OVERVIEW OF PANEL OPTIMIZATION FOR ELECTRIFICATION

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About Us

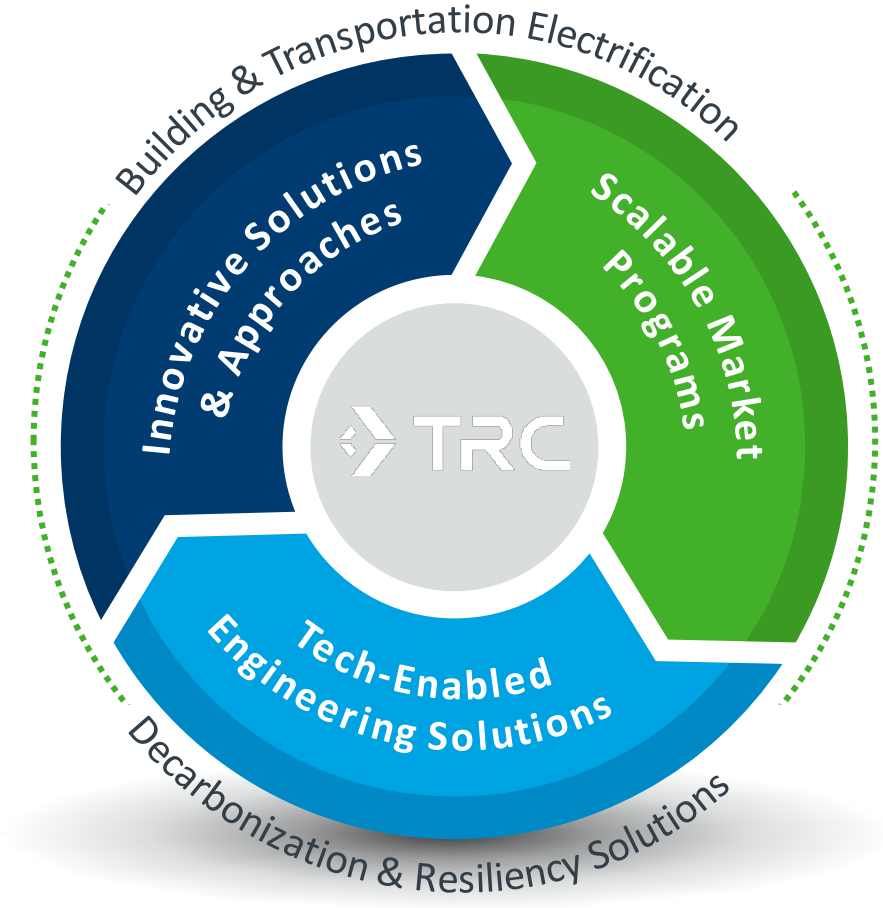
INTRODUCTION

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**.



