# All-Electric Retrofits with Electrical Panel Constraints

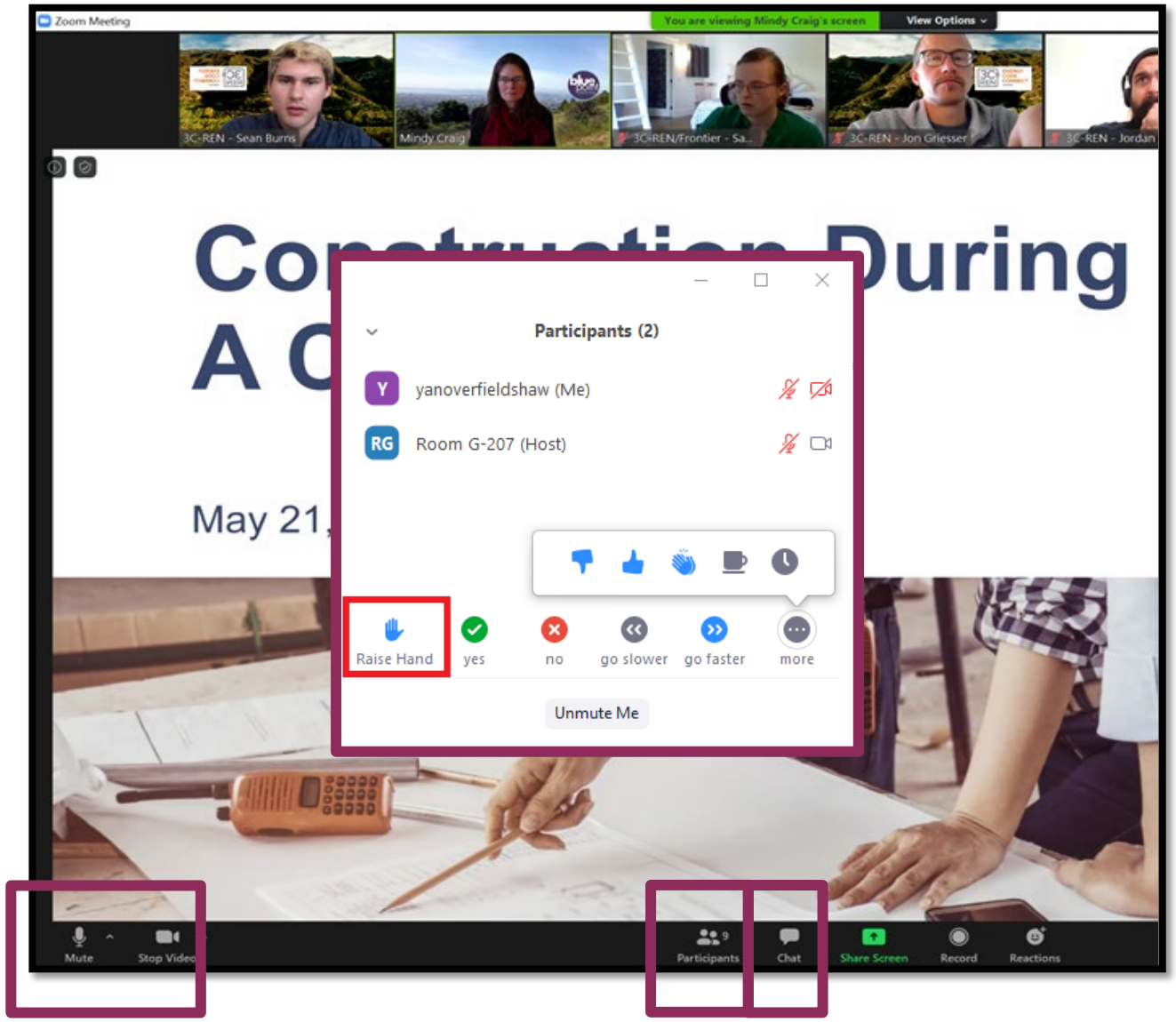
*Nick Brown - Build Smart Group*

*Robert Fortunato - ForStrategy Consulting, Inc*

October 9th, 2024

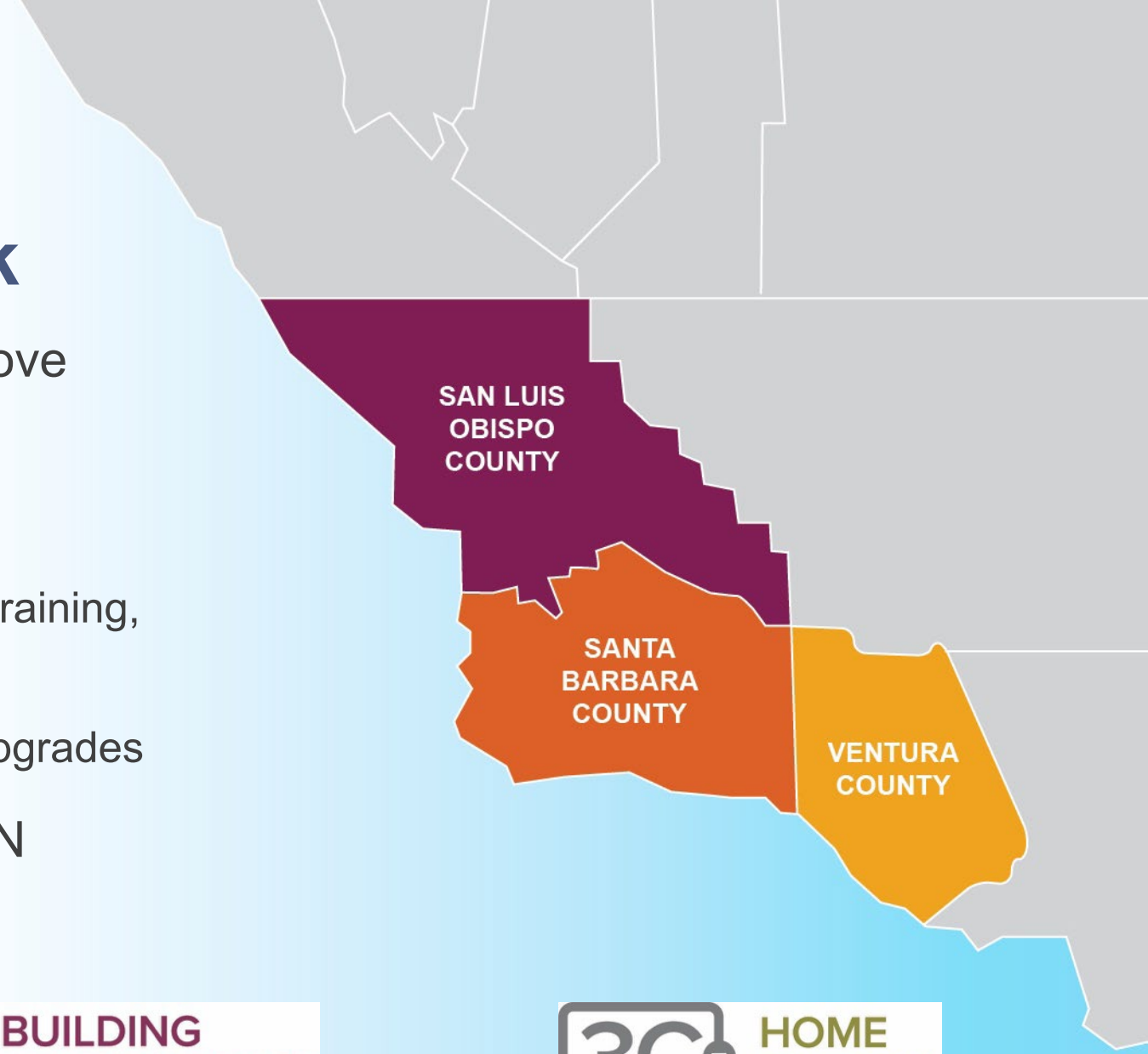
# Zoom Orientation

- Please be sure your full name is displayed
- Please mute upon joining
- Use "Chat“ box to share questions or comments
- Under "Participant" select "Raise Hand" to share a question or comment verbally
- The session may be recorded and posted to 3C-REN's on-demand page. Feel free to ask questions via the chat and keep video off if you want to remain anonymous in the recording.



# 3C-REN: Tri-County Regional Energy Network

- Three counties working together to improve energy efficiency in the region
- Services for –
  - **Building Professionals:** industry events, training, and energy code compliance support
  - **Households:** free and discounted home upgrades
- Funded by ratepayer dollars that 3C-REN returns to the region




3C REN ENERGY CODE CONNECT

3C REN BUILDING PERFORMANCE TRAINING

3C REN HOME ENERGY SAVINGS

3C REN ENERGY CODE CONNECT

- Serves all building professionals
- Three services –
  - **Energy Code Coach**
  - **Training and Support**
  - **Regional Forums**
- Makes the Energy Code easy to follow

Energy Code Coach:
**3c-ren.org/codes**
**805.781.1201**

Event Registration:
**3c-ren.org/events**

# BUILDING PERFORMANCE TRAINING

- Serves current and prospective building professionals
- Expert instruction:
  - **Technical skills**
  - **Soft skills**
- Helps workers to thrive in an evolving industry

Event Registration:
**3c-ren.org/events**

3C REN HOME ENERGY SAVINGS

Multifamily (5+ units)

- No cost technical assistance
- Rebates up to $750/apartment plus additional rebates for specialty measures like heat pumps

Single Family (up to 4 units)

- Sign up to participate!
- Get paid for the metered energy savings of your customers

Enrollment:
**3C-REN.org/contractor-participation**

# All-electric Retrofits With Electrical Panel Constraints

3C-REN

October 9, 2024

# OUR TIME TOGETHER

## Introductions

Our Backgrounds -
Economics & Living All-Electric

## Why All-Electric?

Health, Emissions, Utility Costs, etc

## Calculating Panel Size

What the code requires

## Tools to Evaluate Size

Historical usage, Watt Diet, etc

## Making a Small Panel Work

## Case Studies

# Introductions:

# Who we are and how we upgraded our panels and systems

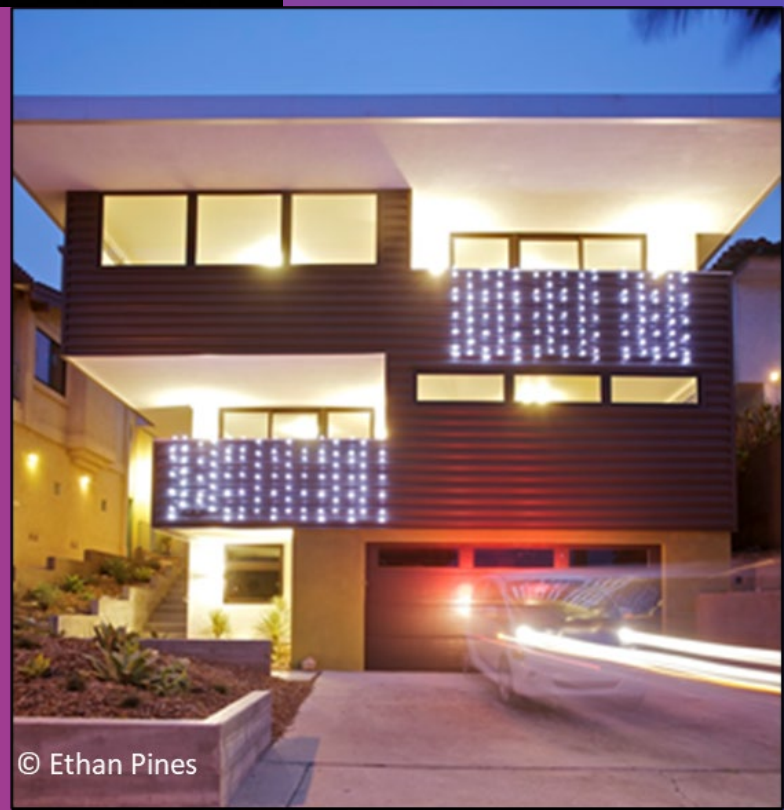
# ROBERT FORTUNATO

**President**

**For Strategy Consulting**

**Owner/Builder Green Idea House,  Hermosa Beach**

ForStrategy Consulting, Inc.

