

California Equitable Housing Decarbonization Project

Final Presentation | July 16, 2026



Presentation Outline

1) Project Overview

2) Findings

a) Adoption Challenges

i) System Level

ii) Household Level

b) Pre-/Post-Retrofit Survey Results

3) Policy Recommendations



Project Overview

**Housing
decarbonization** is
essential for meeting
California's **climate &
equity goals**

The Governor has set building decarbonization targets to meet greenhouse gas reduction goals

Heat pump installations

6 million by 2030

All-electric and electric-ready homes

3 million by 2030

7 million by 2035

**...and ensure an equitable energy transition
(CARB 2022)**

- Affordable and accessible programs
- Work with the most impacted communities
- No disproportionate cost burdens
- Financial incentives to low-income consumers

Significant Challenge

70%

of CA households use polluting appliances/equipment for heating/cooking

Adoption disparities exist by income, housing type, tenure, race, and geography. Home decarbonization rates are higher among homeowners, higher-income households, and those with higher levels of education

(Frank and Nowak, 2016; Guo and Kontou, 2021; Ju et al., 2020; Pigman et al., 2021a; Sunter et al., 2019; Xu and Chen, 2019).

Households with barriers to participation represent a significant share of Californians

56% of Housing Units were built before 1980

45% of households are Low- to Moderate-Income (LMI) Households

44% of households are renters

35% of housing units are Multifamily & Manufactured and Mobile Homes

Equitable Housing Decarbonization: Implementation Approaches

What strategies are needed to expand access to decarbonization programs and reduce adoption disparities?

Goal: Develop recommendations to ensure equity in the design, implementation, and evaluation of housing decarbonization programs

Focus: Priority communities, including low-income households, renters, and Disadvantaged Communities (SB 535)

Study timeframe: 2023-2026

Methodology

Literature Review

Synthesized existing research on equity in residential decarbonization program design, implementation, and outcomes

Household Surveys

Surveyed 60 households pre/post retrofits to assess health, financial, and energy impacts

Interviews

Conducted 125 interviews to identify systemic challenges and best practices in program implementation

Policy Cost Analysis

Analyzed cost – benefit framework and program evaluation metrics



Policy Recommendations

Research Team

Participatory Action Research (PAR) – Advisory Committee Guide all aspects of the research, including data collection, analysis, interpretation, and knowledge dissemination

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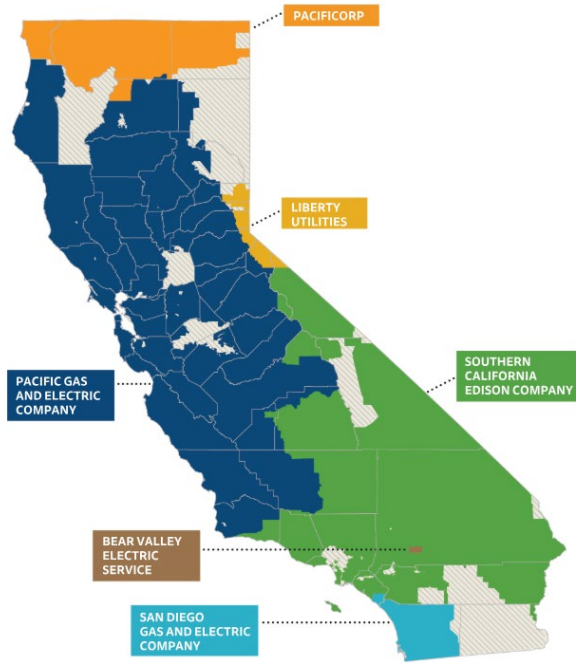
Misbath Daouda, Assistant Professor, School of Public Health

Findings

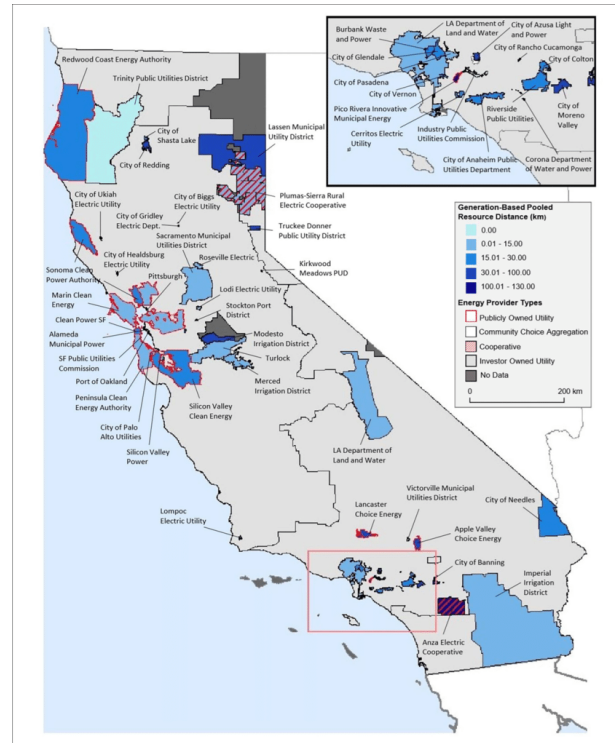
Barriers to Equitable Decarbonization

Many entities administer programs, each with their own eligibility requirements and guidelines.