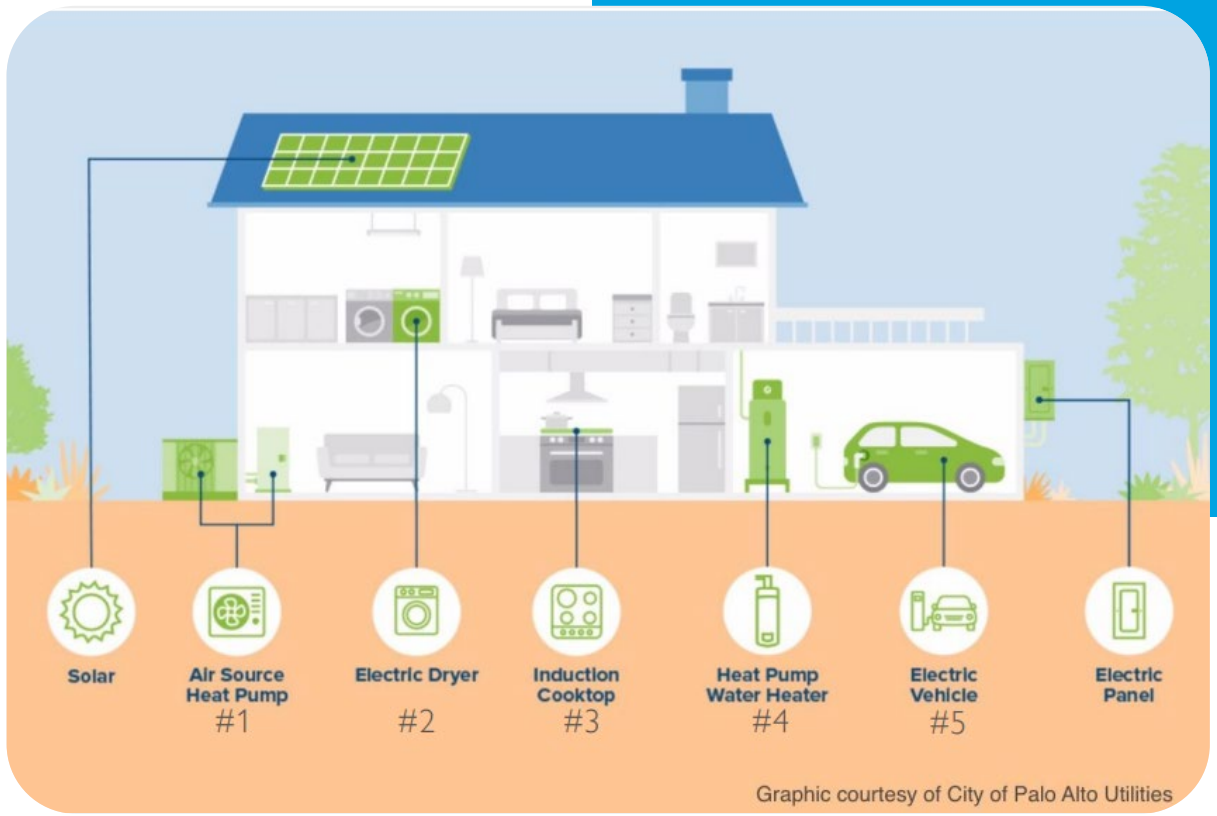
Technology Options

DO ALL HOMES NEED UPGRADED 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



Panel Upgrade vs Service Upgrade

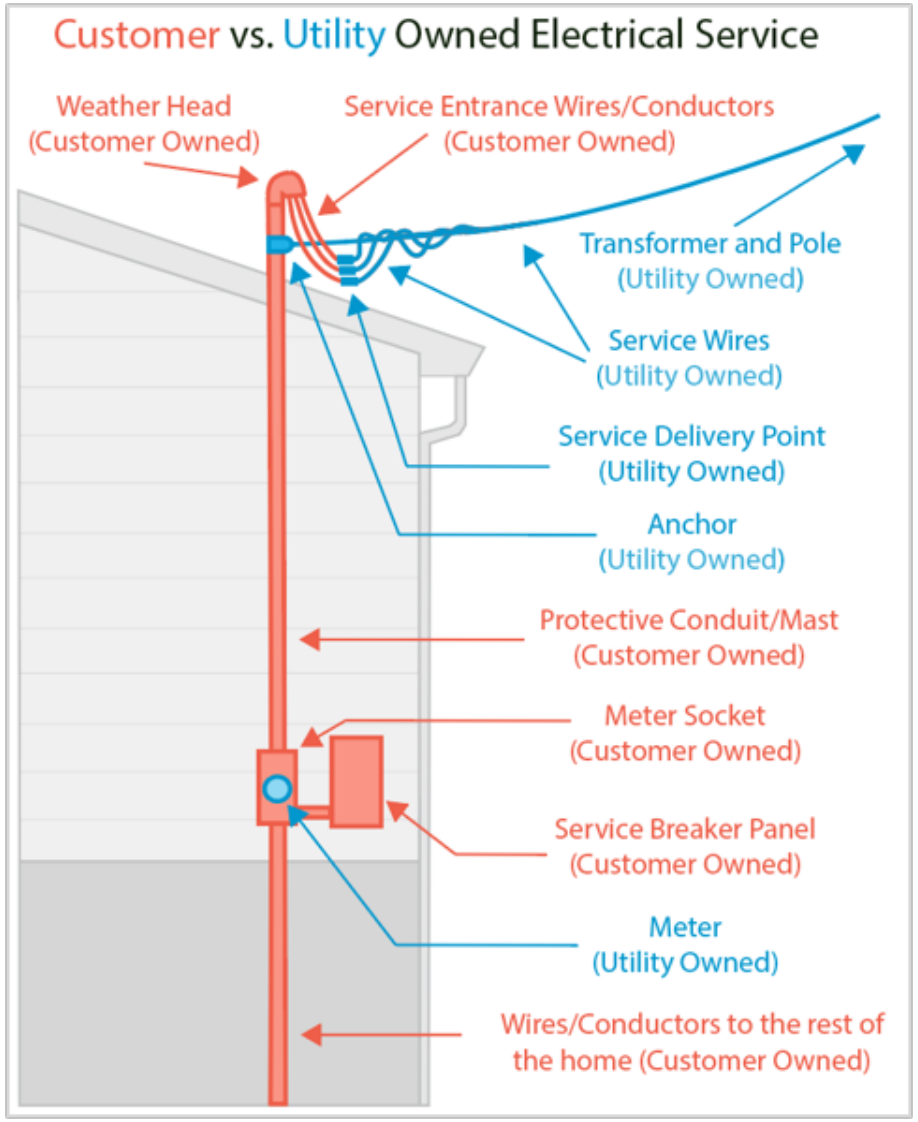
They are related but separate issues

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.

Upsizing vs. Upgrading

Upsizing = Choosing a larger capacity. Upgrading = Choosing a better one.