# Green Idea House

Before

After

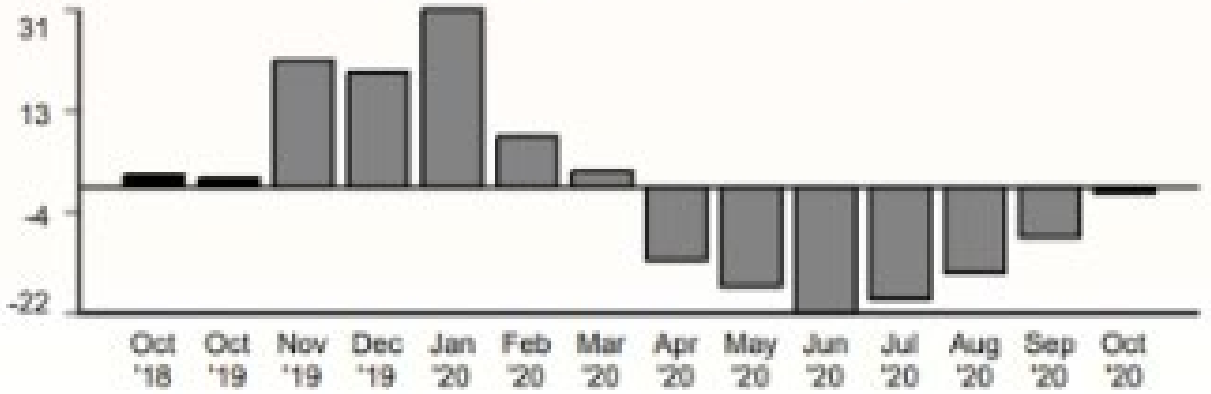
# It Works and is Less Expensive

## Your past and current electricity usage

| | Electricity (kWh) |
|---|---|
| Winter Season - Consumption | |
| On peak | 62 |
| Off peak | 130 |
| Super off peak | 230 |
| Winter Season – Net Generation | |
| On peak | -99 |
| Off peak | -354 |
| Super off peak | -1 |
| **Total electricity usage this month in kWh** | **-32** |

**Your daily average electricity usage (kWh)**

2 Years ago: 2.00 Last year: 1.53 This year: -1.03




***Additional information regarding your Net Consumption/Generation:***

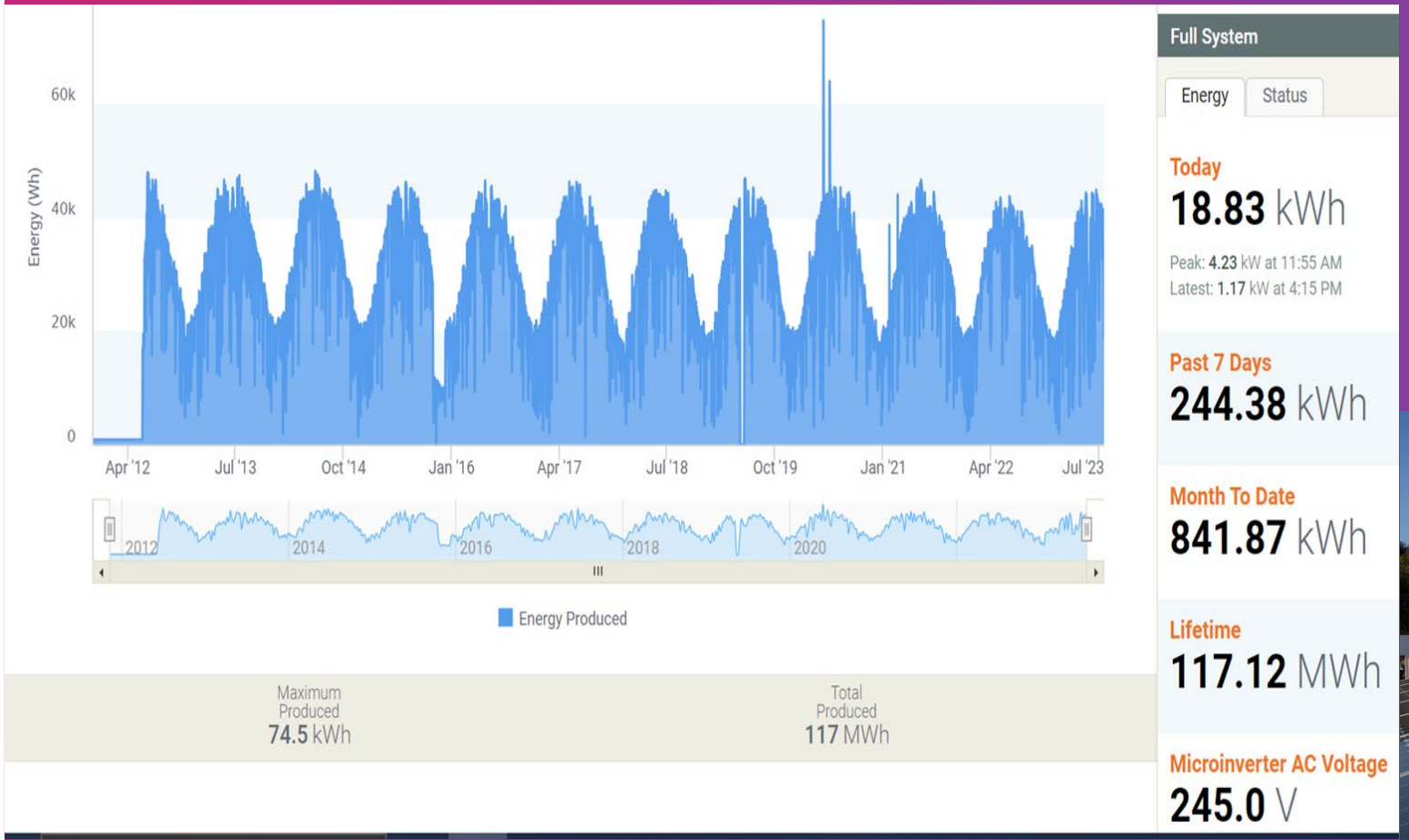
- *Your year-to-date energy charges total as of previous month: -$1,215.44*
- *Your current month energy charge total: -$42.36*
- *Your year-to-date energy charges: -$1,257.80*
- *Your year-to-date kWh: -1,703 kWh*

# Heating and Hot Water
## Before and After

# Induction Cooking


- More efficient by heating cookware – not the room
- Boil water in half the time
- No gas combustion byproducts
- A snap to clean!
- Safer for kids to touch
- Auto-off
- Digital controls

# Talkin’ Bout My Generation




# Talkin’ Bout My Generation

- Saves over $52,800 over the past 11 years in fossil fuels charges - $400/mo. x 11years
- Payback period 3.75 years @ $18k for 6.5kw system
- $.06/kWh over the 25 year warranty period
- System payback of carbon = 6 years, system could last 40+ years
- Additional savings because EVs and all-electric appliances need less maintenance

# Nick Brown

## Owner/Builder, Net Zero Nest + ADU

## President, Build Smart Group

CABEC CERTIFIED CEA ENERGY ANALYST

Nick Brown
R22-15-40004

Net Zero Nest:
- Completed in 2016
- 1,950 sf, 3 BR & 3 Bath
- 4.4 kW PV array (16 panels)
- Now All Electric

All-Electric ADU:
- Completed in 2022
- 576 sf, 1 BR & 1 Bath
- 4.1 kW PV array (12 panels)
- Net Zero Carbon

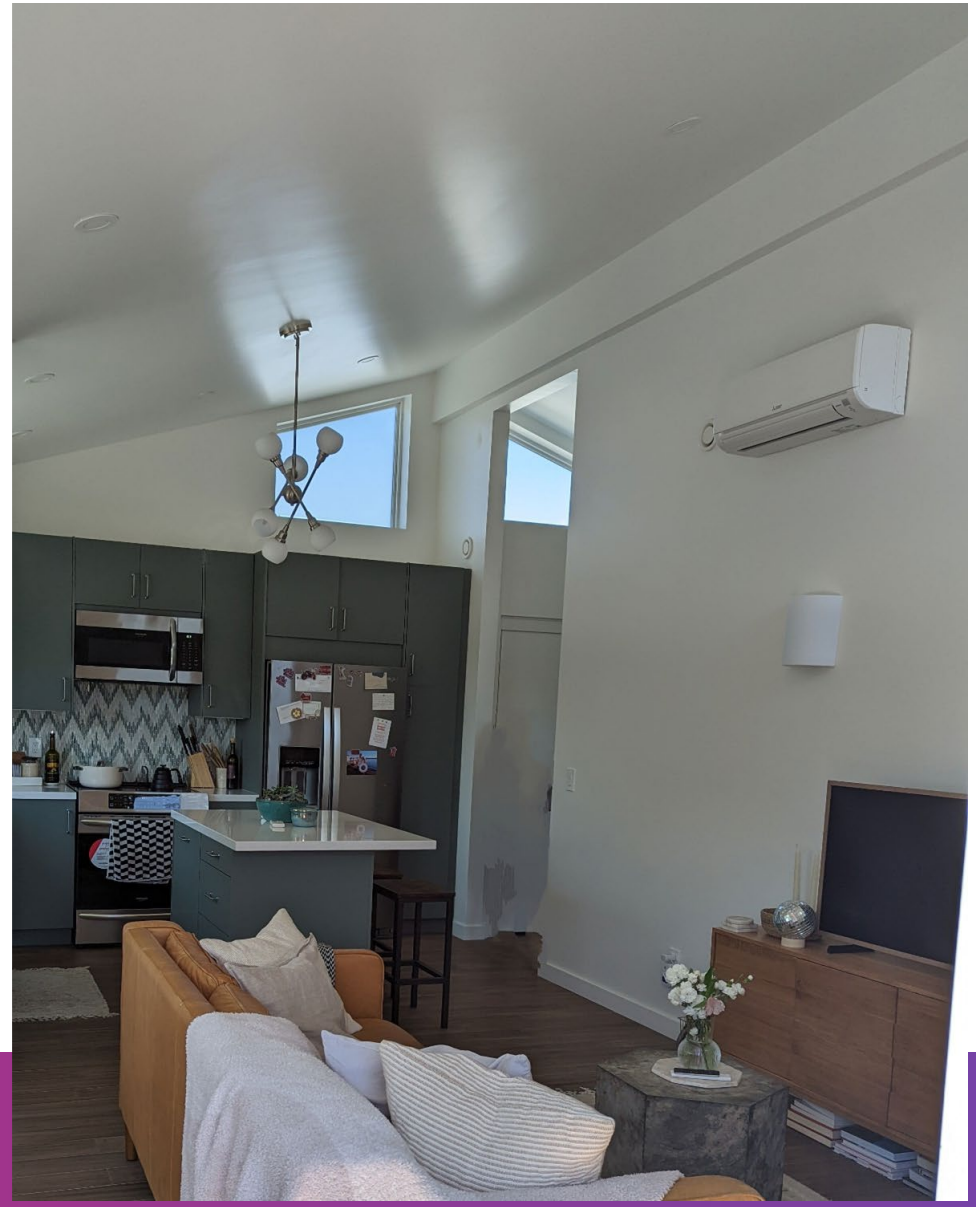
Instructor for various classes:
- All-Electric Homes
- Demyth-defying Heat Pumps
- Installing Heat Pump Water Heaters
- Energy Standards for Residential Architects

# ADU Heat Pump

## HVAC

Ductless variable capacity heat pump

- Slimline outdoor unit is quiet
- 2 indoor units: one in great room and one in bedroom
- Using 2.0 kWh per day



# ADU Heat Pump Water Heater

## Hot Water

50 gallon unit in garage

- 240V, 30 amp
- Heat pump only mode
- Using ~1 kWh per day
- Trouble-free

# ADU Laundry & Cooking

Induction Range

- 240V 40 amps

Washer & Heat Pump Dryer

- 120V 15 amps each


# Main House Electrification

Replacing Tankless Gas Water Heater with Heat Pump Water Heater

- 50 gallon, 120 volt 15 amp plug-in
- Outdoor closet location
- Allows for the end of gas
- Also available in shared circuit models with mixing valves for added capacity and load shifting

# Main House Electrification


Replacing Gas furnace & A/C with Heat Pump

- Slimline 3-ton outdoor unit uses same power as 3-ton A/C unit
- Ducted 36kbtu indoor unit will take place of 80k btu furnace & get power from outdoor unit
- Efficiency gains from variable capacity controller
- One less gas system

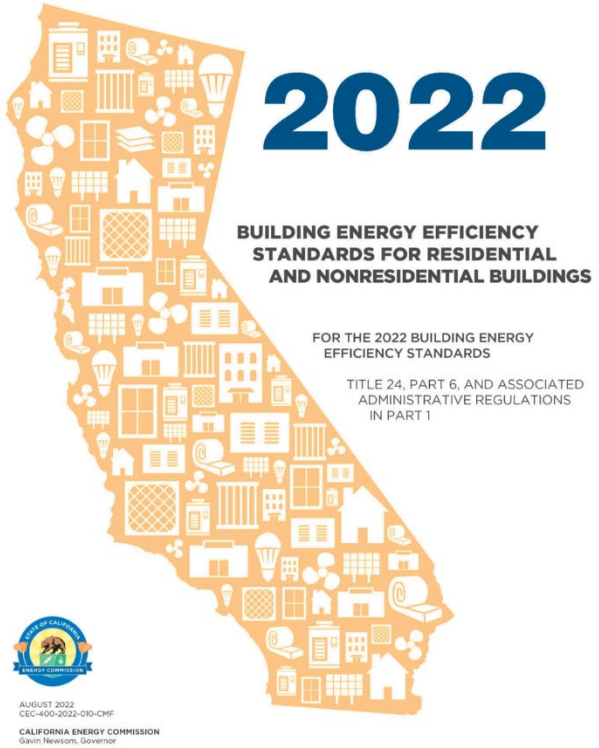
# Main House Electrification

Induction Cooktop & Electric Oven
Heat Pump Dryer and Washer


# Why Electrify?
# What's in it for you?

# All-Electric is Better for so many reasons

- One less utility - Less expensive to build and operate
- Lower utility costs
- Gas Stoves Increase Household Air Pollution ($NO_x$) and the Risk of Childhood Asthma
- Reduced dependence on foreign energy
- Reduced external pollution, GHG emissions
- Better backup power/water in an emergency
- Improved lifestyle
- Billions of dollars in incentives, training….
- Easier energy code compliance



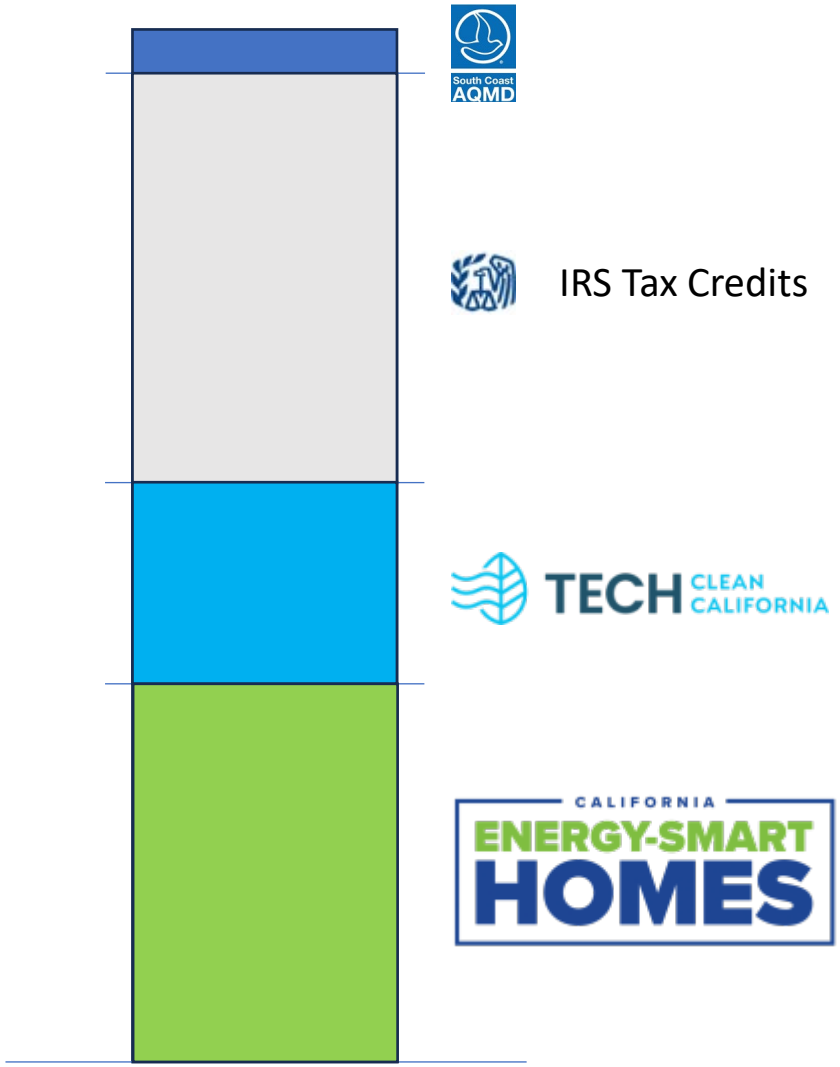
# Why it is a Good Time for a Panel Upgrade: $20,250 - $23,450