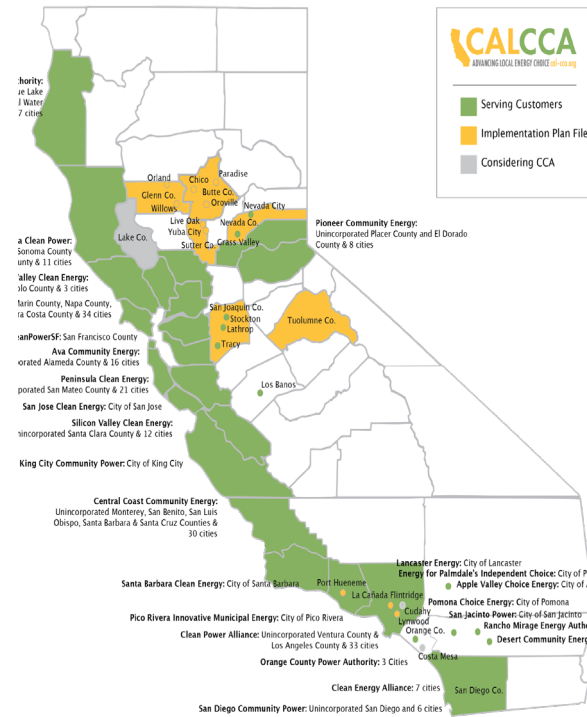
6 Investor-Owned Utilities



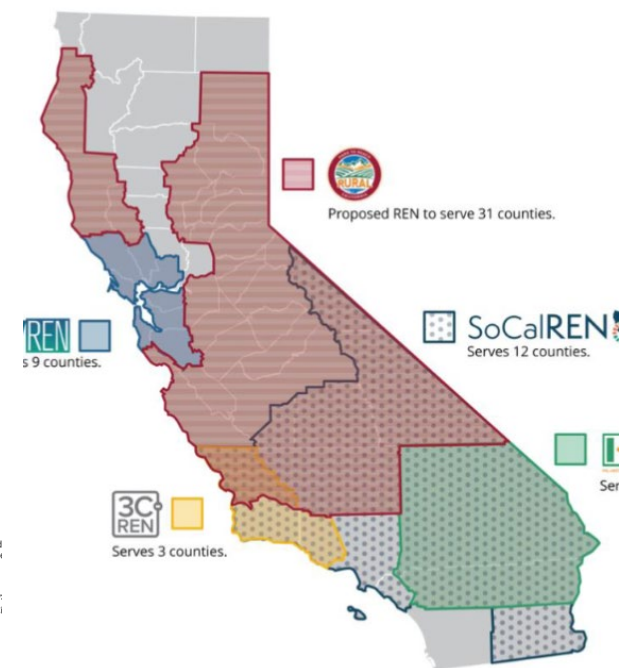
45 Public-Owned Utilities



25 Community Choice Aggregators



7 Regional Energy Networks



+ 482 municipalities across 58 counties

2. Disparities in the Built Environment

Priority communities are more likely to live in older buildings and neighborhoods that require costly upgrades not covered by residential energy programs, making participation prohibitive.



Inadequate energy infrastructure needs upgrades to meet electrification loads (electric panel, circuit, and transformer capacity)



Older buildings require the remediation of health and safety conditions as a prerequisite to electrification (e.g., mold, lead, asbestos)

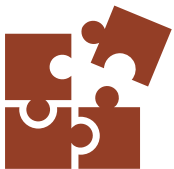
3. Mismatch Between Financial Incentives and Needs



High upfront capital costs make tax credits and rebates inaccessible for LMI households



High electricity rates relative to natural gas costs can increase energy bills post-retrofit



Different eligibility criteria makes it difficult to stack incentives across programs

4. Workforce Challenges

California faces a significant workforce shortage for residential decarbonization, especially in rural areas.

- Contractors play a key role not only in installation, but also in explaining energy programs, scoping projects, and helping households navigate program complexity.

Training pathways are fragmented — trade schools don't teach weatherization or electrification skills and certifications are split across state agencies.

Administrative burden and capital access — small and minority-owned contractors struggle with paperwork, permitting, and reimbursement-based payments that create cash flow barriers.

- Lack of multi-year contracts locks out new entrants.



5. Local Government Capacity

- Building department staff **lack familiarity with decarbonization technologies** — inspectors flag non-issues, give inconsistent guidance, and slow approvals, leading to project delays and higher costs.
- Each jurisdiction's **unique permitting requirements** compound the problem for contractors working across service areas.
- Some local governments in high-resource areas are reducing the administrative burden and implementation costs by offering:
 - Resource centers to connect residents with decarbonization programs.
 - Streamlined online, same-day permitting.



