

Innovative Approaches to Building and Community-Scale Decarbonization

INITIATIVE DESCRIPTION

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- Develops and demonstrates new building- and community-scale decarbonization technologies and strategies to create affordable, scalable, reliable, and equitable pathways for clean energy upgrades across homes, businesses, and neighborhoods.
- Advances affordable residential electrification systems and retrofit solutions for single family, multifamily, and manufactured homes that lower the upfront and operational costs of whole-home electrification.
- Reduces electrification costs by advancing low-power technologies, improving building retrofit packages, and enabling community-scale systems that lower or avoid household and grid upgrade expenses.

PROPOSED INITIATIVE BUDGET	\$126M
% OF TOTAL BUDGET (excl. admin & overhead)	17%
# OF RESEARCH TOPIC AREAS	4

ALIGNMENT SUMMARY

STRATEGIC OBJECTIVE ALIGNMENT

Pages 90-91

“The EPIC program will accelerate innovation, demonstration, and reliable and scalable approaches to deployment that help reduce the all-in cost of whole-home electrification and enable demand flexibility / automated response to process signals or dynamic rates for single-family and multi-family buildings and manufactured housing by 50%, while decreasing residents’ energy costs, by 2035.”

Develops lower-cost, lower-power electrification technologies, streamlined whole-home retrofit solutions, neighborhood-scale systems that reduce per-home and grid upgrade expenses, and advanced approaches to difficult-to-decarbonize commercial buildings that directly reduce the technical and financial barriers to affordable building electrification.

CPUC ALIGNMENT

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- Aligns with CPUC proceedings that are increasingly focused on reducing electrification costs, modernizing grid integration, advancing community-scale decarbonization, and establishing frameworks for thermal energy networks and load-flexible technologies
- Provides validated technologies, cost and performance data, and scalable deployment models that strengthen future planning, shape program and rate design, support standards development, and improve regulatory pathways
- Delivers public-interest, utility-ready innovations that lower system costs, improve grid reliability, and expand equitable access—outcomes the private market and federal programs cannot provide at the scale or specificity that most benefits California ratepayers

Advancing Affordable Building Electrification Systems for Residential Homes

WHAT PROBLEM ARE WE SOLVING?

Pages 95-99

Reducing Cost of Whole Home Electrification

Innovative Approaches to Building and Community-Scale Decarbonization

START	2028
OUTPUTS	2032 – 2035
MARKET READY	2034 – 2035

Buildings often face high electrification system costs — especially in older, low-income, single-family, multifamily and manufactured homes. Uncoordinated electrification and aging electrical infrastructure force ratepayers to pay high upfront equipment and installation costs — often requiring thousands in out-of-pocket electrical upgrades — while threatening higher monthly utility bills through increased grid strain. This research topic targets specific gaps that can help enable and accelerate affordable and scalable building electrification systems.

ALIGNMENT SUMMARY

WHAT IS THE DISTINCT RESEARCH APPROACH?

- Demonstrate lower-power and flexible technologies in a variety of real homes to validate performance. (p. 95)
- Reduce costs of HVAC and HPWHs through improvements in components, ultra-low GWP refrigerants, heat exchangers, distributions systems, cold-climate technologies, non-vapor compression, geothermal applications, and passive cooling, among others. (p. 96)
- Advance and validate plug-and-play DERs, such as portable solar, battery storage, and energy management systems, to enhance appliance performance and improve resilience of homes. (p. 96)

HOW WILL YOU KNOW YOU ARE SUCCESSFUL?

- Generate actionable performance data and identify cost-reduction opportunities of total installed costs. (p. 98)
- Increase equipment reliability, drive electricity savings, mitigate peak load, and reinforce grid stability. (p. 98)
- Avoid infrastructure upgrade costs at the home and distribution levels. (p. 98)
- Enable affordable electrification pathways for DVCs, renters, and tribes. Help lower energy bills and improve indoor air quality and comfort for ratepayers in single family, multi-family, and manufactured homes. (p. 99)

HOW WILL YOU COORDINATE?

- Identify the potential for overlapping research, share priorities, and collaborate on complementary portfolios with EPIC and Gas RD&D Administrators. (p. 98)
- Build on tech advancements and lessons learned in EPC-15-053 non-invasive retrofits, EPC-24-005 home power planner electrification tool, GFO-24-305 next-gen all-electric heat pumps using low-GWP refrigerants, GFO-16-502 reducing gas consumption of heat pumps. (p. 98)
- Complement CalMTA market-transformation initiatives by leveraging EPIC to accelerate technology development and adoption. (p. 98)

Whole-Home Retrofit Solutions

Reducing Cost of Whole Home Electrification

WHAT PROBLEM ARE WE SOLVING?

Pages 99-103

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California’s older existing building stock suffers from widespread insulation and envelope deficiencies that raise energy costs, increase health risks, and leave many—especially renters—unable to pursue upgrades. Conventional retrofit solutions can be costly and disruptive, and split incentives further hinder rental housing improvements. This research develops affordable, scalable, less-invasive envelope and façade retrofit solutions, along with diagnostics, strategies, and business models that expand access to electrification across all home types.

