



# DECODING BUILDING DECARBONIZATION RESEARCH AGENDA

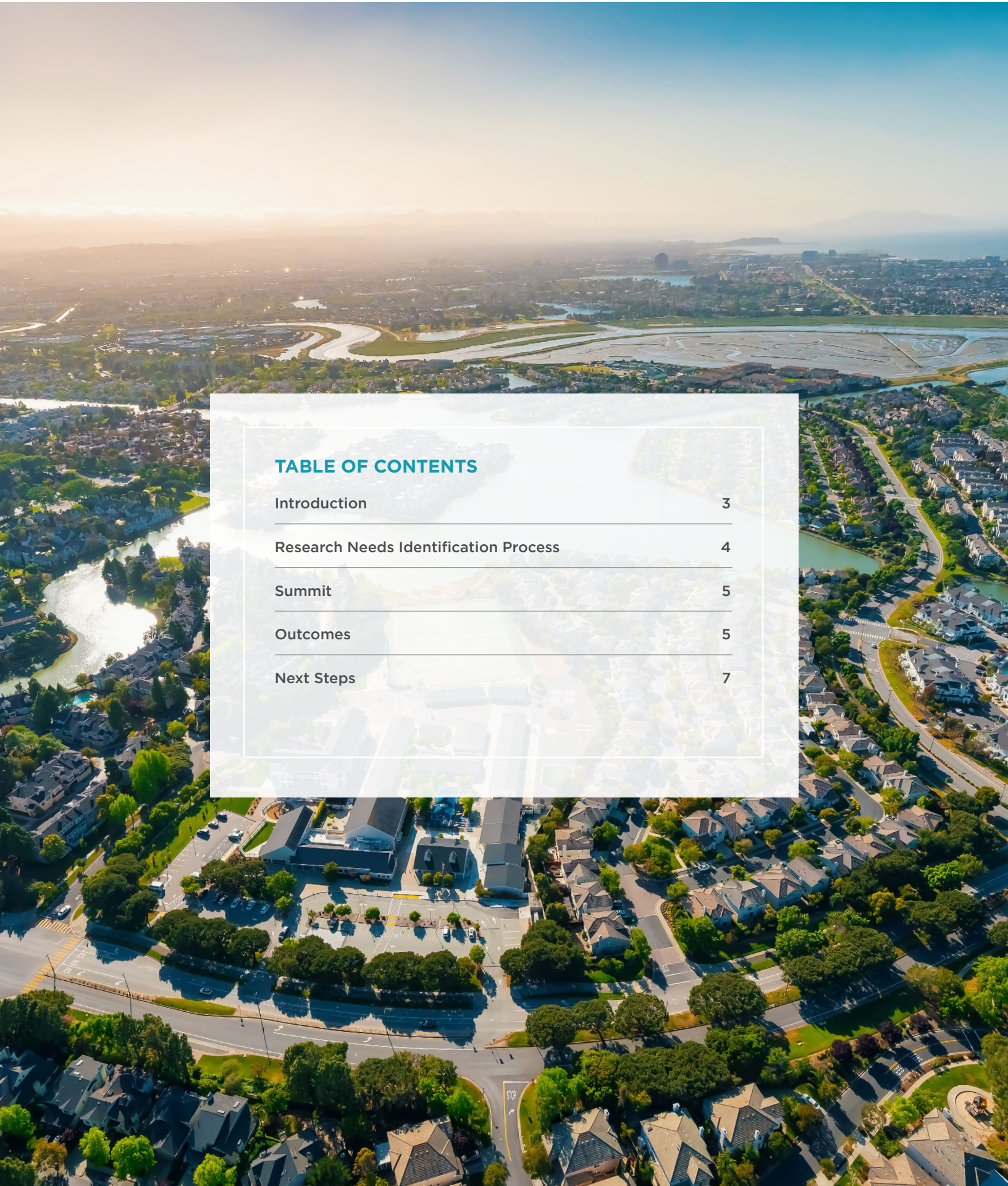
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**BUILDING  
DECARBONIZATION  
COALITION**