$250 EV Charger

~$4,000 PV panels
$2,000 Heat Pump
$2,000 HPWH
$1,200 Efficiency
$600 Elec panel

$1,000-$1,500 Heat Pump
$1,100-$3,800 HPWH
$2,000 Electrical

$4,250 Whole House base incentive
+$250 HP dryer
+$1,000 Elec panel
+$600 Advanced HP bonus



South Coast AQMD

IRS Tax Credits

TECH CLEAN CALIFORNIA

CALIFORNIA ENERGY-SMART HOMES

Single family all-electric retrofit

# Why it is a Good Time for a Panel Upgrade in a DAC: $40,300 - $43,500 per unit

$250 EV Charger

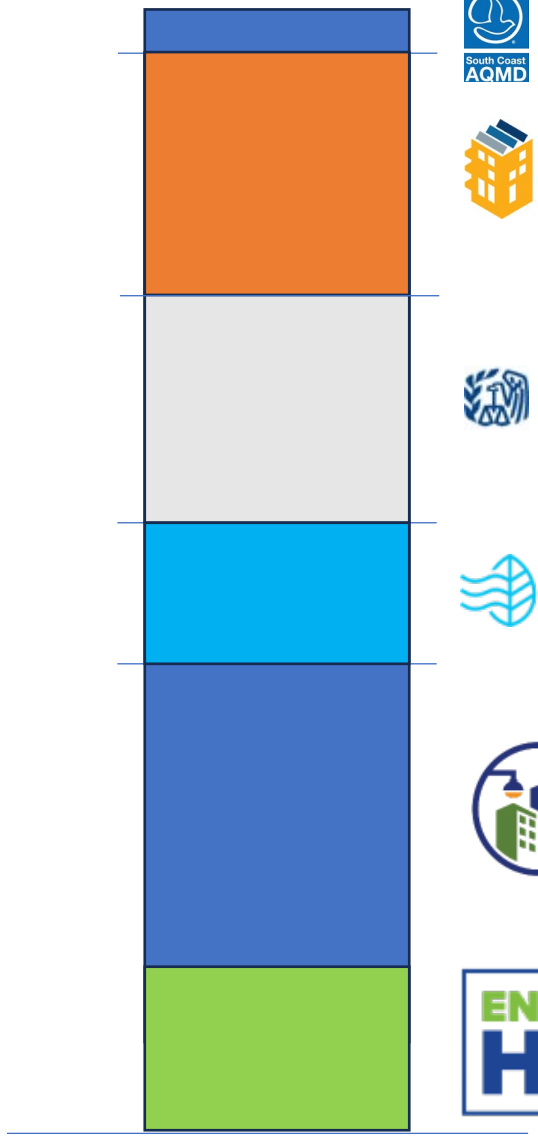
$10,500 for 3 kW solar system for each unit;

$2,000 Heat Pump
$2,000 HPWH
$1,200 Efficiency
$600 Elec panel

$1,000-$1,500 Heat Pump
$1,100-$3,800 HPWH
$2,000 Electrical

$10,000 Heat Pump (@ 100%)
$6,000 HPWH (@ 100%)

$2,200 per unit base incentive
+$250 HP dryer
+$600 Elec panel
+$600 Advanced HP bonus



South Coast AQMD

SOMAH

IRS Tax Credits

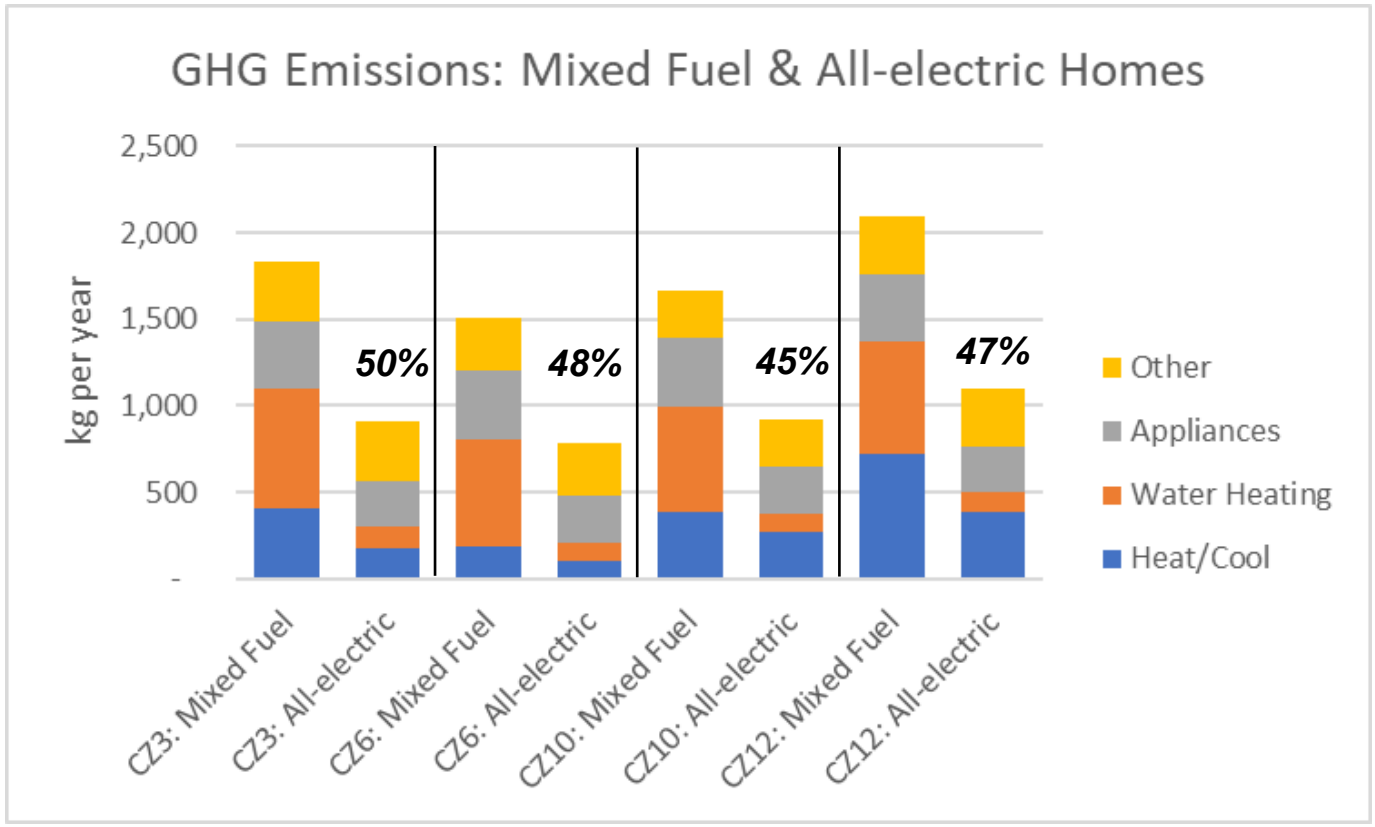
TECH CLEAN CALIFORNIA

MULTIFAMILY ENERGY SAVINGS

CALIFORNIA ENERGY-SMART HOMES

Multifamily low-income all-electric retrofit

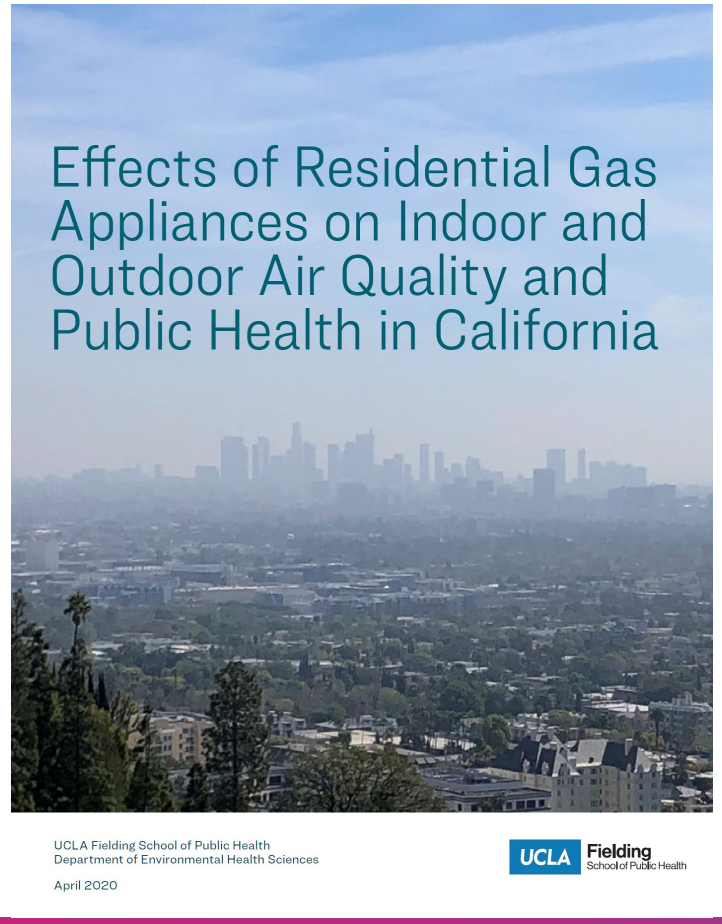
# All-Electric Designs Reduce GHG Emissions ~50%




**TIP: Use your compliance models to design for lower GHG emissions and Zero Net Carbon**

*Source: CBECC-RES 2022 modeling of new 1751 sqft home with standard efficiency gas furnace/heat pump; gas tankless/heat pump water heater; gas & electric appliances*

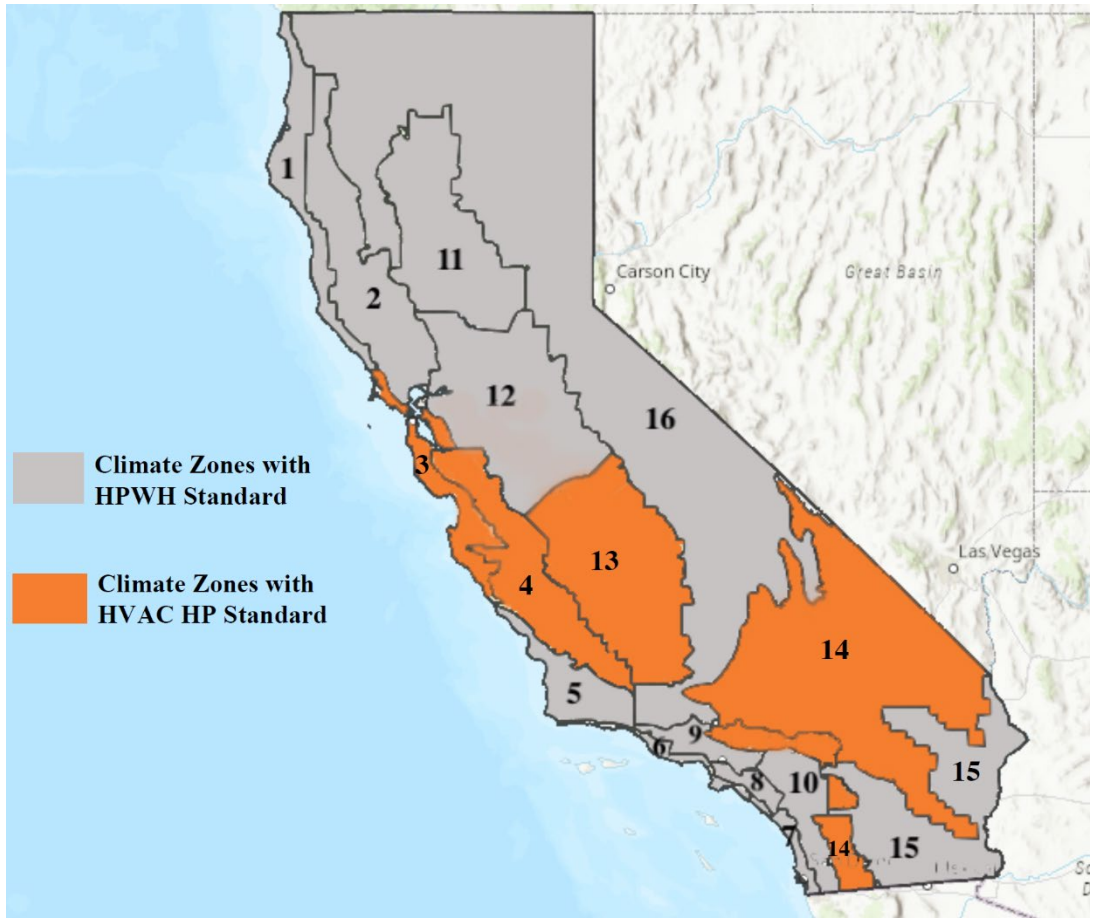
# Indoor Air Better Without Gas in the Home




