



Upsizing **Electrification Potential**, Not Panels: Addressing Barrier of Panel Upgrades

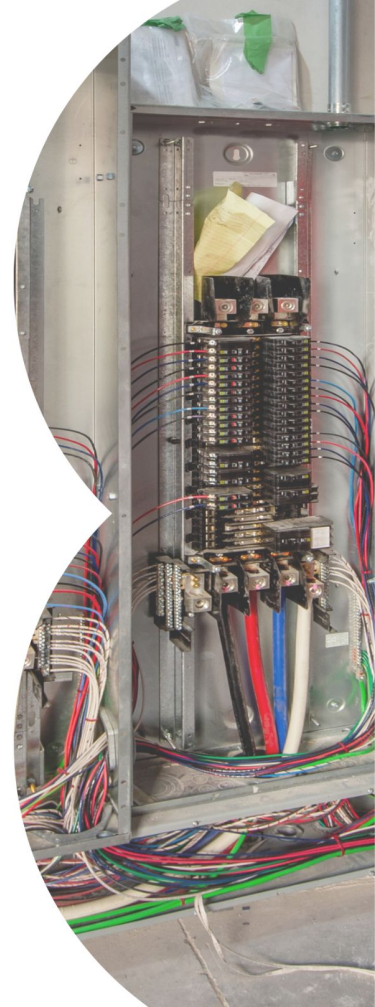
Presented as part of the CCEC Forum | June 13, 2023

Moderator:
Jenny Low, *Build It Green*

POWER GROUP

PANEL OPTIMIZATION WORK AND ELECTRICAL REASSESSMENTS

The POWER group is a space to learn, share, discuss, and work on the complexities of the home electrical panel and associated electrical systems as a key lever to reach our building decarbonization goals as quickly, cost-effectively, and equitably as possible.



Electrical Panel

- The steel box in your home that holds your circuit breakers.
- Function:
 - Connect the utility's infrastructure to the home's electrical system
 - Protects against power surges



Photo: e-M Insurance

Electrical Panel's Power Capacity

- Power is the size of the electrical current
 - Measured in volt-amps (VA)
 - Water analogy: diameter of hose
 - Wider hose → more current flows through
- The panel size reflects its power capacity
- Since the voltage of electricity is constant (120V) to a home, the amperage (A) drives panel capacity

POLL

Panel Sizes

For single family homes, what panel sizes would usually be good enough for electrification?

- a. 60 A
- b. 100 A
- c. 200 A
- d. 400 A

Electrical Panel Upsizing or Upgrading

- Replacing a panel with a higher-capacity version, and/or a better quality panel.
- “Upgrade” is the conventional term
- POWER group prefers the term “upsizing” because a larger panel doesn’t always deliver an improvement in service for the customer.

POLL

Panel Costs

How much would you estimate it to cost to “upsize” a panel (i.e. replace a panel with a higher capacity one)?

- a. \$500
- b. \$3000
- c. \$10,000
- d. \$25,000



Jenny Low

*Program Manager,
Build It Green*



Emily Alvarez

*Program Manager,
StopWaste*



Abhijeet Pande

*Vice President,
TRC*



Laura Feinstein

*Sustainability and
Resilience Policy
Director,
SPUR*

ABOUT BUILD IT GREEN

Where We Started

Build It Green was started in 2005 and launched GreenPoint Rated, its residential green building certification program, in the same year. Our organization served as a hub for passionate building professionals to come together around specific topics within green building.

Build It Green Today

In a return to these roots, Build It Green is now connecting changemakers across California's housing system to advance housing affordability, equity, and environmental goals.

Emily's Background

Emily's background crosses green building, planning, and climate policy. She has worked at the U.S. Green Building Council on the development of the LEED rating system and for both public agencies and the private sector advancing energy policy, reducing GHG emissions, and developing long-range planning documents. She holds a Master of City Planning from UC Berkeley and a BA in Architectural and Environmental Studies from Brown University.



Work at StopWaste

Emily Alvarez is a Program Manager with StopWaste where she leads the Bay Area Regional Energy Network's (BayREN) Green Labeling Program and provides climate action support to cities in Alameda County. The Green Labeling program promotes the U.S. DOE Home Energy Score and aims to increase energy transparency in the single family home marketplace throughout the nine Bay Area counties.

Abhijeet's Background

Abhijeet Pande brings expertise and over 20 years of experience in the fields of energy efficient design, building science research and energy policy.



Work at TRC

In his role as Vice President, Research and Technology Commercialization, he applies his expertise and oversees a group that develops technical analyses and market studies in support of energy policy, program design, energy analysis, codes and standards enhancements, emerging technologies, evaluation and occupant comfort research and analysis.

A focus of his work is 'tech to market' initiatives that move innovative ideas into the marketplace through demonstrations, programs and codes. Under his leadership, the Research and Technology Commercialization group is working on several strategic initiatives around building decarbonization, deep energy retrofits, zero net energy, energy efficiency as a resource and behind-the-meter distributed energy resources.

Laura's Background

Laura Feinstein holds a B.A. from U.C. Berkeley in anthropology and a Ph.D. from U.C. Davis in ecology.



Work at SPUR

She is the Sustainability and Resilience Policy director at SPUR, the Bay Area public policy think tank. Laura leads SPUR's work on climate mitigation, adaptation, and environmental justice.



Local Governments Empowering Our Communities

Upsizing Electrification Potential, Not Panels: Addressing Barrier of Panel Upgrades

Emily Alvarez , StopWaste Program Manager

June 13, 2023



The Bay Area Regional Energy Network (BayREN)



- BayREN is a Program Administrator of Ratepayer Funds from the California PUC
- Collaboration of 9 Bay Area counties to help State meet climate goals through energy savings
- Successful climate, resource, and sustainability programs:
 - Single Family
 - Multifamily
 - **Green Labeling**
 - Commercial
 - Codes & Standards
 - Water Upgrades \$ave



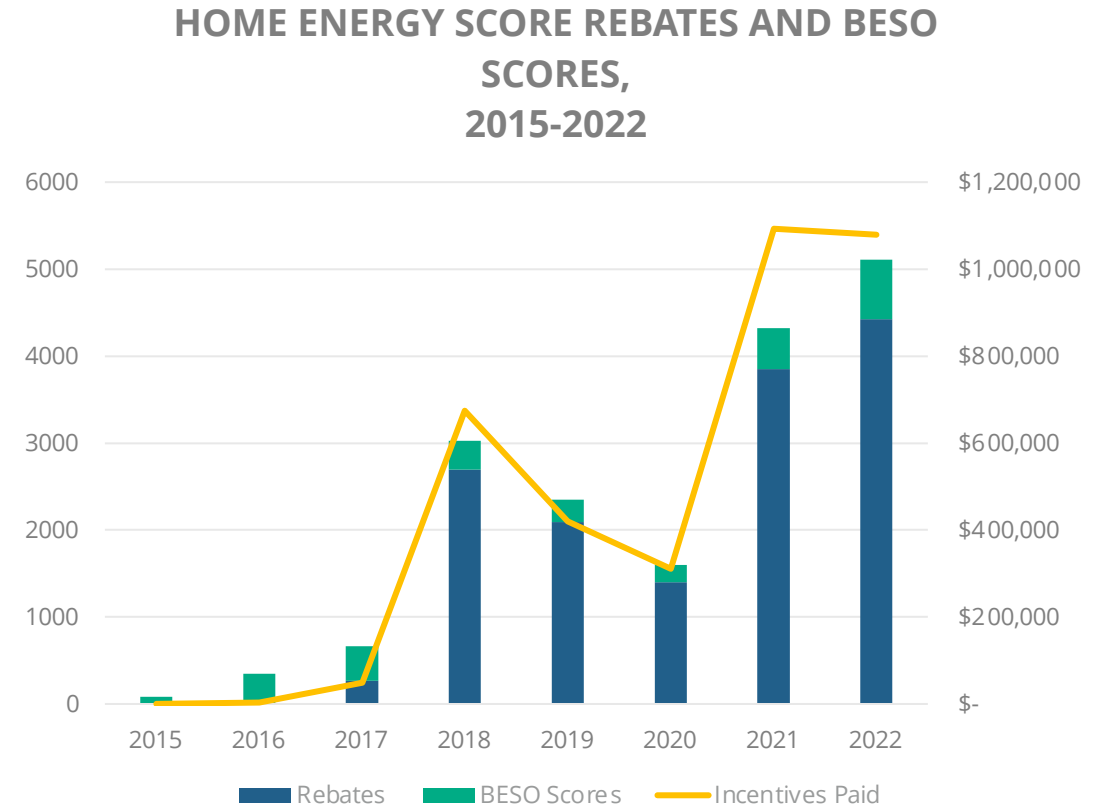
Who is StopWaste?



