



2023 ENERGY STAR Products Partner Meeting

Reducing the Cost of Electrification with Alternatives to Electric Panel Upgrades

Presenters:

Danielle Hoffer – US EPA

Iain Walker – LBNL

Curtis Bonn – SPAN

September 27, 2023





Presenters



Iain Walker
Lawrence Berkley National Lab



Curtis Bonn
SPAN

AGENDA

- What is Electric Ready?
- Benefits
- Speaker presentations
 - Iain Walker
 - Curtis Bonn
- Questions

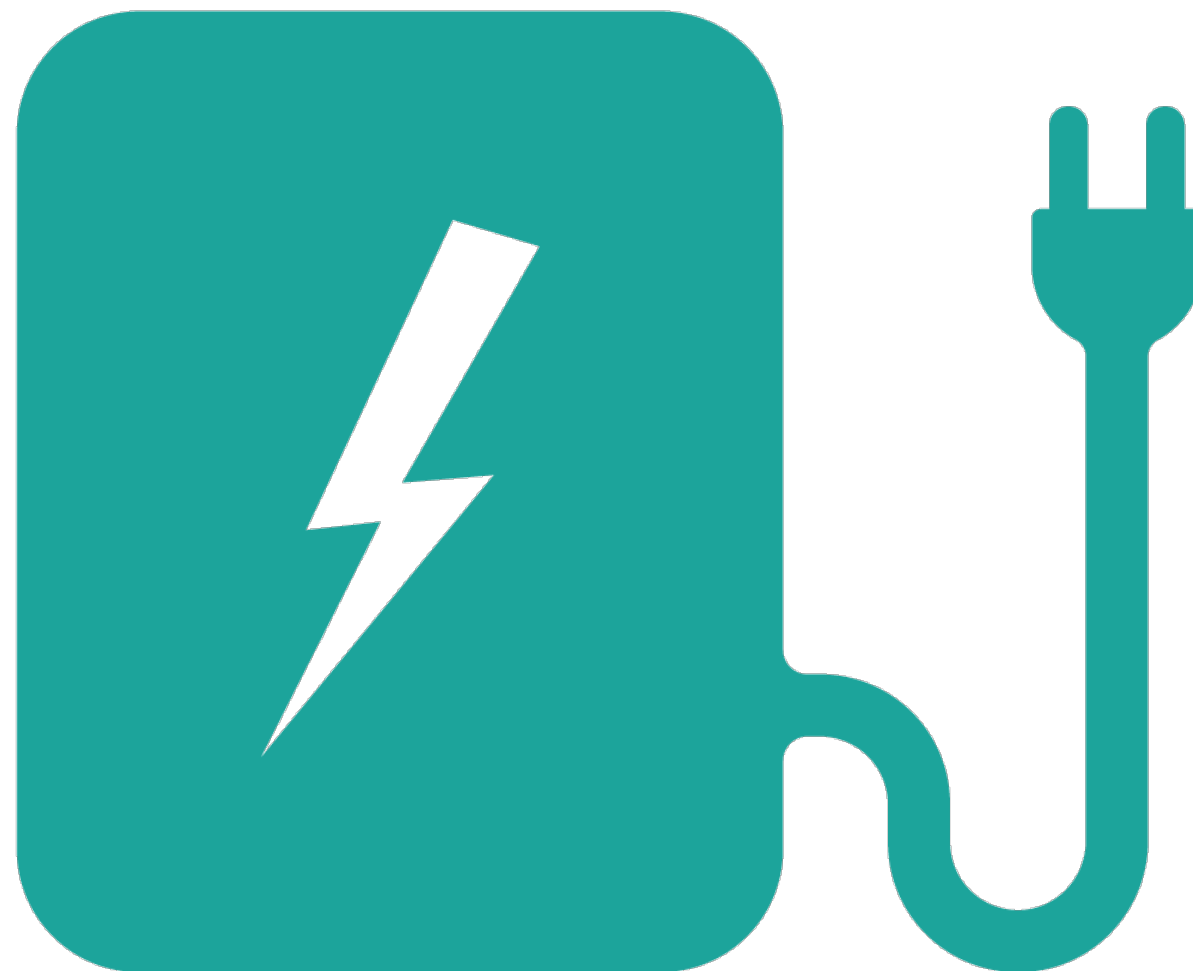
MAKE
YOUR ENERGY
CHOICES COUNT.



What is Electric Ready?

Ensuring the house has the necessary capacity and wiring for additional electric loads as you prepare for the change to cleaner and healthier energy and make replacing old appliances quicker and easier.

New technologies are coming onto the market to ease this transition.





Benefits

- Air Quality
- Comfort
- Convenience
- Financial

THIS WAY TO A CLEAN ENERGY FUTURE

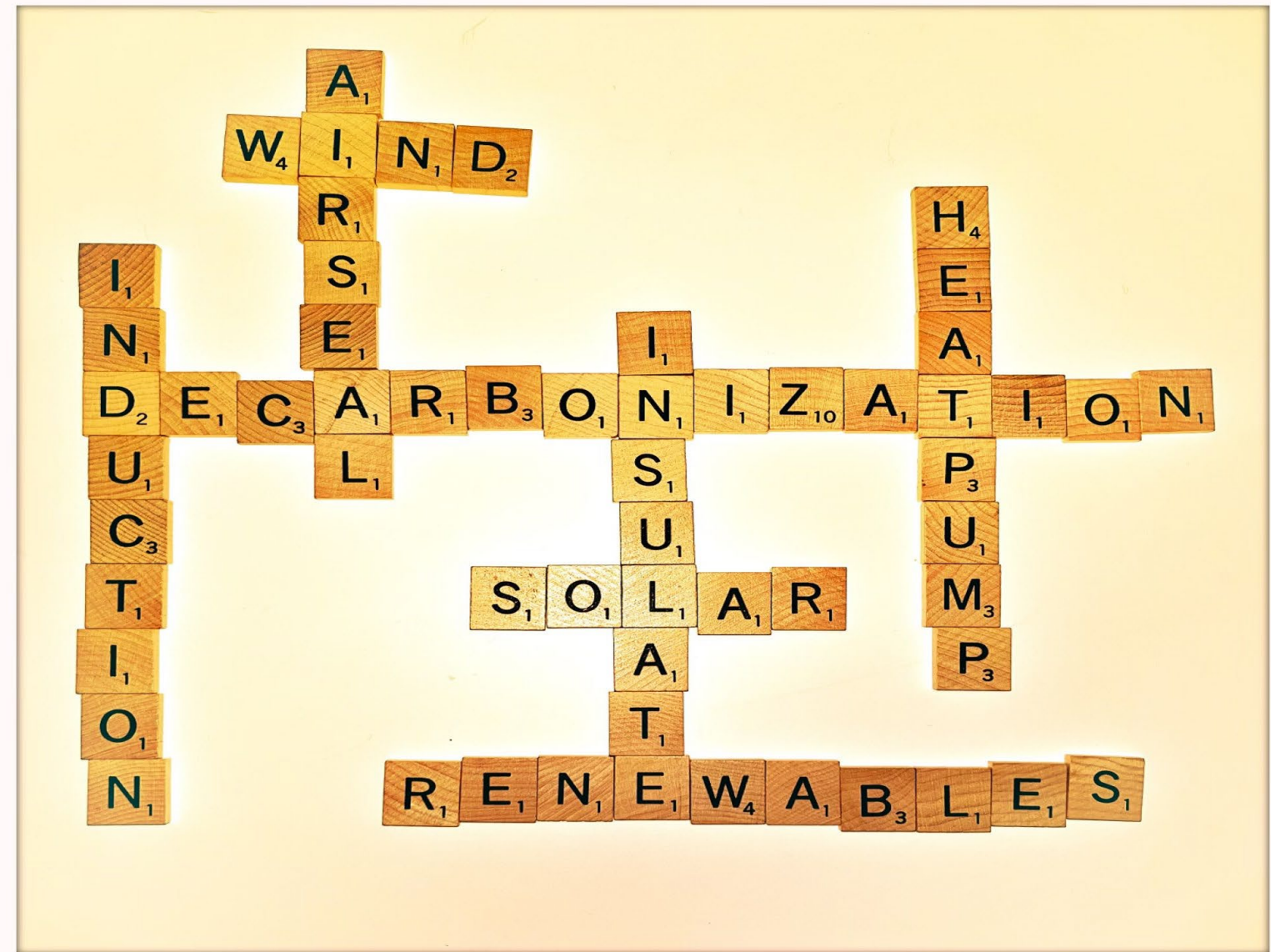


energystar.gov/earthday

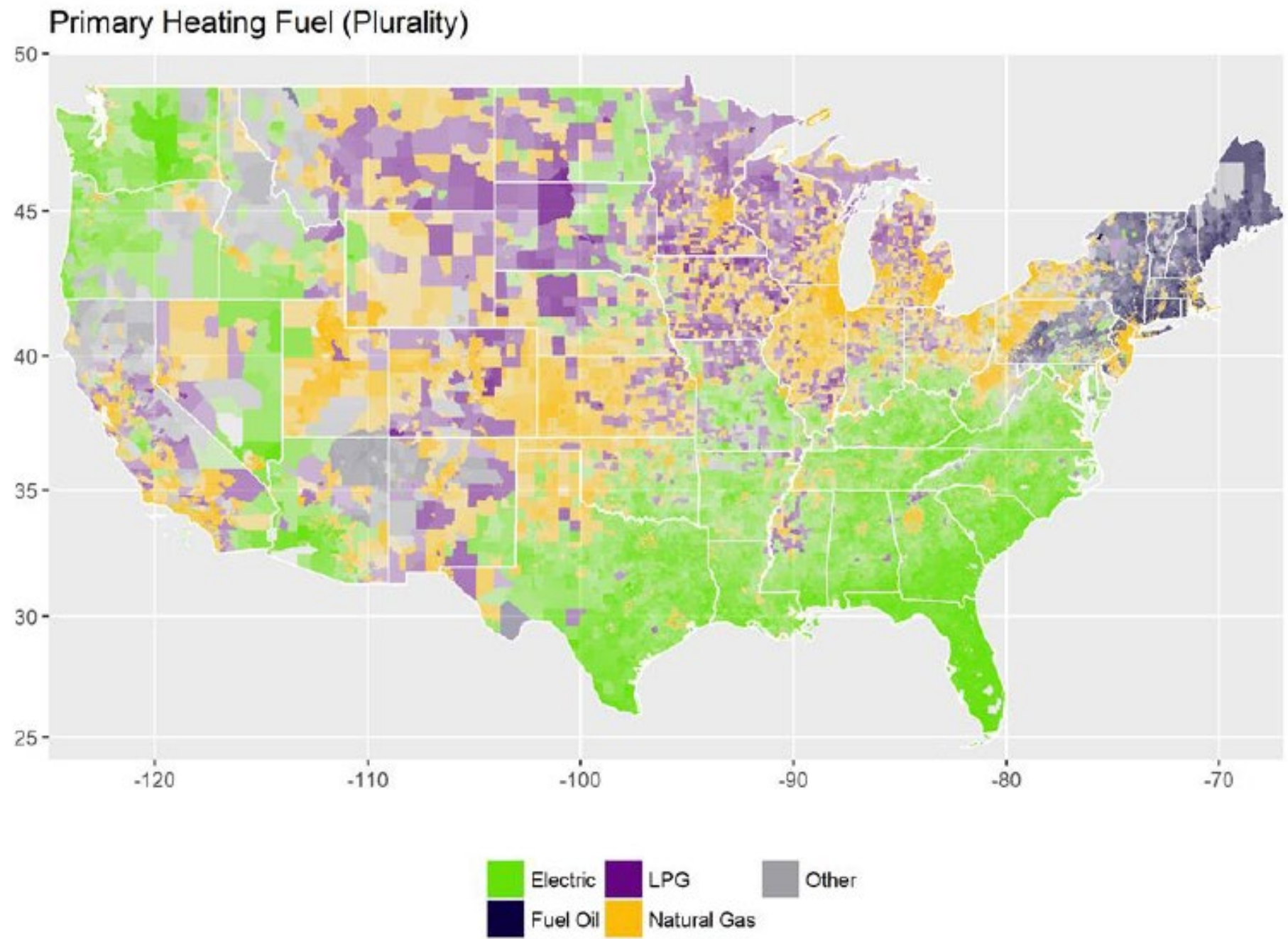


Making Homes Electric Ready – Ways to Avoid or Streamline Electric Panel Replacement

