



February 6, 2023  
Bay Area Air Quality Management District  
375 Beale Street, Suite 600  
San Francisco, CA 94105

**Re: Comments on December 2022 Staff Report and Draft Environmental Impact Report for the Proposed Amendments to Building Appliance Rules 9-4 and 9-6**

Dear Chair Bauters, Board of Directors, and Executive Officer Landers,

SPUR applauds the Air District's leadership on the transition to zero-nitrogen oxide furnaces, boilers and hot water heaters. We have signed on and fully endorse the views expressed in the coalition letter of 56 organizations and individuals shared earlier today from RMI.

This letter is to address some of the understandable concerns regarding electrical service and panel upsizing. SPUR has been conducting in-depth research on how to address the challenge of electrical service upsizing, including electrical panel upsizing, during the transition to clean appliances. Attached is a memo providing a summary of our findings and recommendations. Electrical service upsizing is acting as a barrier to the uptake of clean appliances, but an underappreciated solution for many homes is to avoid service upsizing with careful design choices and the use of load management devices.

Electrical service and panel upsizing is the type of equity and affordability challenge that should be addressed through the Bay Area Air Quality Management District's Implementation Working Group (IWG). We hope the IWG will include our research on how to avoid unnecessary electrical service upgrades as a key strategy to solve the problem of service upsizing.

If you have any questions, please don't hesitate to reach out.

Sincerely,

Laura Feinstein, Ph.D.  
Sustainability and Resilience Policy Director  
SPUR

## **Memo: Preventing unnecessary electrical service upsizing, including panel upsizing**

Panel upsizing increases the electrical capacity of a building's breaker panel to allow for greater peak electrical demand. Larger panels in turn can trigger electrical service upsizing - increasing the capacity of utility infrastructure, such as the service wires and transformer that service a building. Avoiding panel upsizing whenever possible is quicker and less expensive for building owners, and it prevents costly upstream infrastructure upgrades that are borne by utility ratepayers.

Electrical service upsizing, including panel upsizing, is expensive and time-consuming for the property owner. Obtaining a permit and electrical service upgrade from the energy utility can cause delays in the range of weeks to years, effectively preventing electrification. They also are expensive for the utilities and their ratepayers.

A common but erroneous belief among many building energy experts and contractors is that building electrification requires homes to have at least a 200-amp panel. Given that many buildings have smaller panels installed, this belief has sparked a great deal of concern that electrical panel and service upsizing will act as a major bottleneck to building electrification.

Common mistaken assumptions are that most homes have 100 amp panels, and that all homes require a 200 amp panel to fully electrify. On the first point, the TECH Clean California program data for over 9,000 homes showed that 52 percent of all homes (and 42 percent of homes in disadvantaged communities) already had 200 amp panels.

Whether a home can fully electrify without panel upsizing depends on a host of building-specific factors. While there's no universal answer as to what size panel an electrified home requires, it's clear that many - if not most - homes can fully electrify on a 100 amp panel without compromising safety or comfort. Opting for lower-power appliances and use of load-management devices can allow homes to electrify within smaller panel sizes.

Redwood Energy's Watt Diet Calculator provides in-depth information on design choices that minimize the need for panel upsizing, and case studies of how homes up to 3,000 square feet can fully electrify without a panel capacity increase (Exhibit 1).<sup>1</sup> San Mateo County Office Of Sustainability conducted in-depth case studies of ten homes and found that only one home, which had a 60 amp panel, needed to increase panel capacity before electrifying every device in the home.<sup>2</sup>