- Countywide public agency with 17 member agencies representing Alameda County, its 14 cities, and 2 sanitary districts
- Outreach & education for residents and businesses
- Key Programs:
 - Enforce Mandatory Commercial Recycling & Composting Law
 - Food Waste Reduction and Home Gardening
 - Household Hazardous Waste
 - K-12 Environmental Education
 - Green Buildings & Energy Council
 - Support Member Agency Staff
 - ...and more!

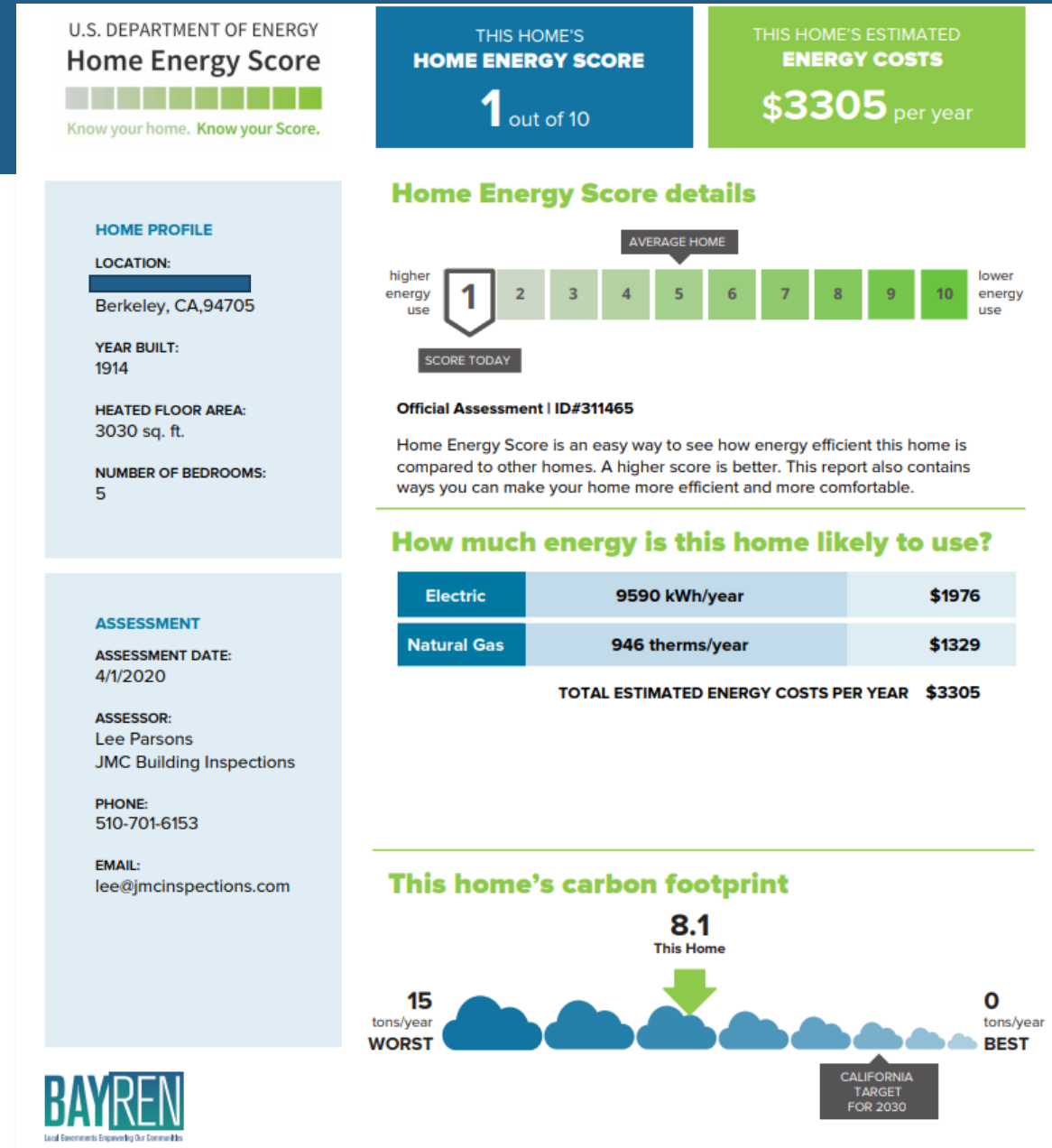
Green Labeling Program Background

- Voluntary regional program launched in 2018
 - Scaled from BESO in Berkeley
- Working to increase energy transparency in the Single-Family marketplace
- Promotes DOE Home Energy Score and engages with/train real estate community
- 2020 & 2023 DOE HES Partner innovation award recipient



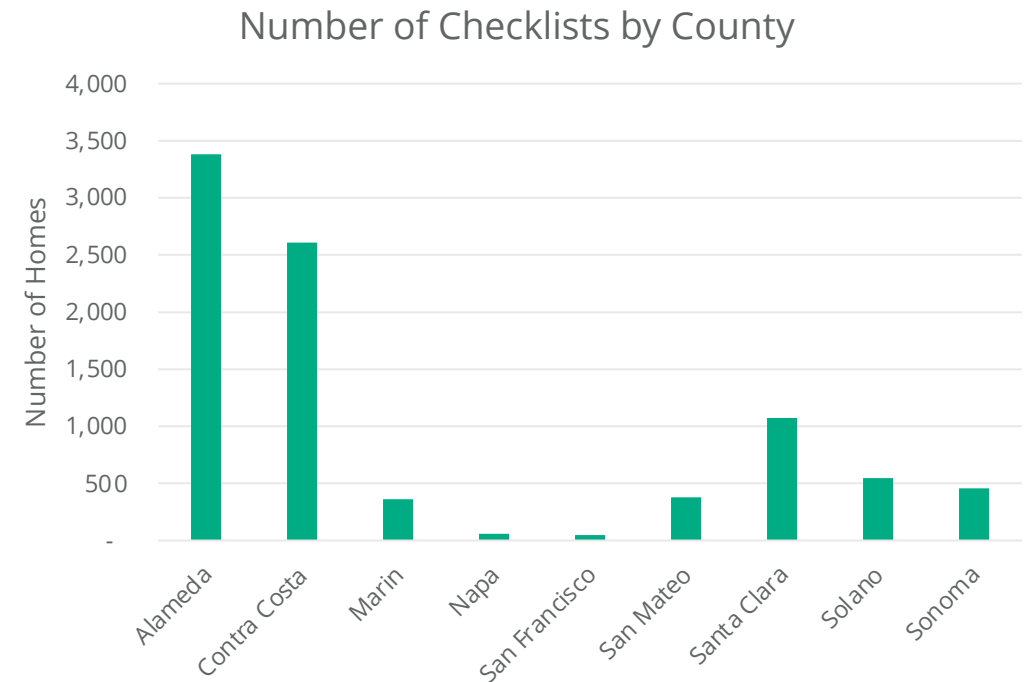
What is HES?