Iain Walker
Staff Scientist
Lawrence Berkeley National Laboratory



Problem Scope: How Many Homes?



>25% of homes are already all-electric
- highly regional
75% of homes have central AC

Electric Heating

- 51% of MF units
- 27% of SF units

Electric DHW

- 55% of MF units
- 41% of SF units

Electric Cookers

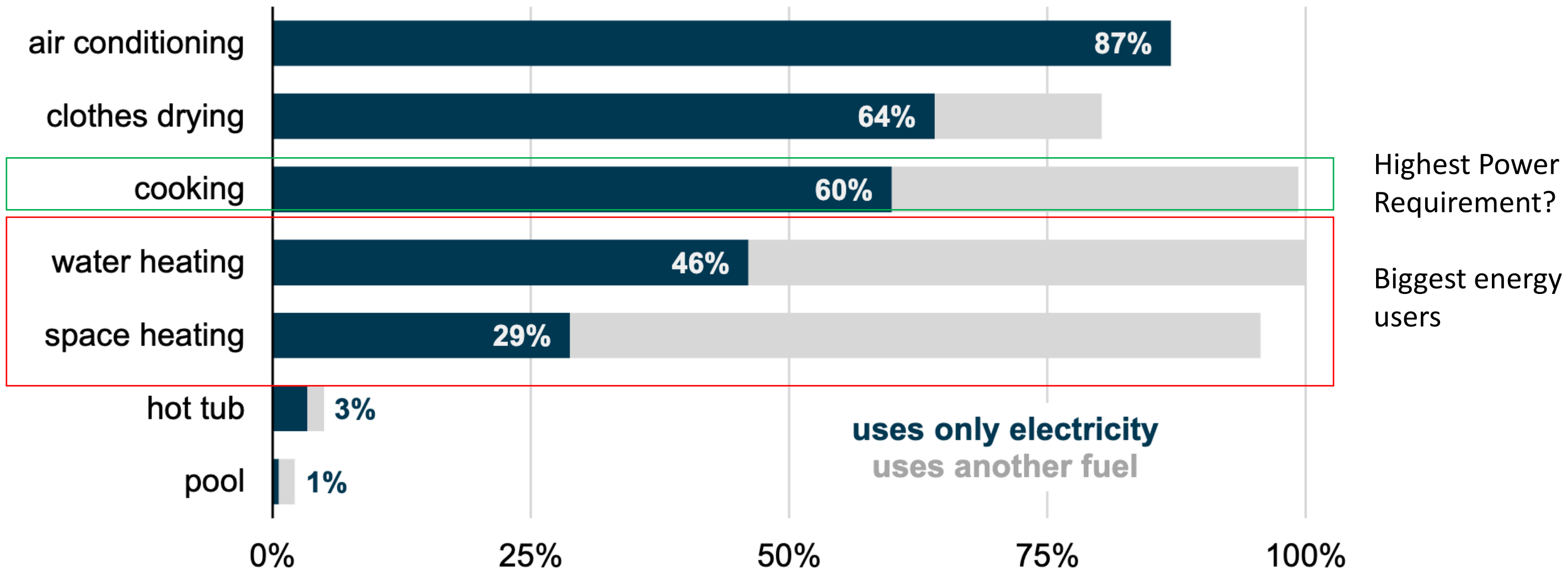
- 67% of MF units
- 56% of SF units

Data from the American Community Survey (2016).

Problem Scope: Electric End-uses



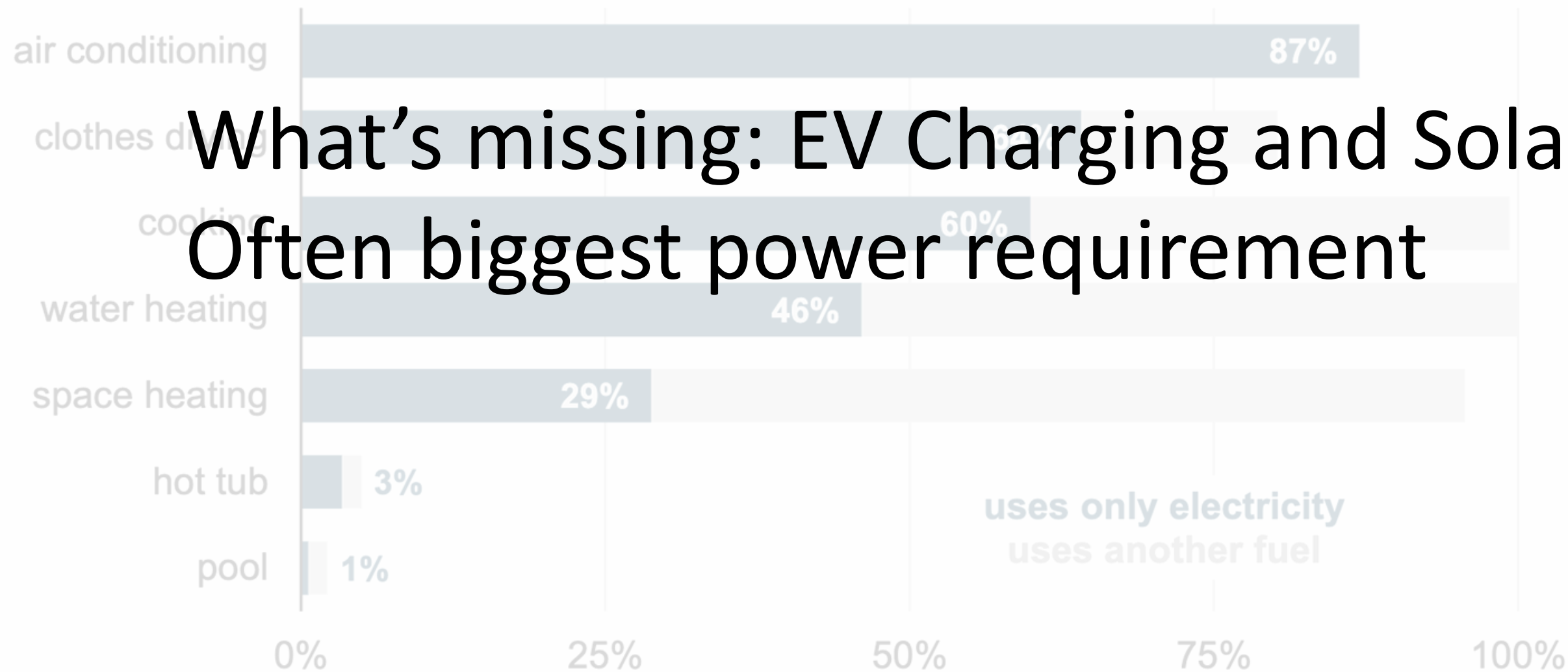
Presence of equipment and use of electricity in U.S. homes (2015)
share of all primary residences



Source: U.S. Energy Information Administration, [2015 Residential Energy Consumption Survey](#)

Problem Scope: Electric End-uses

Presence of equipment and use of electricity in U.S. homes (2015)
share of all primary residences



What's missing: EV Charging and Solar PV
Often biggest power requirement

Source: U.S. Energy Information Administration, 2015 Residential Energy Consumption Survey



Why not just replace all the panels?

What does it cost?

Circuits: **\$250-\$750 each**

Panel: **\$1,000-\$5,000**

Service: **\$1,000-\$25,000** to homeowner + similar amount for utility

Time delays

3-6 months project delays

>1-year lead time on transformers

Utility might reject your interconnection

Additional ratepayer costs for:

- Utility distribution system capacity increases
- New generation/storage

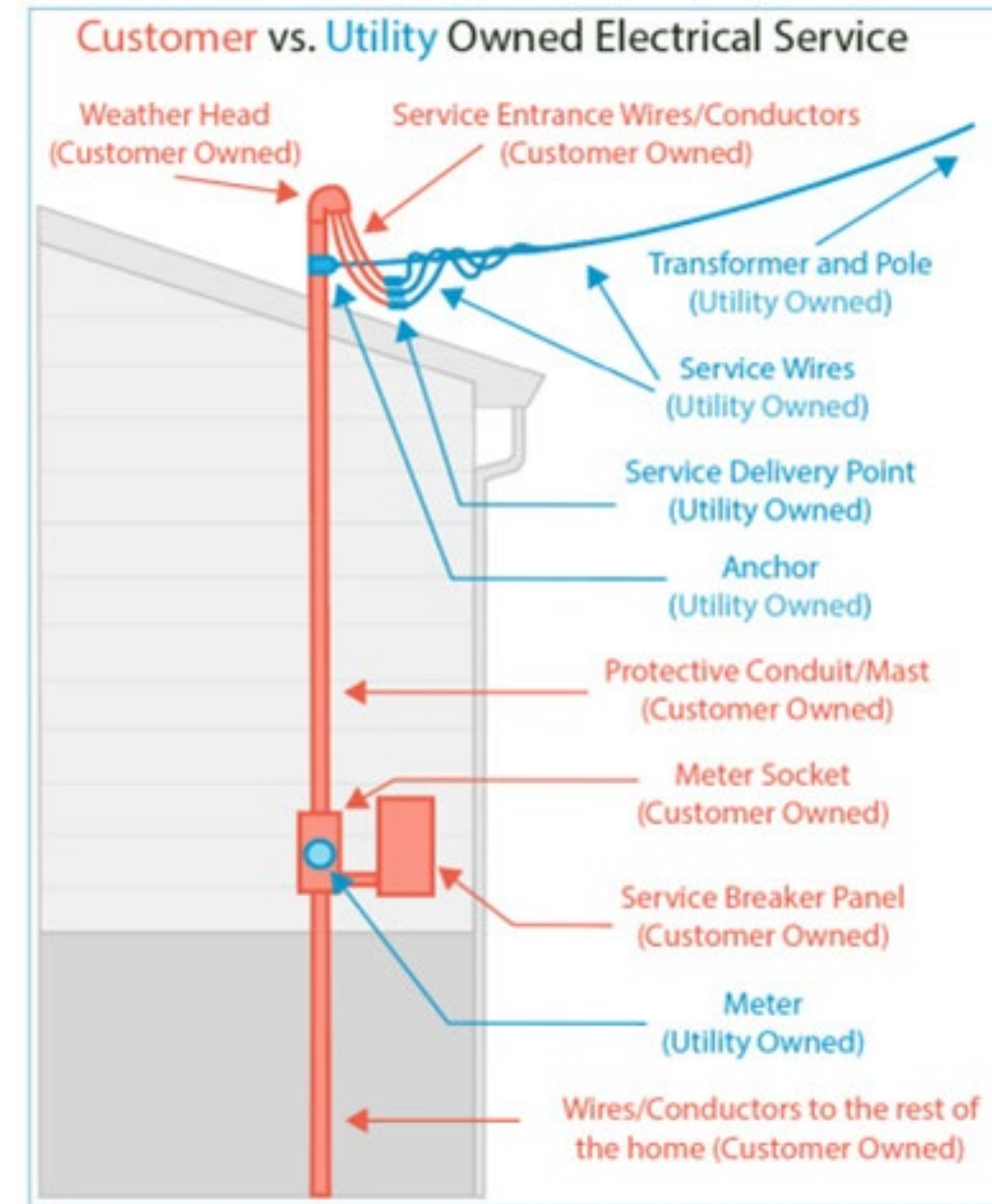


Image courtesy of Redwood Energy

Why not just replace all the panels?

Triggers rewiring: knob
and tube replacement

Another **\$10,000-\$30,000**



Sometimes an update is needed

Old, unsafe or damaged panels

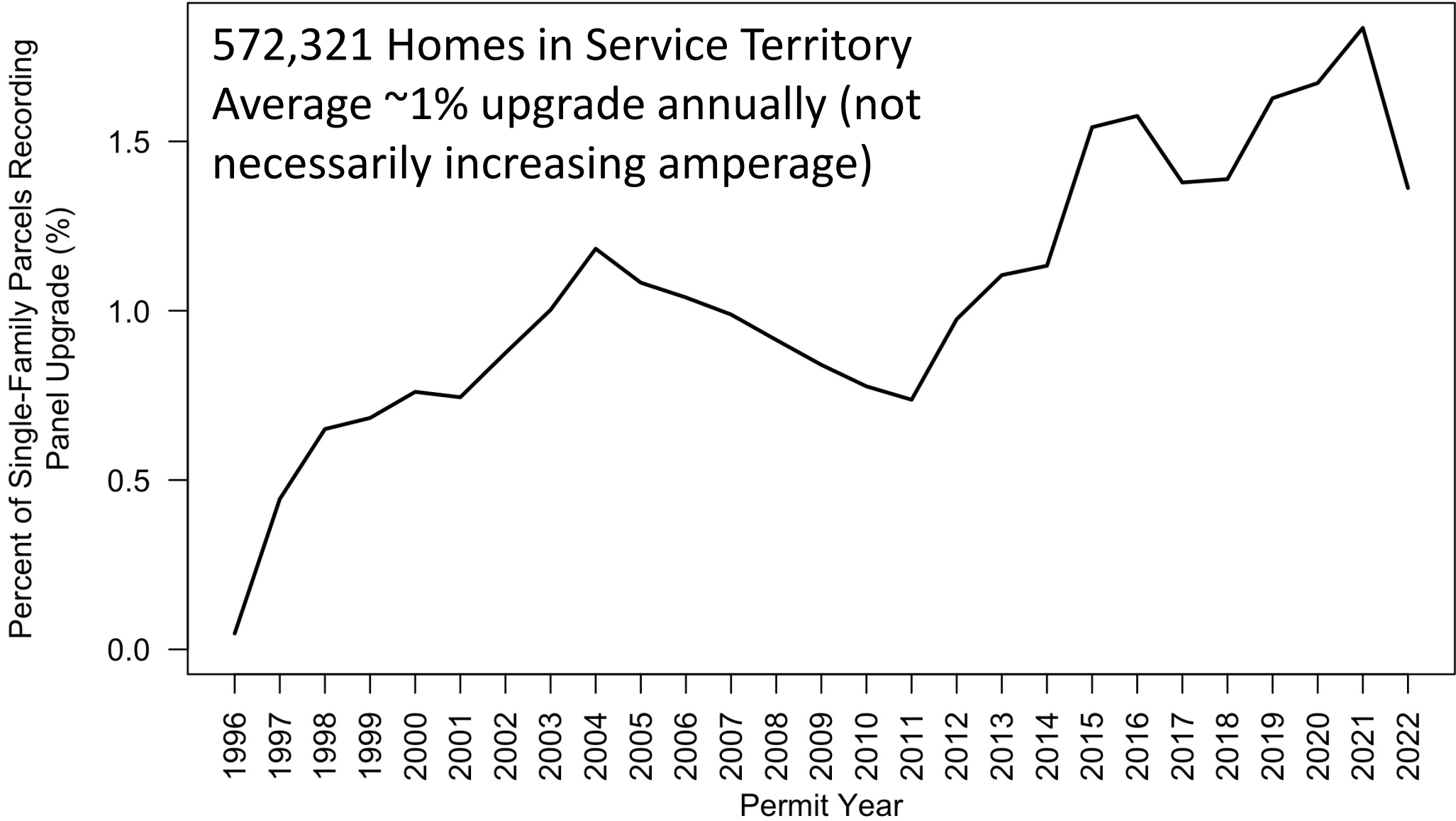
Fuse Boxes

Zinsco/GTE Sylvania and Federal Pacific panels are dangerous



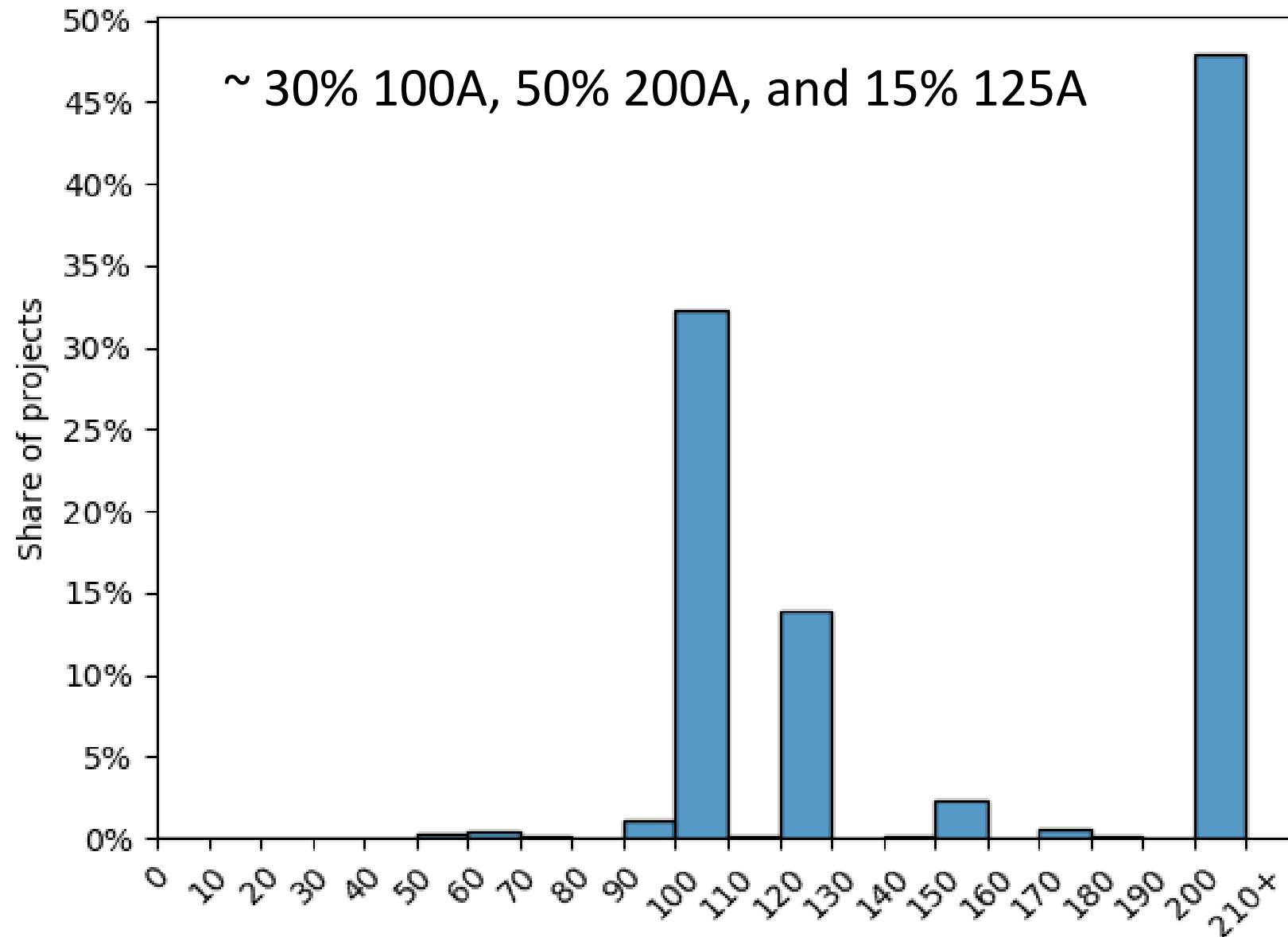
What are current replacement Rates?

Permit Data for LADWP, 1996-2022



** Data courtesy of Eric Fournier, UCLA

What capacity is installed?