- AMA Study – Gas appliances increase risk of childhood Asthma.
- UCLA study found that 90% of homes exceed NOx limits after one hour of cooking
- 4 out of 9 natural gas cooktops exceeded NOx concentrations of 100 ppb
- RMI Study - 20% of childhood asthma in CA due to gas cooking
  - Children living in homes with gas cooking are 34% more likely to have Asthma

# The 2022 California Energy Code: Compliance Easier with All-Electric Systems

- Dedicated electrical circuits, plumbing etc. are required to backup every gas appliance installed
  - Except central HW in multifamily.
- New compliance metric measures GHG emissions
- Heat pumps prescriptive standard
- Gas cooktops require additional mechanical ventilation than electric



# Panel Sizing Matters

## What’s in it for you?

# Why Panel Size Matters

## What's in it for you?

- Save on average $3,000 maybe lots more!
- Save on service line upgrade to transformer
- Solar and batteries can go longer/better in outage
- Avoid upsizing of transformer
- Avoid upsizing of grid and related costs
- Makes decarbonization easier for all

# Why Panel Size Matters

## Bigger is not better:

## Goal is to futureproof electrical/uses below and still have 20amps for EV charging @ 19miles/hour

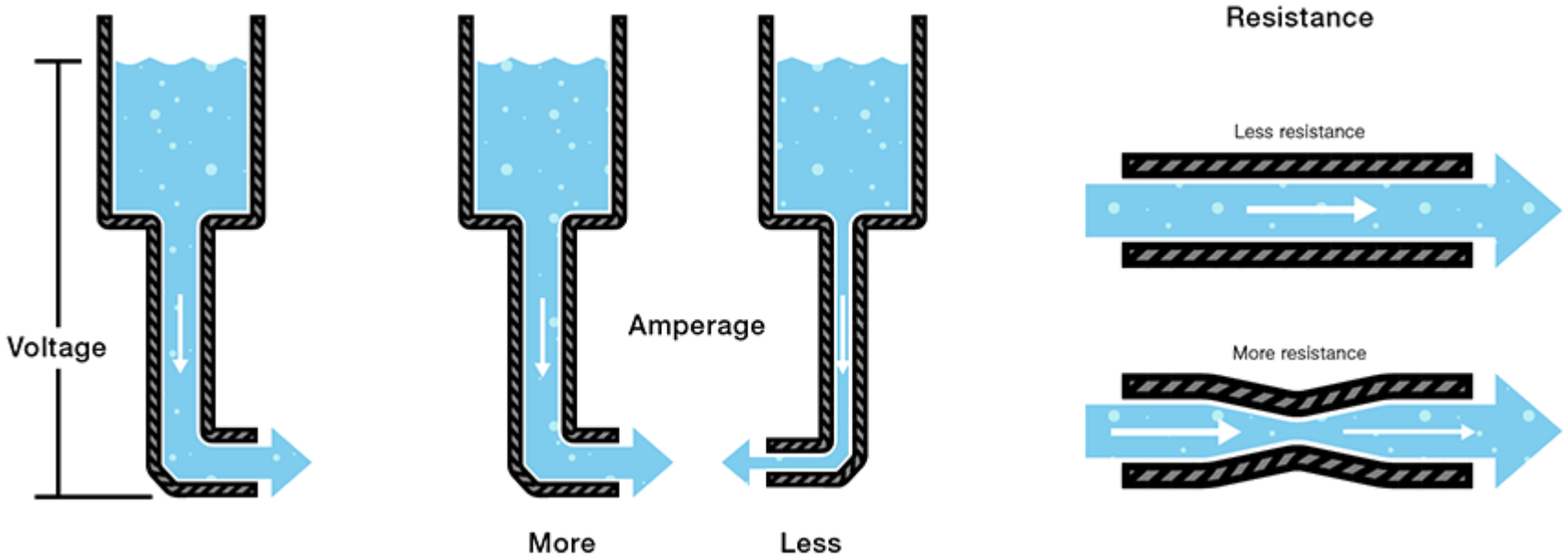
- Knob & Tube wiring/Romex
- Solar & Battery
- EV Charging
- HP Washer/Dryer
- Furnace to HP
- HP Water Heater
- Induction cooking

# Panel Basics

# Electricity is like Plumbing

**Volts x Amps = Watts**

**Pressure x Flow = Power**



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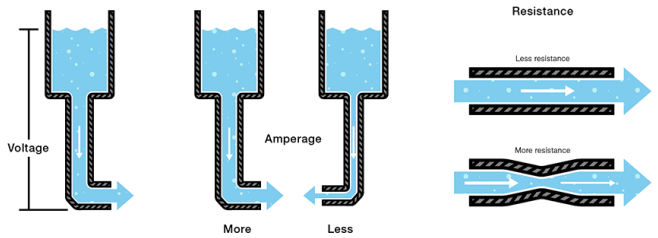
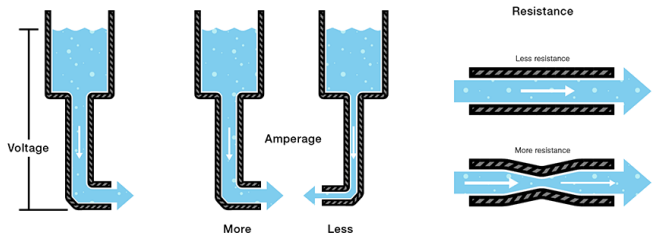



**Kilowatt = kW = 1000 watts = measure of power**

**kWh = Kilowatt Hour = amount of energy used by a 1,000-watt appliance running for one hour**

# Electricity is like Plumbing

Volts x Amps = Watts
Pressure x Flow = Power



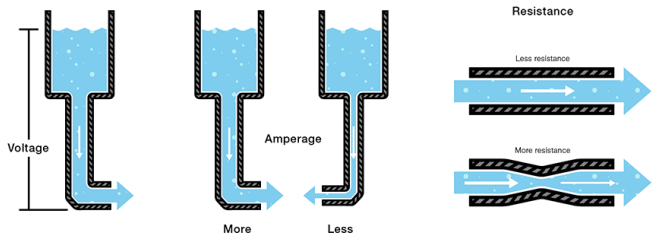

**Peak Panel Capacities**

- **80 amp panel = 240v x 80a = 19,200 watts or 19.2 kW**
- **100 amp panel = 240v x 100a = 24,000 watts or 24 kW**
- **200 amp panel = 240v x 200a = 48,000 watts or 48 kW**

# Electricity is like Plumbing

Volts x Amps = Watts

Pressure x Flow = Power




**Average all-electric house in CA uses 12,128 kWh/year**

**Average 1,000 kWh/month @ .32/kWh = $320**

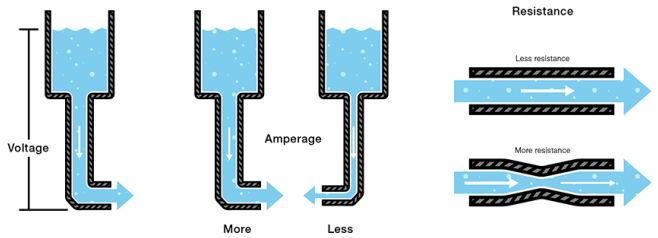
**Average peak load is 10 kW**

**A 6.5 kW solar system generates 6.5 kW @ peak**

# Electricity is like Plumbing

Volts x Amps = Watts

Pressure x Flow = Power




- If 20 amps will do the job, it's better than 30 or 40 amps

- <u>Common Mistakes</u>
  - EV chargers
    - 120V 15 amp = 1.8 kW per hour = 6 miles per hour
    - 240V 20 amp = 4.8 kW per hour = 19 miles per hour
    - 240V 50 amp = 12 kW per hour = 48 miles per hour

# Calculating Panel Size:
## The National Electric Code

# Sizing an Electrical Panel: National Electric Code 220 or NFPA 70

## Method 1: Load Calculations

- Each system's electricity usage calculated
- Base load is derived from house square footage
- Heating/cooling system factored in at 100% full load
- EV chargers at 125% full load
- Other circuits at 40% coincident multiplier
- Size panel to sum of these calculated loads

## Method 2: Historical Usage

- Use actual usage data for 1 year
  Or 30 days with power meter
- Calculate maximum power usage in kW
- Size panel to maximum historical kW

- NOTE: this method not permitted if historical usage includes a renewable energy/PV system

# Panel Upgrades

## How Your Electrician Thinks

- Electrical Code governs panel sizing based on all the loads in your home
- Exceed the rated capacity and you'll need an upgrade
- Better to have too much power

## How to Manage Your Electrician

- Show them your monthly electric usage for the past 12 months
- Give them the power requirements of your new electric systems
- Ask them to show you their calculations
- Think of the future: EV charging, PV panels, batteries, pool equipment and consider upgrading your panel

# The Electrician's Pitfall That Leads to Big Panels

## Gas (therms) x 29.3 = Equivalent kWh

- Don't use gas bills and appliance nameplate information to make approximations
- Model the systems you plan to use with an energy consultant
- Find the circuit size needed

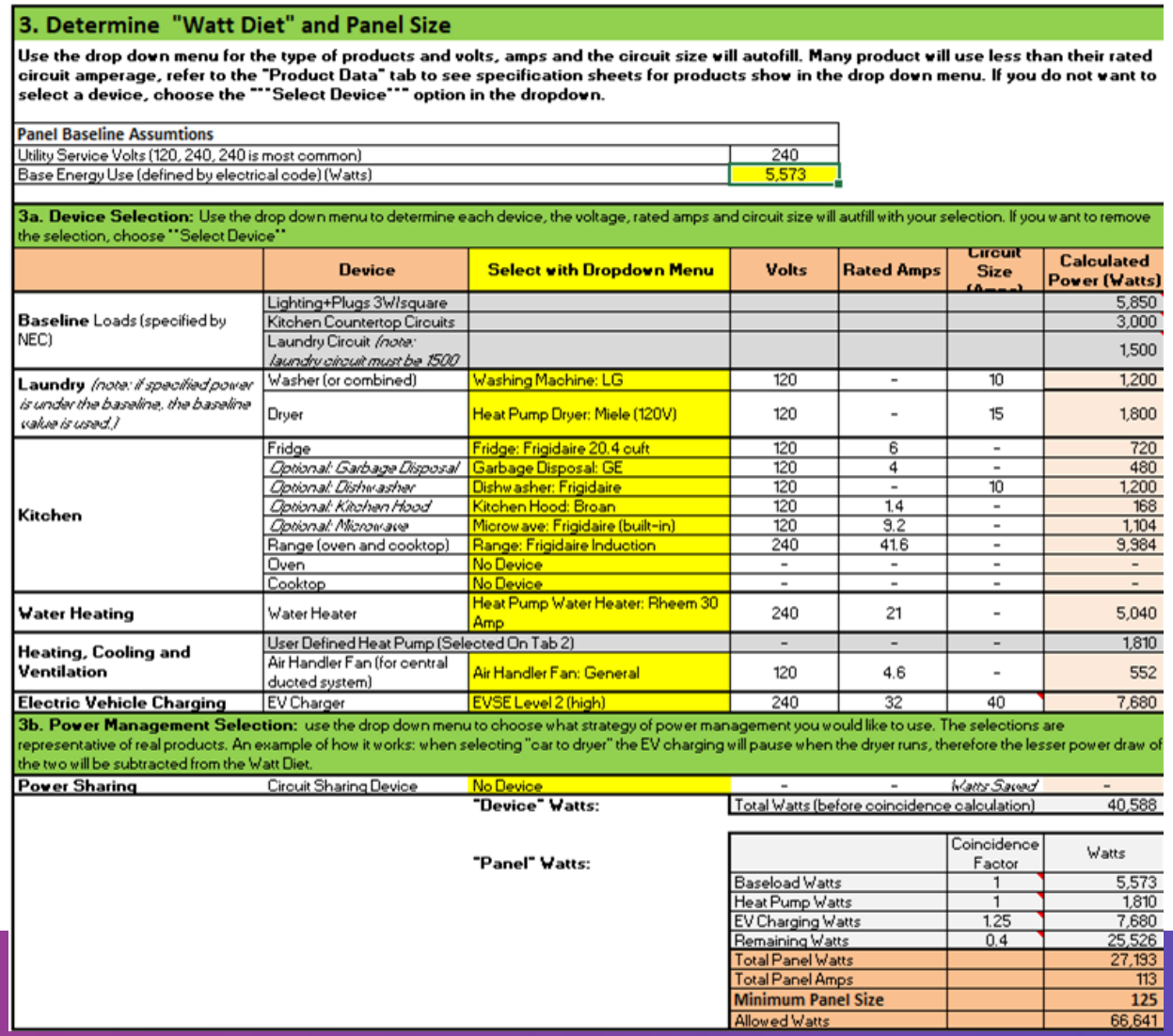
Source: EIA 2020 RECS Survey

# Tools to Evaluate Panel Size

# Watt Diet

## Helps You Fit into Your Panel

- Establish your base load (e.g., lighting and plugs often on)
- Enter your other loads and power requirements from tech sheets
- Watt Diet calculates the panel you need
- Allows for circuit sharing
- ***Watt Diet Calculator***



**3. Determine "Watt Diet" and Panel Size**

**Use the drop down menu for the type of products and volts, amps and the circuit size will autofill. Many product will use less than their rated circuit amperage, refer to the "Product Data" tab to see specification sheets for products show in the drop down menu. If you do not want to select a device, choose the ""Select Device"" option in the dropdown.**

| Panel Baseline Assumtions | |
|---|---|
| Utility Service Volts (120, 240, 240 is most common) | 240 |
| Base Energy Use (defined by electrical code) (Watts) | 5,573 |

