We will be starting soon!

Thanks for joining us

Home Electrification Planning Class 2: Panel Optimization

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August 29, 2023

HOME ELECTRIFICATION PLANNING SERIES

Learn how to develop customized home electrification plans for customers or your own home!

Home Electrification Planning Classes

Aug 22 Class 1: Electrification Planning: Soup to Nuts

- What is an electrification plan
- Importance of electrification planning
- Methods for calculating heating load

Today Class 2: Electrical Panel Optimization

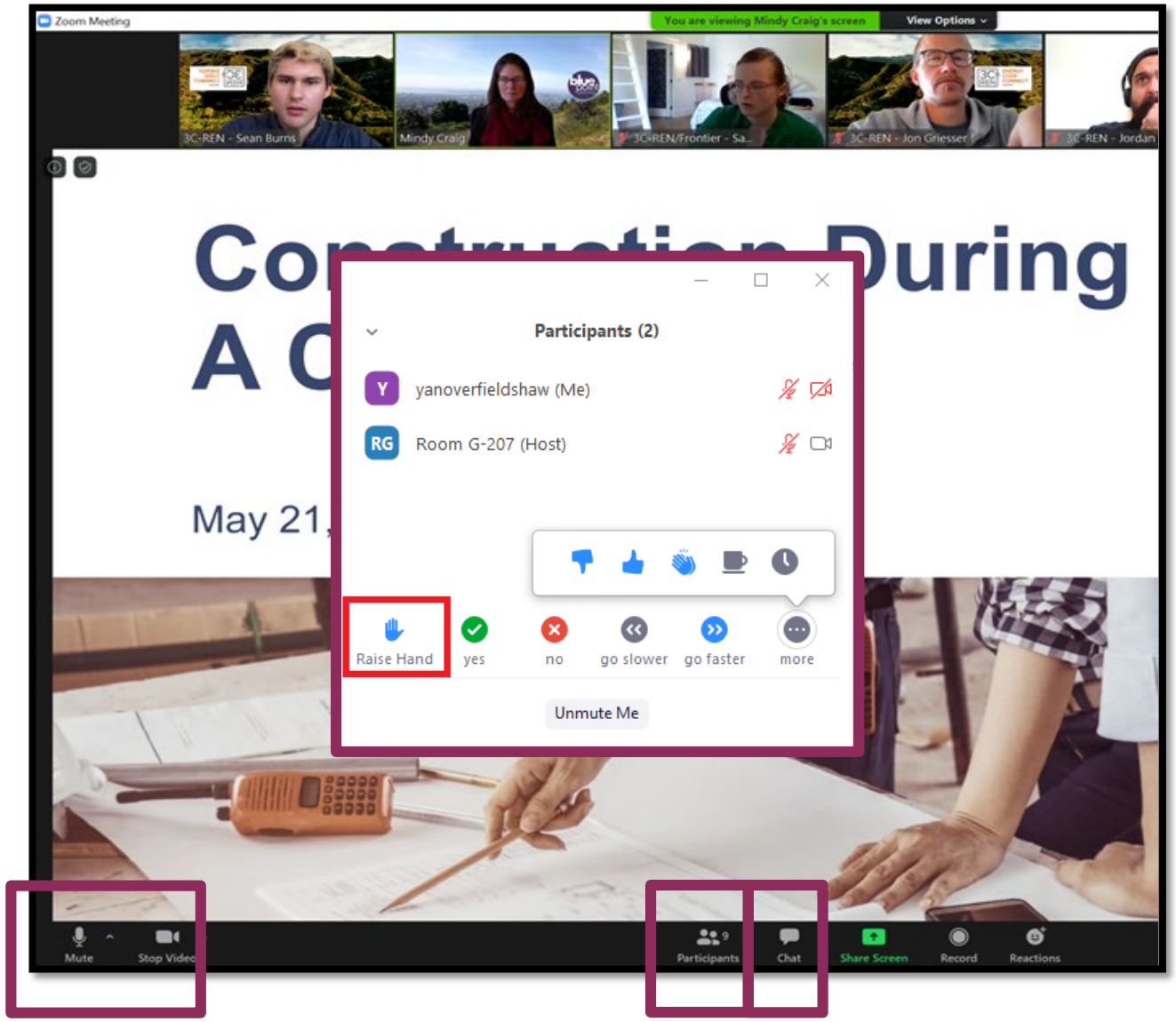
- How to calculate existing electrical load
- Incorporate planned electrification upgrades
- Optimize existing electrical panel capacity

Sept 5 Class 3: Developing an Electrification Plan

- Selecting proper type, sizing, and location for new equipment
- Essential components of an electrification plan
- Setting the homeowner and contractors up for success