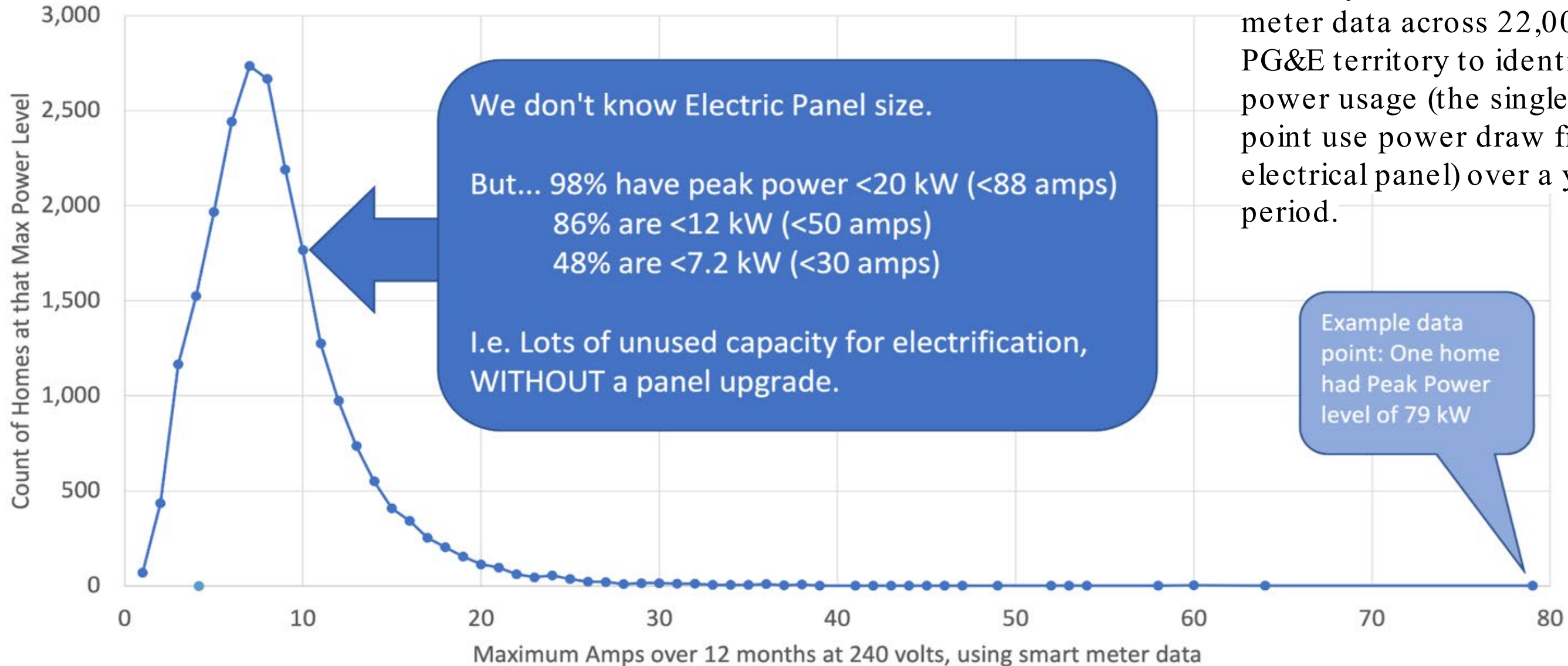


From ~18,000 Home Electrification Projects

- Most data sets represent homes engaging in EE programs (not random)
- Bias to California housing stock
 - California a very gassy state – so may bias these values low
- Mostly single-family data

Can we add new loads?

Count of Peak Power Levels in kW across 22,442 CA Homes



An analysis from HEA of smart meter data across 22,000 homes in PG&E territory to identify peak power usage (the single greatest point use power draw from their electrical panel) over a year-long period.

Beyond Amps – Space for breakers?

- BayRen Home Electrification Checklist
 - 100A: 31% have free space
 - 200A: 48% have free space

NO SPACE



LOTS OF SPACE

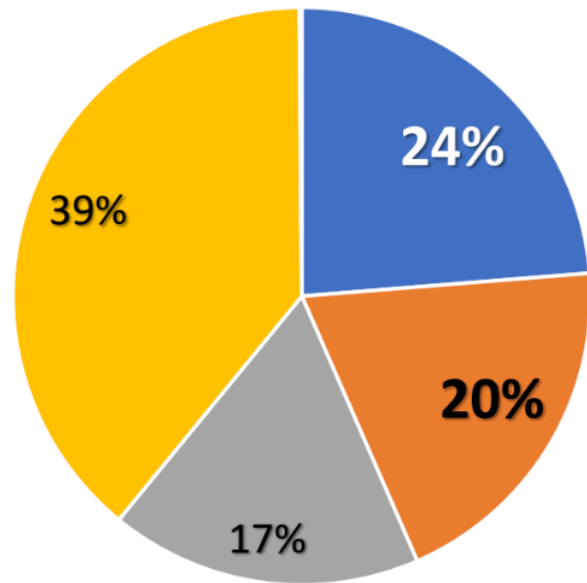


Beyond Amps – Space for breakers?

How many open breaker slots does your panel have?

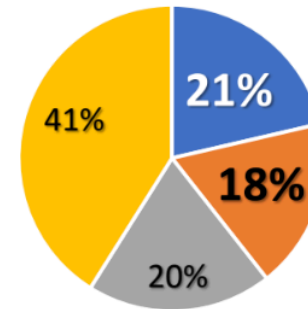
n=2,950

U.S. Summary

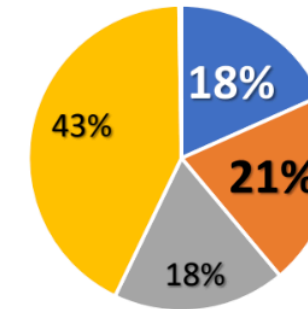


■ 0 ■ 1-2 ■ 3-4 ■ 5 or more

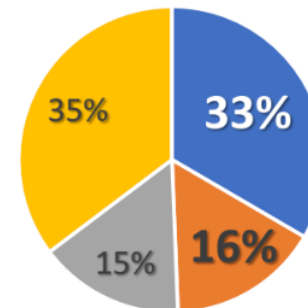
Midwest



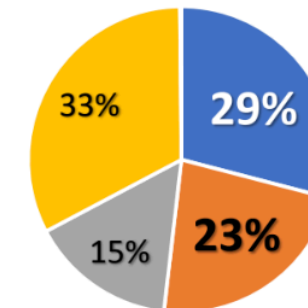
South



Northeast



West



44 % of households have two or less open breaker slots

EPRI Study of
Electrical Panels in US
Homes

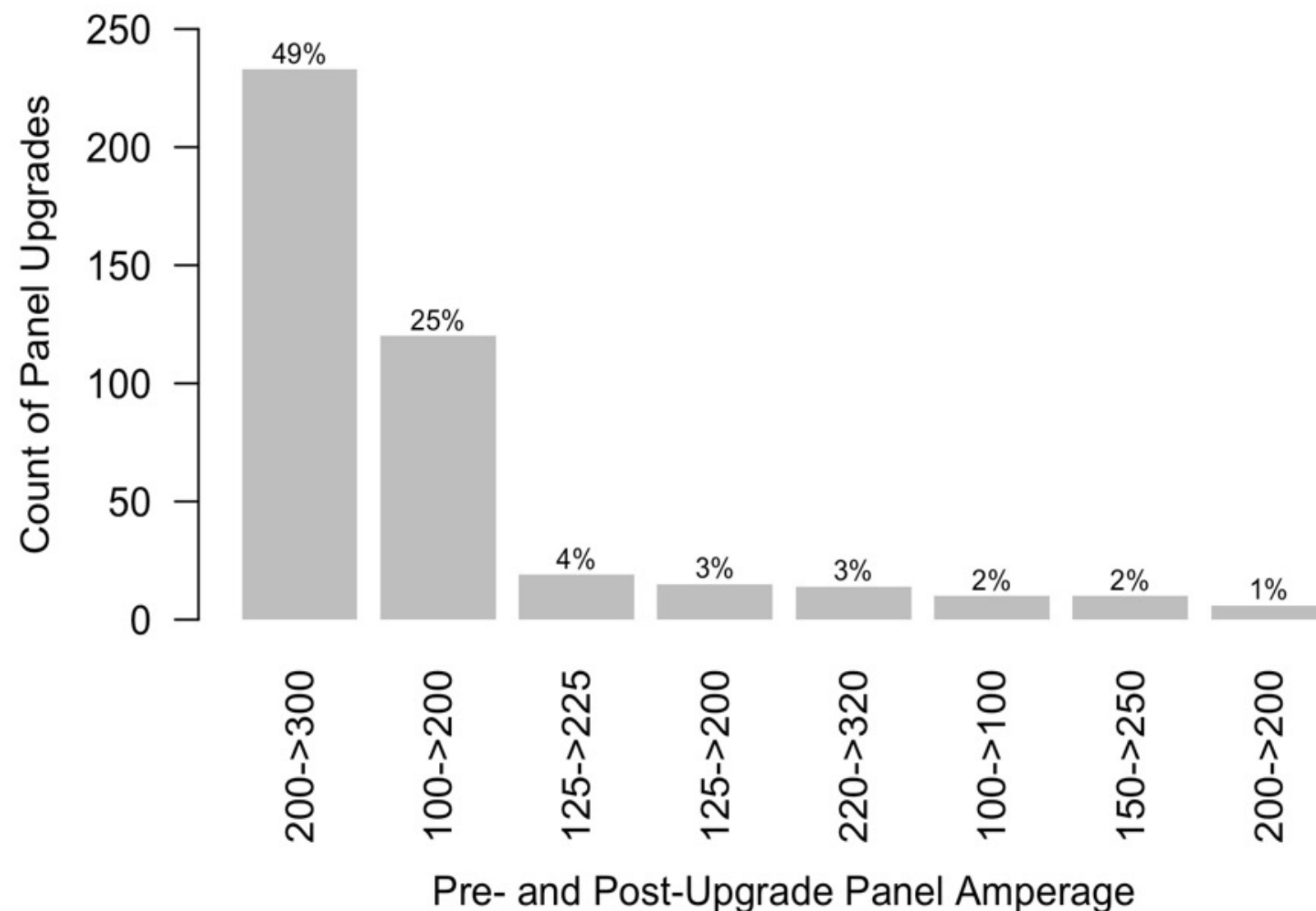
By Doug Lindsey

What's driving panel replacement?

Adding heat pumps not a big factor?

TECH Clean California

- 480 panel replacements out of 10,446 heat pump upgrades (4.6%)
 - **Most panel replacements were from 200A to 300A**
 - Smaller set from 100A to 200A



What's driving panel replacement?

Adding heat pumps not a big factor?