- Developed by U.S. Department of Energy and its national laboratories
- Enables comparison: similar to a miles-per-gallon rating for a car or nutrition facts— but for your home
- Provides homeowners, buyers, and renters comparable and credible information about a home's energy use
- Provides custom recommendations for improvements to homeowners



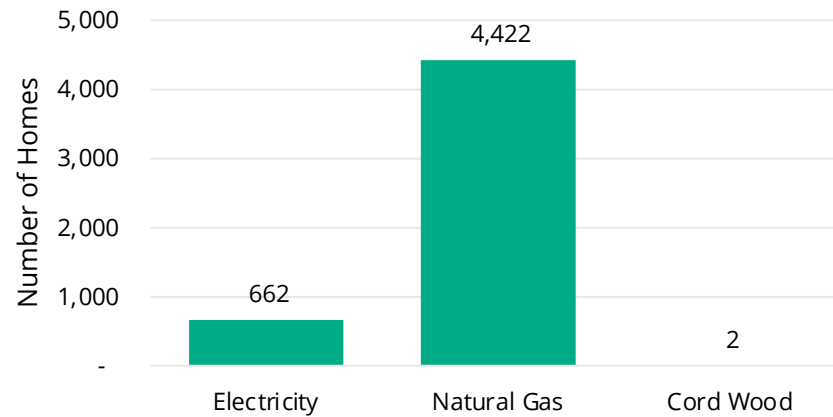
Electrification Checklist

- Pilot program developed to align HES with BayREN/State goals for decarbonization
- Assessors are trained and collect additional items related to electrification
- Ready workforce for electrification and collect data on homes
- Stoves and dryers added to recommendation options

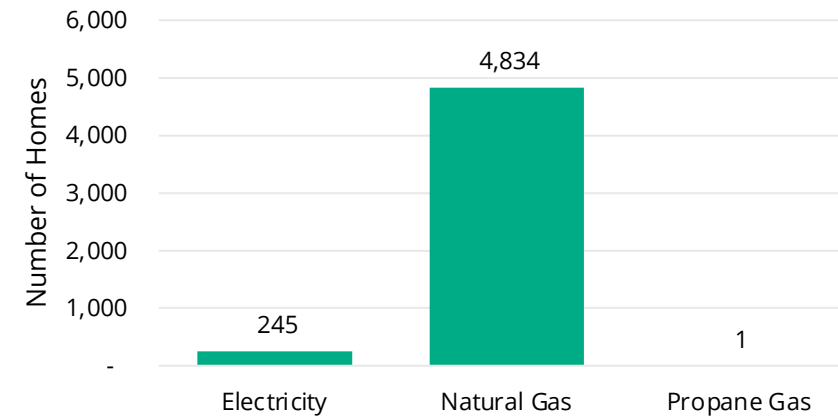


Home Profiles (2022)

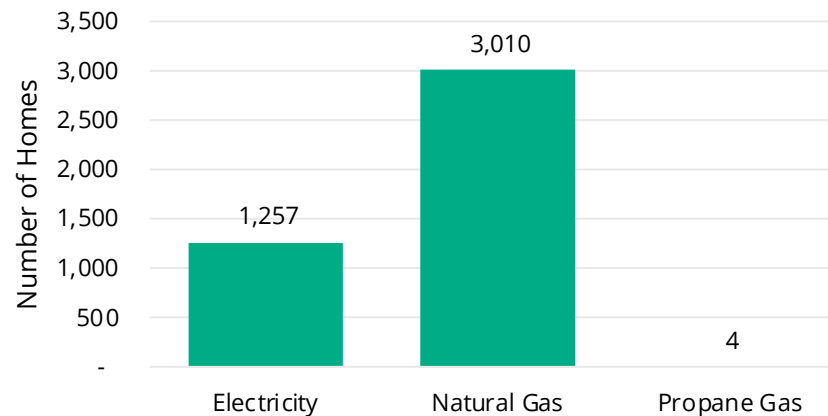
Primary Space Heating Fuel Type



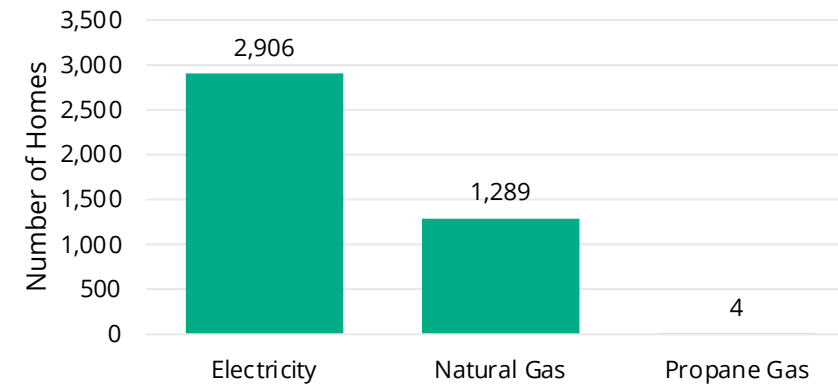
Hot Water Fuel Type



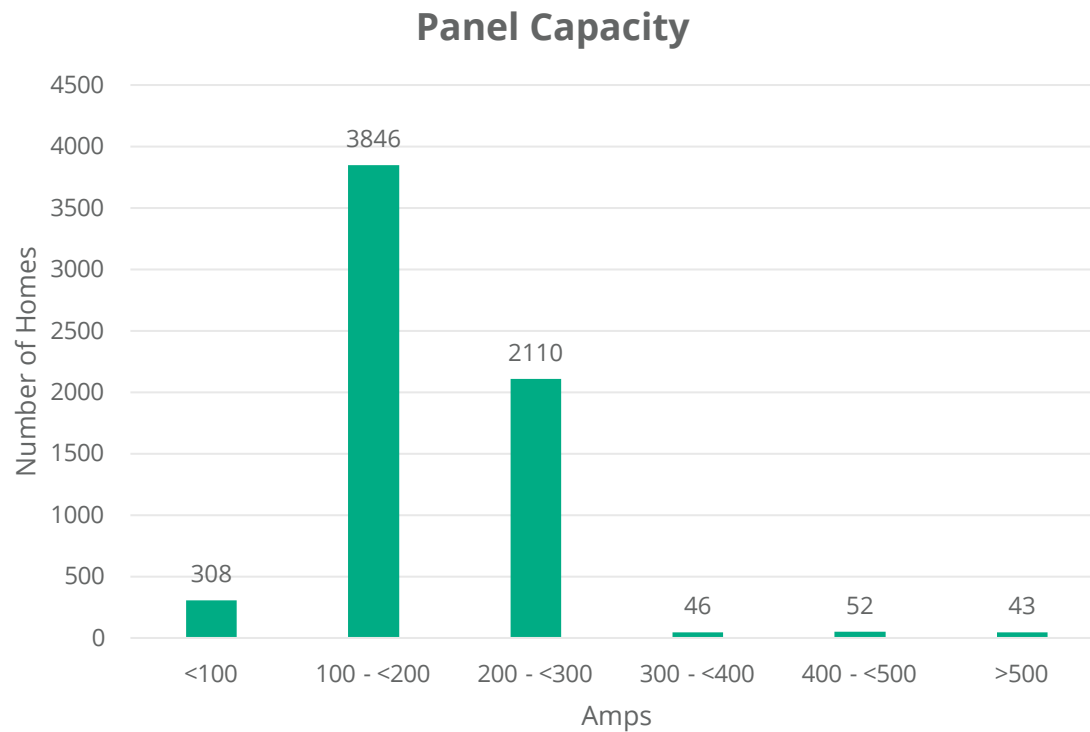
Stove Top Fuel Type



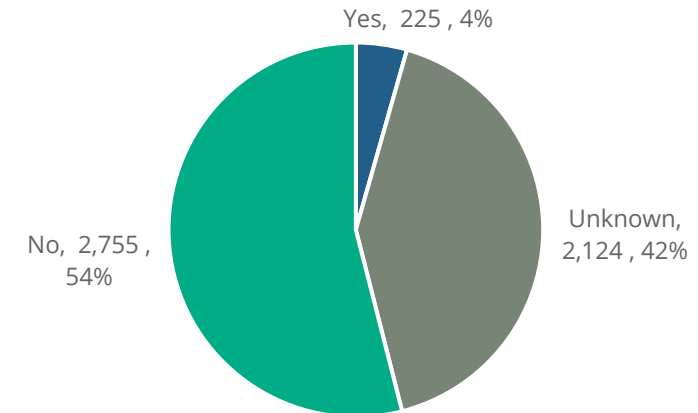
Dryer Fuel Type



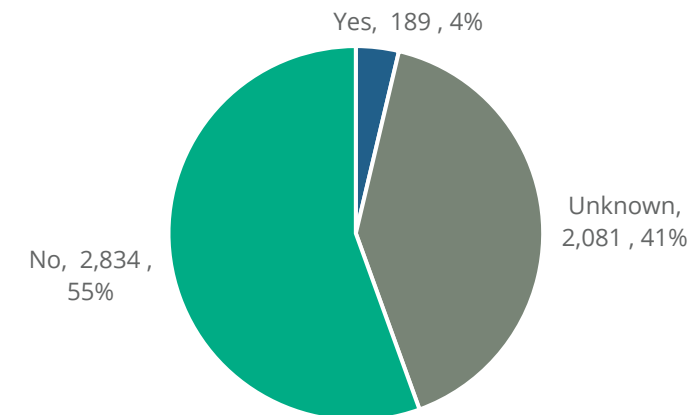
Electrical Capacity & Renewables



Homes with Level 2 EV Charging (2022)