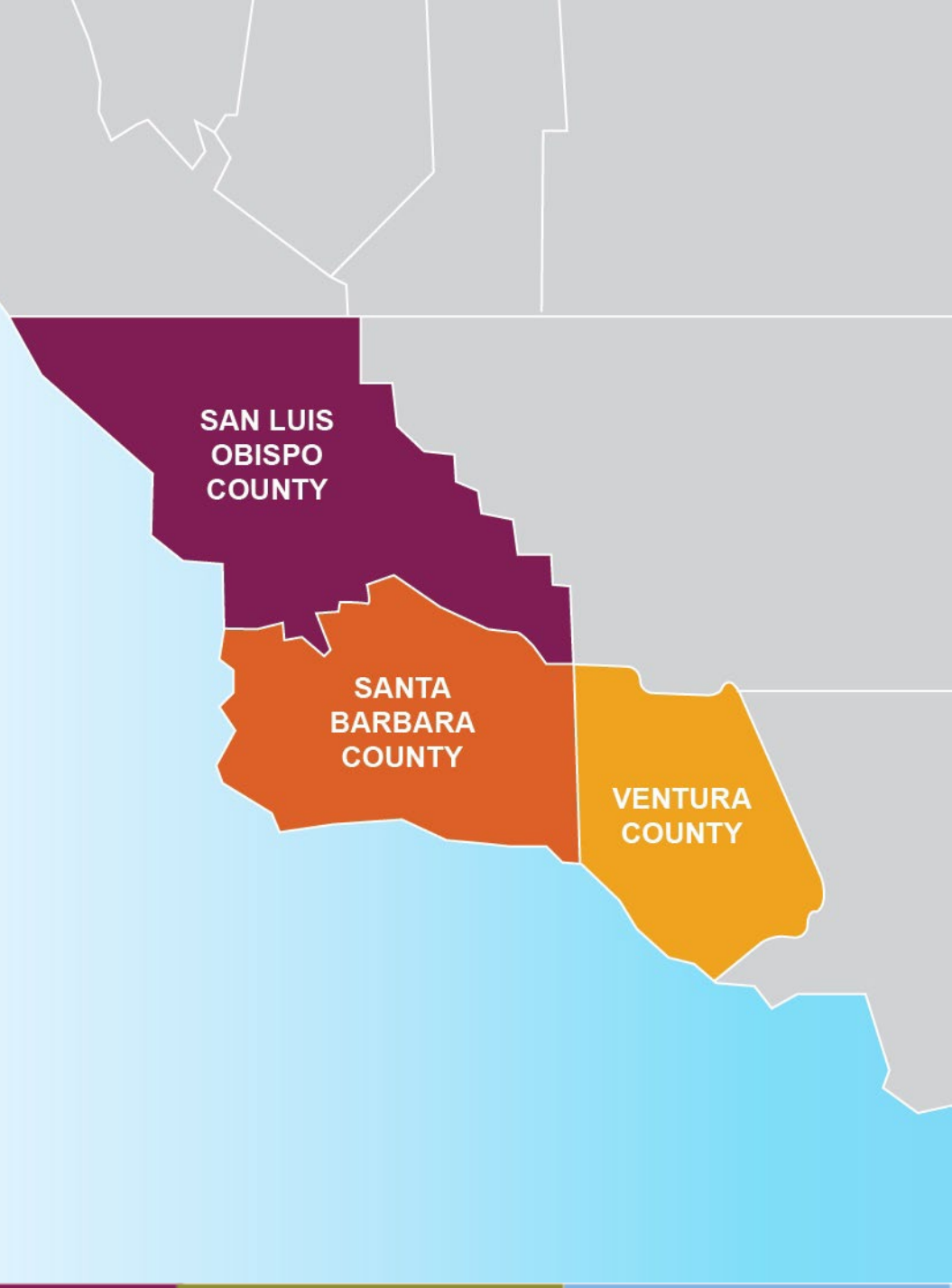
Zoom Orientation

- 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
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ENERGY
CODE
CONNECT


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BUILDING
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HOME
ENERGY
SAVINGS

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REN

Home Electrification

QUICK REVIEW OF LAST WEEK'S MATERIAL

Problems of Electrifying WITHOUT a Plan

- Homeowner's 1st electrification projects use up too many panel amps
- Advised by contractor who is not thinking about whole-home electrification
- Worst offenders:
  - 50-amp car chargers
  - 50-amp HVAC systems

Problems of Electrifying WITHOUT a Plan

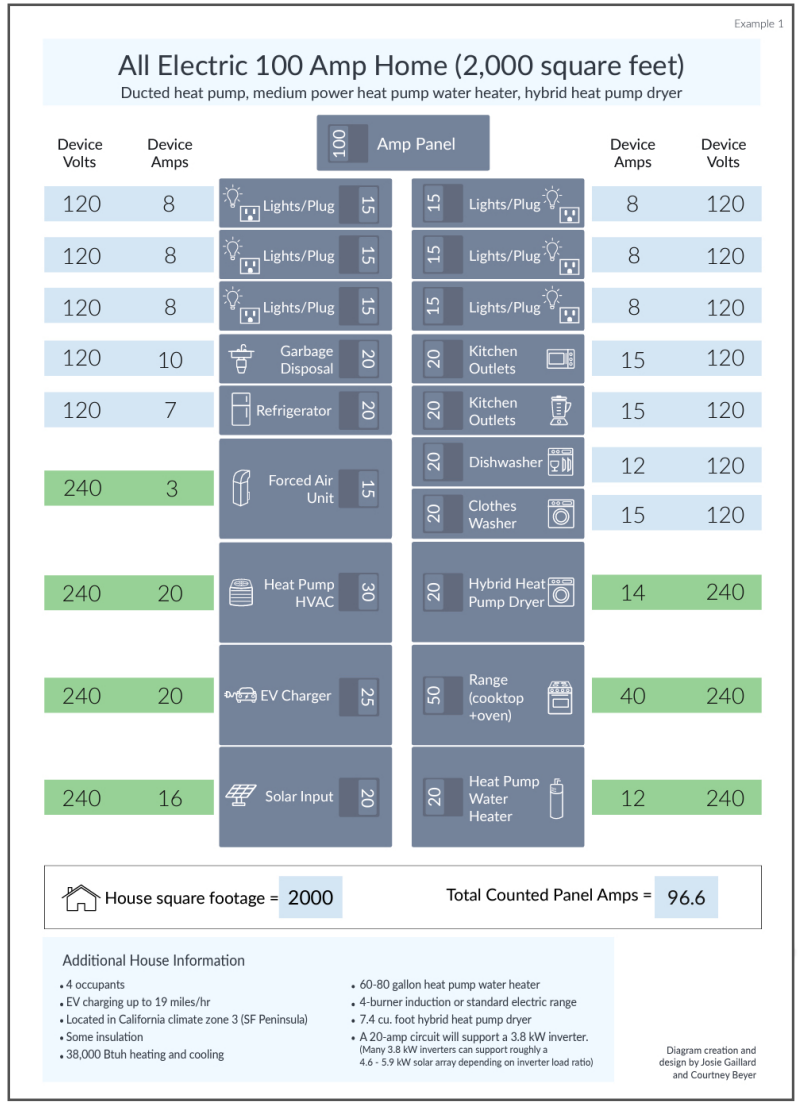
- Electric panel is poorly filled!
- Panel and service line need to be UPSIZED
- Utility gets involved
- Long wait times
- Could cost $5,000 (overhead service line) and $20,000 (underground)

Benefits of Electrifying WITH a Plan

- Helps avoid ~$5,000+ electric panel upgrade
- Provides roadmap for homeowner
- Helps guide tradespeople
- Helps avoid unnecessary work and costly mistakes
- Facilitates right sizing equipment (vs. oversizing)
- Home more likely to be power efficient and grid-friendly

Panel optimization works:

- If house is <3000 sq ft and located in mild climate, 100 Amp panel is usually sufficient
- **Caveat:** Homes with 60 Amp panels or smaller should upsize panel and service line



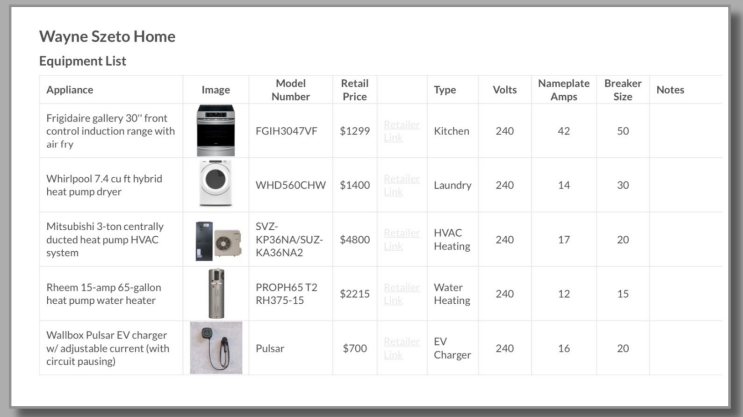
Components of an Electrification Plan

1. Recommended equipment list
2. Electrical load calculations per NEC 220.83(B) or 220.87
3. Wiring plan (optional but helpful)
4. Project list for contractors with photos of existing equipment and locations