~10,000 homes in Vermont

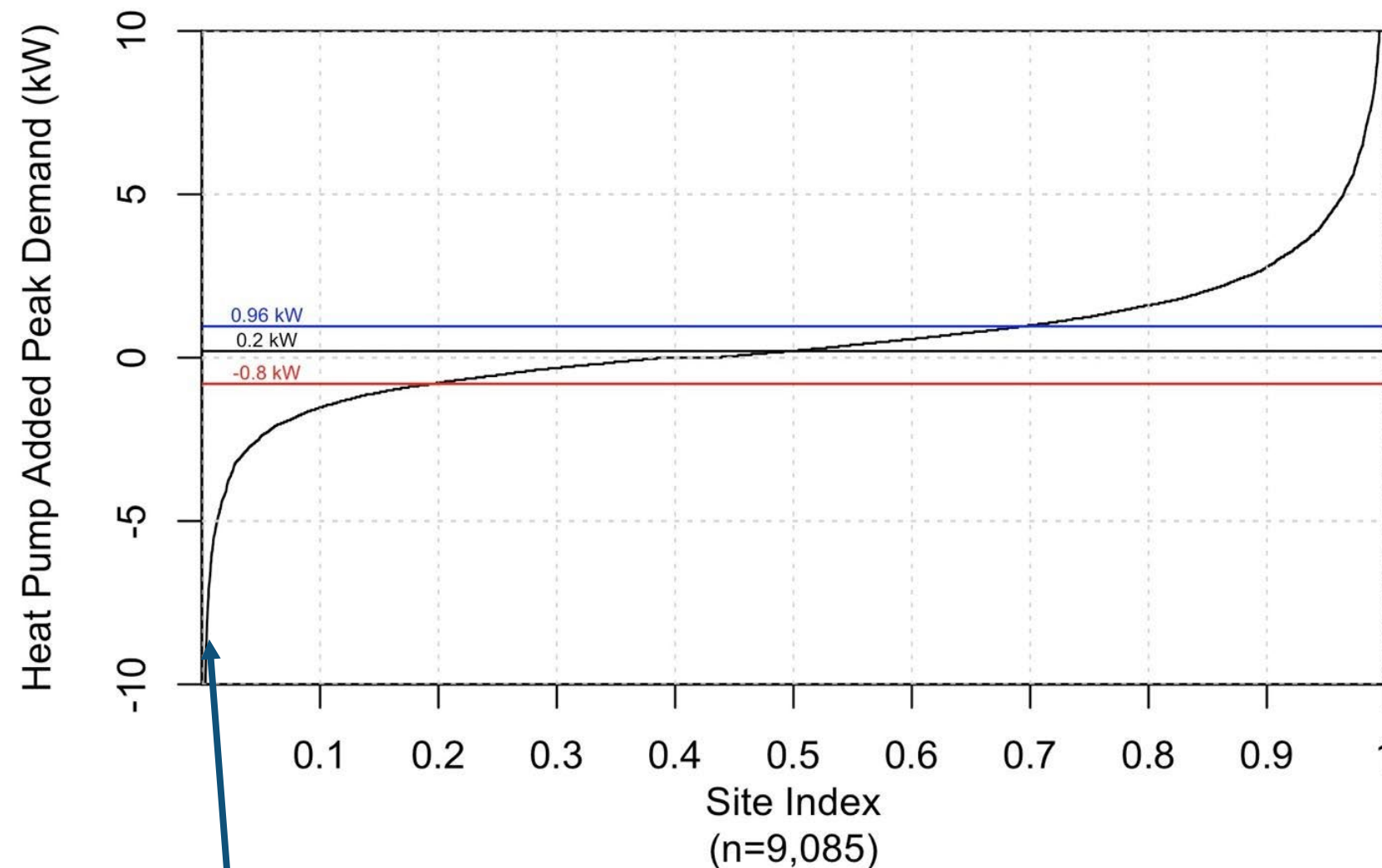
15 minute electric power before and after adding heat pumps

Mean nameplate rating 3.6 kW

Average addition 200 W

Avoid “backup” resistance heat

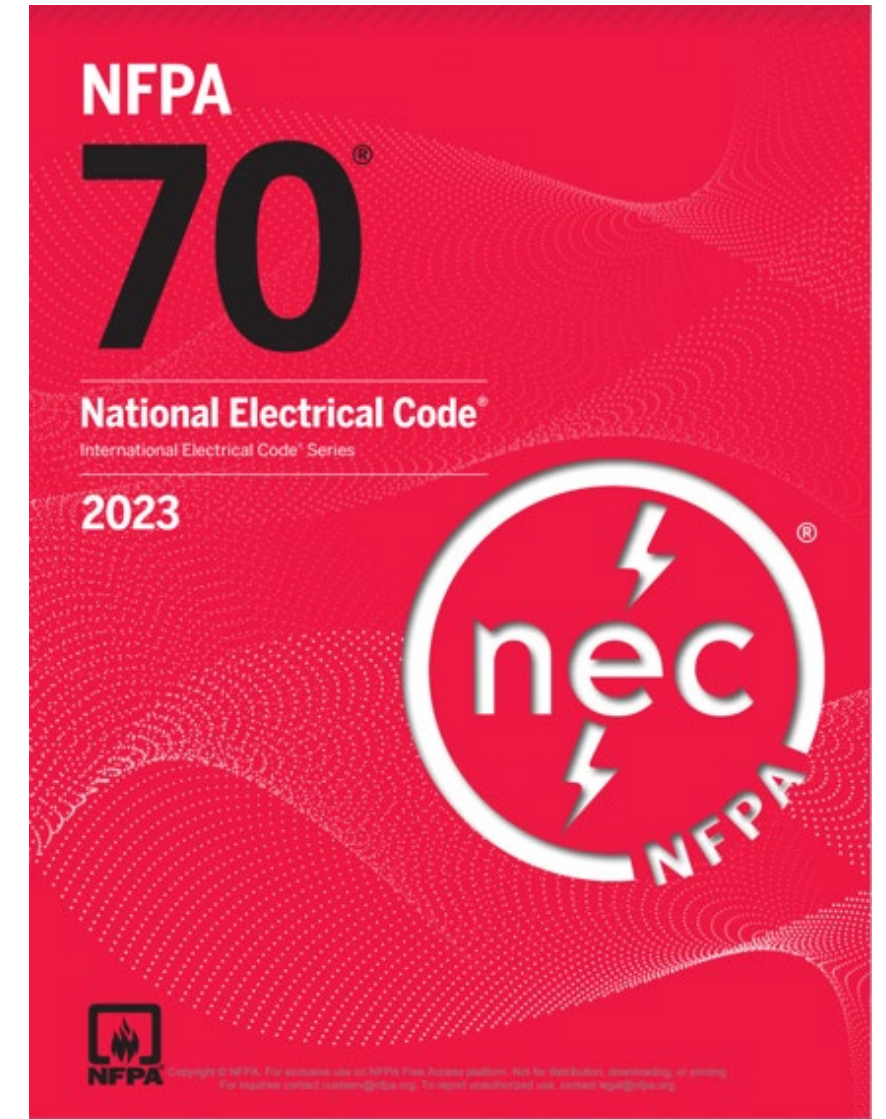
Change thermostat behavior: less (or no) setbacks



Electric Resistance Heated Homes

What IS driving panel replacement and service changes?

1. Reports from utilities: Current main drivers are adding Solar PV and EV Charging
2. Simplified approaches by electricians
 - Not using existing paths in the National Electric Code, e.g., using metered data
 - Profitable upsell?
 - Habit/comfort
3. NEC unclear and not developed with home electrification in mind
4. Local code authorities unprepared
 - Some will not allow circuit sharing or smart panel controls



Smart Electrical Panels

\$3-5k + install

Most complicated and flexible



Circuit Sharing

\$300-600 + install when hard-wired

Least complicated, sometimes DIY



Solutions for Avoiding Panel and Service Upgrades

Others

NEC Load Calculations
Low Power Appliances
Meter collar solutions
Smart circuit breakers

Circuit Pausing

\$400-900 + install

Medium complicated, requires CTs



Use existing methods in NEC

NEC 220.87 – metered data

- Existing loads based on metering data (15 minute)
- Total load = (Metered Load) x 1.25 + New Load

We are working on improvements: based on measured load coincidence + adding a 60 to 15 minute converter so we can use smart meter data

NEC 220.83 – sum connected loads

- Existing loads = sum of connected loads with different treatment when adding HVAC
- **No New HVAC:** 100% of first 8,000 watts + 40% of remaining loads (including heating and cooling)
- **New HVAC:** 100% of first 8,000 watts + 40% of remaining loads + max(heating, cooling)

Understanding the National Electrical Code (NEC): Watt Diet Calculator



<https://www.redwoodenergy.net/watt-diet-calculator>

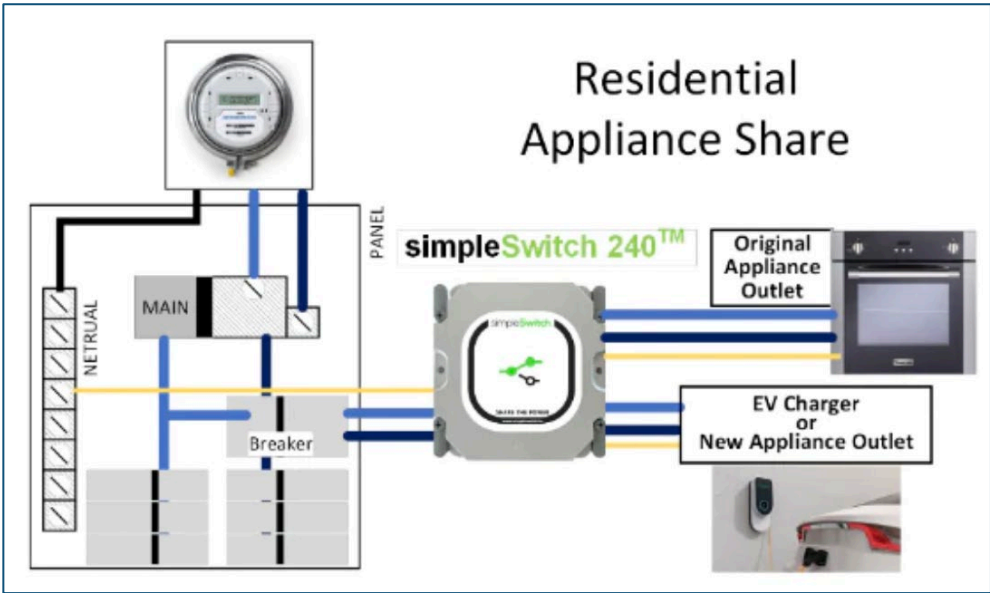
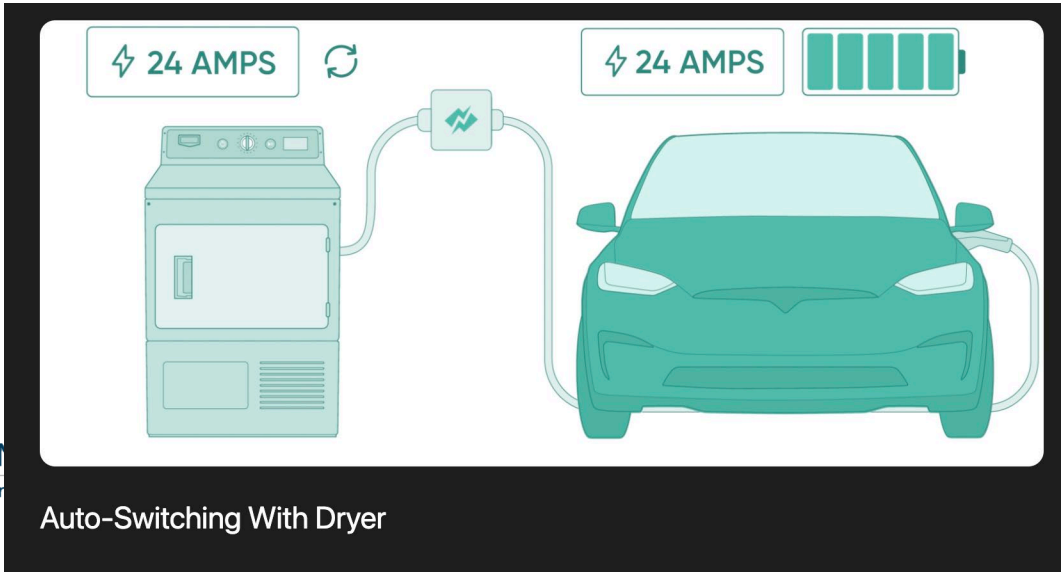
Circuit Sharing