Number of Homes with Storage



Electrical Service Incentives

- Cities/Counties
 - Albany: up to \$2,000 based on income*
 - Piedmont: up to \$1,000 based on income
 - Marin County: up to \$1,000 based on income
- Some CCAs
 - SVCE: up to \$2,000 for pre-wiring (not HPs), \$1,000 for panel, \$500 remove gas meter*
- State
 - TECH/SGIP: up to \$4,000 based on income*
- IRA Tax Credits
 - 30% of cost up to \$600
- HEEHRA Rebates
 - Panel: up to \$4,000 based on income
 - Wiring: up to \$2,500 based on income



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Piecemeal:
Income-based or
geographic
limitations



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Piecemeal: Income-based or geographic limitations

Most do not cover wiring or load-sharing devices



Support Needed!

- Shortage of electricians → longer wait times & higher bids
- Domino effect of houses in a neighborhood electrifying one at a time until infrastructure needs upgrades and someone bears the cost
- Utility reviews can take months!
- Lack of guidance on when panel upgrade is needed from electricians, building departments, and utility

Exacerbated by income and in rural areas



Thank You!
BayREN.org

Emily Alvarez
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UPSIZING ELECTRIFICATION POTENTIAL, NOT PANELS

Technology Options and Policy Considerations

Abhijeet Pande, TRC

June 13, 2023

About Us

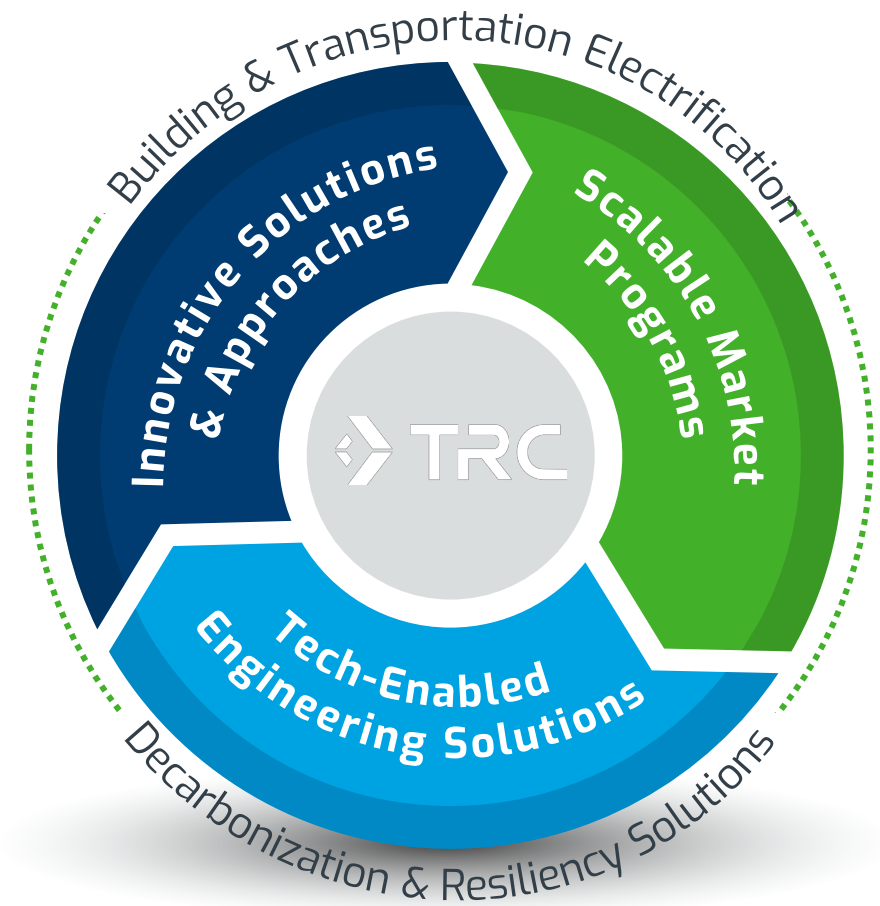
INTRODUCTION

TRC is a global firm providing **environmentally focused and digitally powered solutions** that address local needs.

For more than 50 years, we have set the bar for clients who require consulting, construction, engineering and management services, **combining science with the latest technology** to devise solutions that stand the test of time.

TRC's nearly 6,000 professionals serve a broad range of public and private clients, steering complex projects from conception to completion to **help solve the toughest challenges**.

We break through barriers for our clients and help them follow through for **sustainable results**.



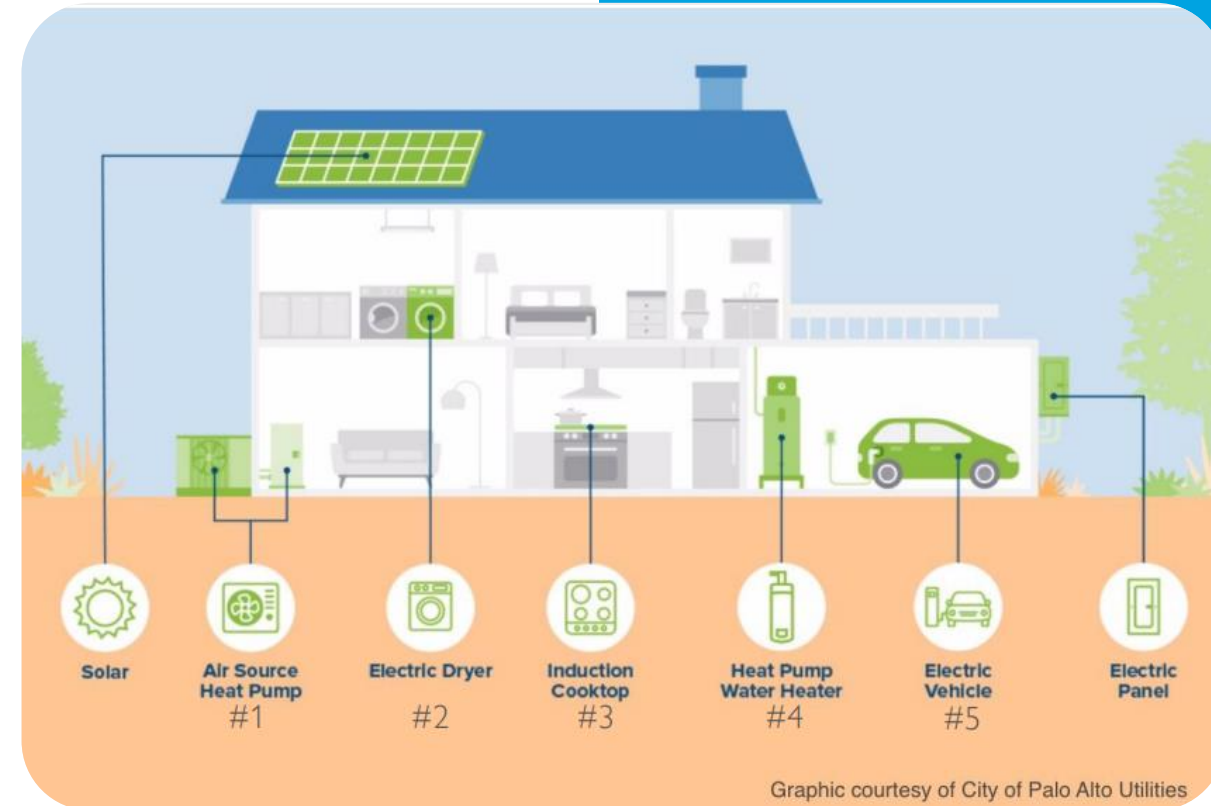
Technology Options

DO ALL HOMES NEED LARGER ELECTRICAL PANELS WHEN ELECTRIFYING THE HOME?