Note:

- Homeowners can do their own or get help from an expert
- Plan takes expert ~30 minutes, homeowner ~3 hours

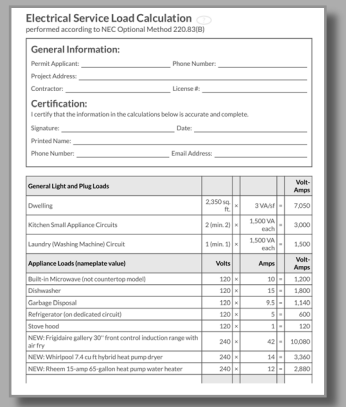
Electrification Plan



Wayne Szeto Home

Equipment List

Appliance	Image	Model Number	Retail Price		Type	Volts	Nameplate Amps	Breaker Size	Notes
Frigidaire gallery 30" front control induction range with air fry		FGIH3047VF	$1299	Retailer Link	Kitchen	240	42	50	
Whirlpool 7.4 cu ft hybrid heat pump dryer		WHD560CHW	$1400	Retailer Link	Laundry	240	14	30	
Mitsubishi 3-ton centrally ducted heat pump HVAC system		SVZ-KP36NA/SUZ-KA36NA2	$4800	Retailer Link	HVAC Heating	240	17	20	
Rheem 15-amp 65-gallon heat pump water heater		PROPH65 T2 RH375-15	$2215	Retailer Link	Water Heating	240	12	15	
Wallbox Pulsar EV charger w/ adjustable current (with circuit pausing)		Pulsar	$700	Retailer Link	EV Charger	240	16	20	



Electrical Service Load Calculation

performed according to NEC Optional Method 220.83(B)

General Information:

Permit Applicant: _____ Phone Number: _____

Project Address: _____

Contractor: _____ License #: _____

Certification:

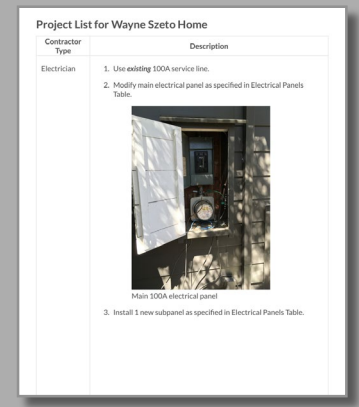
I certify that the information in the calculations below is accurate and complete.

Signature: _____ Date: _____

Printed Name: _____

Phone Number: _____ Email Address: _____

General Light and Plug Loads				Volt-Amps
Dwelling	2,350 sq. ft.	×	3 VA/sf	= 7,050
Kitchen Small Appliance Circuits	2 (min. 2)	×	1,500 VA each	= 3,000
Laundry (Washing Machine) Circuit	1 (min. 1)	×	1,500 VA each	= 1,500
Appliance Loads (nameplate value)	**Volts**		**Amps**	**Volt-Amps**
Built-in Microwave (not countertop model)	120	×	10	= 1,200
Dishwasher	120	×	15	= 1,800
Garbage Disposal	120	×	9.5	= 1,140
Refrigerator (on dedicated circuit)	120	×	5	= 600
Stove hood	120	×	1	= 120
NEW: Frigidaire gallery 30" front control induction range with air fry	240	×	42	= 10,080
NEW: Whirlpool 7.4 cu ft hybrid heat pump dryer	240	×	14	= 3,360
NEW: Rheem 15-amp 65-gallon heat pump water heater	240	×	12	= 2,880

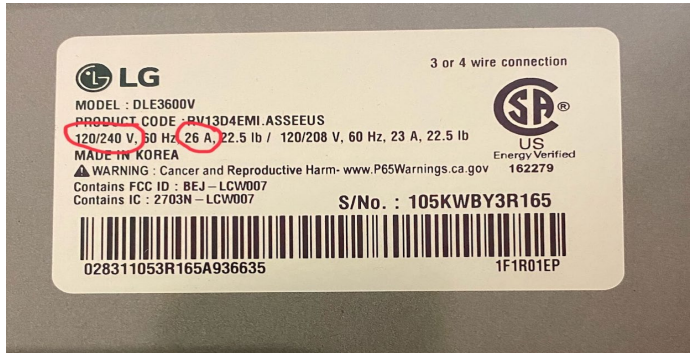


Project List for Wayne Szeto Home

Contractor Type	Description
Electrician	1. Use existing 100A service line. 2. Modify main electrical panel as specified in Electrical Panels Table. Main 100A electrical panel 3. Install 1 new subpanel as specified in Electrical Panels Table.

First Step: Gather Data

1. Utility data showing home's current energy needs
    - Best to gather before home visit
2. Homeowner preferences
3. Home visit observations, measurements and photos



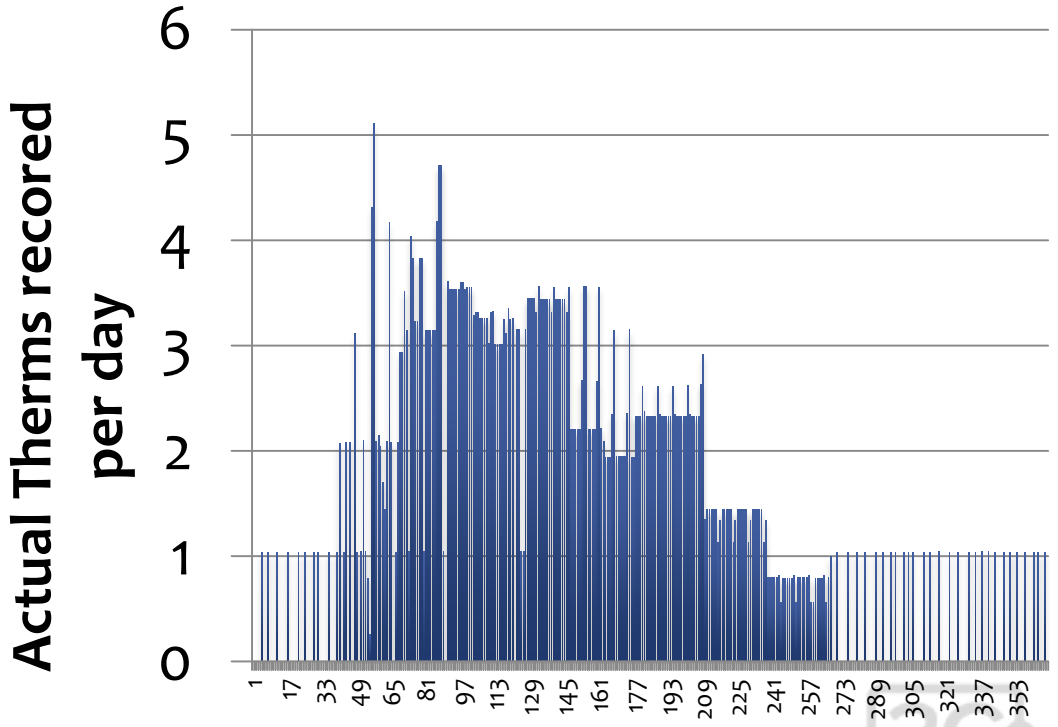
Home Visit Data: Main Panel & Subpanels

- Shut-off breaker capacity of main panel
- Open breaker spaces in main panel and subpanels
- Busbar capacity of main panel and subpanels
- Feeder breaker capacity of subpanels

