces, or fire pits in residential buildings, though there is a provision that makes it possible for restaurants to request an exemption. The city council also requested that staff come back in early 2020 with ordinance language to ban wood fireplaces as an additional health and safety measure.
9/24/2019	City of Davis	Reach Code	City Approved 9/24/19	https://arcalt.org/ordinances	Requires higher energy efficiency standards and electrification readiness in mixed fuel buildings
9/3/2019	City of Alameda	Adoption of Resolution Limiting Natural Gas Infrastructure for New Residential Construction on City Owned Property	Adopted 9/3/19	https://alamedacity.org/ordinances	Recently decided to limit natural gas infrastructure for new residential construction on city-owned property
9/1/2019	City of San Mateo	Electrification Reach Code	City Approved Sept 2019, CEC approved 12/11/19	https://arcalt.org/ordinances	Voted in September 2019 to adopt an electrification reach code. San Mateo does not require all-electric new construction, but incentivizes it through increased energy efficiency requirements for new buildings that use gas. Office buildings with gas would need to be 10% better than the statewide 2019 building code requirements. Single-family and duplex multifamily buildings with gas would need to be at least 2.5 Energy Design Rating points less than the 2019 building code's baseline. The ordinance also adds additional rooftop photovoltaic and electric vehicle charging requirements. One of the first ordinances to be approved by the CEC on 12/11/19.
8/22/2019	City of San Luis Obispo	San Luis Obispo Climate Action Plan	Approved Sept 2019	https://www.slo.org/ordinances	As San Luis Obispo eyes a 2035 target to reach net-zero greenhouse gas (GHG) emissions status, city officials are developing new building codes that will go beyond what the state requires for energy efficiency in new development—while also crafting carbon offset policies and retrofit programs for the community's existing building stock. "The electrification reach code does not mandate all-electric new construction, but steers developers toward climate-friendly all-electric construction by requiring additional energy efficiency and "electrification-readiness." San Luis Obispo adds a small fee for new mixed-fuel buildings based on expected gas consumption. This revenue will be used to help people retrofit their homes with all electric appliances in the future. San Luis Obispo is the first city on the central coast to pass an electrification reach code"
4/19/2019	City of Los Angeles	City of LA: Zero Emissions Buildings	Plan released April 2019	https://www.la2030.org/	The city of Los Angeles recently released a plan for new buildings to be zero-emission by 2030, followed by all existing buildings by 2050
4/16/2019	City of New York	Climate Mobilization Act	Approved 4/16/19	https://council.nyc.gov/legislation	The legislative package includes bills that: Establishes emissions caps for buildings over 25,000 square feet. This bill also establishes the Office of Building Energy and Emissions Performance. Require an assessment of the feasibility of replacing the City's gas-fired power plants with battery storage powered by renewable energy sources. Roofs of certain smaller new residential buildings and non-residential buildings will be equipped with a solar photovoltaic system or a green roof.
3/12/2019	City of Carlsbad	Climate Action Plan Ordinance: Regarding Requirements for Water Heating Systems in New Residential Buildings	Signed 3/12/19, proposed to go into effect 1/1/2020	http://www.carlsbadca.gov/ordinances	The first to adopt a water heating emissions reduction ordinance that will promote the installation of solar thermal or heat pump water heaters in homes. The residential water heating ordinance requires new low-rise residential buildings to install cost-effective water heating measures. Required measures include a water heating system that meets one of the following requirements: Heat pump water heater, or other form of electric water heating system, that meets California Energy Code (Title 24, Part 6) standards and is paired with a ≥0.3KW (300W) photovoltaic system or Solar water heating system that is OG-300 certified and includes ≥40 sq. ft. of collectors or provides a 0.6 solar fraction.