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## INTRODUCTION

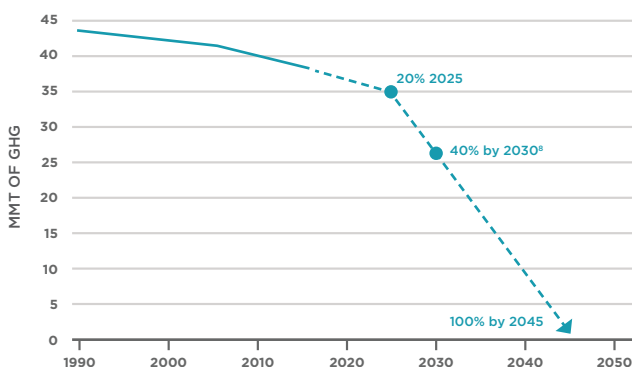
*A Roadmap to Decarbonize California Buildings* (the Roadmap) establishes an ambitious framework for eliminating emissions from buildings. Per the Roadmap, in order to reach the State's 2045 decarbonization goals, including interim milestones to reduce emissions by 40% below 1990 levels by 2030,<sup>1</sup> the share of high efficiency heat pumps for space and water heating and other technologies must increase to 50% by 2025 and 100% by 2030.<sup>2</sup> To overcome the languid speed of appliance replacement, California needs a data-driven approach to clarify and quantify the benefits of decarbonization to drive customer demand and increase market share for heat pumps and other electrified technologies.

To support California's decarbonization goals, the Building Decarbonization Coalition (Coalition) offers this Research Agenda to identify priority research topics that must be addressed to support and accelerate adoption of decarbonization technologies. For the purposes of this document, the term "research" began with a broad interpretation, meaning that suggested research outputs might include strategic policy frameworks, program design reviews, customer surveys, technical feasibility studies, and/or non-energy impacts identification. Understanding that some of these outputs do not fit traditional definitions of "research," the Coalition prioritizes research topics and anticipated outputs that will support, but not

take the place of, broader policy and coordination plans. For instance, although the development of a statewide strategic plan for building decarbonization is a priority policy need, it is not a research topic. That said, quantification of air quality benefits from decarbonization and market assessments by building types are priority research needs to inform a comprehensive statewide decarbonization strategy, and are highlighted as such herein.

The Building Decarbonization Coalition supports the pursuit of each of the priority research studies included in Table 1 of this document and urges state energy agencies, local governments, load-serving entities, manufacturers, and community-based organizations to partner and optimize the available research resources. Through collective collaborative

### DECARBONIZATION OF THE BUILDING SECTOR



### GOAL 1

Customers, builders, contractors and policy-makers are **aware of and demand** building decarbonization measures.

### GOAL 2

Customers receive a **good value** from adopting building decarbonization measures.

### GOAL 3

Building decarbonization provides a **better value to builders and contractors** than fossil-fuel heating.

### GOAL 4

Supply-chains and delivery agents are **able to meet rising demand** for carbon-free building technologies with a quality product.

### GOAL 5

**Policies are aligned** to maximize customer awareness of and interest in building decarbonization, the customer, builder and contractor value proposition, and the industry's ability to meet rising demand.

<sup>1</sup> Assembly Bill 3232 (Friedman, 2018) 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.

<sup>2</sup> Building Decarbonization Coalition, 2018, *A Roadmap to Decarbonize California Buildings*, page 6, Available at: <http://www.buildingdecarb.org/resources/a-roadmap-to-decarbonize-californias-buildings>.



study, California can support decarbonization beyond its regions to seed informed markets globally.

## RESEARCH NEEDS IDENTIFICATION PROCESS

Identification of research needs began with the key five barriers to building decarbonization highlighted in the Roadmap: (1) low awareness and interest; (2) low perceived customer value; (3) low perceived contractor and builder value; (4) low availability of technologies to support decarbonization; and (5) misaligned policy. We also looked closer to the contributing factors that require objective data such as:

- Lack of mainstream customer education on the health and economic benefits of electrification of equipment and appliances;
- Lack of markets to monetize grid and climate values;
- Lack of paths to market for electric load shift enabled by heat pumps;
- Lack of consumer demand;
- Lack of adequate electrical paneling at many homes and businesses; and
- Lack of adequate measurement and valuation of GHG emissions.

With these barriers and contributing factors in mind, Gridworks surveyed the Building Decarbonization Coalition membership for input. Members were

asked to describe the top challenges impacting the developing building decarbonization market that require additional research in each of the following areas:

- Market, technical, and economic potential
- Customer perceptions and purchasing behavior (including marketing)
- Long-term reliability and performance in the field
- Automated price response and demand response
- Equipment specifications and features
- Incentive program design and management
- Measure- or project-level emissions savings and bill impacts
- Equipment cost and installation cost drivers
- Supply chain development, certification, and training
- Other

The Coalition's suggested priority research areas were aligned with challenges stakeholders discussed throughout the year of Roadmap development, which fed into the barriers and contributing factors identified in the Roadmap. Gridworks organized and consolidated the survey responses into 14 preliminary research topics:

1. **Developing low voltage equipment (110V instead of 240V)**
2. **Simplifying design process and tools in coordination manufacturers**