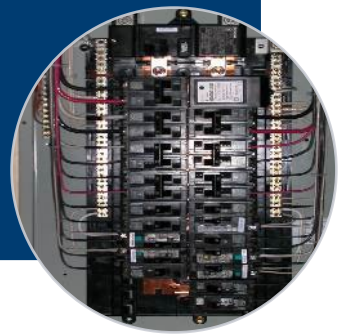
Typical Reasons for Upsizing

- **Capacity limits**
  - Installing a larger solar system
    - than the existing 'busbar' can accommodate
  - Installing Level 2 (240V) EV charger(s)
    - Without ways to mitigate power draw
  - HVAC Upgrades
    - Or installing one where previously there was none
- **Upsizing will include Upgrading**

Sourced in part from: PG&E Service Upgrades for Electrification Retrofits Study Final Report by NV5: May 27, 2022.

Typical Reasons Electrical Panels are Upgraded

- **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
- **Upgrade may not necessarily require upsizing**

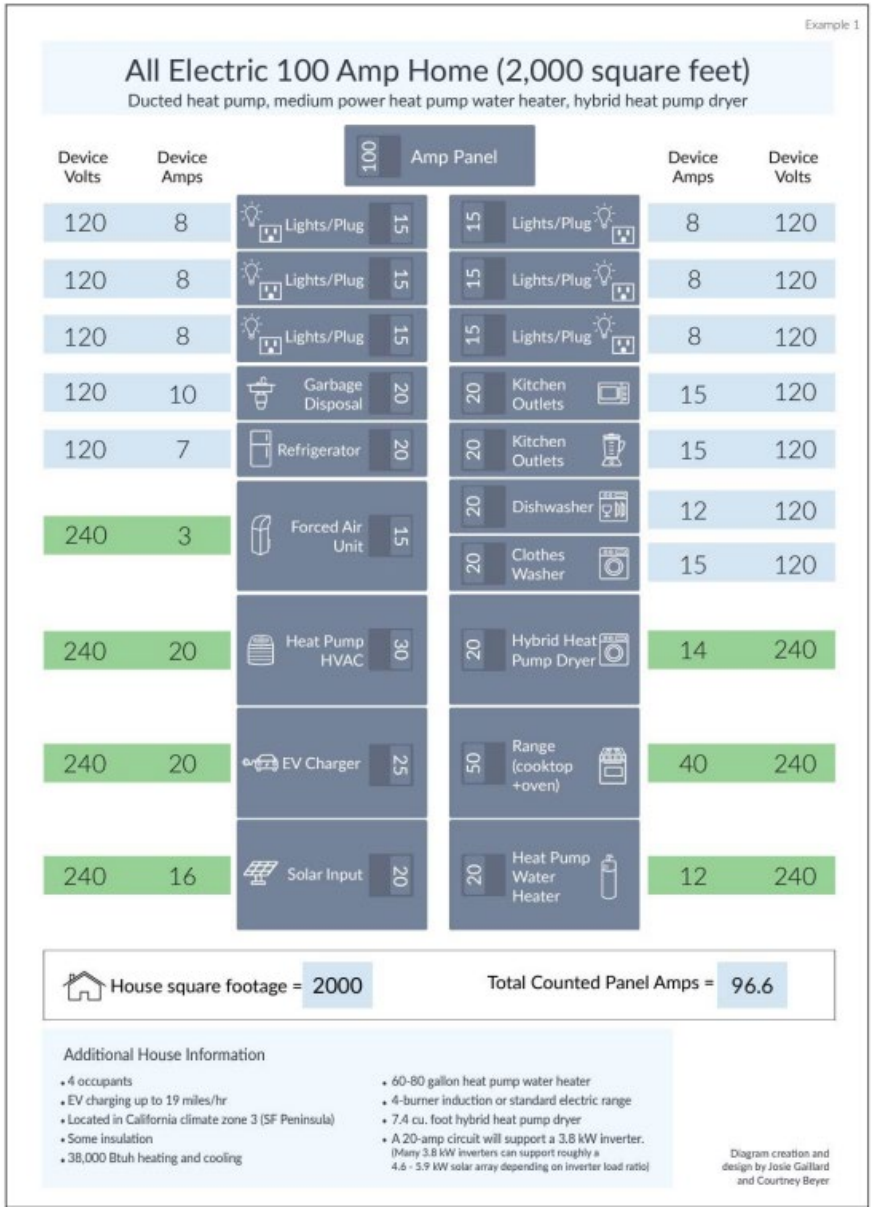


Sourced in part from: Design Guidelines for Home Electrification by Peninsula Clean Energy.

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”

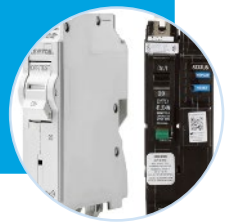
- ‘Circuit Sharing’ for high-amperage devices can support multiple devices on the same circuit/breaker
  - Needs a ‘smart breaker’ or other circuit sharing device
  - Identify devices that are not likely to be used at the same time to avoid ‘constant compromise’
  - Set priorities for which appliances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

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 manager 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

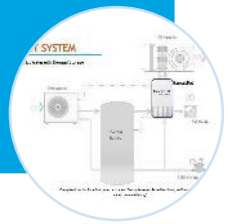
120V Appliances

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- $4,500[1]
- 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 more[1]
- Costs are borne by both the utility and customer
- Can add weeks if not months to the project timeline to get all approvals

Cost of service and panel Upsizing 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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