**3a. Device Selection:** Use the drop down menu to determine each device, the voltage, rated amps and circuit size will autfill with your selection. If you want to remove the selection, choose ""Select Device""

| | Device | Select with Dropdown Menu | Volts | Rated Amps | Circuit Size (Amps) | Calculated Power (Watts) |
|---|---|---|---|---|---|---|
| **Baseline** Loads (specified by NEC) | Lighting+Plugs 3W/square | | | | | 5,850 |
| | Kitchen Countertop Circuits | | | | | 3,000 |
| | Laundry Circuit *(note: laundry circuit must be 1500* | | | | | 1,500 |
| **Laundry** *(note: if specified power is under the baseline, the baseline value is used.)* | Washer (or combined) | Washing Machine: LG | 120 | - | 10 | 1,200 |
| | Dryer | Heat Pump Dryer: Miele (120V) | 120 | - | 15 | 1,800 |
| **Kitchen** | Fridge | Fridge: Frigidaire 20.4 cuft | 120 | 6 | - | 720 |
| | *Optional: Garbage Disposal* | Garbage Disposal: GE | 120 | 4 | - | 480 |
| | *Optional: Dishwasher* | Dishwasher: Frigidaire | 120 | - | 10 | 1,200 |
| | *Optional: Kitchen Hood* | Kitchen Hood: Broan | 120 | 1.4 | - | 168 |
| | *Optional: Microwave* | Microwave: Frigidaire (built-in) | 120 | 9.2 | - | 1,104 |
| | Range (oven and cooktop) | Range: Frigidaire Induction | 240 | 41.6 | - | 9,984 |
| | Oven | No Device | - | - | - | - |
| | Cooktop | No Device | - | - | - | - |
| **Water Heating** | Water Heater | Heat Pump Water Heater: Rheem 30 Amp | 240 | 21 | - | 5,040 |
| **Heating, Cooling and Ventilation** | User Defined Heat Pump (Selected On Tab 2) | | - | - | - | 1,810 |
| | Air Handler Fan (for central ducted system) | Air Handler Fan: General | 120 | 4.6 | - | 552 |
| **Electric Vehicle Charging** | EV Charger | EVSE Level 2 (high) | 240 | 32 | 40 | 7,680 |

**3b. Power Management Selection:** use the drop down menu to choose what strategy of power management you would like to use. The selections are representative of real products. An example of how it works: when selecting "car to dryer" the EV charging will pause when the dryer runs, therefore the lesser power draw of the two will be subtracted from the Watt Diet.

| | | | | | | |
|---|---|---|---|---|---|---|
| **Power Sharing** | Circuit Sharing Device | No Device | - | - | *Watts Saved* | - |

**"Device" Watts:**

| | |
|---|---|
| Total Watts (before coincidence calculation) | 40,588 |

**"Panel" Watts:**

| | Coincidence Factor | Watts |
|---|---|---|
| Baseload Watts | 1 | 5,573 |
| Heat Pump Watts | 1 | 1,810 |
| EV Charging Watts | 1.25 | 7,680 |
| Remaining Watts | 0.4 | 25,526 |
| Total Panel Watts | | 27,193 |
| Total Panel Amps | | 113 |
| **Minimum Panel Size** | | **125** |
| Allowed Watts | | 66,641 |

# Watt Diet Example: 125 amps

## 3. Determine "Watt Diet" and Panel Size

**Use the drop down menu for the type of products and volts, amps and the circuit size will autofill. Many product will use less than their rated circuit amperage, refer to the "Product Data" tab to see specification sheets for products show in the drop down menu. If you do not want to select a device, choose the ""Select Device"" option in the dropdown.**

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| | Device | Select with Dropdown Menu | Volts | Rated Amps | Circuit Size (Amps) | Calculated Power (Watts) |
|---|---|---|---|---|---|---|
| **Baseline** Loads (specified by NEC) | Lighting+Plugs 3W/square | | | | | 5,850 |
| | Kitchen Countertop Circuits | | | | | 3,000 |
| | Laundry Circuit *(note: laundry circuit must be 1500* | | | | | 1,500 |
| **Laundry** *(note: if specified power is under the baseline, the baseline value is used.)* | Washer (or combined) | Washing Machine: LG | 120 | - | 10 | 1,200 |
| | Dryer | Heat Pump Dryer: Miele (120V) | 120 | - | 15 | 1,800 |
| **Kitchen** | Fridge | Fridge: Frigidaire 20.4 cuft | 120 | 6 | - | 720 |
| | *Optional: Garbage Disposal* | Garbage Disposal: GE | 120 | 4 | - | 480 |
| | *Optional: Dishwasher* | Dishwasher: Frigidaire | 120 | - | 10 | 1,200 |
| | *Optional: Kitchen Hood* | Kitchen Hood: Broan | 120 | 1.4 | - | 168 |
| | *Optional: Microwave* | Microwave: Frigidaire (built-in) | 120 | 9.2 | - | 1,104 |
| | Range (oven and cooktop) | Range: Frigidaire Induction | 240 | 41.6 | - | 9,984 |
| | Oven | No Device | - | - | - | - |
| | Cooktop | No Device | - | - | - | - |
| **Water Heating** | Water Heater | Heat Pump Water Heater: Rheem 30 Amp | 240 | 21 | - | 5,040 |
| **Heating, Cooling and Ventilation** | User Defined Heat Pump (Selected On Tab 2) | | - | - | - | 1,810 |
| | Air Handler Fan (for central ducted system) | Air Handler Fan: General | 120 | 4.6 | - | 552 |
| **Electric Vehicle Charging** | EV Charger | EVSE Level 2 (high) | 240 | 32 | 40 | 7,680 |

**3b. Power Management Selection:** use the drop down menu to choose what strategy of power management you would like to use. The selections are representative of real products. An example of how it works: when selecting "car to dryer" the EV charging will pause when the dryer runs, therefore the lesser power draw of the two will be subtracted from the Watt Diet.

| | | | | | | |
|---|---|---|---|---|---|---|
| **Power Sharing** | Circuit Sharing Device | No Device | - | - | *Watts Saved* | - |

**"Device" Watts:**

| | |
|---|---|
| Total Watts (before coincidence calculation) | 40,588 |

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| Total Panel Watts | | 27,193 |
| Total Panel Amps | | 113 |
| **Minimum Panel Size** | | **125** |
| Allowed Watts | | 66,641 |

# Making a Small Panel Work

# Making a Small Panel Work

1) Choose power-efficient appliances (e.g., 120V)
2) Use high efficiency appliances
   (e.g., 20+ SEER2 heat pumps)
3) Use circuit sharing and circuit pausing devices
4) Right-size HVAC systems
5) Decrease your loads (especially on HVAC)

# Power-efficient Appliances

- If 120V will do the job, it's better than 240V
- If 20 amps will do the job, it's better than 30 or 40 amps
  - *HVAC systems*
    - *Run load calcs to see if 20 amp HVAC system will work instead of 30 amp*
  - *Water heaters*
    - *NEVER choose electric; use Heat Pump Water Heaters*

# High Efficiency Appliances

- The more efficient the appliance, the less electricity it needs to do the same work

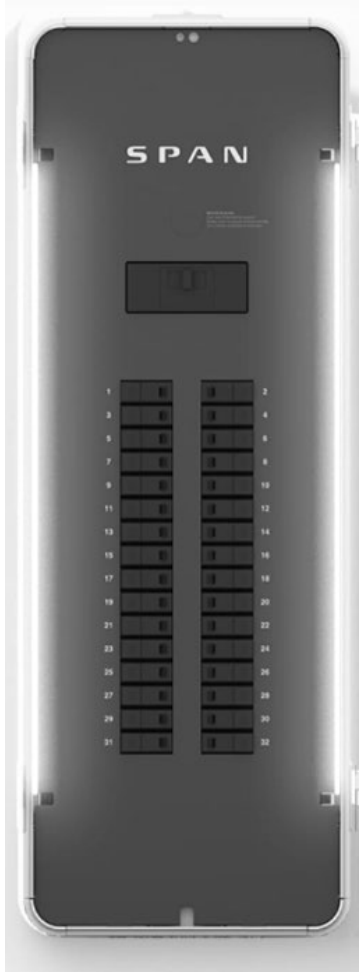
Examples

- HVAC: 21 SEER2 heat pump does 50% more work than 14 SEER2 air conditioner
- Refrigerators: choose one that uses 700 kWh per year, not 1,000 kWh per year
- Water heaters: Heat pump water heaters have COP of ~3.5
  - *3.5 COP = 350% efficient*
  - *Electric tankless are maximum 96% efficient, so they use ~4X more electricity*
- Ranges: induction is ~80% efficient; electric is ~60% efficient; gas is ~40% efficient

# Load Management Devices

https://www.savant.com


https://www.span.io/




When you have more load than your panel/service can deliver:

- Install 2 appliances on one circuit with a circuit sharing device
- Install 2 appliances on one circuit with a circuit pausing device
- Or use smart breakers to manage loads through the app

When you need more physical space for breakers:

- Use tandem breakers
- Join two low-load circuits together (e.g., lighting)
- Install solar system using meter collar

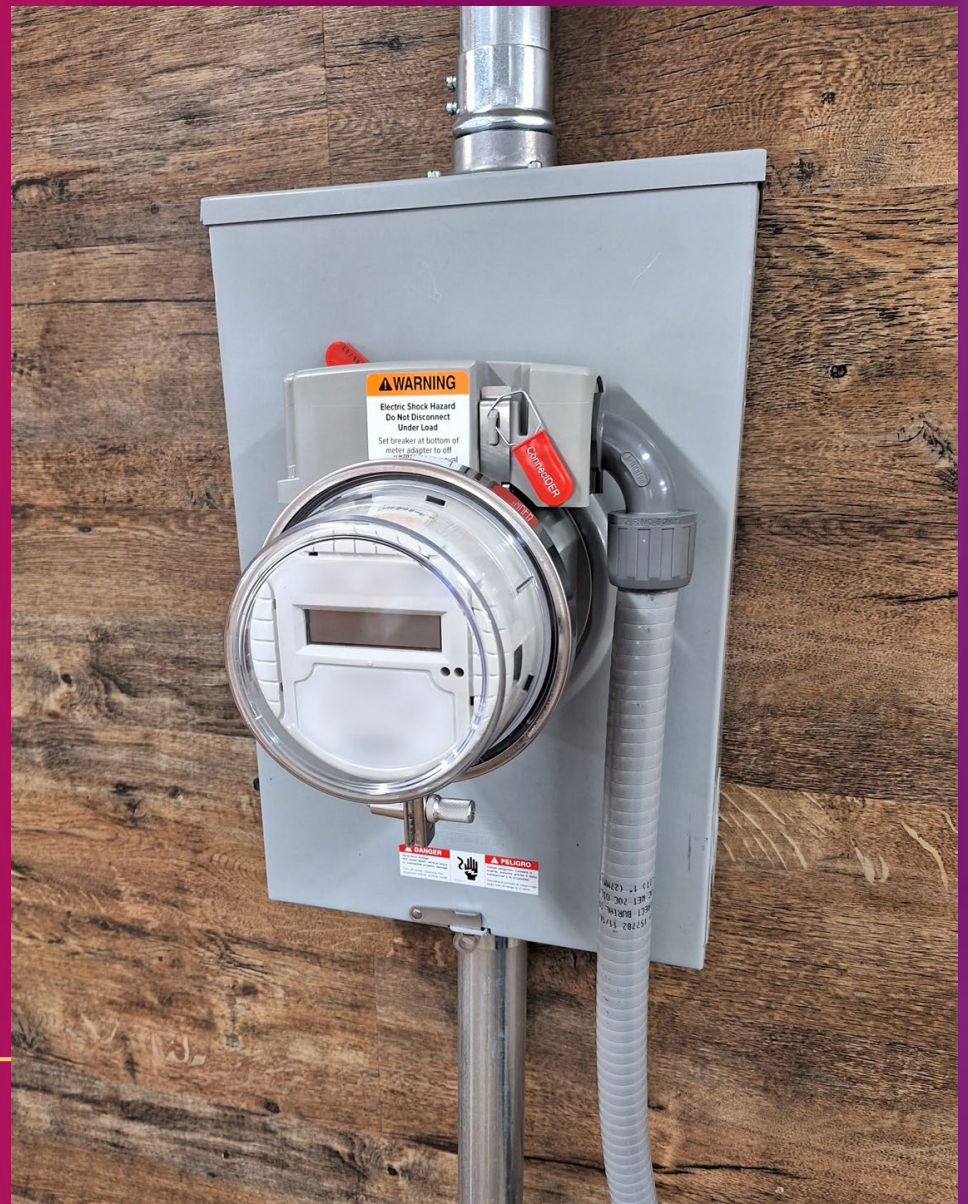
# Load Management Devices


https://www.getneocharge.com


https://emporiaenergy.com


https://ev-lectron.com/collections/socket-splitter

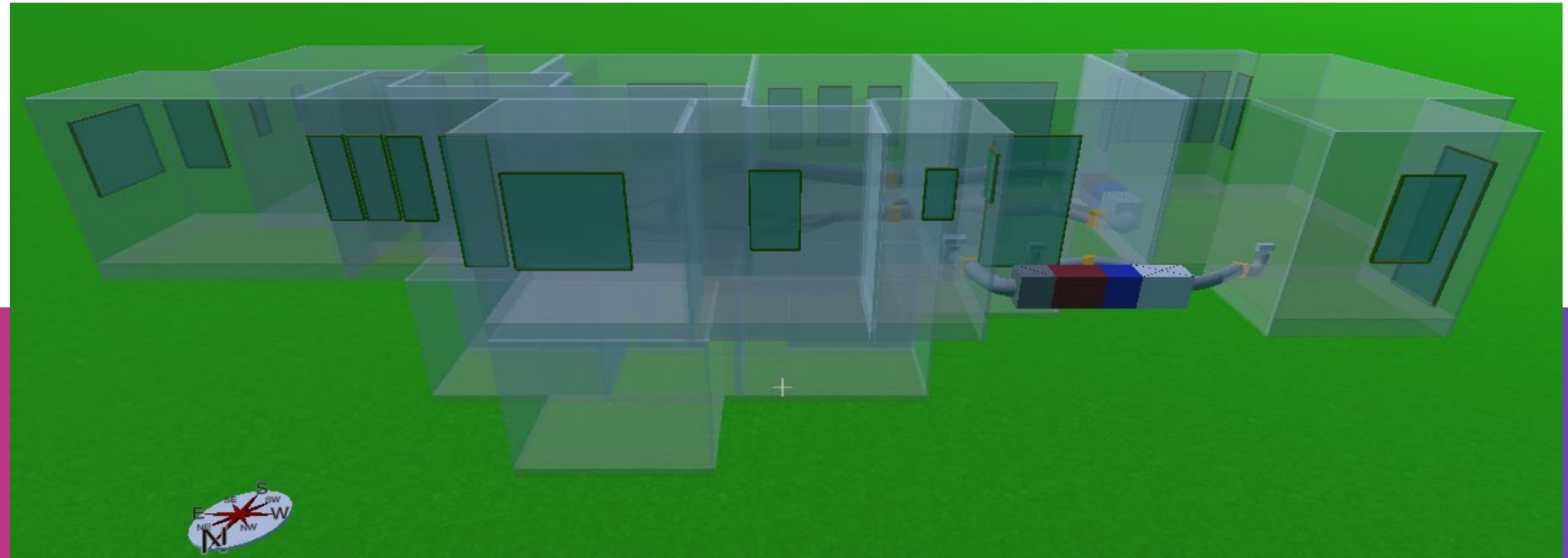
# Meter Collars for PV




- For space-constrained electric panels
- Connect PV system to meter, instead of using a breaker in the electric panel

# Right-sizing

- HVAC systems are commonly sized 2X maximum load
- Pay for ACCA Manual J load calculations to minimize panel problems
- Go ductless
- Upgrade your building envelope if possible to reduce loads
- Choose reasonable size cooking, laundry, water heaters, pools, etc.