Next Step: HVAC Sizing
Peak Day Gas Usage Method

Method:

- Pick heat pump size based on peak (coldest) day needs
- 5.1 therms – 0.4 (non heating) = 4.7 therms
- 4.7 therms x 80% x 100,000 BTU/therm = 376,000 BTUs of heat/peak day
- 376,000 BTU/12,000 BTUs per ton-hour = 31.3 ton-hours of heat needed on peak day
- 31.3 ton-hours / 13 hours of full load operation on peak day = 2.4 tons needed
- 2.4 x (1- 20% duct heat loss and leakage) = 1.9 tons needed if it was ductless



Electrical Load Calculations

NEC 220.83 (B) AND 220.87

Electricity Basics

Watts = Amps x Volts
(Power = Current x Pressure)

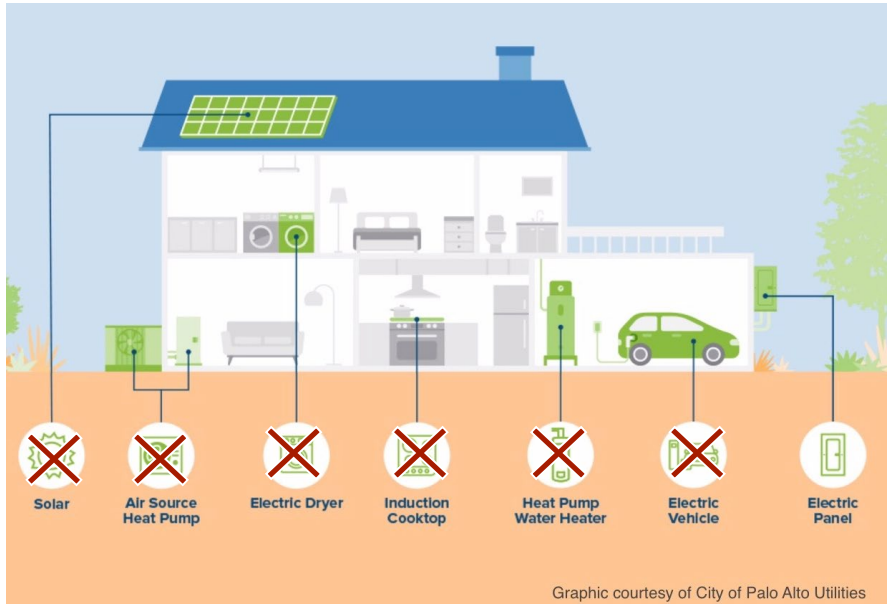
Example: **60 watts = _?_ amps x 120 volts**
60 watts = 0.5 amps x 120 volts

Amps = Watts / Volts **0.5 A = 60 W / 120 V**

Load Calculation: Step #1 Sum Existing Electric Loads

Home A

Total floor area:	**1,500 sq ft**
Main service capacity:	**100 amps**
No. of gas appliances:	**4**



Load Type	Amps	Volts	Watts
Kitchen Circuit	12.5	x 120	= 1500
Kitchen Circuit	12.5	x 120	= 1500
Laundry Circuit	12.5	x 120	= 1500
Refrigerator	10	x 120	= 1200
Dishwasher	10	x 120	= 1200
Garbage Disposal	5	x 120	= 600
Lights + Plugs	(3 watts / sq foot)		= 4500
		Subtotal	= 12,000

Here we are using NEC code section: 220.83 (B)

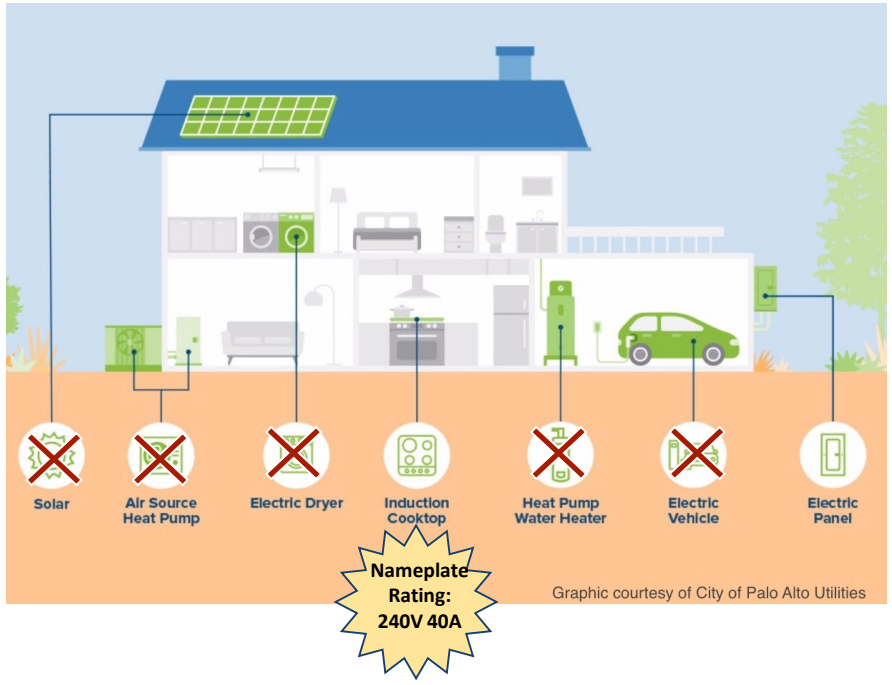
Load Calculation: Step #2 Add New Electric Load, an Induction Range