Through mid-May 2020, not an exhaustive list

University Goals & Policies Related to Building Decarbonization

Date	Organization	Policy	Status	Link/Source	Description
7/24/2019	UC	Sustainable Practices: UC Green Building Design	Issuance Date: 7/24/19	https://policy.ucop.edu/policies/uc-green-building-design	No new building or major renovation that is approved after June 30, 2019 shall use onsite fossil fuel combustion (e.g., natural gas) for space and water heating (except those projects connected to an existing campus central thermal plant).
7/24/2019	UC	Sustainable Practices: Sustainable Building Operations for Campuses	Issuance Date: 7/24/19	https://policy.ucop.edu/policies/sustainable-building-operations-for-campuses	All locations shall complete a UC Green Laboratories Action Plan by summer 2018 to determine strengths and areas for improvement within the operations of research laboratories in respect to sustainability and carbon neutrality.
7/24/2019	UC	Sustainable Practices: Climate Protection	Issuance Date: 7/24/19	https://policy.ucop.edu/policies/climate-protection	Climate neutrality from scope 1 and 2 sources by 2025 (Carbon Neutrality Initiative announced 11/13/2013); Climate neutrality from scope 3 sources by 2050 or sooner. Immediate goal of reducing GHG emissions to 1990 levels by 2020, pursuant to the CA Global Warming Solutions Act
7/24/2019	UC	Sustainable Practices: Clean Energy	Issuance Date: 7/24/19	https://policy.ucop.edu/policies/clean-energy	University of California is committed to reducing its greenhouse gas emissions by reducing energy use and switching to clean energy supplies. - 2% annual EUI reduction - Install on-site renewable electricity and energy storage systems whenever cost-effective - 100% clean energy by 2025
12/3/2018	Stanford University	100% Solar by 2021	2021 Goal	http://sustainability.stanford.edu/100-solar	After implementation of the SESI program in 2015—which transitioned the campus to an electrically-powered heating and cooling system—the campus is well on its way to accomplish its target to reduce Scope 1 and Scope 2 emissions by 80% in advance of the 2025 deadline. This also falls decades ahead of California's statewide requirement that electricity be 100% carbon-neutral by 2045. To accomplish this, in 2021 a second solar generating station will come online and increase the university's renewable electricity portfolio to 100%, up from 69% today.
9/1/2015	Stanford University	Energy and Climate Plan (2008-2012) Third Edition	implemented 2015	http://sustainability.stanford.edu/energy-climate-plan	Stanford Energy Systems Innovations (SESI). A GHG reduction options report was prepared in 2008, approved and funded in 2012, completed in 2015. Natural gas-powered cogeneration facility produced 90 percent of Stanford's GHG emissions prior to 2015. As the cogeneration plant approached the end of its useful life, Stanford examined conversion to new options that assured reliability, contained cost, and reduced GHGs. Stanford Energy System Innovations (SESI) is Stanford's new district energy heating, cooling, and electricity system designed to meet the energy needs of Stanford University in a
12/9/2016	CSU Bakersfield		Climate commitment signed 12/9/16		Commitment signed, currently developing climate action plan
12/17/2015	CSU Chico	Climate Action Plan	Climate commitment signed 12/17/15	https://arcalternative.org/2015/12/17/csuc/	Chico has committed to becoming carbon neutral by 2030.
4/6/2015	CSU Channel Islands		Carbon commitment signed 4/6/15		Carbon commitment signed, no climate action plan or goal date established
1/27/2015	CSU East Bay	Climate Action Plan	Carbon commitment signed 1/27/15	https://arcalternative.org/2015/01/27/csueb/	Cal State East Bay has committed to becoming carbon neutral by 2040
4/7/2011	CSU Fullerton	Climate Action Plan	Carbon commitment signed 4/7/11	https://arcalternative.org/2011/04/07/csuf/	Fullerton has committed to becoming carbon neutral by 2050. Their 2015 Climate Action Plan identifies electrification and use of biogas as solutions towards carbon neutrality.
1/1/2016	CSU Humboldt	Climate Action Plan	Climate commitment signed 1/1/16	https://arcalternative.org/2016/01/01/csh/	Humboldt has committed to becoming carbon neutral by 2050.
4/4/2016	CSU Los Angeles	Climate Action Plan	Climate commitment signed 4/4/16	https://arcalternative.org/2016/04/04/csula/	Cal State LA has committed to carbon neutrality by 2045. "Making new buildings all-electric will effectively reduce Cal State LA's carbon footprint without the complications of decarbonizing natural gas consumption through purchasing either carbon offsets or directed biogas. 39 Buildings that are all-electric, the only delivered energy type that can be effectively offset with renewable energy, have shown to be comparable or slightly less expensive than combined gas and electric buildings from a 20-year life cycle cost perspective, factoring in both capital and energy costs"
4/12/2016	CSU Long Beach	Climate Action Plan	Climate commitment signed 4/12/16	https://arcalternative.org/2016/04/12/csulb/	Long Beach has committed to becoming carbon neutral by 2030.
4/15/2016	CSU Monterey Bay	Climate Action Plan	Climate commitment signed 4/15/16	https://arcalternative.org/2016/04/15/csm/	CSU Monterey Bay has committed to becoming carbon neutral by 2030.
10/5/2015	CSU Northridge	Climate Action Plan	Climate commitment signed 10/5/15	https://arcalternative.org/2015/10/05/csun/	CSU Northridge has committed to becoming carbon neutral by 2040.
2/5/2007	CSU Pomona	Climate Action Plan	Carbon commitment signed 2/5/07	https://arcalternative.org/2007/02/05/csp/	Cal Poly Pomona has committed to becoming carbon neutral by 2030.
4/19/2016	CSU Sacramento	Climate Action Plan	Carbon commitment signed 4/19/16	https://arcalternative.org/2016/04/19/csu-sacramento/	Sacramento State University has committed to becoming carbon neutral by 2040.
3/5/2015	CSU San Diego	Climate Action Plan	Carbon commitment signed 3/5/15	https://arcalternative.org/2015/03/05/csud/	San Diego State has committed to becoming carbon neutral by 2050. SDSU identifies electrification of their cogeneration system as a path towards carbon neutrality.
5/9/2007	CSU San Francisco	Climate Action Plan	Carbon commitment signed 5/9/07	https://arcalternative.org/2007/05/09/csu-sf/	San Francisco State University commits to reducing emissions below 1990 levels: 25% by 2020 and 40% by 2030.
4/8/2016	CSU San Luis Obispo	Climate Action Plan	Climate commitment signed 4/8/16	https://arcalternative.org/2016/04/08/csulob/	Cal Poly San Luis Obispo has committed to becoming carbon neutral by 2030. Their 2016 Climate Action Plan identifies biogas as a strategy for reducing carbon emissions.