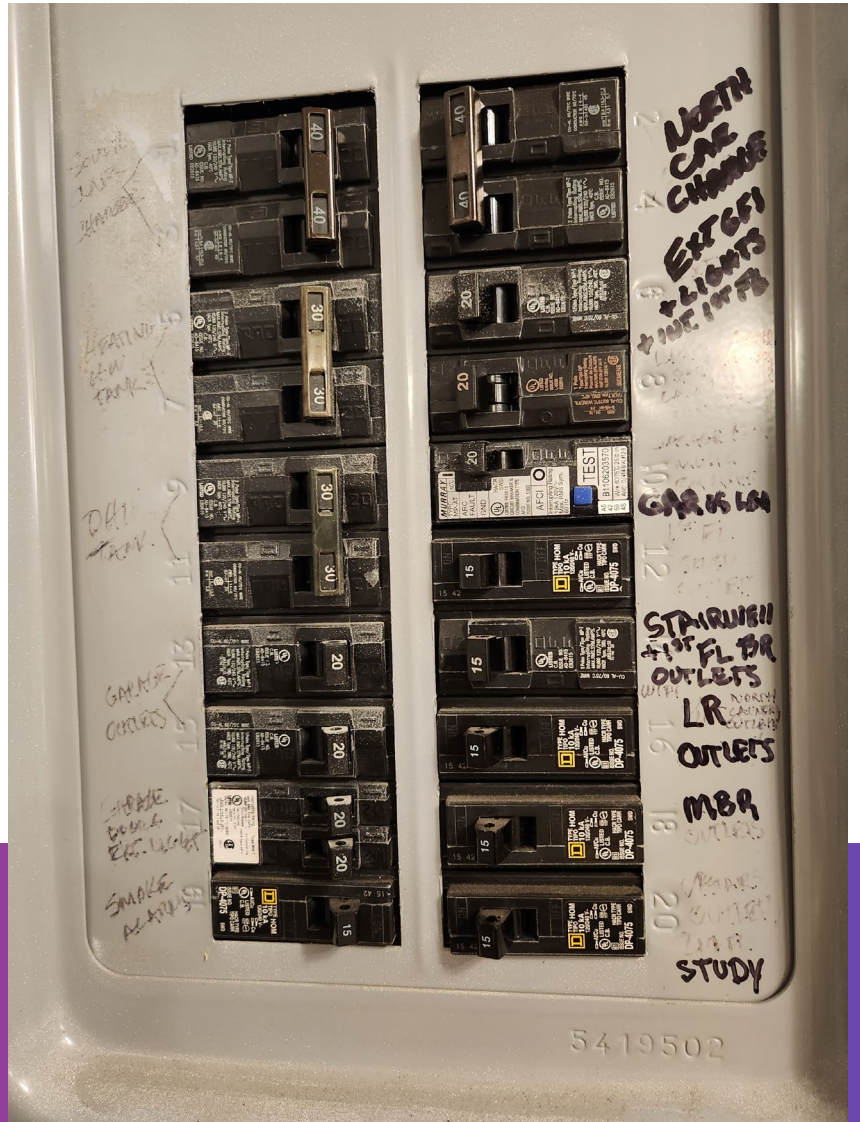


# Case Studies

# Green Idea House:
# All-electric on 200 amps

# Panel and Sub-panel

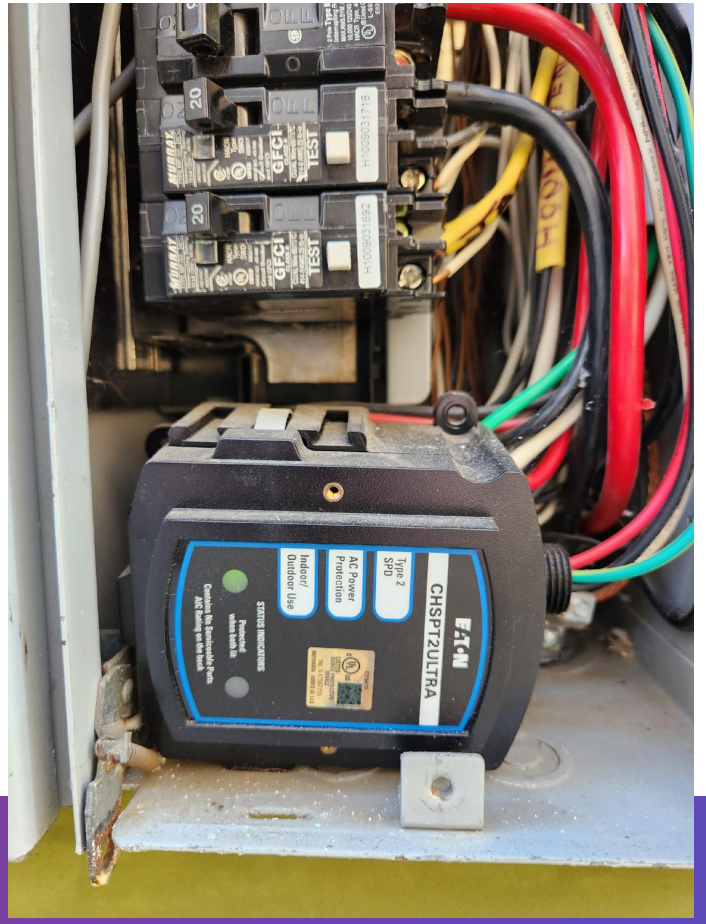
## Early Sizing Experiment

# Have One Trench – Not Two

## With Gas – Additional Trenching, Hookup and Meter Charges

# Install and Check Your Whole house Surge Protector

# Typical Difficulty
# 1930’s Bungalow with 80 Amp Service

# Power- and Energy-efficient Equipment: Packaged Terminal Heat Pumps

Ephoca

# 120v HP Washer Dryer Combo

# 120v Induction Cooking

## TRUE INDUCTION TI-2B Built-In Double Burner Induction Glass Cook-Top 120V Black

4.4 out of 5 stars 197

$380.00

- German made Schott-Ceran smooth ceramic glass that is scratch, chip/shatter, high heat resistant and has no crevices for controls making it simple to clean. The unit has a one piece ceramic glass surface made for easy cleaning. All that is needed is a damp cloth to wipe down the top.
- There are multiple safety features within the unit, it has a built-in safety turn-off feature that registers when the cookware is removed from the burner and placed back on, allowing for a safe cooking experience. Once the cooktop reaches its maximum temperature of 450 degrees, it will stay at that temperature and will not exceed it .
- 1800 watts of cooking power and can run off a standard 110 outlet.
- This unit can also be portable and placed wherever you would like, which is beneficial for dorm rooms, camping, or needing extra burners for a special occasion. True Induction is the choice cooktop of Winnebago and many other RV manufacturers.
- Includes True Induction's trademark EZ touch controls and child safety controls.
- Glass Top Measurement: 24 3/8" Width x 15" Depth
- Base Measurement: 23 5/8'' Width x 14 1/8'' Depth x 2 1/4'' Height

Show less

# 120v Induction Cooking: with Onboard Batteries


Impulse

Channing Street Copper

# Watt Diet: 80 amp panel

## 3. Determine "Watt Diet" and Panel Size

**Use the drop down menu for the type of products and volts, amps and the circuit size will autofill. Many product will use less than their rated circuit amperage, refer to the "Product Data" tab to see specification sheets for products show in the drop down menu. If you do not want to select a device, choose the "**Select Device**" option in the dropdown.**

| Panel Baseline Assumtions | |
|---|---|
| Utility Service Volts (120, 240, 240 is most common) | 240 |
| Base Energy Use (defined by electrical code) (Watts) | 4,838 |

**3a. Device Selection:** Use the drop down menu to determine each device, the voltage, rated amps and circuit size will autfill with your selection. If you want to remove the selection, choose **Select Device**

| | Device | Select with Dropdown Menu | Volts | Rated Amps | Circuit Size (Amps) | Calculated Power (Watts) |
|---|---|---|---|---|---|---|
| **Baseline** Loads (specified by NEC) | Lighting+Plugs 3W/square foot | | | | | 3,750 |
| | Kitchen Countertop Circuits | | | | | 3,000 |
| | Laundry Circuit *(note: laundry circuit must be 1500 Watts)* | | | | | 1,500 |
| **Laundry** *(note: if specified power is under the baseline, the baseline value is used.)* | Washer (or combined) | Washing Machine: LG | 120 | - | 10 | 1,200 |
| | Dryer | Heat Pump Dryer: Miele (120V) | 120 | - | 15 | 1,800 |
| **Kitchen** | Fridge | Fridge: Frigidaire 20.4 cuft | 120 | 6 | 15 | 720 |
| | *Optional: Garbage Disposal* | Garbage Disposal: GE | 120 | 4 | 15 | 480 |
| | *Optional: Dishwasher* | Dishwasher: Frigidaire | 120 | - | 10 | 1,200 |
| | *Optional: Kitchen Hood* | Kitchen Hood: Broan | 120 | 1.4 | 15 | 168 |
| | *Optional: Microwave* | Microwave: Frigidaire (built-in) | 120 | 9.2 | 15 | 1,104 |
| | Range (oven and cooktop) | Range: Frigidaire Induction | 240 | 41.6 | 40 | 9,984 |
| | Oven | No Device | - | - | - | - |
| | Cooktop | No Device | - | - | - | - |
| **Water Heating** | Water Heater | Heat Pump Water Heater: Rheem 120V / 15A | 120 | 15 | 15 | 1,800 |
| **Heating, Cooling and Ventilation** | User Defined Heat Pump (Selected On Tab 2) | | 120 | 15 | 20 | 1,800 |
| | Second Heat Pump | PTHP: Innova DK92 (second largest) | 120 | 15 | 20 | 1,800 |
| **Electric Vehicle Charging** | EV Charger | EVSE Level 2 (low) | 120 | 15 | 15 | 1,800 |

**3b. Power Management Selection:** use the drop down menu to choose what strategy of power management you would like to use. The selections are representative of real products. An example of how it works: when selecting "car to dryer" the EV charging will pause when the dryer runs, therefore the lesser power draw of the two will be subtracted from the Watt Diet.

| | | | | | | |
|---|---|---|---|---|---|---|
| **Power Sharing** | Circuit Sharing Device | No Device | - | - | *Watts Saved* | - |

**"Device" Watts:**

| Total Watts (before coincidence calculation) | 30,606 |
|---|---|

**"Panel" Watts:**

| | Coincidence Factor | Watts |
|---|---|---|
| Baseload Watts | 1 | 4,838 |
| Heat Pump Watts | 1 | 1,800 |
| EV Charging Watts | 1.25 | 1,800 |
| Remaining Watts | 0.4 | 22,169 |
| Total Panel Watts | | 17,755 |
| Total Panel Amps | | 74 |
| **Minimum Panel Size** | | **80** |
| Allowed Watts | | 40,744 |

# Two Houses on 225 amps

Main house:

- 200 amp panel
- Mixed fuel, planning to electrify
- 4 kW PV system

ADU being added:

- All-electric
- 4 kW PV system

Will they fit in 200 amps???