Home A

Total floor area: **1,500 sq ft**

Main service capacity: **100 amps**

No. of gas appliances: **3**

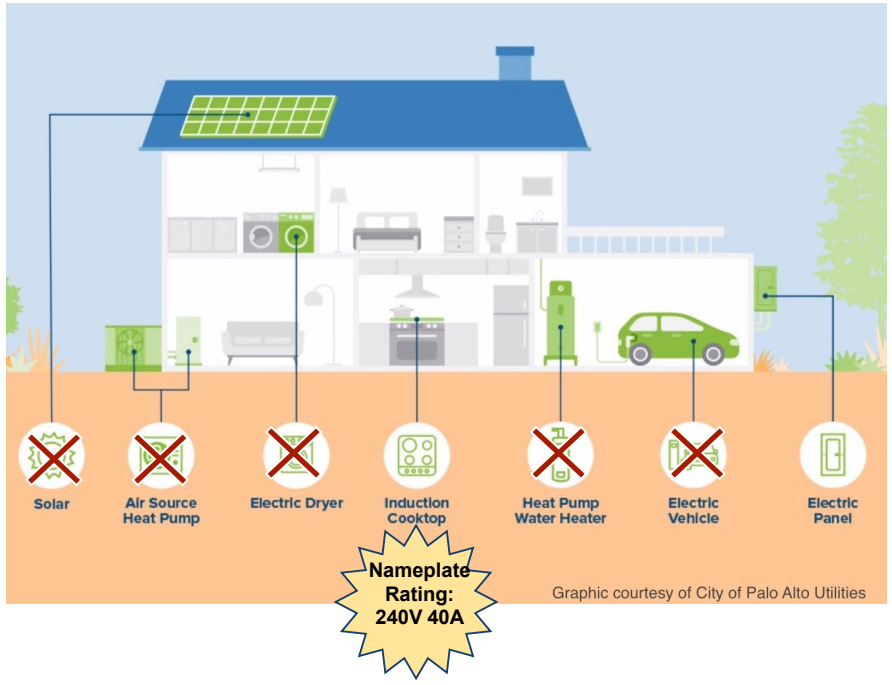


Load Type	Amps	Volts	Watts
Kitchen Circuit	12.5	x 120	= 1500
Kitchen Circuit	12.5	x 120	= 1500
Laundry Circuit	12.5	x 120	= 1500
Refrigerator	10	x 120	= 1200
Dishwasher	10	x 120	= 1200
Garbage Disposal	5	x 120	= 600
Lights + Plugs	(3 watts / sq foot)		= 4500
Induct. Range	40	x 240	= 9600
		Subtotal	= 21,600

Here we are using NEC code section: 220.83 (B)

Load Calculation: Step #3 Apply Coincidence Factors

Home A
Total floor area: **1,500 sq ft**
Main service capacity: **100 amps**
No. of gas appliances: **3**



Load Type	Amps	Volts	Watts
Kitchen Circuit	12.5	x 120	= 1500
Kitchen Circuit	12.5	x 120	= 1500
Laundry Circuit	12.5	x 120	= 1500
Refrigerator	10	x 120	= 1200
Dishwasher	10	x 120	= 1200
Garbage Disposal	5	x 120	= 600
Lights + Plugs	(3 watts / sq foot)		= 4500
Induct. Range	40	x 240	= 9600
		Subtotal	= 21,600
First 8,000 watts @ 1.0 coincidence factor			= 8,000
Remaining watts @ 0.4 coincidence factor			= 5,440
		Total	= 13,440

Here we are using NEC code section: 220.83 (B)

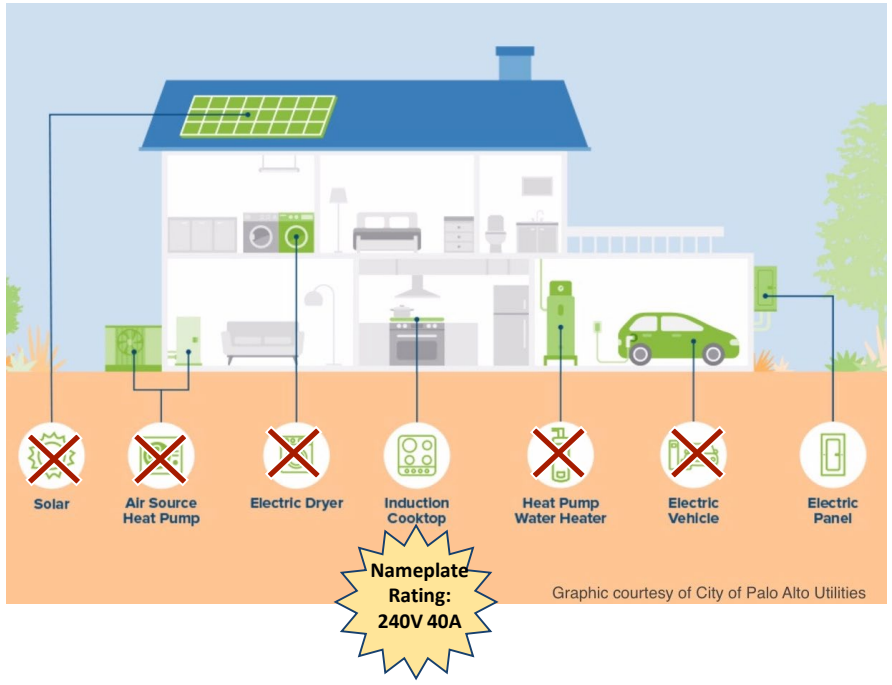
Load Calculation: Step #4 Calculate Load in Amps & Compare to Service Capacity

Home A

Total floor area: **1,500 sq ft**

Main service capacity: **100 amps**

No. of gas appliances: **3**



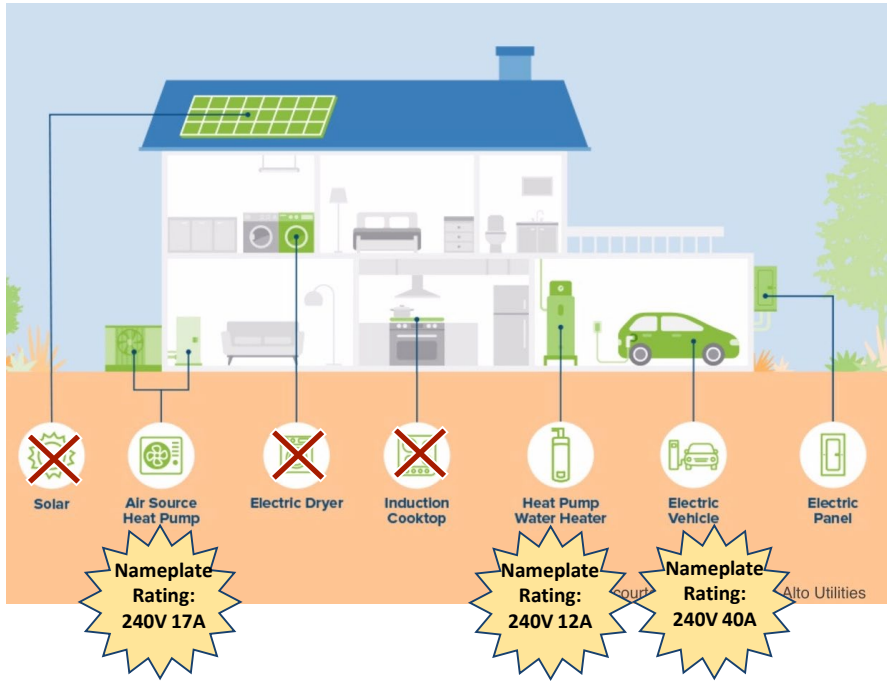
Load Type	Amps	Volts	Watts
Kitchen Circuit	12.5	x 120	= 1500
Kitchen Circuit	12.5	x 120	= 1500
Laundry Circuit	12.5	x 120	= 1500
Refrigerator	10	x 120	= 1200
Dishwasher	12	x 120	= 1200
Garbage Disposal	5	x 120	= 600
Lights + Plugs	(3 watts / sq foot)		= 4500
Induct. Range	40	x 240	= 9600
		Subtotal	= 21,600
First 8,000 watts @ 1.0 coincidence factor			= 8,000
Remaining watts @ 0.4 coincidence factor			= 5,440
		Total	= 13,440