Short Answer – NO

Longer Answer –

There are several options currently available, but each home may need to be assessed for feasibility and technical fit



Why would One Need a Panel Upgrade?

And do you also need a Service Upgrade?

Service size limits capacity from the utility pole to your home.
Panel can't provide more power than service size allows.

200-amp 'standard' for
newer single-family homes

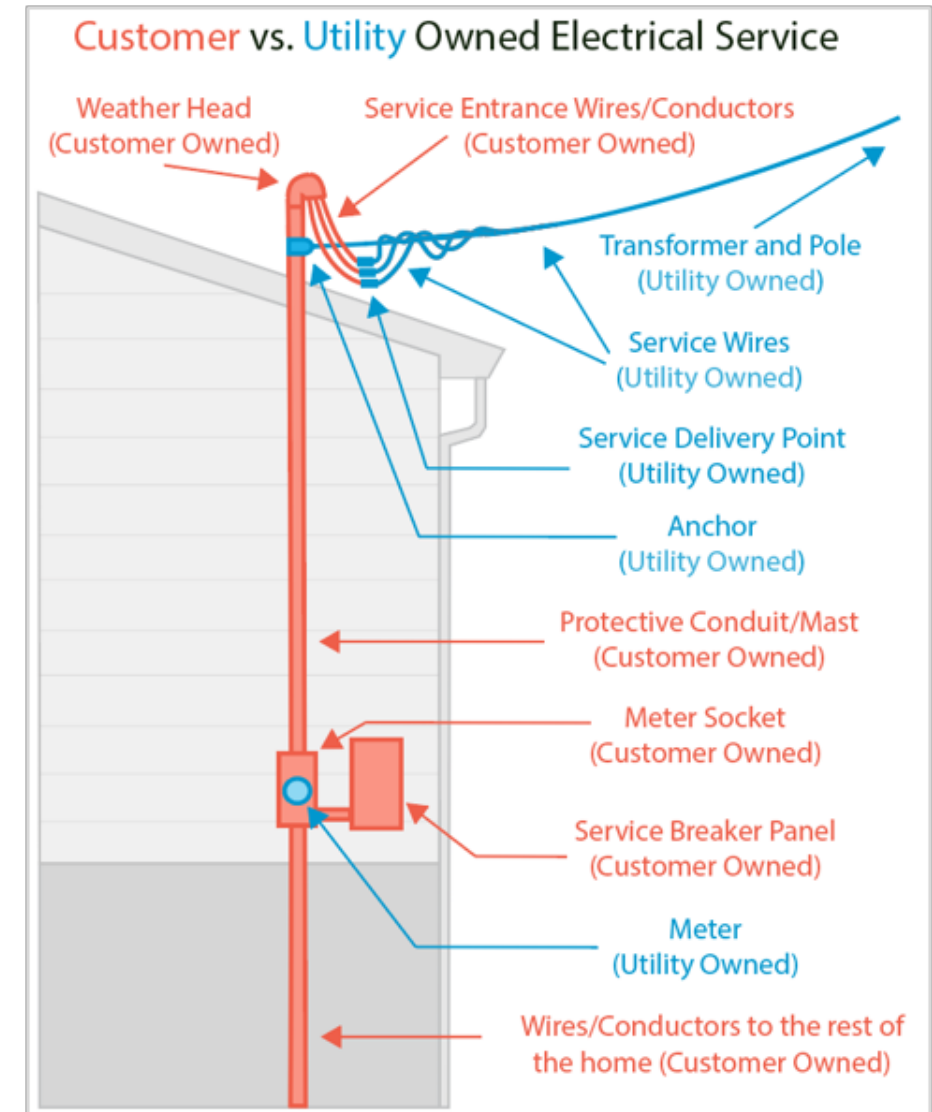
Older homes may have
smaller service



Electrical Panel limits home energy load at any given time

Number of circuits may be
limited by number of
breakers

Homes may not be circuited
correctly



Courtesy of Emily Higbee, Redwood Energy Research Director
Sourced from: PG&E Service Upgrades for Electrification Retrofits Study Final Report by NV5: May 27, 2022.

Why would Electrical Panel Need Upsizing?

And do you also need a Service Upsizing?

- **Installing a larger solar system** than the existing 'busbar' can accommodate
 - Can be managed with smart inverters
- **Installing Level 2 (240V) EV charger(s)**
 - Can be avoided with circuit sharing with other electrified appliances
 - Or simply using lower amperage EV chargers
- **HVAC Upgrades**
 - Adding cooling or upgrading from older, smaller HVAC (e.g. window A/C) to whole house cooling
 - Using higher efficiency or lower power HVAC systems can avoid the need for upgrades

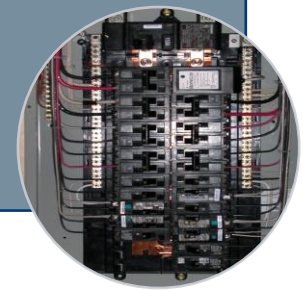
Typical Reasons for Service Upsizing



Sourced from: [PG&E Service Upgrades for Electrification Retrofits Study](#) Final Report by NV5: May 27, 2022.

- **Capacity limits**
 - Panel cannot provide enough power
- **Space constraints**
 - All available circuit breaker spaces are used
 - No space available to add dedicated circuits
- **Panel is unsafe to use**
 - Some older panels from the mid-century or with older fuse boxes
 - No substitute to upgrading the panel – but upgrade may not necessarily require upsizing