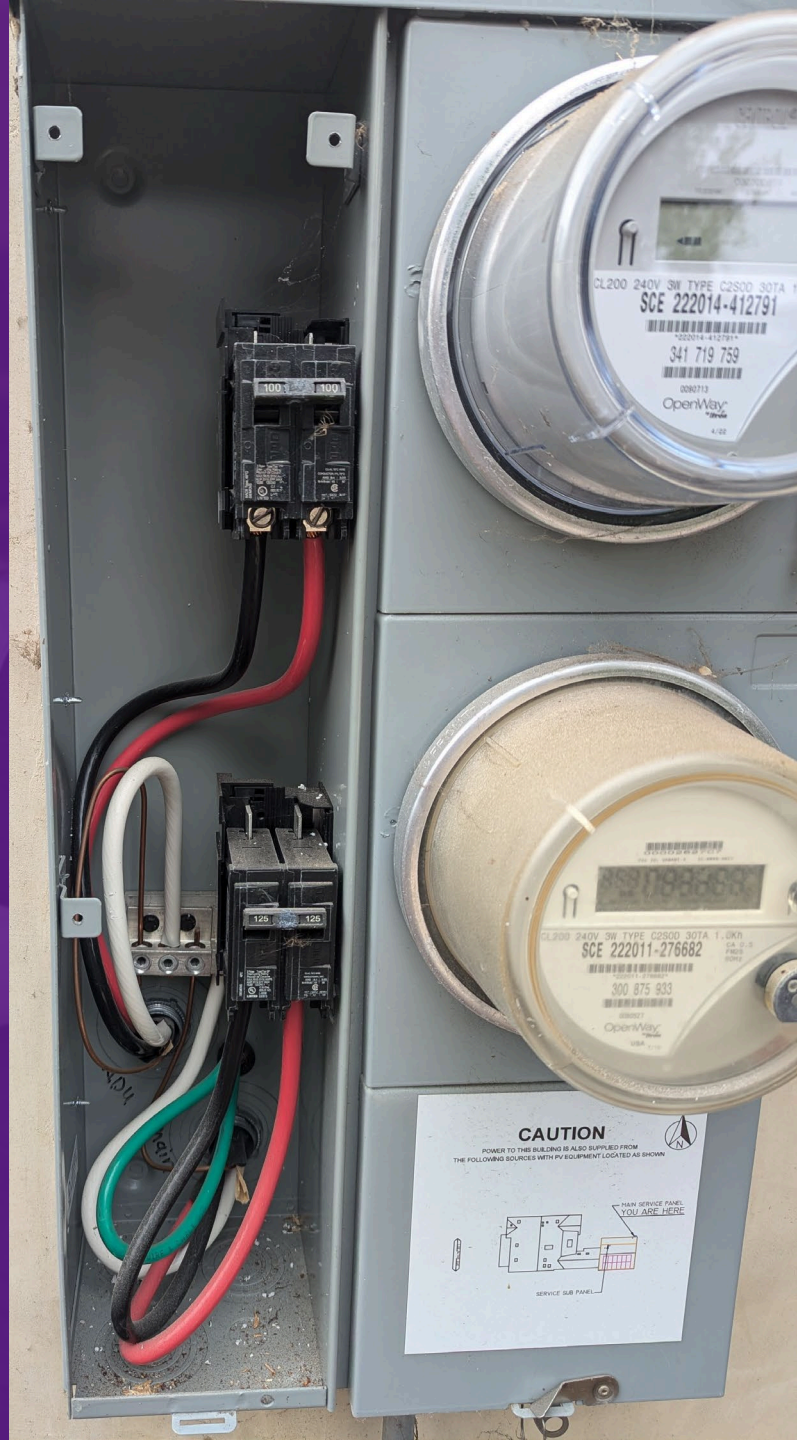
# Two Houses on 225 amps

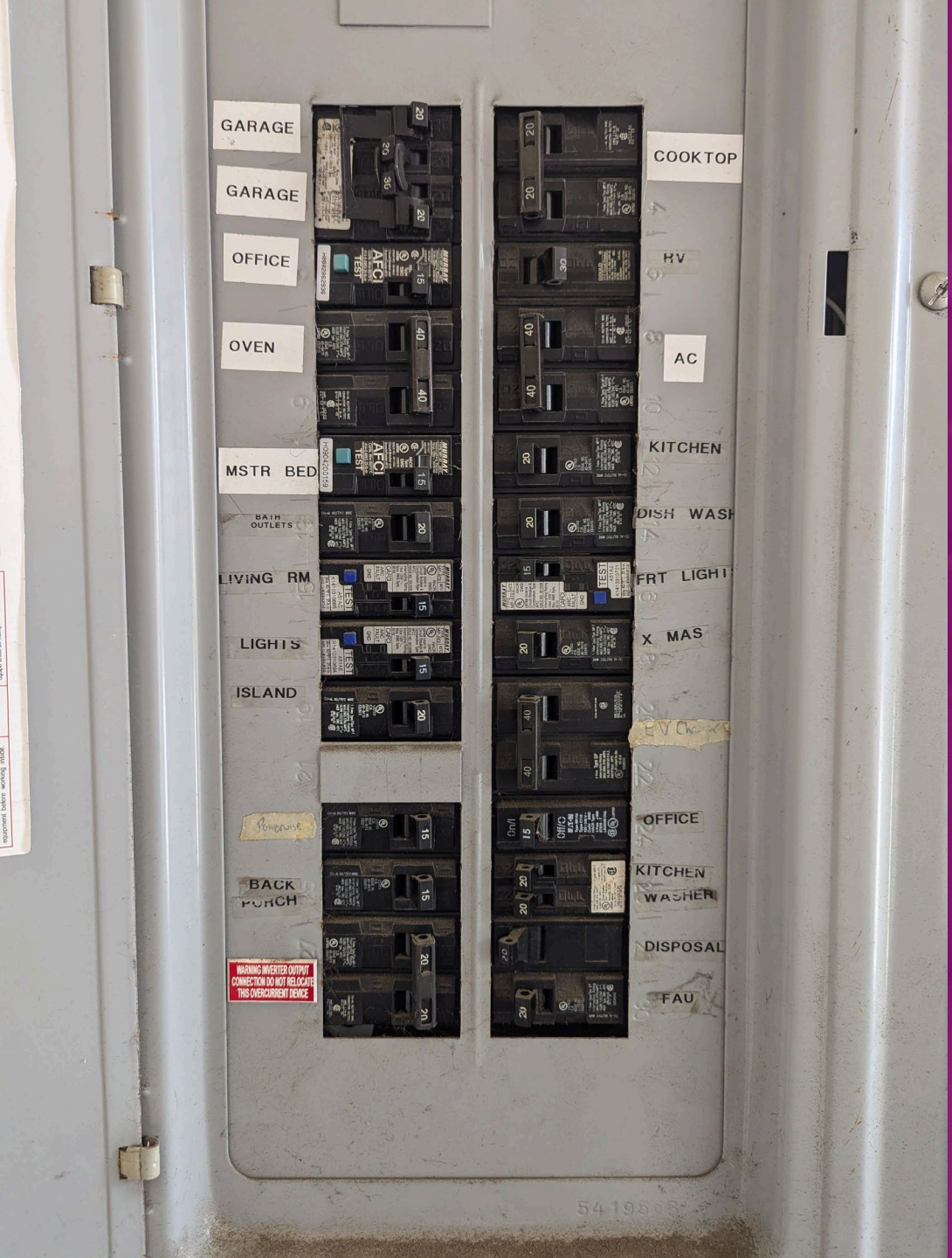

Main house:

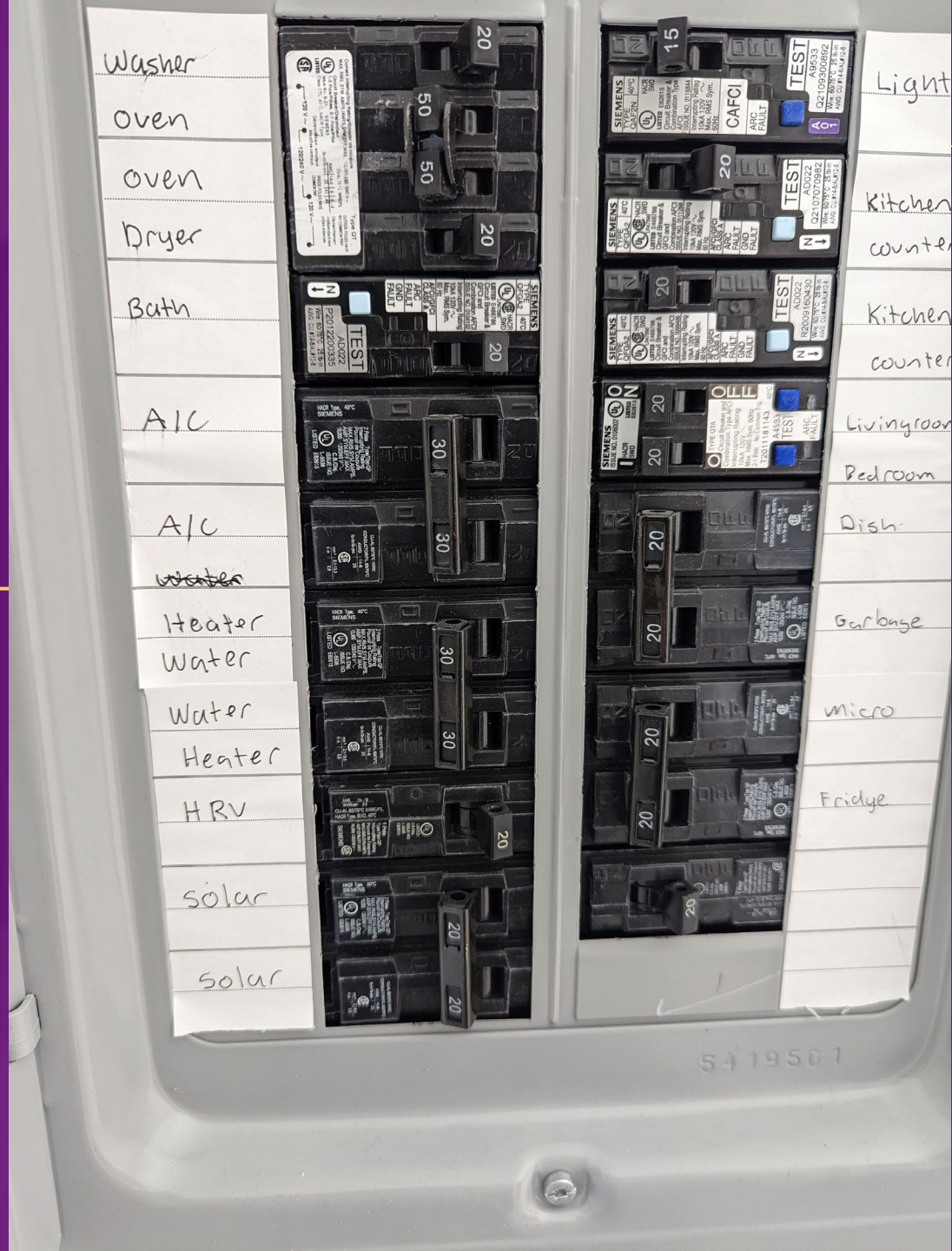
- 125 amp service
- 200 amp panel becomes subpanel
- All electric
- 4 kW PV system

ADU:

- New 100 amp service and subpanel
- All electric
- 4 kW PV system




GARAGE
GARAGE
OFFICE
OVEN
MSTR BED
BATH OUTLETS
LIVING RM
LIGHTS
ISLAND
BACK PORCH
COOKTOP
HV
AC
KITCHEN
DISH WASH
FRT LIGHT
X MAS
OFFICE
KITCHEN
WASHER
DISPOSAL
FAU
WARNING INVERTER OUTPUT CONNECTION DO NOT RELOCATE THIS OVERCURRENT DEVICE


Washer
Oven
Oven
Dryer
Bath
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A/C
~~Water~~
Heater
Water
Water
Heater
HRV
solar
solar
Light
Kitchen
counter
Kitchen
counter
Livingroom
Bedroom
Dish
Garbage
micro
Fridge

## 3. Determine "Watt Diet" and Panel Size

**Use the drop down menu for the type of products and volts, amps and the circuit size will autofill. Many product will use less than their rated circuit amperage, refer to the "Product Data" tab to see specification sheets for products show in the drop down menu. If you do not want to select a device, choose the "**Select Device**" option in the dropdown.**

| Panel Baseline Assumtions | |
|---|---|
| Utility Service Volts (120, 240, 240 is most common) | 240 |
| Base Energy Use (defined by electrical code) (Watts) | 5,573 |

**3a. Device Selection:** Use the drop down menu to determine each device, the voltage, rated amps and circuit size will autfill with your selection. If you want to remove the selection, choose **Select Device**

| | Device | Select with Dropdown Menu | Volts | Rated Amps | Circuit Size (Amps) | Calculated Power (Watts) |
|---|---|---|---|---|---|---|
| **Baseline** Loads (specified by NEC) | Lighting+Plugs 3W/square foot | | | | | 5,850 |
| | Kitchen Countertop Circuits | | | | | 3,000 |
| | Laundry Circuit *(note: laundry circuit must be 1500 Watts)* | | | | | 1,500 |
| **Laundry** *(note: if specified power is under the baseline, the baseline value is used.)* | Washer (or combined) | Washing Machine: Samsung | 120 | - | 15 | 1,800 |
| | Dryer | Heat Pump Dryer: Miele (120V) | 120 | - | 15 | 1,800 |
| **Kitchen** | Fridge | Fridge: Frigidaire 27.6 cuft | 120 | 8.5 | - | 1,020 |
| | *Optional: Garbage Disposal* | Garbage Disposal: GE | 120 | 4 | - | 480 |
| | *Optional: Dishwasher* | Dishwasher: Frigidaire | 120 | - | 10 | 1,200 |
| | *Optional: Kitchen Hood* | Kitchen Hood: Broan | 120 | 1.4 | - | 168 |
| | *Optional: Microwave* | Microwave: Frigidaire (built-in) | 120 | 9.2 | - | 1,104 |
| | Range (oven and cooktop) | No Device | - | - | - | - |
| | Oven | Oven: Built in GE | 240 | 11.9 | 20 | 2,856 |
| | Cooktop | Cooktop: Frigidaire 4 Element 30in | 240 | 35 | 40 | 8,400 |
| **Water Heating** | Water Heater | Heat Pump Water Heater: Rheem 120V / 15A | 120 | 15 | - | 1,800 |
| **Heating, Cooling and Ventilation** | User Defined Heat Pump (Selected On Tab 2) | | 240 | 30 | 40 | 1,570 |
| | Second Heat Pump | No Device | 120 | 15 | 20 | - |
| Solar Panels | 4.4 kW PV system | | 240 | 20 | 20 | 4,800 |
| **Electric Vehicle Charging** | EV Charger | EVSE Level 2 (high) | 240 | 32 | 40 | 7,680 |

**3b. Power Management Selection:** use the drop down menu to choose what strategy of power management you would like to use. The selections are representative of real products. An example of how it works: when selecting "car to dryer" the EV charging will pause when the dryer runs, therefore the lesser power draw of the two will be subtracted from the Watt Diet.

| | | | | | | |
|---|---|---|---|---|---|---|
| **Power Sharing** | Circuit Sharing Device | No Device | - | - | *Watts Saved* | - |