Through mid-May 2020, not an exhaustive list

Utility Initiatives Supporting Building Decarbonization

Date	Organization	Policy	Status	Link/Source	Description
1/1/2020	Peninsula Clean Energy, Silicon Valley Clean Energy, San Mateo County Office of Sustainability	2019 Building Electrification & EV Infrastructure Reach Code Initiative	Under Council Review, will be effective 1/1/2020	https://peninsularead.org/	Peninsula Clean Energy (PCE), Silicon Valley Clean Energy (SVCE) and the San Mateo County Office of Sustainability (OOS) are joining together to reduce greenhouse gas (GHG) emissions within their service territories by developing forward-thinking building and transportation electrification reach codes. In support of municipalities and counties in PCE & SVCE service territory, PCE & SVCE
7/1/2019	Southern California Edison	Clean Energy Optimization Pilot (CEOP)	Pilot underway with select CSU and UC campuses	https://arcalternative.org/	Performance-based incentive program based on campus-level greenhouse gas (GHG) reductions. Four year pilot underway at CSUDH and CalPoly Pomona.
4/1/2019	SMUD, LADWP, Marin Clean Energy, Sonoma Clean Power	Incentives and Programs for Electric Heat Pumps		https://www.ethree.org/	including the Sacramento Municipal Utility District (SMUD), Los Angeles Department of Water and Power (LADWP), Marin Clean Energy, and Sonoma Clean Power have begun to offer incentives and programs for electric heat pumps as a cost-saving and greenhouse-gas saving measure
12/13/2018	CPUC	R.15-03-010 San Joaquin Valley Disadvantaged Communities	CPUC Approval 12/13/18	https://arcalternative.org/	Authorized Pacific Gas & Electric Company, Southern California Edison, and third parties to spend nearly \$51 million to replace propane- or wood-burning appliances with all-electric models in more than 1,600 low-income San Joaquin Valley households.