Typical Reasons Electrical Panels are Upsized

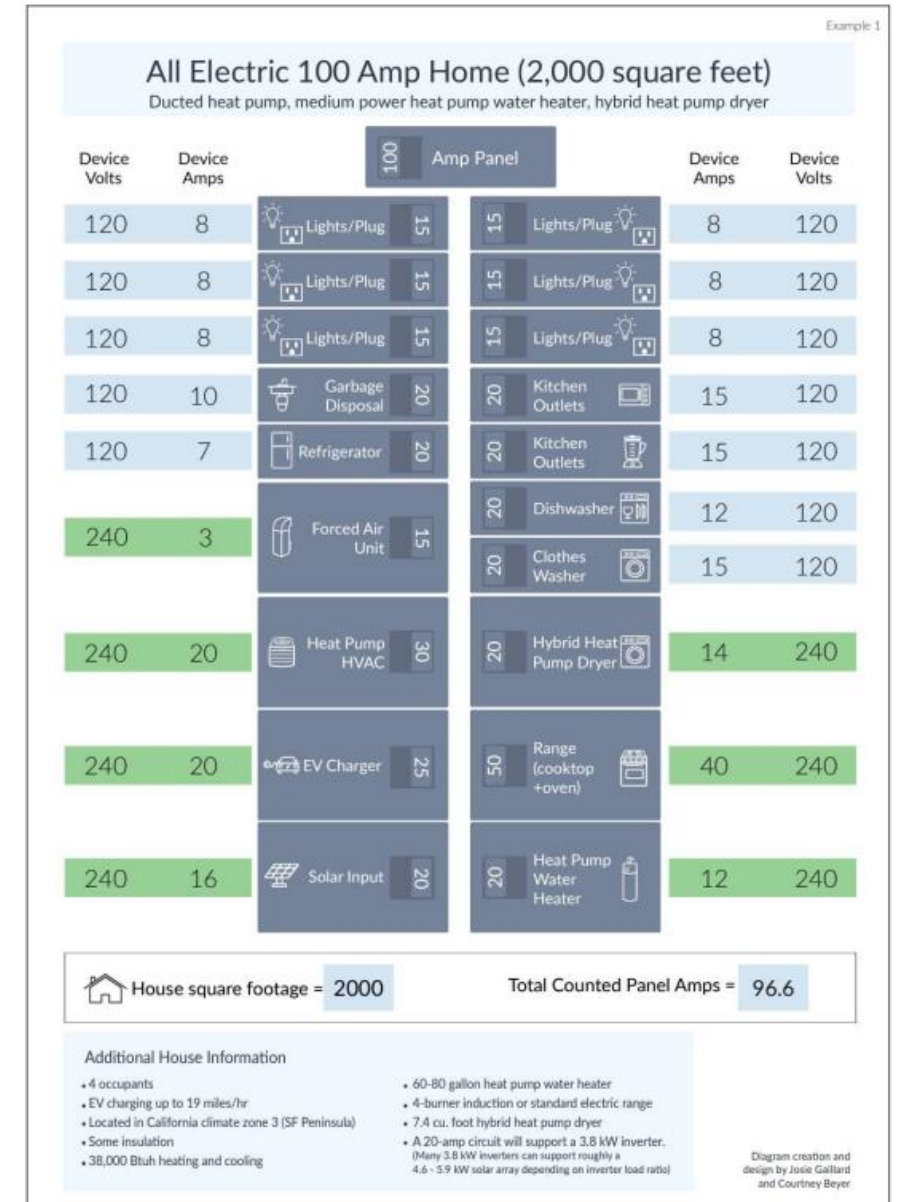


Sourced from: [Design Guidelines for Home Electrification](#) by Peninsula Clean Energy.

Strategies to Avoid Electrical Panel Upsizing

“Watt Diet”

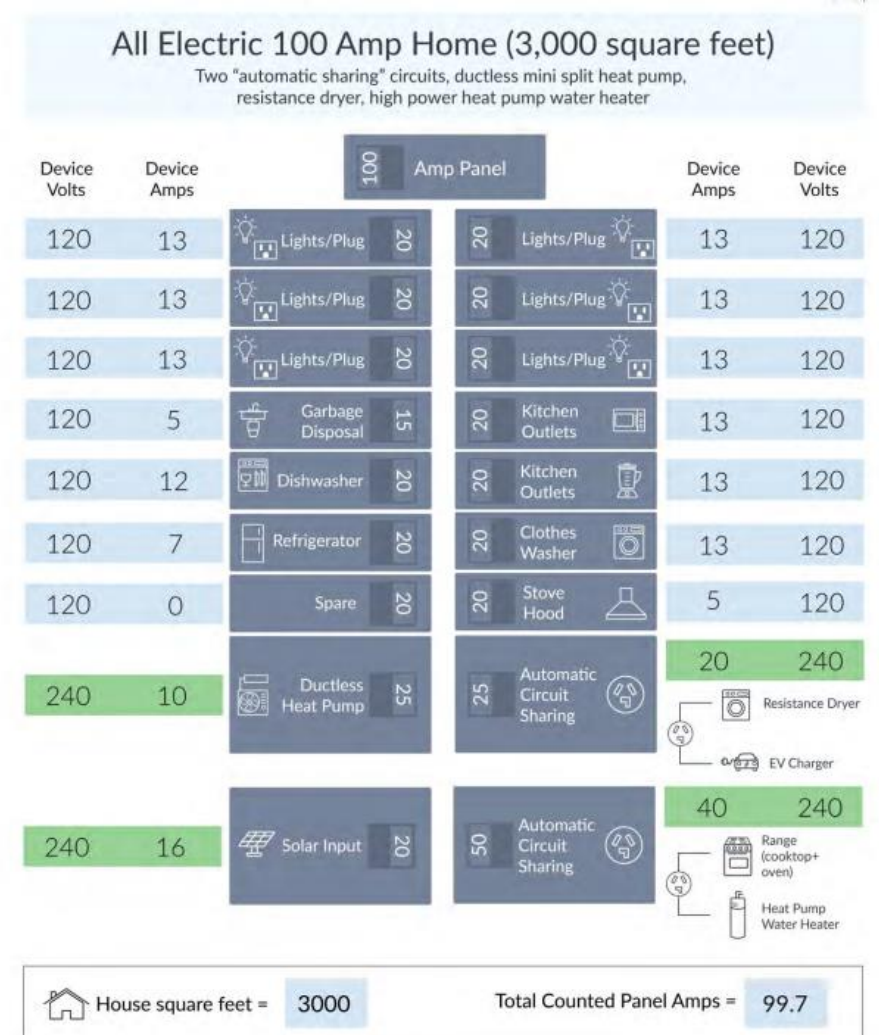
- Choose power efficient appliances
 - Appliances that use less power
 - 120V appliances where feasible
 - 240V appliances with lower power draws
- All-in-one devices are better than two or more separate devices
 - A slide-in electric range/oven combo uses far less power than a separate range and oven wired independently
 - Newer devices that heat water for DHW and space heating save power over separate DHW and HVAC systems
- Proper circuiting is crucial to have dedicated breakers for large appliances
 - Grouping similar appliances under the same circuits



Strategies to Avoid Electrical Panel Upsizing

“Watt Diet”

- ‘Circuit Sharing’ for high-amperage devices can support multiple devices on the same circuit/breaker
 - Needs a ‘smart breaker’ or other circuit sharing device
 - Identify devices that are not likely to be used at the same time to avoid ‘constant compromise’
 - Set priorities for which appliances take precedence over others that share the same circuit
 - For example, EV chargers can be paused whenever a dryer is in use



Additional House Information

- 4-6 occupants
- EV charging up to 19 miles/hr
- Located in California climate zone 3 (SF Peninsula)
- Some insulation
- 30,000 BTU heating and cooling
- 40-80 gallon heat pump water heater
- 4-burner induction or standard electric range
- 7.4 cu. foot standard resistance dryer
- A 20-amp circuit will support a 3.8 kW inverter. (Many 3.8 kW inverters can support up to a 5.8 kW solar array depending on inverter load ratio)

Diagram creation and design by:
Josie Gallard,
Courtney Beyer,
and Tom Kabat

Strategies to Avoid Electrical Panel Upsizing

Smart Panels, Smart Breakers and Circuit Pausers

1. Control individual circuits via smart controls built into the breaker
2. Most offer WiFi connectivity for remote control

Smart Breakers



1. Allow sharing one breaker for multiple devices
2. Device installed 'downstream' of the breaker
3. Multiple appliances plugged into the sharing device

Circuit Sharing



1. Includes smart breakers
2. Panel has built in ability to manage overall load
3. Can control individual circuits as well as balance loads across circuits
4. Remote management capabilities

Smart Panels



Strategies to Avoid Electrical Panel Upsizing

Power Efficient Appliances

1. 120V Heat Pump Water Heaters can work on 15 amps
2. 120V Ductless Mini-Splits or Through-wall Heat Pumps for space heating
3. May require a dedicated circuit or work with circuit sharing devices

120V Appliances



1. Average commute is less than 40 miles/day
2. Most EVs can work just fine with Level 1 chargers
3. Level 2 chargers can also be set to use less amperage than maximum rating

Low Power EV Chargers



1. Water + Space Heating in one device
2. Stovetop and Oven in one combination device
3. Washer/Dryer in one device

Combination Devices



Consequences of Unnecessary Panel/Service Upgrades

Costs, Time, and Resources

- Upsizing panels
 - Adds thousands of dollars to the project costs
 - \$2,000- \$4,500¹
 - Lot more if doing extensive rewiring, re-circuiting or relocating panels
 - Adds permits, utility sign-offs and adds weeks to the project timeline
- Upsizing service
 - Costs even more – up to \$30,000 or more¹
 - Costs are borne by both the utility and customer
 - Can add weeks if not months to the project timeline to get all approvals
- Added together, the cost of service and panel upgrades can exceed cost of the electrification measures themselves in some cases
 - The state has limited resources (even if CA is the fifth largest economy in the world)
 - If these upgrades are done without careful planning, potential to waste billions and goodwill

¹ Redwood Energy & NV5, Service Upgrades for Electrification Retrofits study, 2022.