6. Diversity of Ownership and Building Types

California's diverse ownership structures and building types — e.g., rental, multifamily, HOA-governed, and/or manufactured housing — each create distinct barriers to decarbonization.

Multifamily buildings and manufactured homes face unique regulatory and energy infrastructure hurdles.

- In MMH communities, master-metered systems and aging panels create barriers to individual electrification

Property owners have **varying levels of capacity and resources** to undertake projects.

- **Split incentives suppress rental retrofits** — landlords bear the cost of decarbonization while tenants receive the energy savings, weakening owner motivation to invest.
- **Renters may face rent increases and/or displacement** if retrofits occur without sufficient tenant protections.

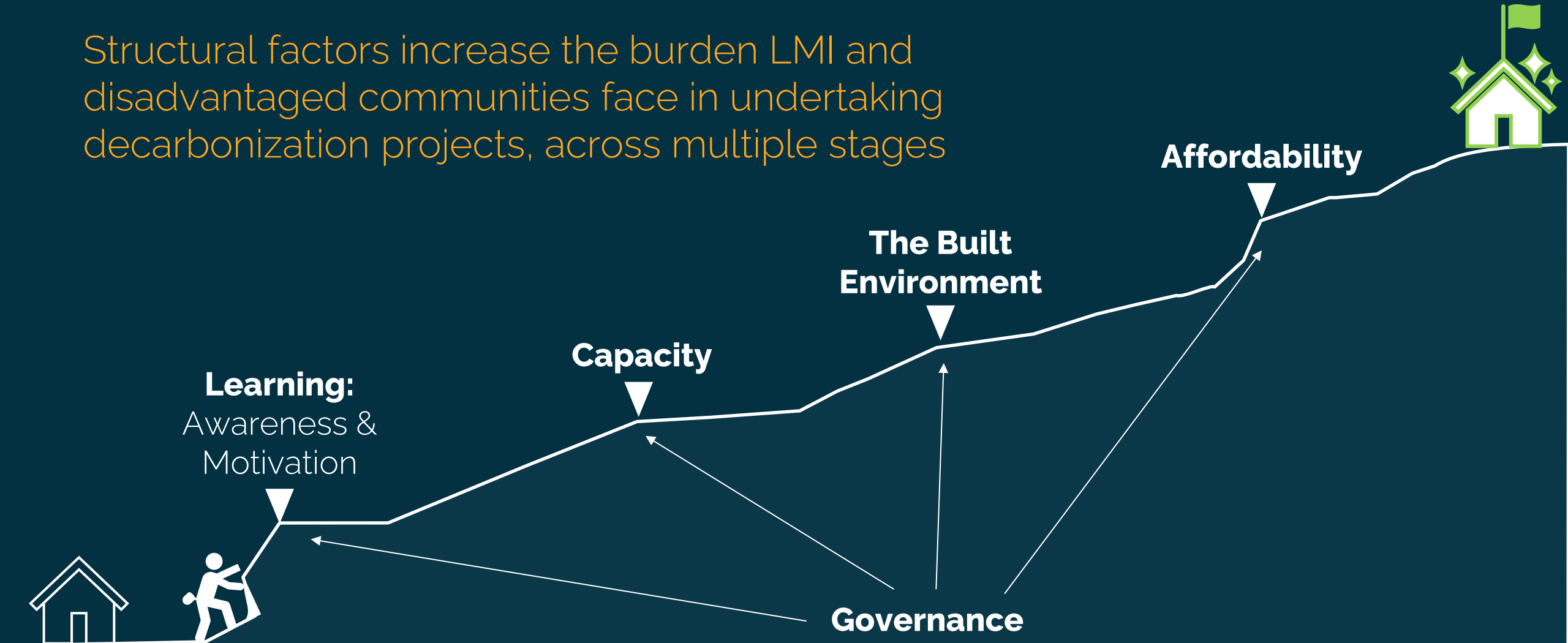


Structural Barriers Intersect



Participation Burden

Structural factors increase the burden LMI and disadvantaged communities face in undertaking decarbonization projects, across multiple stages



Learning

Access to trusted
sources of information
and understanding of
benefits and motivation
to act

Influencing Factors

Individual Level

- Knowledgeable network (e.g., friends, family, colleagues)

Community Level

- **Community-based organizations** and/or online communities with expertise in residential energy programs
- Knowledgeable **workforce**
- Enabling **public policy** (e.g., energy assessment at point of sale, reach codes)
- Marketing that resonates with **local priorities** and **language** access

Capacity

Having the time and ability to navigate and manage complex multi-step programs

Influencing Factors

Individual Level

- Organizational, technical, and administrative capacity
- Tenure (renter/owner)