Through mid-May 2020, not an exhaustive list

Building Decarbonization Resources

Title	Organization	Link/Source	Description
University of California Strategies for Decarbonization: Replacing Natural Gas	UC & TomKat	https://www.ncees.org/energy/decarbonization	Strategies: (1) reduce energy demand via improved EE (2) substitution of renewable gas (3) electrification of end uses. - Energy storage will create synergies with these three approaches Barriers: losing money on expensive CHP investments, cheap operating costs for CHP, electrification of heating and temp required for end use - limited, difficulties to electrify lab spaces (contractual obligations,
Insights From the California Energy Policy Simulator	Energy Innovation	https://arcalterna.com/california-energy-policy-simulator	Examines California's current greenhouse gas emission trajectory and identifies six policy opportunities for deepening emission reductions
ZERO Code for California	Architecture 2030 Initiative	https://zero-code.org/	The ZERO Code for California (ZERO CodeCA) is a building energy standard developed by Architecture 2030 that applies to new commercial, institutional, high-rise residential, and hotel/motel buildings, the prevalent building types being constructed in cities today. The ZERO CodeCA, which can be adopted immediately, integrates cost-effective energy efficiency standards with on-site and/or off-site renewable energy resulting in Zero-Net-Carbon (ZNC) buildings. ... The ZERO CodeCA includes prescriptive and performance paths to compliance based on the California Building Energy Efficiency Standards (BEES) and is supported by the compliance tool and simulation software CBECC-Com. The ZERO CodeCA is also supported by a web-enabled
Deep Decarbonization in a High Renewables Future	CEC	https://www.ethr.org/deep-decarbonization-in-a-high-renewables-future	Ten mitigation scenarios are evaluated, each designed to achieve the state's greenhouse gas reduction goals subject to a changing California climate. All mitigation scenarios are characterized by high levels of energy efficiency and conservation, renewable electricity generation, and transportation electrification. The mitigation scenarios differ in their assumptions about biofuels and building electrification, among other variations. The High Electrification scenario is found to be one of the lower-cost and lower-risk mitigation scenarios, subject to uncertainties in building retrofit costs as well as implementation challenges.
Draft 2019 Integrated Energy Policy Report (IEPR)	CEC	https://ww2.energy.ca.gov/2019-IEPR	Chapter 2: Building Decarbonization and Energy Efficiency
2018 Integrated Energy Policy Report (IEPR) Update, Volume II	CEC	https://ww2.energy.ca.gov/2018-IEPR	.
Decarbonization of Heating Energy Use in CA Buildings	Synapse Energy for NRDC	https://www.synapseenergy.com/research/decarbonization-of-heating-energy-use-in-ca-buildings	Looks at market opportunities, market barriers, and technologies for space heating and water heating, current policies, and policy roadmap
CA Energy Codes and Standards Study	California Energy Codes and Standards	Non-Res: https://www.energy.ca.gov/energy-codes-and-standards	A study released by the California Codes and Standards program found that, on average, it costs around \$6,000 less to build an all-electric single-family home than it does to build a mixed fuel home with natural gas. The savings come from not having to hook up natural gas infrastructure or pipe it to the home, said Rachel Kuykendall, senior program manager at Sonoma Clean Power, which has worked with other local groups to offer \$5,000 to homeowners affected by the 2017 wildfires to rebuild their homes so they run only
Building Decarbonization Assessment Project Scope	CEC	https://arcalterna.com/building-decarbonization-assessment-project-scope	This memorandum sets forth the scoping categories, issues, and schedule, for the California Energy Commission's (CEC) implementation of Assembly Bill 3232
Residential Building Electrification in CA	E3	https://www.ethr.org/residential-building-electrification-in-ca	This study evaluates the consumer economics, greenhouse gas savings and grid impacts of electrification in residential low-rise buildings across six representative homes type in six climate zones in California. Consumer economics are evaluated in three ways, by comparing: 1) upfront installed capital costs, 2) energy
Economics of Electrifying Buildings	Rocky Mountain Institute	https://rmi.org/information/economics-of-electrifying-buildings	This study analyzes the economics and carbon impacts of electrifying residential space and water heating both with and without demand flexibility—the ability to shift energy consumption in time to support grid needs. We compare electric space and water heating to fossil-fueled space and water heating for both new construction and home retrofits under various electric rate structures in four cities: Oakland, California;
Analysis of the Role of Gas for a Low-Carbon California Future	SoCalGas, Navigant	https://www.socalgas.com/analysis-of-the-role-of-gas-for-a-low-carbon-california-future	This report quantifies the amount of RG that would need to be supplied to SoCalGas' retail customers to decarbonize gas at similar pace as the electric supply. That is, how much RG would have to be supplied so building end uses have the same GHG footprint regardless of whether they use or gas or electric appliances.
Optionality, Flexibility & Innovation: Pathways for Deep Decarbonization in California	Energy Futures Initiative	https://energyfutures.org/optionality-flexibility-innovation	Analyzes ways the state can meet its aggressive 2030 low-carbon energy goals and outlines the innovation agenda needed for midcentury deep decarbonization

Building Decarbonization Resources (Continued)