Plug Sharing (sometimes DIY)

- Existing 240V receptacle near new load
- Example: *Existing dryer outlet in garage + new EV in garage*

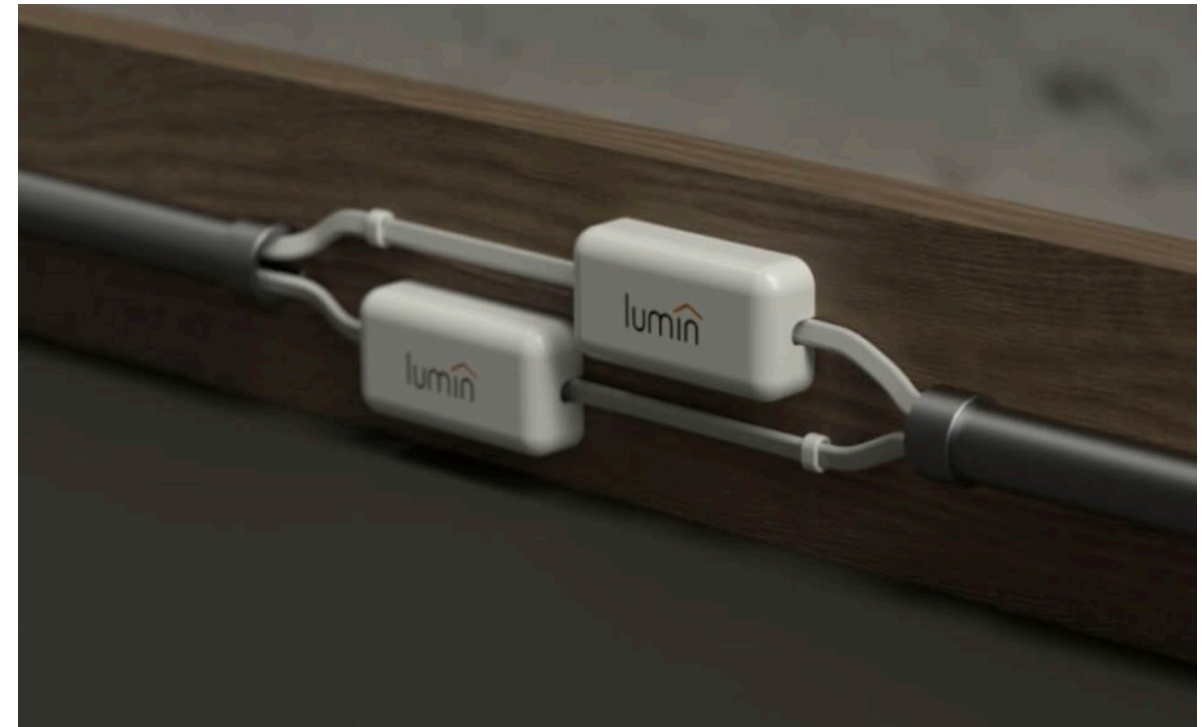
Circuit Sharing (not DIY)

- Hardwired or plug 240v loads
- Not necessarily co-located
- Like a “smart junction box”
- Example: *Existing DHW in basement + new EV charger in garage*



Circuit Pausing

- Control relay for circuit communicates with metering placed on the mains or feeder, turns load off at 80% of rated capacity.
- Load maybe treated as zero in NEC electrical load calculations
- **\$400-900 + installation**
- Installation is more complex due to installing CTs and necessary communication hardware
- Saves panel load, does NOT save physical space



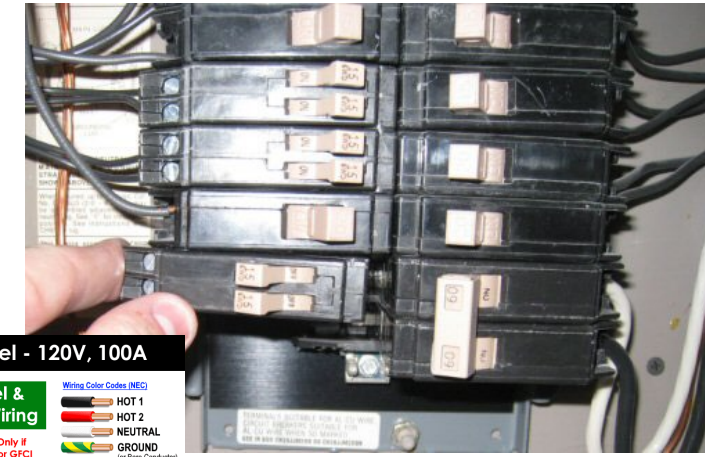
Other solutions

Tandem breakers and subpanels if space is an issue

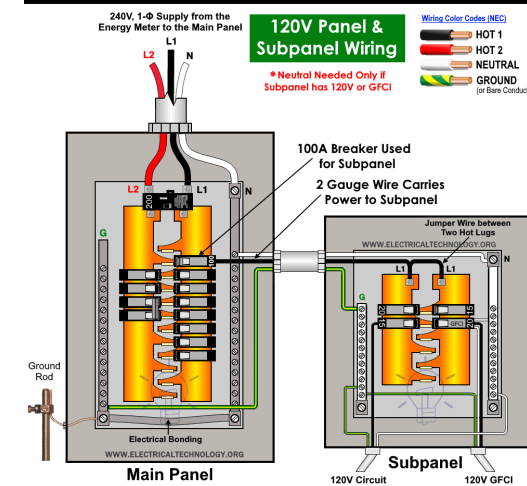
Meter collars for PV and EVs



120V Battery-integrated appliances



Wiring Installation of a Subpanel - 120V, 100A



Smart circuit breakers



120V plug-in appliances



120V Condensing and HP dryers



Integrating transportation

- Current poor public charging infrastructure:
 - Need to be able to charge at home
 - Challenges for multifamily
- EV could easily be the biggest home load
 - Restrict power to 7.2kW – overnight charge completely recharges most EVs
 - Encourage low-power charging – good for most households
 - Use timers/smart circuit sharing/meter collars



DOE developing solutions for hard to electrify homes



More general Upgrades also help



<https://www.herox.com/EASEPrize>

Rethinking rebates?

Currently \$2500 for a panel upsize (IRA up to \$4000 + \$2500 for additional wiring)

- Allows high power devices and higher peak load from home to utility
- New distribution and transformer upsizing - these costs passed on to ratepayers

Future rebates should be for **avoiding** panel upsizing; reduces grid stress in the future as we electrify

- Low power, high performance heat pumps (no backup resistance heat)
- 120 V HPWH (no backup resistance heat)
- 120 V induction cooking
- 120 V Condensing and heat pump clothes dryers
- Circuit sharing and pausing
- Limit EV's to level 2 and use controllers
- Meter collars for Solar PV and EVs
- Support load metering NEC compliance path – make peak data readily available

Summary

1. Its not as bad as we think

- Not an issue for already electric homes
- A lot of homes have plenty of power available – depends on metering?
 - Utilities should make this data readily available
- The big energy users and CO₂ emitters (heating and hot water) are **not** driving panel and service replacements
- Big drivers are EV charging and Solar PV

2. There are technical solutions now and more coming for **Low Power Electrification**

- Limit EV's to 7.2 kW
- Low power 120V appliances (some with battery/thermal storage)
- Meter collars, circuit sharers, circuit pausers, smart panels
- The NEC has approaches we need to popularize (e.g., “Watt Diet”) and is (hopefully) going to get better
- Need to support electricians and code inspectors in this transition
- Coming soon: battery integrated appliances: low input power + high output power when needed

SPAN[®]