13,440 watts / 240V = 56 amps ✓

Load Calculation: Adding Electric HVAC, HPWH + EV Charging

Home B

Total floor area:	**2,000 sq ft**
Main service capacity:	**100 amps**
No. of gas appliances:	**2**



Load Type	Amps	Volts	Watts
Kitchen Circuit	12.5	x 120	= 1500
Kitchen Circuit	12.5	x 120	= 1500
Laundry Circuit	12.5	x 120	= 1500
Refrigerator	10	x 120	= 1200
Dishwasher	10	x 120	= 1200
Garbage Disposal	5	x 120	= 600
Lights + Plugs	(3 watts / sq foot)		= 6000
		Subtotal	= 13,500

In this example, we use NEC code sections: 220.83 (B) + 625.40

Load Calculation: Adding Electric HVAC, HPWH + EV (NEC 625.40)

			Device Watts
General light and plug	2000	3 W/sq ft	6,000
2 Kitchen counter + 1 Laundry	3	1500 W/c	4,500
Refrigerator		Nameplate	1,200
Dishwasher + Garbage Disposal		Nameplate	1,800
15 Amp HPWH (12A/240V)		Nameplate	2,880
		Subtotal	16,380

							Coinc. Factor		Panel Watts
First 8,000 Watts			8,000	x	1.0	=	8,000
Remaining Watts			8,380	x	0.4	=	3,352
Heat Pump HVAC (17A/240V)		Nameplate	4,080	x	1.0	=	4,080
50 Amp EV Charger (40A/240V)		EVSE Setting	9,600	x	1.25	=	12,000
Total counted Watts									27,342
Divide Watts/240 Volts									114 Amps

No! Exceeds panel capacity

Load Calculation: Adding Electric HVAC, HPWH + EV (NEC 625.40)

			Device Watts
General light and plug	2000	3 W/sq ft	6,000
2 Kitchen counter + 1 Laundry	3	1500 W/c	4,500
Refrigerator		Nameplate	1,200
Dishwasher + Garbage Disposal		Nameplate	1,800
15 Amp HPWH (12A/240V)		Nameplate	2,880
		Subtotal	16,380

							Coinc. Factor		Panel Watts
First 8,000 Watts			8,000	x	1.0	=	8,000
Remaining Watts			8,380	x	0.4	=	3,352
Heat Pump HVAC (17A/240V)		Nameplate	4,080	x	1.0	=	4,080
30 Amp EV Charger (**24A**/240V)		EVSE Setting	**5,760**	x	1.25	=	**7,200**
Total counted Watts									22,692
Divide Watts/240 Volts									