**"Device" Watts:** Total Watts (before coincidence calculation) 43,528

**"Panel" Watts:**

| | Coincidence Factor | Watts |
|---|---|---|
| Baseload Watts | 1 | 5,573 |
| Heat Pump Watts | 1 | 1,570 |
| EV Charging Watts | 1.25 | 7,680 |
| Remaining Watts | 0.4 | 28,706 |
| Total Panel Watts | | 28,225 |
| Total Panel Amps | | 118 |
| **Minimum Panel Size** | | **125** |
| Allowed Watts | | 66,641 |

**Main House: 125 amps**

## 3. Determine "Watt Diet" and Panel Size

**of products and volts, amps and the circuit size will autofill. Many product will use less than their rated circuit**

| Panel Baseline Assumtions | | | |
|---|---|---|---|
| Utility Service Volts (120, 240, 240 is | | | 240 |
| Base Energy Use (defined by electrical | | | 4,130 |

**3a. Device Selection:** Use the drop down menu to determine each device, the voltage, rated amps and circuit size

| | Device | Select with Dropdown Menu | Volts | Rated Amps | Circuit Size (Amps) | Calculated Power (Watts) |
|---|---|---|---|---|---|---|
| **Baseline** Loads (specified by NEC) | Lighting+Plugs 3W/square foot | | | | | 1,728 |
| | Kitchen Countertop Circuits | | | | | 3,000 |
| | Laundry Circuit *(note: laundry circuit must be 1500 Watts)* | | | | | 1,500 |
| **Laundry** *(note: if specified power is* | Washer (or combined) | Washing Machine: Samsung | 120 | - | 15 | 1,800 |
| | Dryer | Heat Pump Dryer: Miele (120V) | 120 | - | 15 | 1,800 |
| **Kitchen** | Fridge | Fridge: Frigidaire 20.4 cuft | 120 | 6 | - | 720 |
| | *Optional: Garbage Disposal* | Garbage Disposal: GE | 120 | 4 | - | 480 |
| | *Optional: Dishwasher* | Dishwasher: Frigidaire | 120 | - | 10 | 1,200 |
| | *Optional: Kitchen Hood* | No Device | - | - | - | - |
| | *Optional: Microwave* | Microwave: Samsung (with exhaust fan) | 120 | 13.5 | 15 | 1,620 |
| | Range (oven and cooktop) | Range: Frigidaire Induction | 240 | 41.6 | 40 | 9,984 |
| | Oven | No Device | - | - | - | - |
| | Cooktop | No Device | - | - | 40 | - |
| **Water Heating** | Water Heater | Heat Pump Water Heater: Rheem 30 Amp | 240 | 15 | - | 3,600 |
| **Heating, Cooling and Ventilation** | User Defined Heat Pump (Selected On Tab 2) | | 240 | 20 | 20 | 1,570 |
| | Second Heat Pump | No Device | 120 | 15 | 20 | - |
| **Electric Vehicle Charging** | EV Charger | No Device | - | - | - | - |

**3b. Power Management Selection:** use the drop down menu to choose what strategy of power management you

| | | | | | | |
|---|---|---|---|---|---|---|
| **Power Sharing** | Circuit Sharing Device | No Device | - | - | *Watts Saved* | - |

**"Device" Watts:** Total Watts (before coincidence calculation) 27,502

**"Panel" Watts:**

| | Coincidence Factor | Watts |
|---|---|---|
| Baseload Watts | 1 | 4,130 |
| Heat Pump Watts | 1 | 1,570 |
| EV Charging Watts | 1.25 | - |
| Remaining Watts | 0.4 | 21,802 |
| Total Panel Watts | | 14,421 |
| Total Panel Amps | | 60 |
| **Minimum Panel Size** | | **80** |
| Allowed Watts | | 41,805 |

**ADU: 80 amps**

# 10-unit All-electric Apartment Building on 600 amps

Current Systems:

- Gas furnaces in each unit, No cooling
- Gas central hot water system
- Gas ranges
- Gas central clothes dryer
- 200 amp main panel, 40 amp subpanels
- Insurance requiring 400 amp main panel upgrade & replacing subpanels

Envisioned Systems:

- Heat pumps in each unit, heating & cooling
- Heat pump central water heating system
- Induction ranges
- Electric/heat pump central clothes dryer
- 600 amp main panel, 60 amp subpanels

## 3. Determine "Watt Diet" and Panel Size

**of products and volts, amps and the circuit size will autofill. Many product will use less than their rated circuit**

| Panel Baseline Assumtions | | | |
|---|---|---|---|
| Utility Service Volts (120, 240, 240 is | | | 240 |
| Base Energy Use (defined by electrical | | | 4,575 |

**3a. Device Selection:** Use the drop down menu to determine each device, the voltage, rated amps and circuit size

| | Device | Select with Dropdown Menu | Volts | Rated Amps | Circuit Size (Amps) | Calculated Power (Watts) |
|---|---|---|---|---|---|---|
| **Baseline** Loads (specified by NEC) | Lighting+Plugs 3W/square foot | | | | | 3,000 |
| | Kitchen Countertop Circuits | | | | | 3,000 |
| | Laundry Circuit *(note: laundry circuit must be 1500 Watts)* | | | | | 1,500 |
| **Laundry** *(note: if specified power is under the baseline, the baseline value is* | Washer (or combined) | No Device | - | - | - | - |
| | Dryer | No Device | - | - | - | - |
| **Kitchen** | Fridge | Fridge: Frigidaire 20.4 cuft | 120 | 6 | - | 720 |
| | *Optional: Garbage Disposal* | Garbage Disposal: GE | 120 | 4 | - | 480 |
| | *Optional: Dishwasher* | Dishwasher: Frigidaire | 120 | - | 10 | 1,200 |
| | *Optional: Kitchen Hood* | Kitchen Hood: Broan | 120 | 1.4 | - | 168 |
| | *Optional: Microwave* | Microwave: Frigidaire (built-in) | 120 | 9.2 | - | 1,104 |
| | Range (oven and cooktop) | Range: Frigidaire Induction | 240 | 41.6 | - | 9,984 |
| | Oven | No Device | - | - | - | - |
| | Cooktop | No Device | - | - | - | - |
| **Water Heating** | Water Heater | No Device | - | - | - | - |
| **Heating, Cooling and Ventilation** | User Defined Heat Pump (Selected On Tab 2) | | 120 | 20 | 20 | 1,000 |
| | Second Heat Pump | No Device | 120 | 15 | 20 | - |
| **Electric Vehicle Charging** | EV Charger | No Device | - | - | - | - |

**3b. Power Management Selection:** use the drop down menu to choose what strategy of power management you would like to use. The selections are

| | | | | | | |
|---|---|---|---|---|---|---|
| **Power Sharing** | Circuit Sharing Device | No Device | - | - | *Watts Saved* | - |

**"Device" Watts:** Total Watts (before coincidence calculation) 20,656

**"Panel" Watts:**

| | Coincidence Factor | Watts |
|---|---|---|
| Baseload Watts | 1 | 4,575 |
| Heat Pump Watts | 1 | 1,000 |
| EV Charging Watts | 1.25 | - |
| Remaining Watts | 0.4 | 15,081 |
| Total Panel Watts | | 11,607 |
| Total Panel Amps | | 48 |
| **Minimum Panel Size** | | **50** |
| Allowed Watts | | 23,138 |

**Each unit: 50 amps & Central HW & Laundry 100 amps**

# The Homeowner Electrification Worksheet & Scavenger Hunt

**Homeowner Electrification Worksheet**
**& Scavenger Hunt**

Attention, homeowners! Your mission is to get clear on your goals and then embark on a scavenger hunt within the walls of your very own home.

What are your project goals? Check all that apply:

- Save on first costs through incentives/tax credits
- Save on operating expenses/fuel charges
- Make the house more comfortable
- Reduce health and safety risks
- Reduced localized pollution
- Other _____

List the age, condition, and life expectancy for each:

| Items | Age | Condition | Life Expectancy |
|---|---|---|---|
| | | | |

# WORKING WITH CONTRACTORS

## How to Find and Qualify the Best Ones and Manage Them Efectively

# Finding Contractors

- Be clear and specific from the outset
  - *Have a written Project Requirements document that you share*
  - *Detail the work you would like performed/ products specified*
- Referrals are helpful
- Platforms/reviews can give you leverage
  - *HomeAdvisor or the National Association of the Remodeling Industry (NARI), Thumbtack, Yelp*

# Qualifying Contractors

- Licensed, experienced and references on what you need to have done?
- Check State Contractor's License Board, BBB and places they advertise (Thumbtack..)
- Interview each of them – you will learn about them and the project
- Who is already down the learning curve - or won't charge you 50% extra for them to learn?
- Ask: How many times have you done something similar? Where? When? What is the size of your crew? What are you working on now? How busy? How are change orders handled? What is the warranty on the work? Get references.

# Checking References and Contracting

- Check real references in similar location or jurisdiction:
  - *What went well, what did not go well?  Would you recommend again?*
- Workers compensation and liability Insurance certificates in your name?
- Have an umbrella policy yourself
- Get detailed estimates
- Have exact schedule of payments and start with no more than 10 - 20 % deposit
- The name on the permit is responsible for the work
- Be leery of low bid

# Resources

Watt Diet calculator - https://www.redwoodenergy.net/watt-diet-calculator

California Energy Smart Homes - https://caenergysmarthomes.com/

TECH Rebate Program - https://switchison.org/

Building Decarbonization Coalition - https://buildingdecarb.org/

# Keep in Touch!

**Robert**

fortunato@forstrategy.com

**Nick**

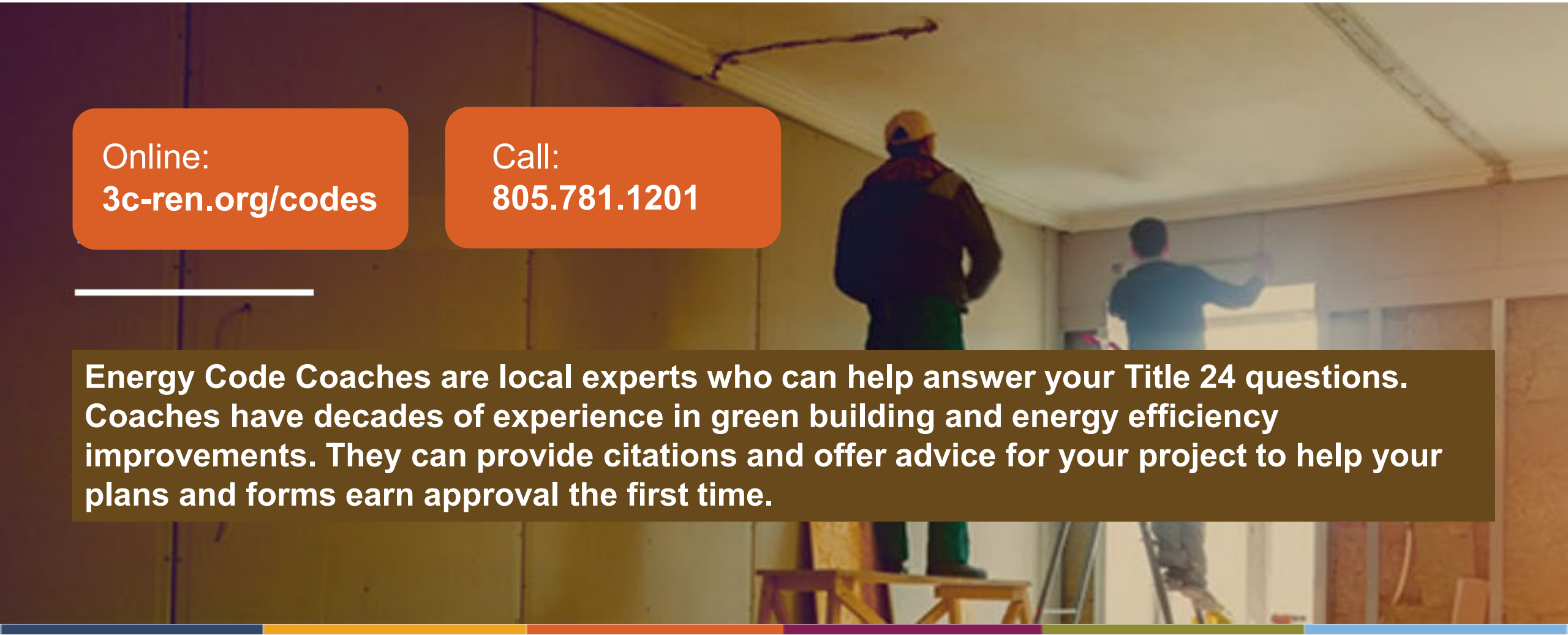
nick@buildsmartgroup.com

# Questions about Title 24?

## 3C-REN offers a *free* Code Coach Service

3C REN

BALANCE™ Green Consulting



Online:
**3c-ren.org/codes**

Call:
**805.781.1201**

**Energy Code Coaches are local experts who can help answer your Title 24 questions. Coaches have decades of experience in green building and energy efficiency improvements. They can provide citations and offer advice for your project to help your plans and forms earn approval the first time.**

# Closing

- Continuing Education Units Available
  - Contact shuskey@co.slo.ca.us for AIA and ICC Lus
- Coming to Your Inbox Soon!
  - Slides, Recording, & Survey – Please Take It and Help Us Out!
- Upcoming Courses:
  - October 10th - Certified Passive House Designer/Consultant (CPHD) Pacific Fall Hybrid Cohort
  - October 15th - A Builder's Perspective on Zero Net Energy
  - October 18th - Building the Future: Electrification Strategies for Electricians
  - October 22nd - Zero Emissions Multifamily Passive House
  - October 23rd - Solar PV: Technology and Valuation
  - October 25th - Regional Forum: SMVCA's Inaugural Cornhole Tournament
  - October 30th - Carbon-Free Homes: Features, Benefits, Valuation
- Visit www.3c-ren.org/events for our full catalog of trainings.

## Thank you!

For more info:
3c-ren.org

For questions:
info@3c-ren.org

3C REN

TRI-COUNTY REGIONAL ENERGY NETWORK

SAN LUIS OBISPO • SANTA BARBARA • VENTURA