3. **Scope and cost of necessary electrical panel upgrades**
4. **Changing perspectives about low emissions technologies, including leveraging demonstration kitchens**
5. **Increasing value to contractors to invest in the training to install decarbonization technology**
6. **Messaging and marketing on individual economics/customer value**
7. **Lowest cost combinations of heat pump HVAC equipment with improved insulation and ducting**
8. **Best practices to facilitate and enable installation of heat pump technology in emergency replacements - supply chain, contractor training, customer awareness**
9. **Combining offerings with energy efficiency, pay for performance**
10. **Identifying/measuring/promoting health, comfort, and safety benefits of electrification**
11. **Engaging and including low and moderate income customers, particularly renters**
12. **Addressing split incentives**
13. **Energy resiliency in an all-electric paradigm - e.g., microgrids, infrastructure strains, wildfire mitigation/adaptation/recovery**
14. **Interaction between built environment and transportation electrification - e.g., panels and building-level infrastructure needs, load shifting potential and tools to measure, forecast, implement, and automate**

## SUMMIT

With the preliminary research topics developed, the Building Decarbonization Coalition and Gridworks hosted a one-day summit to discuss the topics in more detail, clarify whether any additional topics are needed, and identify priorities and interdependencies among the topics.

Input and discussion at the summit was robust with 36 organizations represented across 55 attendees. Individuals from community choice aggregators (CCAs), municipal utility providers (munis), investor-owned utilities (IOUs), local governments, state energy agencies, manufacturers, property managers, program implementers, housing advocates, researchers, and environmental advocates participated in small group discussions facilitated by industry experts under each research area.

Throughout the course of the day, more than 60 priority topics were identified, each with varying ability to be addressed via research and development. Many

stakeholders identified the need for interagency policy coordination and consolidation of program offerings as a priority topic. Although interagency coordination and streamlined program offerings are important for building decarbonization, these outcomes are not necessarily the result of research and development. That said, better understanding and quantification of air quality benefits from decarbonization and market assessments by building types are research topics that can inform a comprehensive statewide decarbonization strategy, and are highlighted as such herein.

In the course of discussion, it was apparent that there were studies underway or recently completed studies that addressed priority topics, but were not well-publicized among the audience. Stakeholders felt that there is a need for a central repository of decarbonization studies to improve coordination and avoid redundant efforts. The California Energy Commission (CEC), California Public Utilities Commission (CPUC), and California Air Resources Board (ARB) were identified as critical partners in facilitating the development of any such research repository.

## OUTCOMES

We identify seven (7) priority research areas with suggested priority studies (Table 1). The priority studies identified below are drawn from stakeholder input throughout the survey and summit efforts. The Coalition identifies these studies to highlight near-term research projects that state agencies and decarbonization advocates may take on to better understand the opportunities and impacts for building decarbonization. Some studies may already be planned or in progress independent of the Building Decarbonization Coalition. To accelerate building decarbonization, the Coalition may opt to partner on or independently fund specific studies. Further coordination is needed among stakeholders to ensure an organized and efficient research approach.