Title	Organization	Link/Source	Description
CA's Building Decarbonization Opportunity: Knowing Where We Are and Delivering What We Need	Building Decarbonization Coalition	https://arcalterna.org/	<p>Highlights recent work by the California Energy Commission, showing that a decarbonization strategy that relies on building electrification will save consumers billions of dollars compared to other carbon reduction strategies. Even still, the report identifies significant barriers to electrification for consumers and the workforce -- including upfront costs, workforce readiness and regulatory tools that don't account for the full suite of benefits of decarbonization.</p> <p>The report recommends that state regulators reconfigure the existing cost-benefit tests that guide programs to appropriately account for the true costs of fossil fuels. Other recommendations to guide the regulatory framework include:</p> <ul style="list-style-type: none"> Focusing on key results, ultimately the reduction of GHG emissions from buildings at the lowest possible costs, Delivering customer value; Supporting flexible implementation; and Keeping clean energy affordable.
Building Decarbonization: Legal Opportunities and Hurdles for Local Governments	Building Decarbonization Coalition	https://arcalterna.org/	Memorandum assesses the legal framework within which local governments can decarbonize new and existing residential and commercial buildings in California.
Rate Design for Beneficial Electrification	Building Decarbonization Coalition	https://arcalterna.org/	Recommends addressing baseline allowances, providing optional time-of-use rates that reward off-peak electricity use, and revisiting high usage charges for residential customers.
Strategies and Approaches for Decarbonization	Building Decarbonization Coalition	https://arcalterna.org/	<p>highlights best practices from across the nation that will help guide California's implementation</p> <ul style="list-style-type: none"> - Mid-Stream programs for heat pumps in NY, Northwest EE Alliance - upstream heat pump program - Rate Design Approaches: AZ Public Service, Salt River Project - Electric Water Heating Programs: Portland General Electric, Green Mountain Power, AZ Public Service - Financing Programs - Electrification Incentive Programs (Res): Palo Alto Utilities, SMUD
A Roadmap to Decarbonize California's Buildings	Building Decarbonization Coalition	http://www.buildingdec.org/	Phase I: Market Readiness, Phase II: Market Deployment, Phase III: Scaling the Market. Looks at new buildings, existing buildings, barriers and goals
2025 California Demand Response Potential Study - Charting California's Demand Response Future: Final Report On Phase 2 Results	LBNL	https://drrc.lbl.gov/	<p>This study estimates the potential size and cost of future DR resources for California's three investor-owned utilities (IOUs): Pacific Gas and Electric Company (PG&E), Southern California Edison Company (SCE), and San Diego Gas & Electric Company (SDG&E).</p> <p>We address two fundamental questions:</p> <ol style="list-style-type: none"> 1. What cost-competitive DR service types will meet California's future grid needs as it moves towards clean energy and advanced infrastructure?
2019 California Energy Efficiency Action Plan	CEC	https://www.energy.ca.gov/	The 2019 update will combine content from the past Existing Building Energy Efficiency Action Plan, Senate Bill 350 Doubling Energy Efficiency by 2030 report, the Low Income Barriers Study, the Clean Energy in Low-Income Multifamily Buildings Action Plan, and ongoing building decarbonization research.
Building Decarbonization Reach Code Fact Sheet	Building Decarbonization Coalition	http://www.buildingdec.org/	Summarizes what reach codes are and why they're important
Costa Rica Plan for Decarbonization by 2050	Costa Rica	https://www.nrdc.org/	Planning for decarbonization sets the path between the current goals and those of 2050, in line with the objectives of the 2030 Agenda and the Paris Agreement. This National Plan identifies technological transformation routes for each one of the sectors. The actions are presented in 10 sectoral focus areas with policy packages in three periods: beginning (2018-2022), inflection (2023-2030) and massive deployment
Decoding Building Decarbonization Research Agenda	Building Decarbonization Coalition	https://gridworks.org/	Brings together ideas from across the industry on R&D priorities to accelerate building decarbonization. More than 35 organizations provided input to Gridworks via survey and an in-person summit to highlight seven topic areas and 20 studies that agencies, load serving entities, research institutes, and community organizations may partner on to overcome barriers and quantify benefits of building decarbonization.
Decoding Grid Integrated Buildings Report	Building Decarbonization Coalition	https://gridworks.org/	Summarizes the potential impacts that building electrification may have on building-level infrastructure including electrical panels and local distribution infrastructure. During the report development, more than 47 organizations participated in a two-day summit to help Gridworks articulate what California needs to better

Through mid-May 2020, not an exhaustive list