Community Level

- Access to **participant support** services (e.g., energy navigator model)
- Access to **specialized programs** that address the specific needs of renters, and residents of multi-family buildings, and mobile or manufactured homes
- **Workforce** with decarbonization knowledge and skills (train local contractors, streamline certifications)

The Built Environment

Physical readiness of housing and energy infrastructure for electrification

Influencing Factors

Individual Level

- Condition of the home (e.g., are there retrofit needs such as remediating lead/asbestos or upgrading panel capacity)

Community Level

- **Funding for health and safety upgrades** (either by increasing program funds or coordinating programs to enable braiding)
- **Local electric grid capacity and transparency**
- **Place-based strategies** that can address the cumulative participation burden in LMI and priority communities

Affordability

Ability to cover installation costs and afford the energy bill post-installation

Influencing Factors

Individual Level

- Income and/or wealth

Community Level

- **Structure financial incentives to meet participants' needs** (e.g., no-cost direct-install programs)
- **Green financing mechanisms** such as Go-Green financing and Inclusive Utility Investment (IUI) programs
- Ensure **sufficient funding** OR ability to **braid funding** across programs
- **Scope projects** to reach bill neutrality or savings
- **Rate schedules** that enable bill neutrality or savings post-implementation

Governance

The level of coordination among government agencies to streamline services to participants; partnerships with community organizations to adapt programs to local needs

Influencing Factors

- **Coordination** among state-level government agencies and the housing, energy, and health sectors
- **Inclusion of community partners** in the design, implementation, and evaluation of programs
- **Evaluation of distributional equity and impacts** that allows for program targeting and improvement

Findings

Pre-/Post-Retrofit

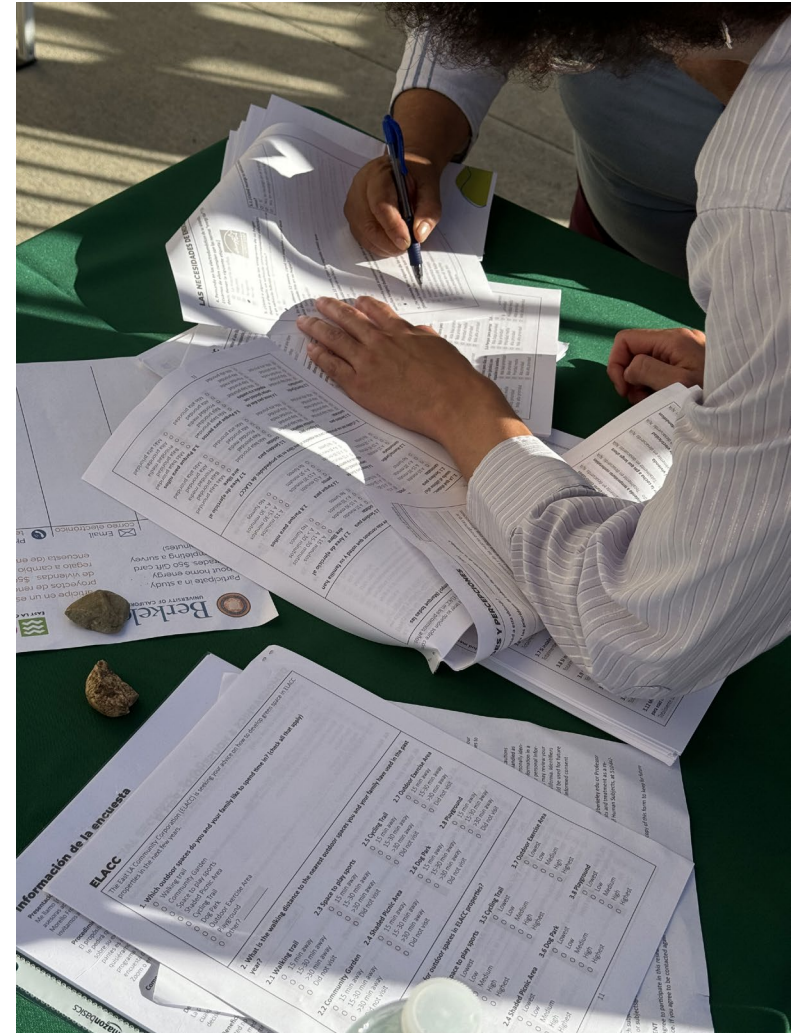
Survey

Research Goals

Studies have examined barriers to decarbonization, but there is **less evidence on the impacts of electrification projects on household outcomes.**

We **designed a pre-/post-retrofit survey** to understand:

- household's experiences with the new equipment/technology
- whether households experience measurable improvements in energy security post-retrofit
- whether improvements in energy security depend on implementation.