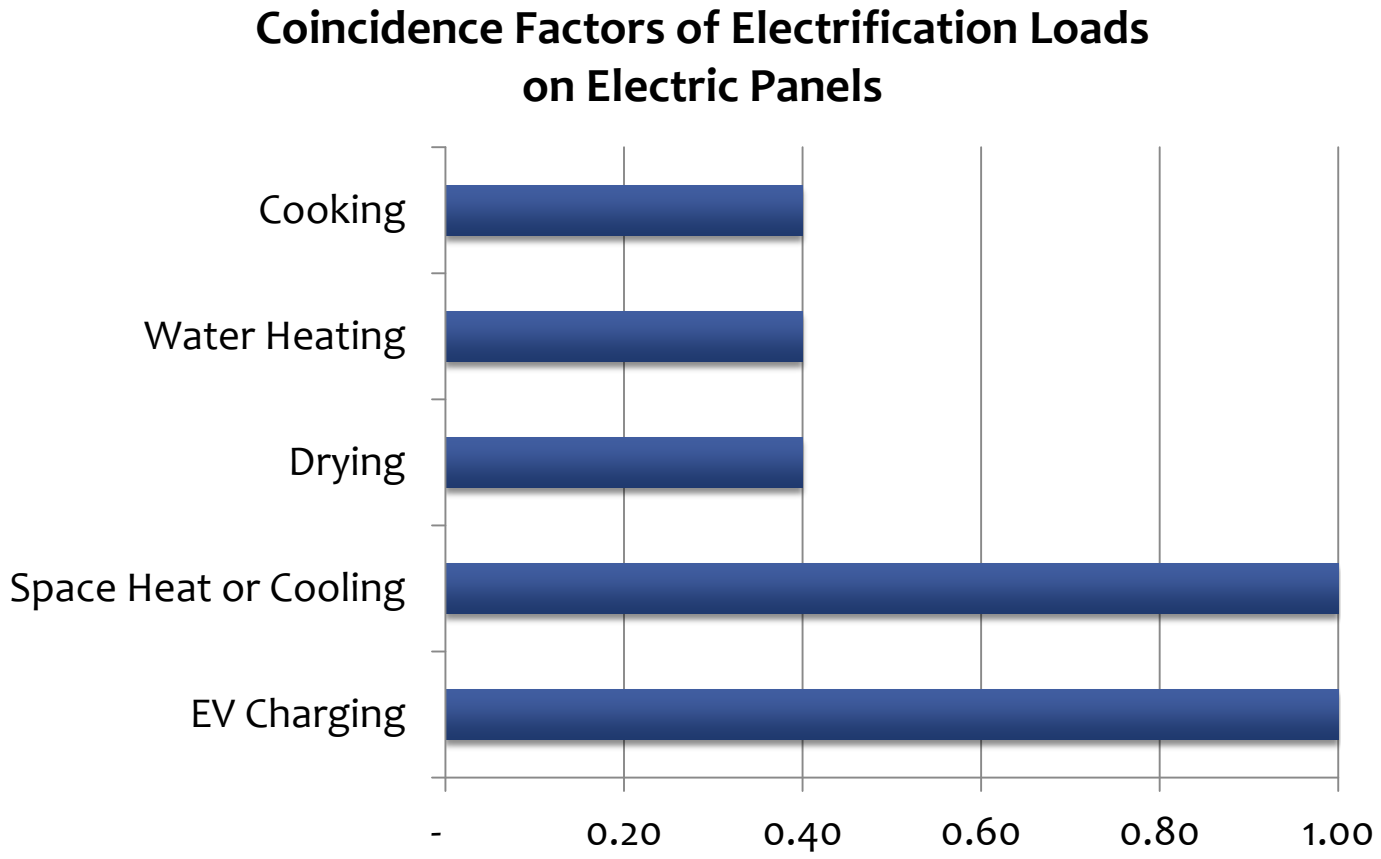
Good! Under panel capacity 94 Amps

Electrical Load Calculations

General Light and Plug Loads					Volt-Amps
Dwelling	2,350 sq. ft.	×	3 VA/sf	=	7,050
Kitchen Small Appliance Circuits	2 (min. 2)	×	1,500 VA each	=	3,000
Laundry (Washing Machine) Circuit	1 (min. 1)	×	1,500 VA each	=	1,500
Appliance Loads (nameplate value)	**Volts**		**Amps**		**Volt-Amps**
Built-in Microwave (not countertop model)	120	×	10	=	1,200
Dishwasher	120	×	15	=	1,800
Garbage Disposal	120	×	9.5	=	1,140
Refrigerator (on dedicated circuit)	120	×	5	=	600
Stove hood	120	×	1	=	120
NEW: Frigidaire gallery 30'' front control induction range with air fry	240	×	42	=	10,080
NEW: Whirlpool 7.4 cu ft hybrid heat pump dryer	240	×	14	=	3,360
NEW: Rheem 15-amp 65-gallon heat pump water heater	240	×	12	=	2,880
General Loads Subtotal					32,730
First 8,000 VA @ 100%					8,000
Remaining VA @ 40%					9,892
General Loads Total					17,892
Other Loads (nameplate value)	**Volts**		**Amps**		**Volt-Amps**
NEW: Electric Vehicle Charging Load @ 125% (with circuit pausing)	240	×	0	=	0
Bathroom Heater #1 @ 100%	120	×	11	=	1,320
NEW: Mitsubishi 3-ton centrally ducted heat pump HVAC system @ 100%	240	×	17	=	4,080
Other Loads Total					5,400
Total Load (General + Other)					23,292 VA
Divide Load by 240 Volts					97 A
Rating of Existing Electrical Service					100 A
Panel Upgrade Required?					No

NEC Article 220.83(B) Coincidence Factors

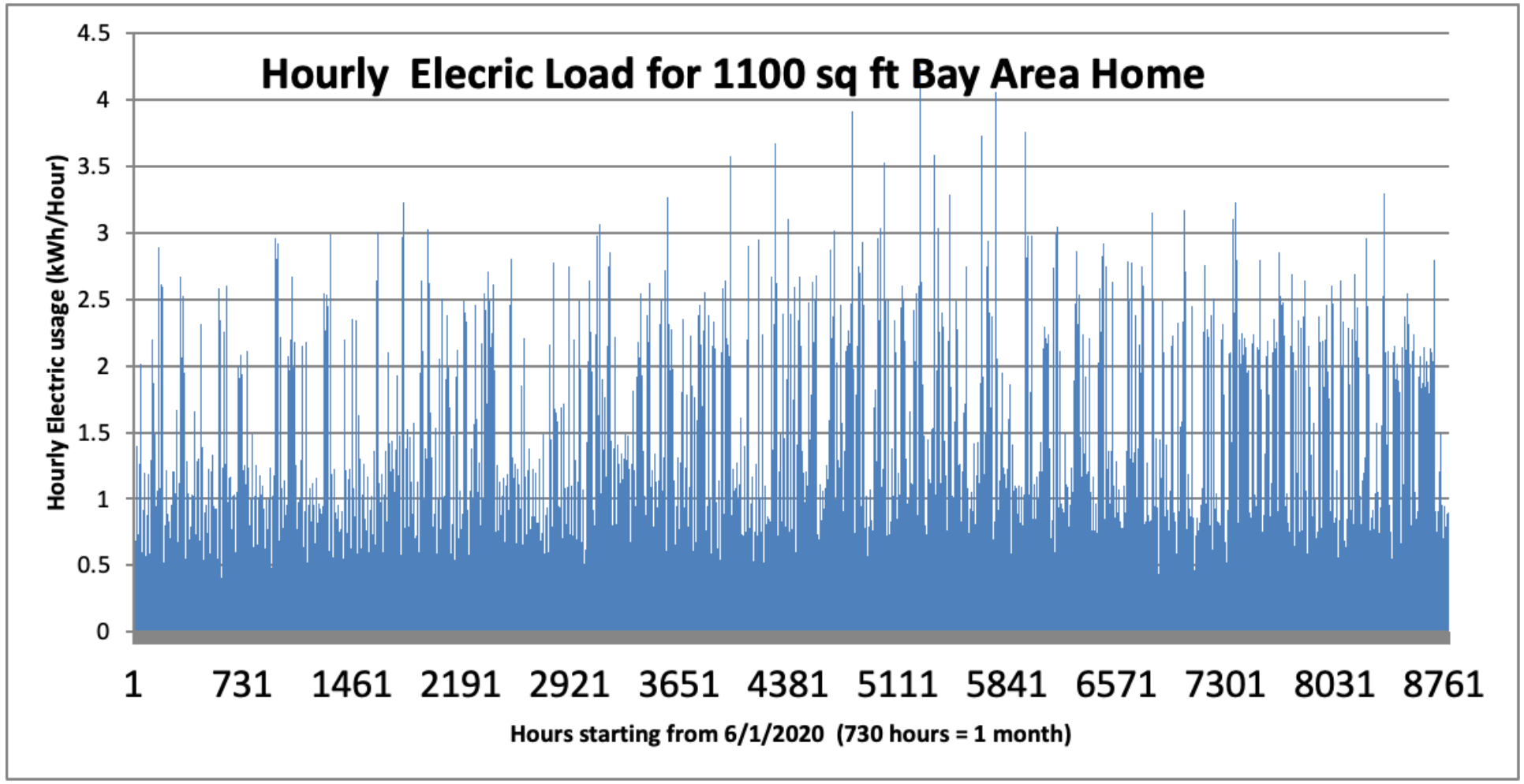
- When using NEC 220.83(B), these are the electrification coincidence factors for adding equipment
- When using NEC 220.87, the factors are all 100% for adding equipment