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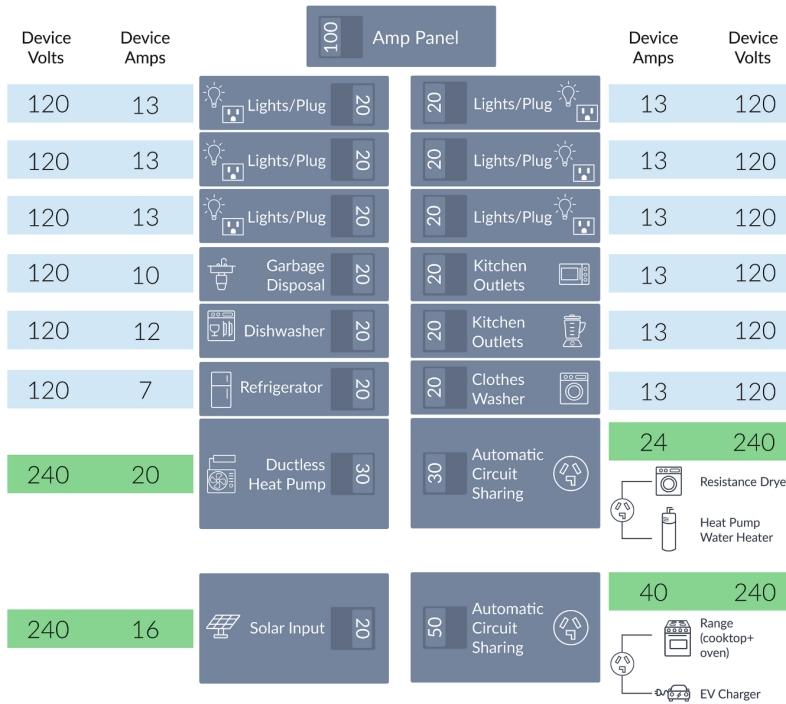
<sup>1</sup> Redwood Energy. "Watt Diet Calculator," 2022. <https://www.redwoodenergy.net/watt-diet-calculator>.

<sup>2</sup> Gaillard, Josie, and Tom Kabat. "CASE STUDIES: COSTS FOR DECARBONIZING EXISTING SINGLE-FAMILY HOMES." County of San Mateo Office of Sustainability, January 2023. <https://www.smcsustainability.org/energy-water/decarbonizing-homes/cost-plans/>.

**Exhibit 1. Thoughtful design can allow homes to electrify with a 100-amp panel.**  
 Redwood Energy’s case study of a 3,000 square foot home that fully electrified all appliances.

Example 2

**All Electric 100 Amp Home (3,000 square feet)**  
 Two “automatic sharing” circuits, ductless mini split heat pump, resistance dryer, high power heat pump water heater



House square feet =	<b>3000</b>	Total Counted Panel Amps =	<b>97.2</b>
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**Additional House Information**

- 4-6 occupants
- EV charging up to 38 miles/hr
- Located in California climate zone 3 (SF Peninsula)
- Some insulation
- 48,000 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

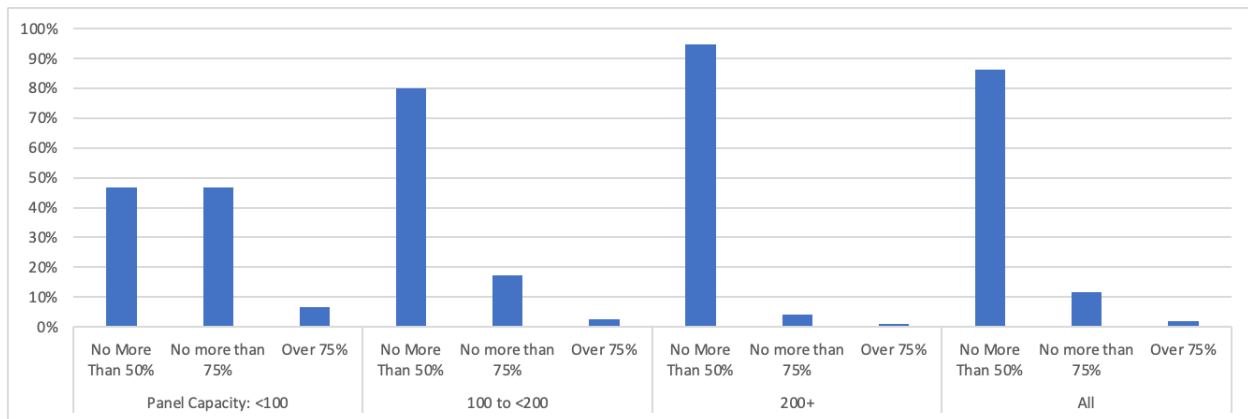
Load calculations per the National Electrical Code Section 220.82(B) and 220.83(B)

	<b>Neo Charge<sup>127</sup></b> Smart Splitter	<b>BSA Electronics<sup>128</sup></b> Dryer Buddy	<b>SimpleSwitch<sup>129</sup></b> 240V Circuit Switch	<b>Splitvolt<sup>130</sup></b> Splitter Switch	<b>Thermolec<sup>131</sup></b> DCC	<b>Evduty<sup>132</sup></b> Smart Current Sensor
Cost (\$)	\$500 (Appliance) \$550 (Dual Car)	\$200 – 365 (several outlet versions)	\$550 (240V) \$650 (EV) \$550 (120V)	\$319	\$1,050 (DCC-9), \$945 (DCC-10)	\$500

Source: Images reproduced from Redwood Energy. “Watt Diet Calculator,” 2022. <https://www.redwoodenergy.net/watt-diet-calculator>.