SPAN Mission

Enabling Electrification for All



The challenge

48M U.S. homes need a panel upgrade to enable Electrification*



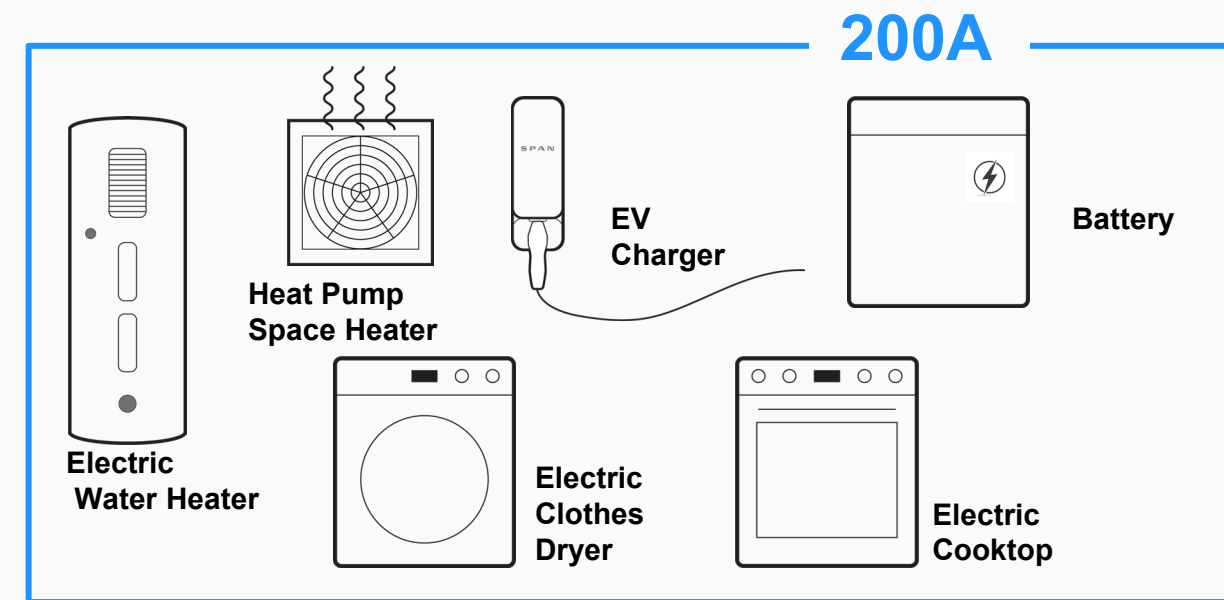
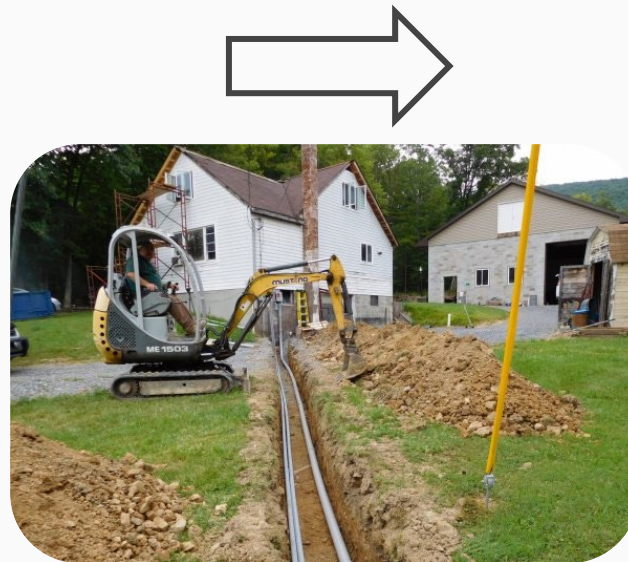
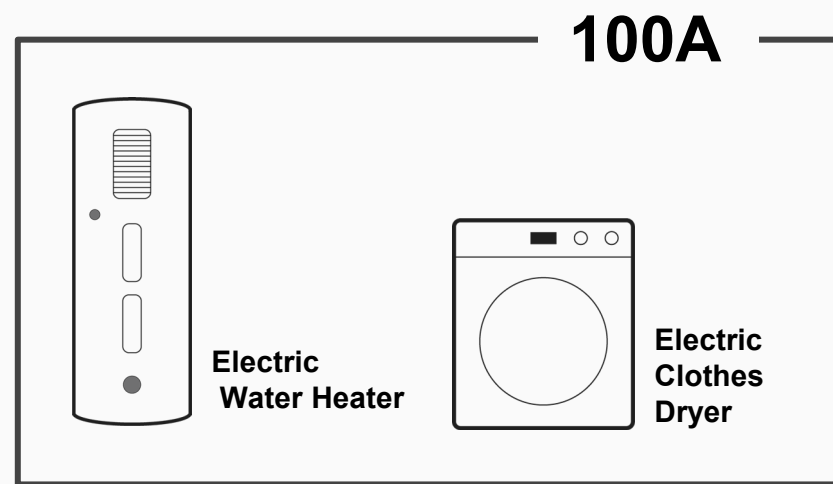
Vision | Electrify 10M homes by 2030

Upgrading electric service sizes is slow, expensive, and inequitable

Slow: long project timelines and extensive grid planning requirements

Expensive: costs homeowners an additional \$2-30k+ per project*

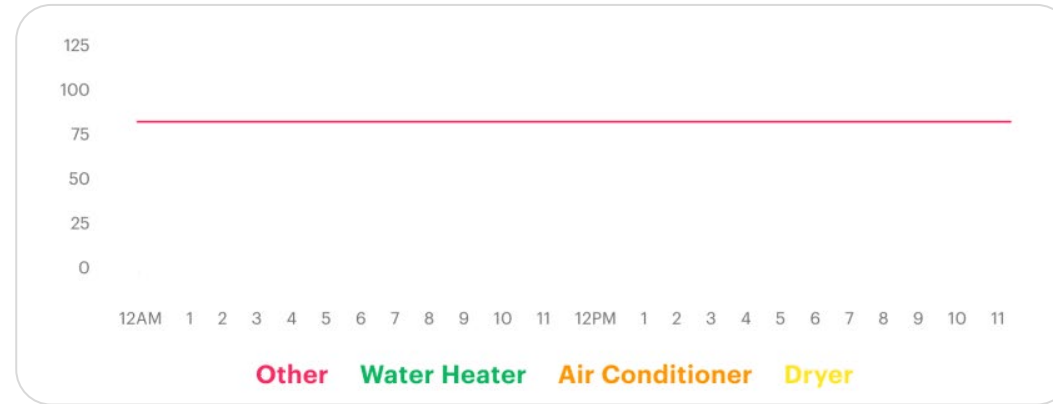
Inequitable: distribution costs make it difficult to afford electrification, especially for LMI ratepayers



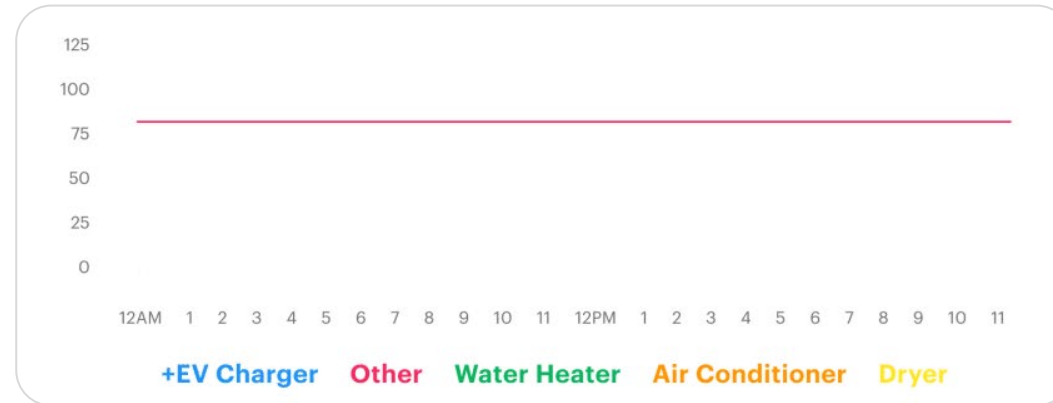
* Source: Rewiring America, Pecan Street

SPAN's PowerUp™ Technology

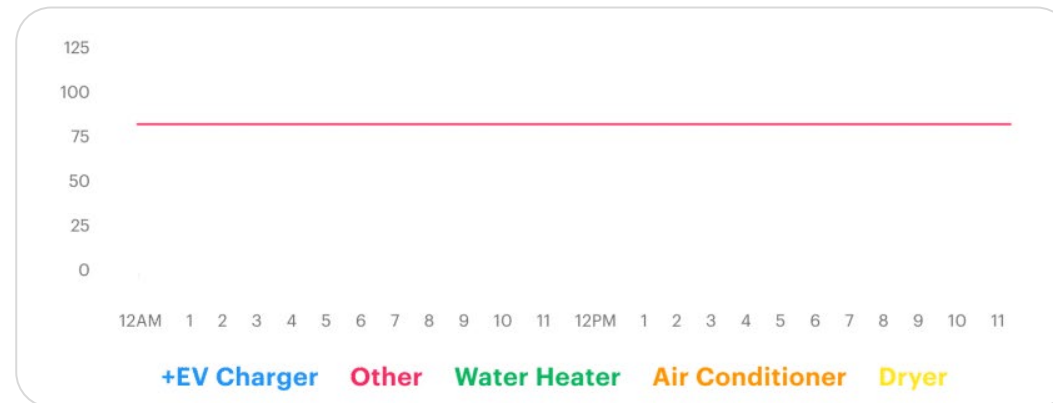
Intelligently shifts load of your choice



Before home electrification, 100A service is adequate ...



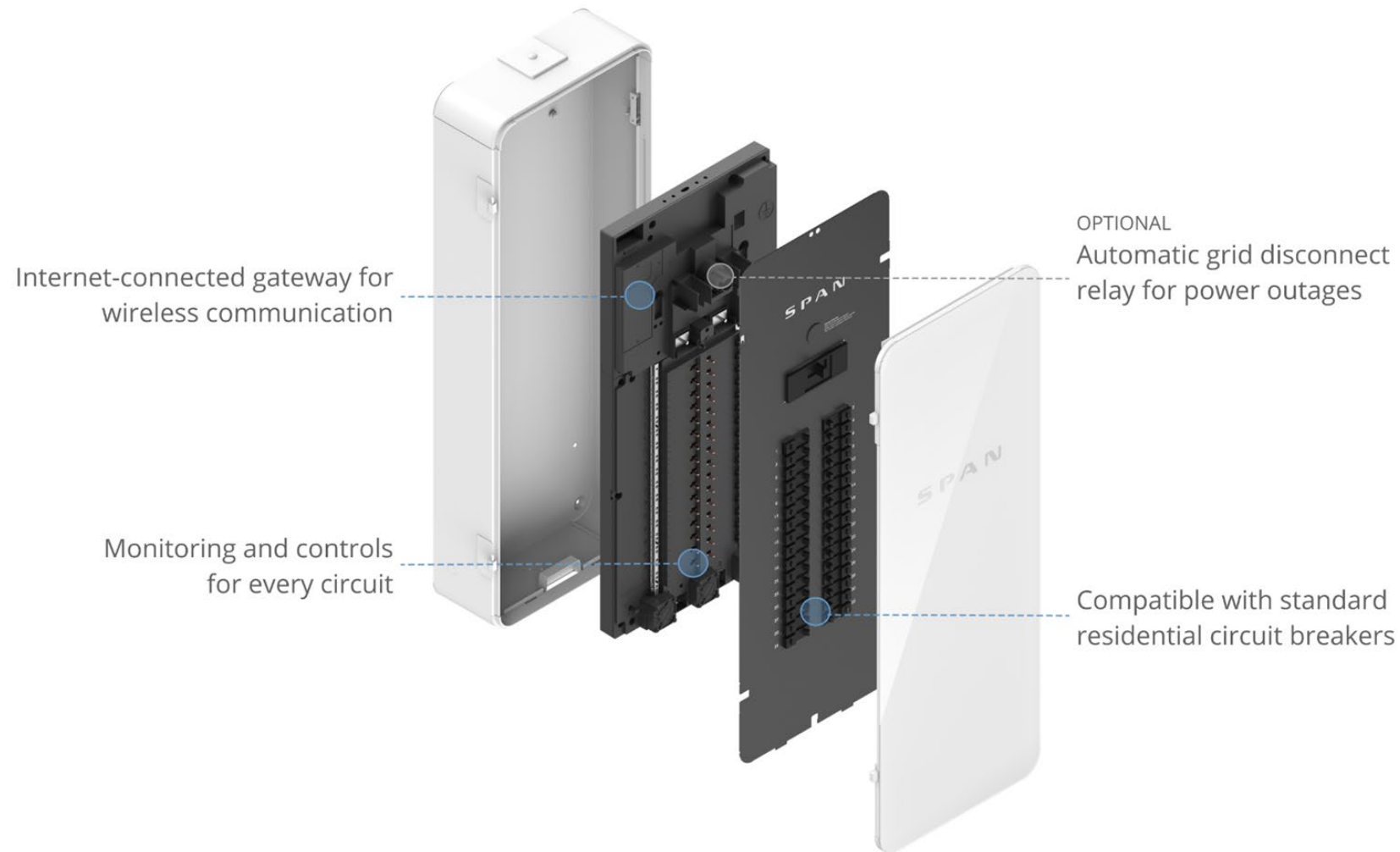
...but when adding an EV charger, service upgrades often become necessary.