Research Design

60 renters and homeowners in LA and the Bay Area

- Majority low-income renters, female, older age, racially diverse
- Administered survey in English, Spanish, Mandarin, and Korean

All received heat pumps for space heating/cooling and water heating

Surveyed pre-retrofit and at least 6 months post-retrofit

- Captures different climate conditions (summer/winter)
- No demographic differences between pre/post groups

San Francisco Bay Area

Pre: 36
Post: 19

Los Angeles

Pre: 24
Post: 18

Measuring Energy Security

We developed a weighted measure that captures different elements of energy security, resulting in a 100-point “Energy Security Score” (0=worst, 100= best)

Physical quality of the home

- Lack of functioning equipment
- Lack of thermal comfort

Economic status of the household

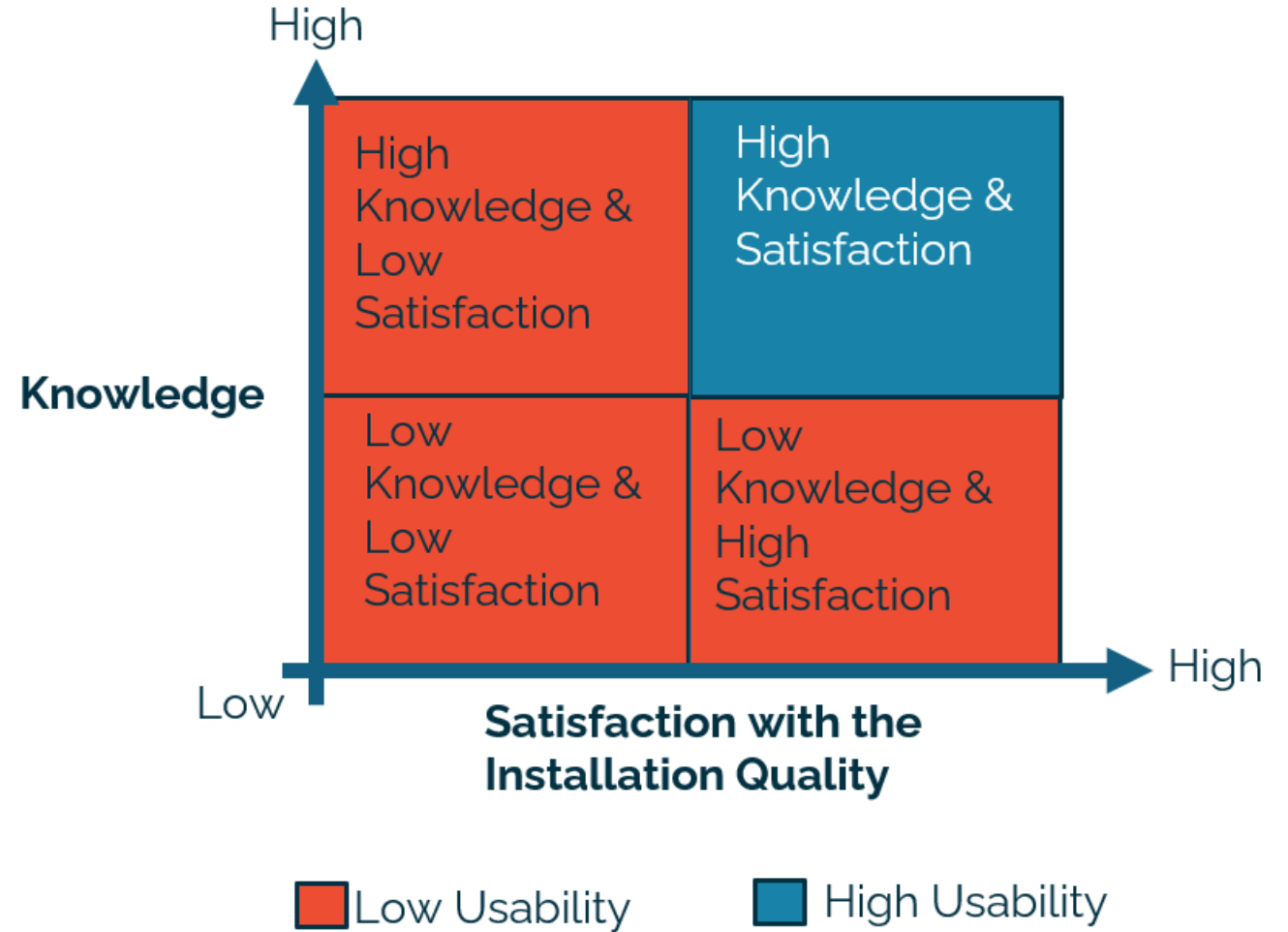
- Late in paying energy bills or receiving disconnection notice

Coping strategies

- Constrained use of the home
- Making tradeoffs between paying for energy bills and buying food/medicine

Differences in Experience

We found significant differences in households' **ability to use** the new appliances **and optimize** their use **for energy efficiency** post-implementation due to either **poor installation** or lack of adequate **guidance**



Differences in Outcomes Post-Retrofit

High Usability - 43% (16/37) of respondents were satisfied with the installation quality and understood how to effectively use their heat pump.