The assumption that most homes require a panel size increase to fully electrify is belied by work from electrification experts showing that it is feasible to comfortably electrify many homes on 100 amps, and by data showing that most homes have a great deal of unused panel capacity. For example, Home Energy Analytics has compiled a dataset on residential panel capacity utilization for 359 of their customers. Among customers of Home Energy Analytics, the majority of electrical panels, even those in the 100 amp range, use no more than half their capacity (Exhibit 2). For a 2000 square foot home, it would be typical for a heat pump water heater plus central heat pump HVAC to require 23 amps. More than 95% of homes in their dataset had at least 25 amps of unused capacity.

**Exhibit 2. Many homes, even those with panels in the 100 amp range, can fully electrify without upsizing the panel.** Only 15% of homes participating in an energy savings program used more than half their panel’s capacity.



Source: Home Energy Analytics (HEA). “Dataset on Residential Panel Capacity and Utilization.” Shared by Steven Schmidt of Home Energy Analytics, October 13, 2022.

Preventing unnecessary panel upsizing and minimizing the increase when the panel needs additional capacity can make it easier for a large swath of the building stock to convert to clean appliances. As the old saying goes, “The best way to solve a problem is not to have it.”

### Recommendations

The driving forces behind unnecessary panel upsizing are a lack of awareness of load-management technologies, problems with the California Electrical Code, and electrification incentive programs that offer subsidies for panel upsizing without requiring due diligence to explore alternatives.

Incentive programs should be updated to cover the costs of offering customers an analysis of how to fully electrify without panel upsizing and offering discounts on load management technology. Devices such as circuit switches, smart circuit splitters, and smart current sensors

can manage electrical demand to prevent the need for electrical service upsizing (see Technology Case Study: Load Management Devices).

Meanwhile, workforce education programs should cover how and why to electrify without upsizing panels. Load management devices and power-efficient appliance selections minimize or erase the need to upsize panels.<sup>3</sup>

The state of California could greatly improve its understanding of how many electrical panels are likely to require upsizing as it converts to clean appliances by gathering a representative sample of information on panel size. The California Energy Commission could update its Residential Appliance Saturation Study and include panel size in the next version.<sup>4</sup>

Last, the National Electrical Code (NEC) and California Building Electrical Code are badly in need of an update. The California Building Code largely follows the NEC, but the Building Standards Commission can choose to deviate from the NEC. The code has two sections on how to satisfy panel capacity standards during retrofits. One section is easy to follow but tends to produce a substantial overestimate of panel requirements. The other section yields more accurate estimates, but its language is confusing and complicated. In addition, the NEC allows for the electrical panel to be sized according to non-coincident loads, but doesn't clarify that load management devices can satisfy that requirement. The California Building Standards Commission should modify the state's electrical code to make it simpler to follow the more accurate pathway to estimate necessary panel size, and to clarify that the use of load management devices can allow the panel to be sized for non-coincident loads. The Building Standards Commission can act on its own, or the legislature could direct it to take action.

The Bay Area Air Quality Management District can play a pivotal role in persuading local, state and federal government to solve the underlying drivers of unnecessary panel upsizing.

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<sup>3</sup> Gaillard, Josie, and Tom Kabat. "Case Studies: Costs For Decarbonizing Existing Single-Family Homes." County of San Mateo Office of Sustainability, January 2023.

<https://www.smcsustainability.org/energy-water/decarbonizing-homes/cost-plans/>.

<sup>4</sup> California Energy Commission. "2019 California Residential Appliance Saturation Study (RASS) Executive Summary," July 2021.

[https://webtools.dnv.com/CA\\_RASS/Uploads/CEC-200-2021-005-ES.pdf](https://webtools.dnv.com/CA_RASS/Uploads/CEC-200-2021-005-ES.pdf).