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ALIGNMENT SUMMARY

WHAT IS THE DISTINCT RESEARCH APPROACH?	HOW WILL YOU KNOW YOU ARE SUCCESSFUL?	HOW WILL YOU COORDINATE?
• Demonstrate nondestructive and less-disruptive diagnostic tools for assessing building conditions and accelerating installations. (pp. 100 - 101) • Demonstrate renter-focused, rapidly deployable, and minimally disruptive retrofit solutions in SF, MF, and manufactured homes. (pp. 100 - 101) • Develop and demonstrate models and strategies that address split-incentive challenges. (pp. 100 - 101) • Pilot field demonstrations to validate performance and market readiness of retrofit solutions for greater uptake. (p. 100)	• Creation of a clear pathway from applied research development to market facilitation to lower total cost of electrification and increase access. (p. 102) • Whole-home solutions that help to decrease retrofit costs and increase building performance. (p. 102) • Progress on lowering total cost of electrification and energy bills for DVCs and rental households. (p. 102)	• Continue coordination with EPIC and Gas R&D Administrators to ensure research complements and aligns with other electrification and decarbonization initiatives. (p. 101) • Build on technology development and lessons learned in PIR-18-007 phase change material insulation wall retrofits, GFO-19-307 envelope and prefabrication technologies, GFO-22-501 window retrofits and fireplace air leakage, and GFO-24-310 existing building retrofits. (p. 93; p. 101) • Complement CalMTA market-transformation initiatives by collaborating on technologies to accelerate adoption. (p. 102)

Neighborhood-Level Decarbonization

Reducing Cost of Whole Home Electrification

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WHAT PROBLEM ARE WE SOLVING?

Pages 102-108

Individual building electrification is not often well-coordinated to align with or optimize neighborhood-level decarbonization. Current approaches do not sufficiently integrate thermal energy networks (TEN's), shared central plants, DER orchestration, and flexible loads across multifamily, small and medium-sized businesses (SMB), and mixed-use districts. These gaps limit the ability to reduce peak demand, improve public safety power shutoff (PSPS) resilience, defer distribution upgrades, and deliver affordable and equitable decarbonization at scale.

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ALIGNMENT SUMMARY

WHAT IS THE DISTINCT RESEARCH APPROACH?

- Demonstrate integrated neighborhood-level decarbonization systems that optimize DERs, storage, flexible loads, and efficiency through models such as community TENS and shared central plants across multiple buildings. (p. 105)
- Generate feeder-level grid data impacts to show how coordinated TENS, DERs and flexible load can reduce peak demand, load shift, and improve PSPS resilience, and avoided/deferred distribution upgrades. (pp. 106 – 107)
- Develop replicable deployment models for multifamily, SMB, and mixed-use districts that align technology performance, utility planning, ownership, and affordability. (p. 104)

HOW WILL YOU KNOW YOU ARE SUCCESSFUL?

- Validate neighborhood-level design models for shared decarbonization systems, such as community TENS and shared central plants, that enable more efficient DER orchestration, storage, and flexible loads. (p. 106, 107)
- Develop deployment guidance that translates demonstration results into utility planning, ownership, and permitting pathways for scalable neighborhood decarbonization (p. 108)
- Produce a replicable neighborhood decarbonization model, with success measured by peak demand reduction, and deferred distribution upgrade costs. (p. 106)

HOW WILL YOU COORDINATE?

- Coordinate on complementary research scopes with Gas RD&D to avoid duplication on TENS and EPIC's above ground DER, controls, and grid-integration focus. (p. 102)
- Build on prior CEC agreements and initiatives, including geothermal modeling (EPC-16-022), heat extraction (GEO-16-004), and low-temperature geothermal wells (500-17-004). (p. 102)
- Structure multiphase, community-centered, early-stage outreach workshops that engage tribal governments and CBOs. (p.103-104)

Advanced Decarbonization Pathways for Difficult-to-Decarbonize Commercial Buildings

WHAT PROBLEM ARE WE SOLVING?

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Reducing Cost of Whole Home Electrification

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Large commercial buildings can have significant thermal loads that current electrification technologies are challenged to meet. They often face high operating costs, peak demand charges, and continued gas dependence since high-temperature heat pumps, heat recovery systems, and integrated thermal solutions may not be commercialized or economic. Unmitigated peak load from these buildings can strain existing distribution infrastructure, increasing system costs that ultimately flow through to ratepayers.

ALIGNMENT SUMMARY

WHAT IS THE DISTINCT RESEARCH APPROACH?

- Develop and test innovations such as high-temperature (>160°F) ultra-low-GWP heat pumps, heat recovery chillers, and thermal storage for commercial retrofits. (p. 109)
- Support integrated thermal networks linking systems, such as HVAC, refrigeration, hot water, and process heat, to optimize whole building performance. (p. 109)
- Adapt solutions for commercial, institutional, and light industrial loads to expand applicability and reduce costs. (p. 109)
- Produce retrofit guidance and validated operating strategies for complex facilities such as hospitals, groceries, universities, and cold storage. (p. 109)

HOW WILL YOU KNOW YOU ARE SUCCESSFUL?

- Performance data shows gas displacement, peak load reduction, and efficiency gains from integrated systems. (p. 110)
- Replicable retrofit packages with defined performance and cost metrics are developed and disseminated. (p. 110)
- Design tools and operational models support grid integration and market adoption. (p. 110)
- Integrated pilots achieve gas reduction, feeder peak reduction, and heat recovery utilization, with improved system COP and validated retrofit pathways. (p. 110)

HOW WILL YOU COORDINATE?

- Coordinate with EPIC Administrators to align demonstrations and avoid duplication. (p. 111)
- Engage Gas R&D Administrators where process heat and boiler displacement intersect within the electricity sector focus. (p. 111)
- Build on technology development and lessons learned in EPC-19-030 CO₂ central heat-pump water heating, EPC-23-031 advanced R744 simultaneous heating-cooling heat pumps, EPC-23-032 large-building heat-recovery demonstrations, EPC-23-034 scalable low-GWP retrofit heat pumps, and EPC-23-030 non-compression cooling (p. 111)