Exemplary quote:

"I am very satisfied with the new appliances. They are much quieter and work so much better than the old ones and I am not afraid to use them compared to before as my bills are cheaper and they are of better quality."

Low Usability - 57% (21/37) of respondents experienced installation issues or did not understand how to use the new equipment, expressing dissatisfaction.

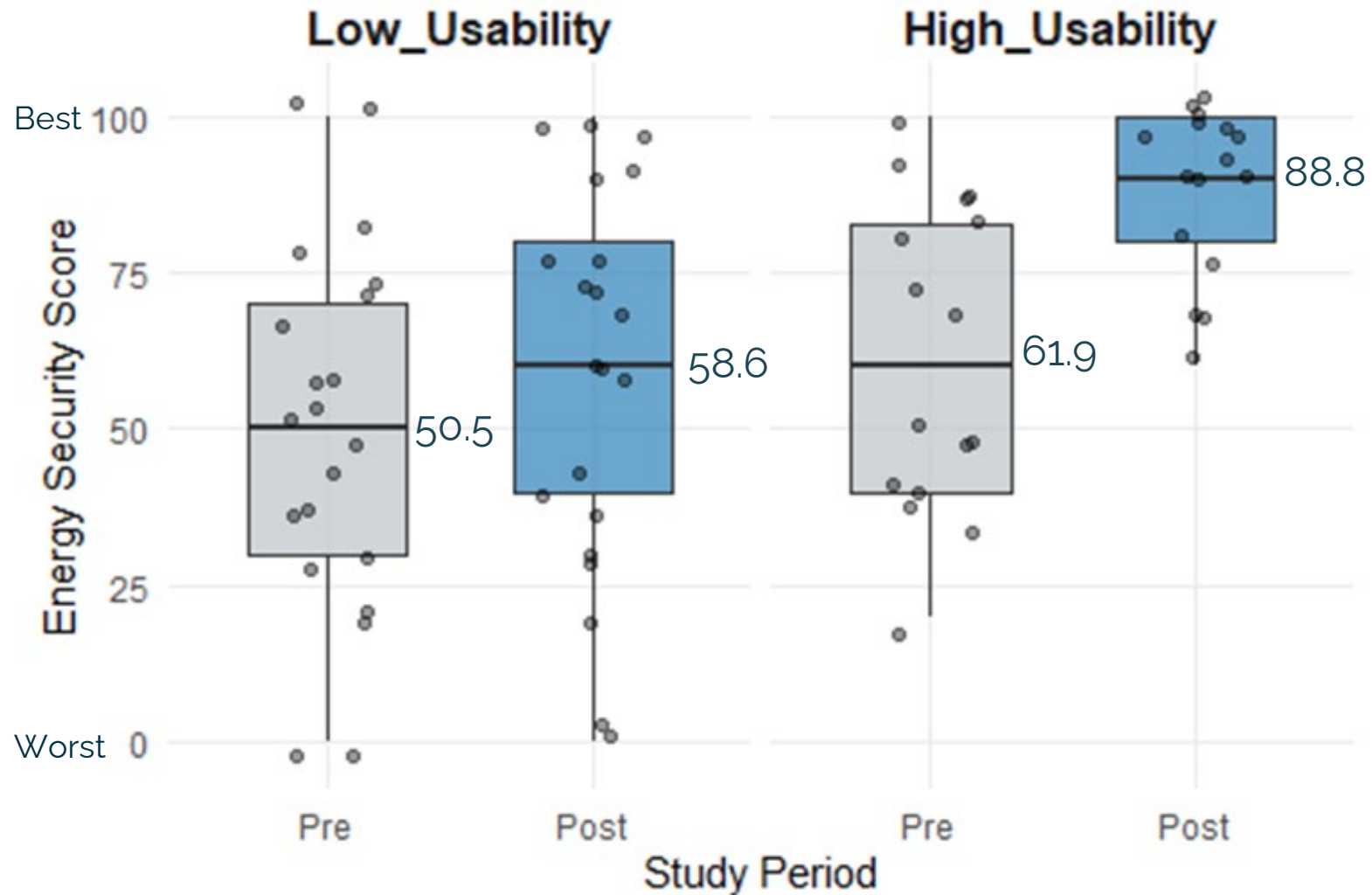
Exemplary quotes:

"We have to wait one hour for hot water to come out after someone finishes showering."

"The heating is uneven - one room is significantly warmer than the other rooms."

"Since the new indoor heating system was installed, the power in my home sometimes goes out."