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Policy Changes Necessary

Electrical Codes, State and Federal Energy Policies

- National Electrical Code requires calculations that ‘bake-in’ oversizing of panels
 - Average home panel rarely reaches its rated capacity during normal usage
 - Updates to the NEC are necessary to take into account better AMI data to update sizing guidelines

- State and Federal energy policies and programs need more guardrails
 - Incentives for panel upsizing need to be tied to actual need as opposed to perceived needs
 - Incentives for strategies that avoid panel and service upsizing will be more cost-effective and expedient

- Workforce education necessary
 - Electricians and contractors need to be aware of strategies to avoid panel upsizing



Prepared by:
Abhijeet Pande



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***UPSIZING ELECTRIFICATION
POTENTIAL, NOT PANELS:***

Streamlining Building Decarbonization to Accelerate California's Clean Air & Climate Goals

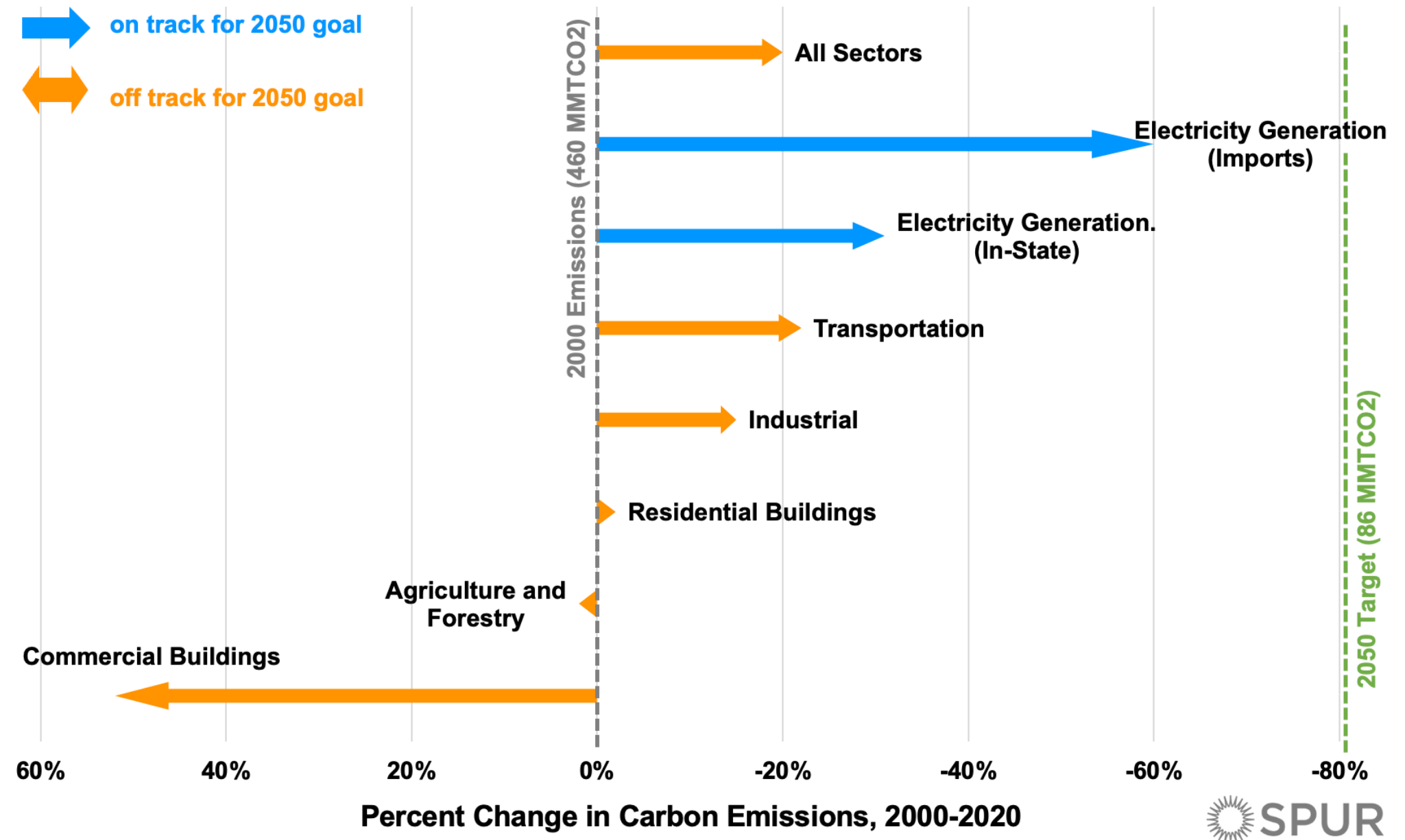
Laura Feinstein, SPUR • California Climate & Energy Forum • June 13, 2023



Why Streamlining Electrical Service Upgrades Is Critical



Buildings Are Holding California Back On Its Climate Goals



Energization:

**Extending an electricity line
or expanding distribution
infrastructure to service
new or expanded customer
load**

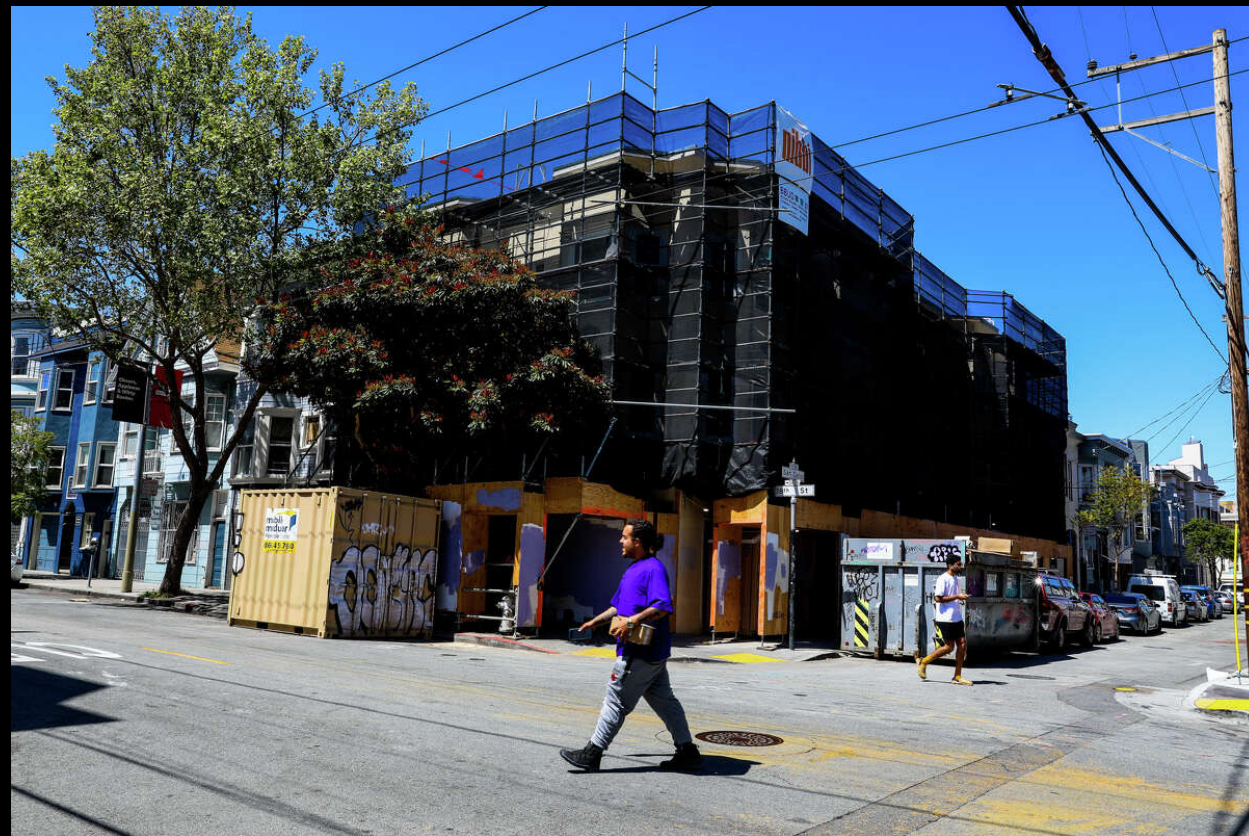


California's Energization Problem

Electric semi trucks sitting unused because EV chargers haven't been energized



Affordable housing sitting in San Francisco empty because it has no power



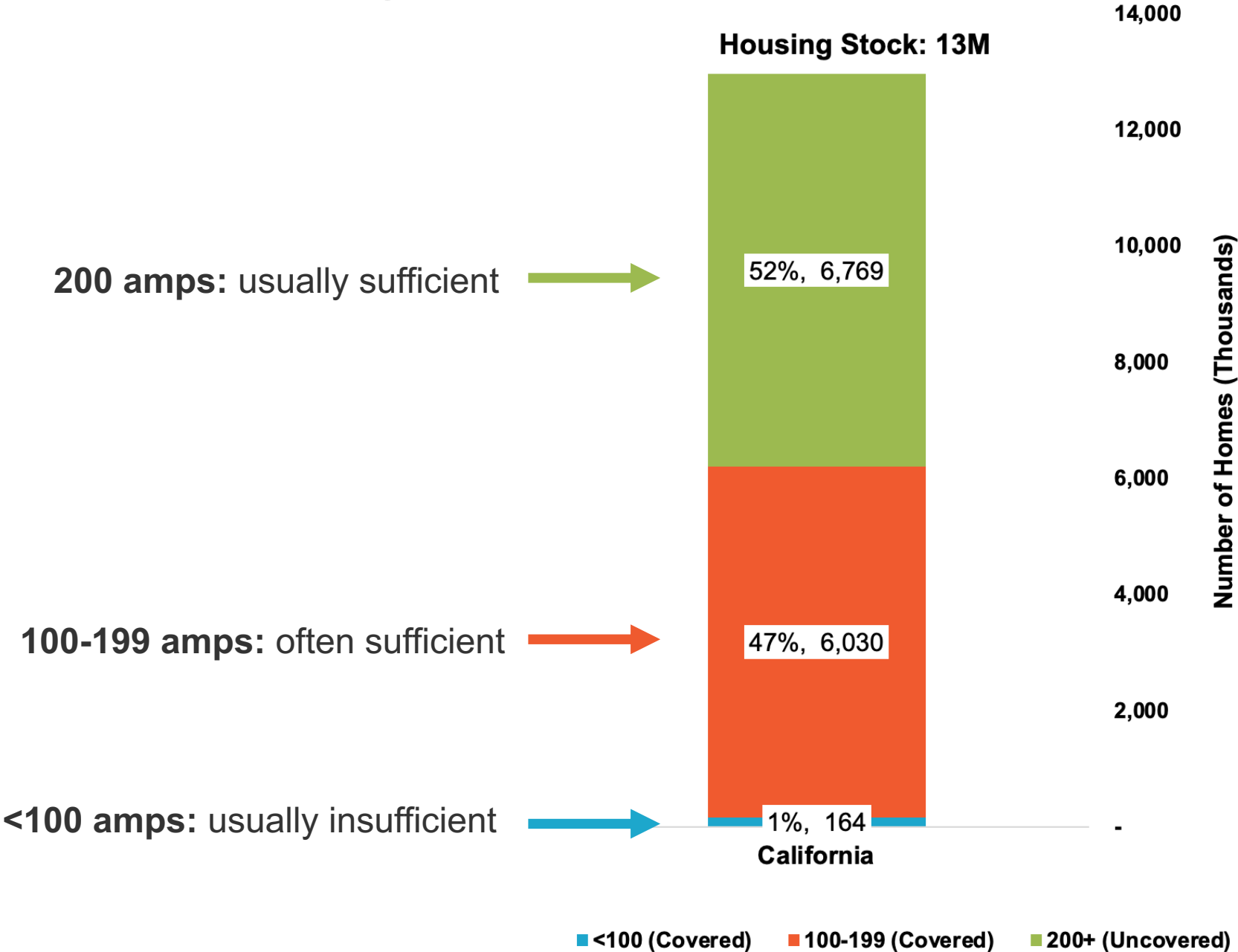




When electrifying an existing home, if the panel capacity is....

Source: SPUR analysis of data from Home Energy Analytics Energy Efficiency Program Data (2022), TECH Clean California Heat Pump Incentives Data (2023), BayREN Home Energy Advisors Data (2022), and American Community Survey data on housing stock (2021).

The three datasets on panel size are not random samples and may be skewed towards wealthier & easier-to-reach customers.



Policy Solutions to Streamline Panel & Service Upsizing



Avoid: Upsize Less Often

- Encourage use of more accurate section of the Electrical Code to estimate load (Section 220.87)
- Remove baked-in bias to overestimate load in the National Electrical Code



SimpleSwitch Allows
2 appliances to share
one circuit



DCC9
Sheds load for one
circuit



Span.io
Sheds load for 0-32
circuits in the panel



ConnectDER Meter Collar



EARU Smart Circuit
Breaker

Avoid: Upsize Less Often

- Improve contractor and customer awareness of how to avoid panel upgrades without sacrificing comfort & convenience



**Instantaneous
(Tankless) Hot
Water Heater**

Heats water almost instantly as it moves through the system, only requiring energy while in use.

- ✓ **Energy-efficient?** Yes. This device requires a lot of power, but only for a short time. Its overall energy use is low.
- ✗ **Power-efficient?** No. This device demands a lot of power at once, requiring most, if not all, of a standard electric panel's capacity.



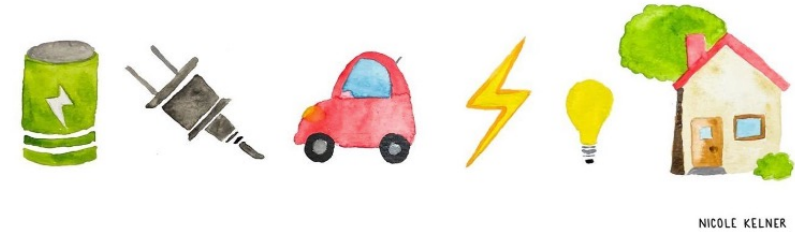
**Heat Pump Hot
Water Heater**

Uses electricity to extract heat from the air and heat water in a storage tank.

- ✓ **Energy-efficient?** Yes. This device may operate for a long time, but its rate of energy consumption (power) is low.
- ✓ **Power-efficient?** Yes. This device uses much less power, both because it is 30% more efficient and because it deploys its power more gradually.

Avoid: Upsize Less Often

- Offer concierge services to support customers in avoiding unnecessary panel and service upgrades



Home Electrification Plan for Sydney Larson and Brian Schuster- from QuitCarbon

📅 Date

Empty

▼ 1 more property

Welcome to your electrification journey! We know that we have to make deep cuts to carbon emissions in the coming decade to avoid the worst impacts of climate change. The good news is that we know a lot about what it will take to achieve our carbon reduction goals — now we just need to start taking action. By embarking on QuitCarbon's planning process, you're taking responsibility for your piece of the solution. Home by home, community by community, we can all make a meaningful contribution and build a better, cleaner, healthier future.



Prepare: Upsize Before It's an Emergency

- Assist customers to proactively plan for electrification
- Pass laws & regulations to encourage electrification readiness at the most cost-effective times, such as time of sale and time of retrofit



Solve the Problem: Make Upsizing Simple, Fast and Affordable

- Better planning and proactive electrical distribution system upgrades
- Allow faster recovery of costs for utilities
- Shift some costs from customers to ratepayers
- Neighborhood decarbonization approaches
- Bills to Watch: SB 410 (Becker), AB 50 (Wood)



Understand the Problem

Representative sample of panel & service capacity and utilization

- **Add panel size to the CEC's Residential Appliance Saturation Survey**

How can load-management devices be integrated into load calculations in the National Electrical Code?



Thank You

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