SPAN dynamically shifts loads based on homeowner preferences to intelligently control overall consumption and avoid costly upgrades.

SPAN Panel

Say Goodbye to 100-year-old technology



Features

Circuit-level (32) control gives unprecedented, hardware-based energy intelligence

PowerUp™ dynamic load-control enables Electrification without a service upgrade

Whole-home Demand Response

Actionable energy insights & alerts

40% longer home battery back-up

Amazon Alexa-enabled

SPAN Panel can mitigate a service upgrade and unlock Level 2+ charging speeds with SPAN's Drive EV Charger

SPAN Drive



High Performance charging that's Smart and Beautiful

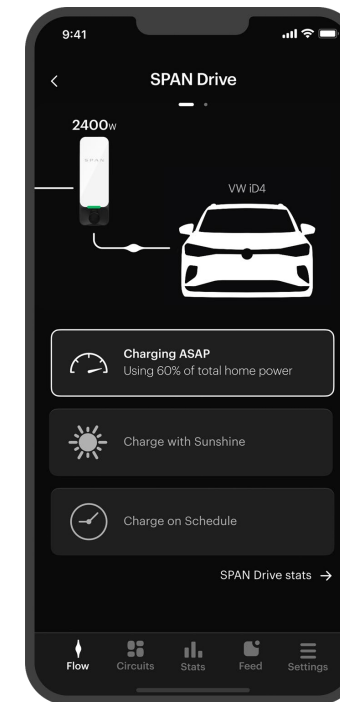
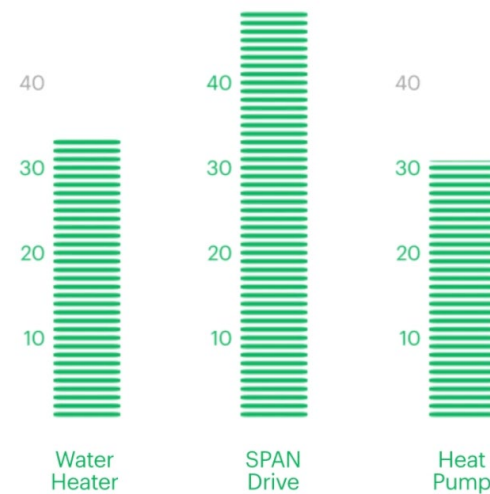
Features

Partners with SPAN Panel for a holistic EV charging experience

Unlocks Level 2+ charging (48 amps) for any home without an electrical service upgrade

TOU-rate scheduling w/ local utility

Compatible with all EV's



SPAN Home app

Pairs with SPAN Panel for unparalleled home energy management

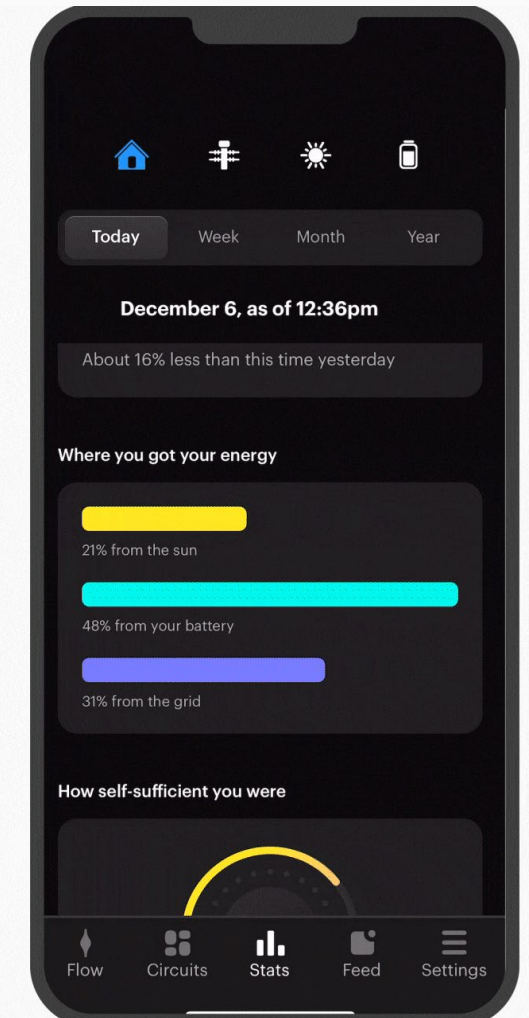
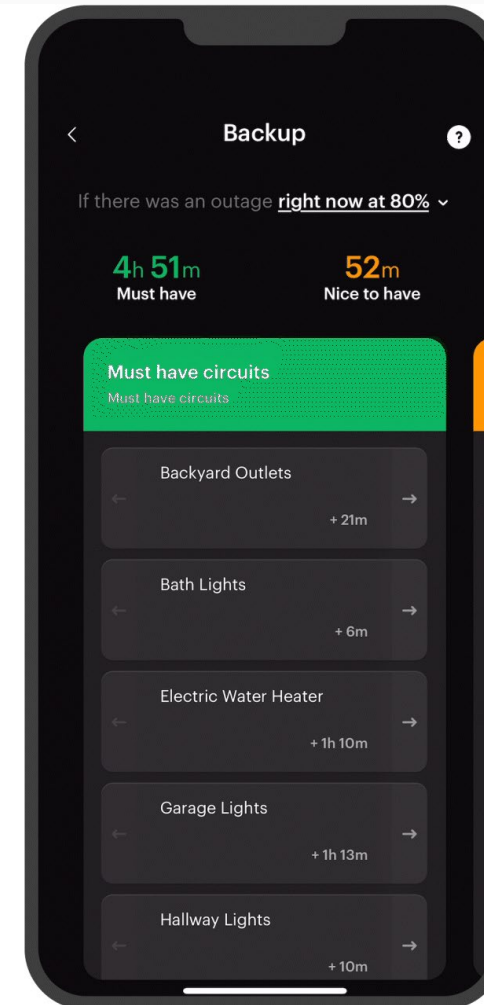
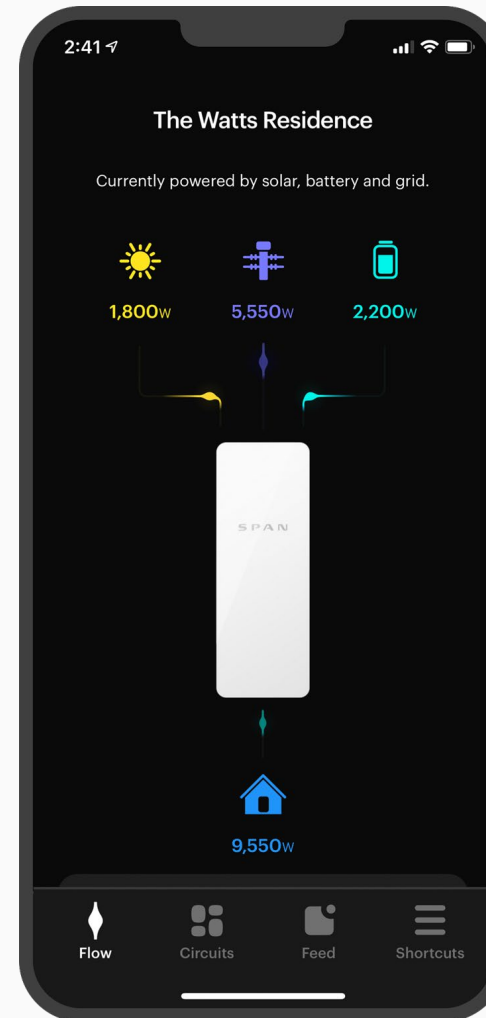
Full Home Monitoring & Control

Actionable energy data & insights

Optimize battery backup by +40%

Real-time ON/OFF circuit control

Works with Amazon Alexa





Utility: Green Mountain Power

Location: Colchester, VT

Type: Direct install program

Customers: 100 customers receiving Panel + free Installation

Testing:

- Electrical load management & circuit-level control
- DER integration incl. batteries, EV chargers and solar panels
- Customer benefit of real-time circuit-level data on usage

Timeframe: 2021 - 2024

Coming soon: Hillside East Development

- 155 all-electric homes
- SPAN Panel + Drive, rooftop solar, Tesla Powerwall, & Heat Pump
- Microgrid (VPP) & utility-scale back-up



Nicor Gas Smart Neighborhood

Utility: Nicor Gas / Southern Co.

Location: Aurora, IL

Type: Affordable (LMI) Net-Zero Smart Home Deployment

Customers: 1 of 4 Southern Co. Smart Neighborhoods

- Each home receives a SPAN Panel, solar panels, battery storage and energy efficient windows and lighting

Timeframe: New Builds beginning late 2023



SPAN x Mitsubishi



The smarter
electrical panel

SPAN

Converting from fossil fuels to heat pumps often leads to service upgrades

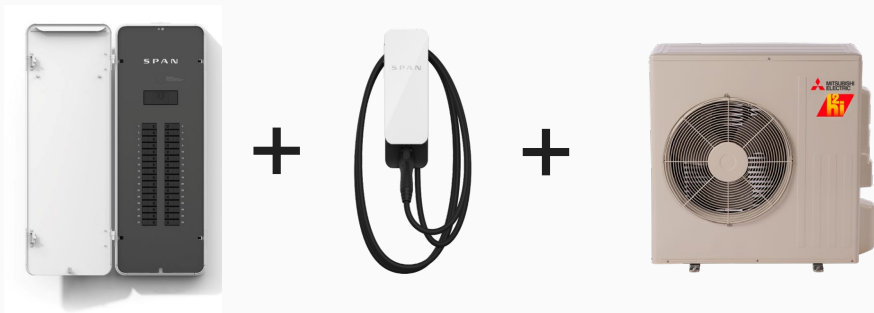
SPAN x Mitsubishi will use advanced variable energy orchestration to safely keep total home usage within the existing electrical service.

SPAN Panel can now control any load from the breaker including Batteries, EV chargers, and Heat Pumps by adjusting power usage.

And we're just getting started.

SPAN + HEEHRA = Equitable Electrification

**Before HEEHRA,
electrifying LMI
homes was \$\$,\$\$\$.**



**HEEHRA unlocks
nearly \$15,000 in LMI
Rebates for Smart
Panels, Wiring, & Heat
Pumps.**

**For low-income households (under 80 percent of Area Median Income), the Electrification Rebates cover 100 percent of your heat pump costs up to \$8,000, electrical panel costs up to \$4,000, & Wiring costs up to \$2,500 (RewiringAmerica.org)*

***LMI homeowners likely eligible for IRA Panel Credit (25C) of \$600 and EV Charger Credit (Form 8911) of \$1,000*



Questions?

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Consumer Tool (including Electric Ready):

www.energystar.gov/HomeUpgrade