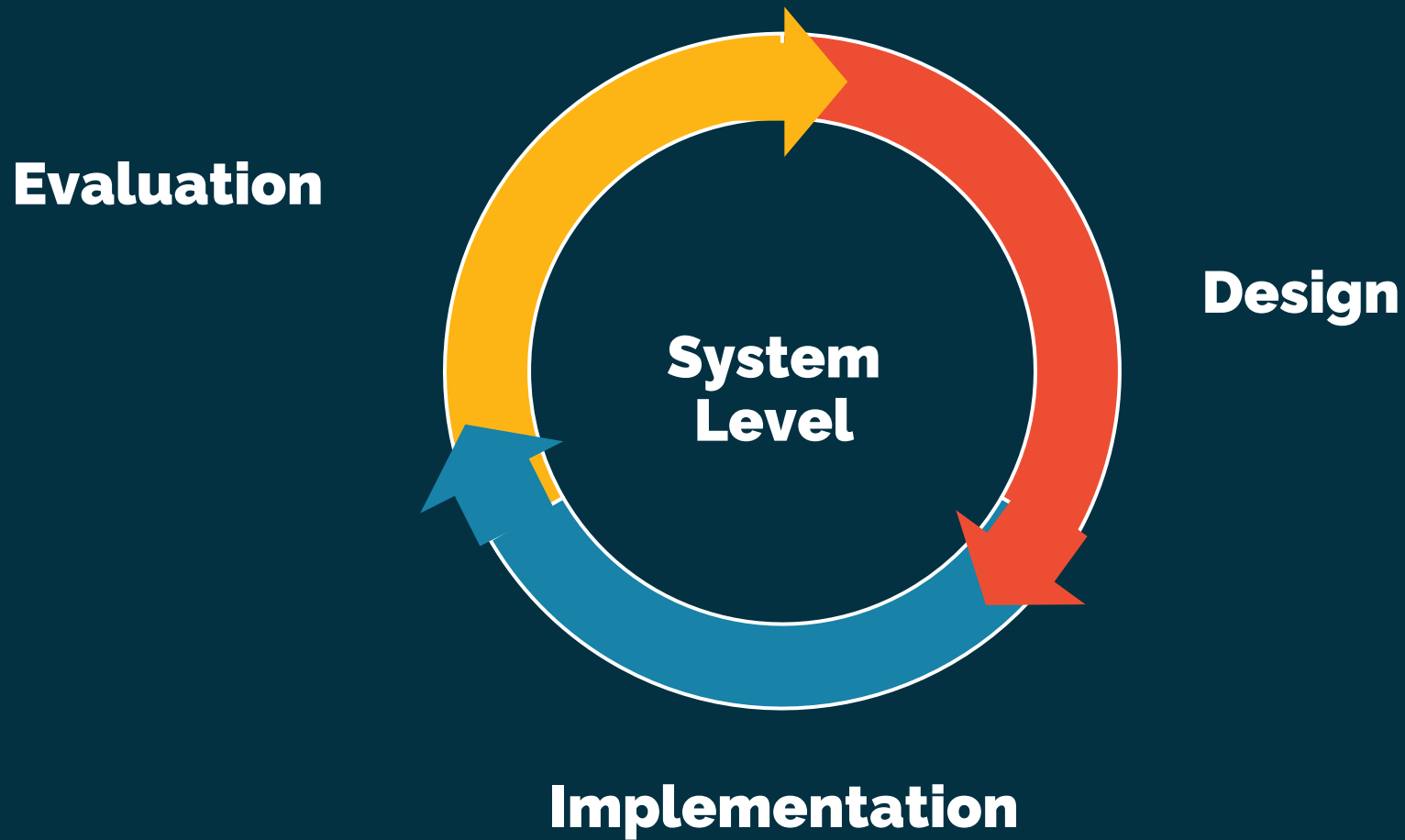
Usability Influences Post-Retrofit Energy Security Score

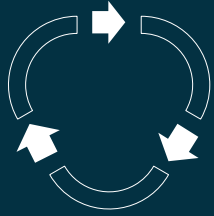


High usability group had a statistically significant larger increase in their energy security score compared to low usability group (27 points on average)

Policy Recommendations

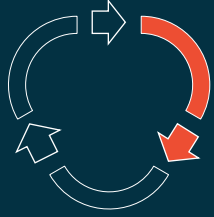
Policy Recommendations by Policy Stage





System Level

- **Form an inter-agency working group** to coordinate program design, implementation, and evaluation among state agencies and local representatives, and report on progress towards climate, energy, and equity goals.
- **Leverage cross-sector partnerships among energy service providers, housing agencies, and healthcare partners** to align funding for combined health, safety, and electrification retrofits.
- **Engage Community-Based Organizations (CBOs)** as fully compensated, strategic partners across program design, implementation, and evaluation.



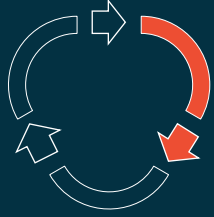
Program Design

1/4

Increase Funding for Retrofit Needs

Increase funding for retrofit needs in priority communities by either:

- Allocating flexible funding for health, safety, and electrical upgrades that are prerequisite to electrification programs.
- Coordinating measures and eligibility criteria to enable incentive stacking across energy, health and housing programs.