TABLE 1. Priority Research Topics and Studies

TOPIC	PURPOSE	PRIORITY STUDIES	POTENTIAL RESEARCH PARTNERS
COMPREHENSIVE STATEWIDE STRATEGY AND POTENTIAL STUDIES	Efficient spending requires that California take a strategic approach to building decarbonization. The state needs to <b>adopt a comprehensive framework and conduct potential studies to target resources.</b>	Potential studies for residential and commercial sectors for electrifying space and water heating technologies in existing buildings under varying future clean energy scenarios (e.g., high solar plus storage adoption, high versus low electric vehicle adoption, reduction of existing gas infrastructure)	CEC, CPUC, research labs
		Feasibility study to <b>develop a screening tool to identify cost-effective building decarbonization opportunities by building type</b> — necessary data inputs, available data sources, and coordination needs	Local governments
PROGRAM DESIGN AND CONSOLIDATION	Utilities, community choice aggregators, and local governments already offer customers hundreds of programmatic options to reduce emissions. The <b>varying program rules create confusion and limits the ability to combine funding sources.</b>	Process evaluation for load serving entities’ energy efficiency and demand response program portfolios to <b>identify opportunities to streamline program delivery and include electrification technologies</b>	CPUC, CEC, munis, IOUs, CCAs, US Department of Energy (DOE), research labs
		Literature review of program evaluations for existing upstream and midstream programs to <b>identify redundant programs and determine best practices that should be combined into one program offering</b>	CPUC, CEC, munis, IOUs, CCAs
MARKET ASSESSMENTS	Climate change goals will not be met without robust and self-sustaining markets for decarbonization technologies. <b>Establishing self-sustaining markets requires data on the barriers and needs of each customer segment and building type.</b>	<b>Barriers study for retrofits of centralized systems for high-rise buildings</b>	Manufacturers, property managers, housing advocates
		<b>Contractor needs assessment survey</b> to offer decarbonized technologies	Labor representatives
		<b>Survey and review of jurisdictions with high rates of permit compliance</b> to identify actions and policies to improve compliance rates in jurisdictions with low compliance rates.	CPUC, CEC, Contractors State License Board, California Building Officials, research labs, NEEA
		<b>Market assessment by building type</b> (e.g., low-rise multifamily, high-rise multi-family, rental properties, small commercial, etc.) — identify available and incumbent technologies, costs (equipment, labor and maintenance in near- and long-term), benefits, and barriers	IOUs, munis, CCAs, property managers, housing advocates
TECHNICAL NEEDS	There are technical gaps in the available equipment, such as lack of electric dryers that can meet commercial and multi-family building needs, electrical panel capacity constraints, and lack of consistent communication protocols for smart appliances. <b>Technical gaps must be filled to meet customer energy needs without impact to the customer.</b>	<b>Feasibility study for high capacity heat pump water heaters and dryers</b> to meet multi-family building needs	Housing advocates, manufacturers, research labs
		Load study of existing all-electric buildings to <b>better understand load management practices and tools that can avoid an electrical panel upgrade in future projects</b>	CPUC, CEC, IOUs, munis, CCAs, research labs
		<b>Communications protocol requirements for appliances</b> and two-way EV chargers (V2G/V2H) to participate in automatic demand response programs	Manufacturers, research labs, IOUs, CCAs, DOE, research labs, Northwest Energy Efficiency Association (NEEA)
INDOOR AIR QUALITY AND NON-ENERGY IMPACT QUANTIFICATION	Indoor air quality improvements and non-energy impacts are expected to be important factors to motivate customers to switch to heat pump and electric technologies.	Literature review of quantified <b>effects of air conditioning in reducing heat-related illnesses and application to California climate zones</b>	ARB, community-based organizations
		<b>Evaluation of health, comfort, and safety impacts and benefits</b> of eliminating fossil fuel combustion from cooking in homes	CPUC, CEC, ARB, community-based organizations, local health departments
		<b>Feasibility study to deploy natural refrigerants</b> in heat pump technologies — available products, costs, barriers, and benefits	CPUC, ARB, manufacturers, research labs
CUSTOMER MESSAGING AND MARKETING	Effective customer communication and engagement are critical to creating demand for decarbonization technologies.	<b>Customer perception survey</b> for neighborhood and/or community-scale retrofits (e.g., for San Joaquin Valley pilots) for both residential and commercial accounts	Community-based organizations
		<b>Review of regional heat pump marketing campaigns</b> and applicability to California	Environmental advocates, munis, community-based organizations
		Evaluation of the CPUC’s Statewide Energy Marketing Program (Energy Upgrade California) campaign and <b>adaptations to incorporate building decarbonization</b>	CPUC, CEC, ARB, community-based organizations
EQUITY	Specific attention should be focused on low-income and disadvantaged communities to ensure that those communities are prioritized and benefiting from building decarbonization efforts.	<b>Barriers study for low income and disadvantaged (e.g., English as a second language, elderly, rural) communities to electrify end uses</b>	CPUC, CEC, community-based organizations
		Literature review to identify potential to streamline programmatic offerings across different organizations (e.g., housing, solar incentives) to low income and disadvantaged communities	CPUC, CEC, ARB, community-based organizations, housing advocates
		<b>Economic impact assessment of forecasted electric and gas rate scenarios in low-income households to better understand when and how electrification can be cost-effective</b>	CPUC, IOUs, munis, community-based organizations

NEXT STEPS

The summit demonstrated that there is substantial agreement about the pressing need for research and differing perspectives on research priorities. Understandably, priorities vary by agencies and organizations, as well as funding sources for specific studies. High level areas of agreement on research priorities primarily covered market intelligence and workforce readiness, include:

1. Market assessment by building type that reviews available technologies, costs, and benefits.
2. Contractor needs assessment survey for facilitating and accelerating building decarbonization.
3. Marketing research to determine what messages resonate with customers.

The Building Decarbonization Coalition supports the pursuit of each of the priority research studies included in Table 1 of this document. Partnerships and shared outputs are critical to an efficient research approach and we encourage state energy agencies, local governments, load-serving entities, manufacturers, and community-based organizations to collaborate and optimize the available research resources. Through a coordinated approach, California can support decarbonization beyond its own boundaries and seed informed markets globally.







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