Program Design

2/4

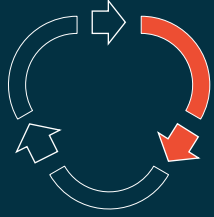
Target Programs to Needs

Match incentive structure to needs

- No-cost direct install programs for low-income households
- Inclusive utility investments or green financing for moderate-income households

Address energy affordability

- Scope projects to reach bill neutrality or savings
- Help participants enroll in electricity bill assistance programs and offer/provide access to affordable rate plans



Program Design

3/4

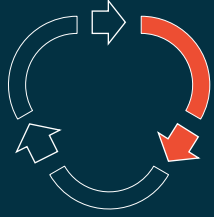
Provide Participant Support

Include participant support across three critical domains:

- Learning (Awareness and Motivation)
- Capacity
- Post-Implementation Quality Control & Education

Scale models that already work, such as the energy navigator model and local resource centers.

Adopt tenant protections in housing decarbonization incentive programs and clarify their enforcement.



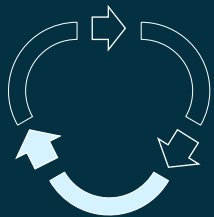
Program Design

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Meet Specific Needs of Different Property Owners

Target programs to address the needs of different property ownership structures

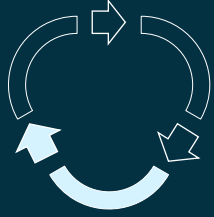
- **HOAs:** Provide technical assistance
- **Subsidized Housing:** Plan utility allowances to support decarbonization
- **Multifamily Properties:** Ensure solar and storage benefits are distributed equitably across all units
- **Mobile/Manufactured Homes and Parks:** Address electrical deficits and split incentives between lot owners and residents



Program Implementation 1/2

Coordinate Implementation Across Housing and Energy Infrastructure Needs

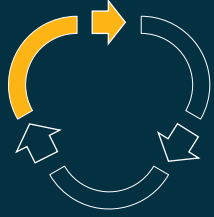
- **Coordinate electrical panel capacity and energy** infrastructure readiness with decarbonization projects to ensure the technical ability to electrify.
- **Use place-based approaches in priority communities** including geographic clustering or zonal decarbonization to coordinate building retrofits, grid upgrades, and gas decommissioning at the neighborhood scale.



Program Implementation 2/2

Build Local Capacity for Implementation

- **Invest in workforce development:** Standardize decarbonization certifications, invest in high-road training partnerships, and provide financial support and simplified reporting to help small businesses enter the market.
- **Support local governments:** Provide local building departments with training and standardized guidelines for new technologies to expedite permitting.



Program Evaluation 1/2

Embed Non-Energy Benefits and Equity in Policy Cost Analysis

Refine methodology for benefit cost analysis.

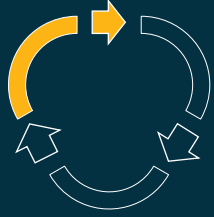
Cost-effectiveness tests — like the Total Resource Cost (TRC) test – are poorly suited to measuring equity in decarbonization programs

Incorporate health, thermal comfort, and safety **non-energy benefits (NEBs)** into benefit-cost analyses

Pilot **“equity adders”** that give greater weight to programs delivered in priority communities

-> How an equity adder works:

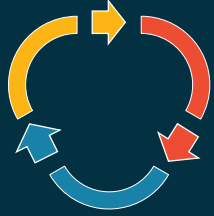
***\$1.00** of energy savings in a priority community is valued at **\$1.20** in the benefit-cost analysis.*



Program Evaluation 2/2

Track Distributional Equity

- Require **distributional equity analysis (DEA)** across all building decarbonization programs — not just equity-designated ones.
- **Standardize distributional metrics.** Report participation, completions, and incentive dollars by income, tenure, race/ethnicity, and geography — at the portfolio level.
- **Collect and report participant-level data.** A common set of indicators would show who is served — and who is left out — statewide.
- **Survey households and assess energy (in)security before and after retrofits.** Use the project's 10-question Energy Security Score to assess decarbonization program impacts.



Knowledge Gaps & Future Research Needs

- **Spatially and temporally evaluating equity outcomes** of programs (including design/implementation adjustments) using neighborhood proxies would provide timely and important insights into whether and how programs are achieving sustainability and equity goals.
- **Workforce issues**, including a better understanding of living and prevailing wages and how best to dismantle barriers for small contractors should be further studied.
- More systematic and ongoing pre-/post implementation **assessments of how decarbonization programs affect household energy (in)security** and other non-energy outcomes are needed.

Key Takeaway

Traditional Approach

Responsibility falls on individuals

Programs focus on equipment and **not** on the implementation process.

Each agency manages its own mandate independently.



Transformative Approach

Holistic system-oriented interventions

Programs focus on participant experience and remove barriers at each step of the process (including post-retrofit) in partnership with CBOs and local actors.

Agencies collaborate to coordinate program design, implementation, and evaluation.

Thank you

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