Load Calculation with 220.87

- Top down history approach
- Starts with peak usage interval last yr (15-min or 1-hr)
- Estimates remaining Feeder, Panel or Service space
- Peak Load * 1.25
- New devices get the remaining ampacity
- Good for adding 1-2 new devices per year
- **Note:** Can not be used if you have solar PV, battery or load management devices already

Determining How Much Electrification a Panel can Accommodate



Using 220.87

- Multiply the 15-minute peak by 1.25 and subtract that from the panel's capacity to find the remaining kW nameplate space
  - e.g. 15-minute peak = 10 kW x 1.25 = 12.5 kW
- Existing 100-amp panel is 24 kW (100 amps x 240 volts)
- 24 kW – 12.5 kW = 11.5 kW nameplate space remaining
- You can add up to 11.5 kW of new attached or dedicated loads

Applying 220.87

Example:

Using 12 months of hourly loads

Max 1-hour peak	4.25	kW	
1.25 x Annual Hourly highest load	5.31	kW	Reserved for existing uses
Panel Capacity	100	Amps	
Panel Capacity	24	kW	
Available Panel Capacity 1st wave	18	kW	Available for new uses
Available Panel Capacity 1st wave	75	Amps	of 240 Volt nameplates or
Available Panel Capacity 1st wave	150	Amps	of 120 Volt nameplates

NEC code sections relevant to electrification

- 220.82 (B) New Homes 10 kW @ 1.0
- 220.82 (C) New Homes HVAC @ 1.0 with some diversity for strip heat and 4+ separate zones
- 220.83 (A) Existing Homes 8 kW @1.0
- 220.83 (B) Existing Homes adding HVAC @ 1.0 coincidence factor
  - First 8 kW of other loads also counts at 1.0 coincidence factor
- 220.54 For multifamily and laundromat dryer fleets, not single-family homes
- 220.87 To use historic hourly usage to find the remaining panel capability
- 625.40 For applying the 1.25 combination long duration factor and coincidence factor for EVSE loads all the way up through the service line

Optimizing the Panel:

ELECTRICALLY & PHYSICALLY

7 ways to lower your panel amps

1. Pick high efficiency equipment (Heat Pump HSPF > 10)
2. Pick power efficient versions of: heat, water, dryer, cooking, EVSE
   e.g. HPs without backup resistance, low Amp HPWHs
3. Avoid oversizing (HP 2-3 tons for most homes, EVSE 20Amps = 39k miles)
4. Pick multifunction devices (e.g. combo washer/dryer, range)
5. Consider circuit sharing devices (e.g. alternate dryer & EV charger)
6. Consider circuit pausing devices (e.g. pauses charger or HPWH)
7. Decrease your loads (e.g. insulation and better shower heads)

Circuit Sharing Devices

- Examples:
  - NeoCharge, Dryer Buddy and SplitVolt let your dryer and EV charger share the existing dryer outlet (and circuit).
  - SimpleSwitch 240 is a hardwired circuit sharing device to let two 240V items share the same circuit and take turns.
- General:
  - They let two devices share, giving priority to one, and letting the other start when the priority device finishes.
- Code counting: Lets you not count the smaller of the two loads
- Bonus: Saves two poles in the electric panel by sharing one circuit

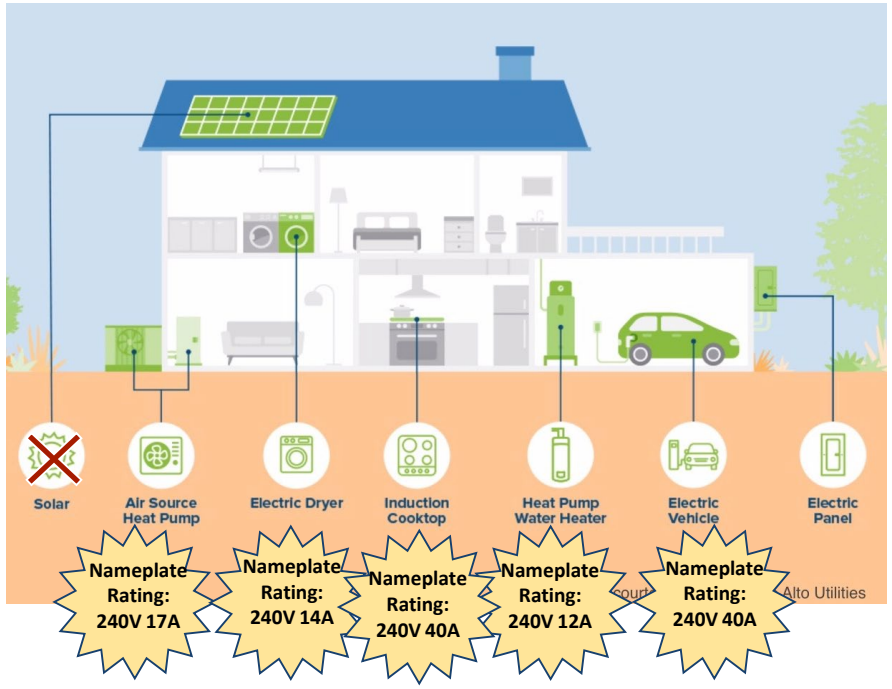
Circuit Pausing Devices

- Examples:
  - Thermelec DCC9 and SimpleSwitch 240M pause the car charger if the load on the electric panel goes over the 80% full level
  - Emporia Smart Charger with Emporia Vu also pasues the car charger if the load on the electric panel goes over the 80% full level
  - Lumin Smart Panel and Lumin Smart Breakers will do the same
- General: Circuit Pausing devices pause the controlled load when needed to keep panel load below a target level.
- Code counting: Lets you not count the controlled load

Load Calculation: All Electric

Home B

Total floor area:	**2,000 sq ft**
Main service capacity:	**100 amps**
No. of gas appliances:	**0**



Load Type	Amps	Volts	Watts
Kitchen Circuit	12.5	x 120	= 1500
Kitchen Circuit	12.5	x 120	= 1500
Laundry Circuit	12.5	x 120	= 1500
Refrigerator	10	x 120	= 1200
Dishwasher	10	x 120	= 1200
Garbage Disposal	5	x 120	= 600
Lights + Plugs	(3 watts / sq foot)		= 6000
		Subtotal	= 13,500

In this example, we use NEC code sections: 220.83 (B) + 625.40

Load Calculation: All Electric

			Device Watts
General light and plug	2000	3 W/sq ft	6,000
2 Kitchen counter + 1 Laundry	3	1500 W/c	4,500
Refrigerator		Nameplate	1,200
Dishwasher + Garbage Disposal		Nameplate	1,800
15 Amp HPWH (12A/240V)		Nameplate	2,880
HP Dryer (14A/240V)		Nameplate	3,360
Induction Range (40A/240V)		Nameplate	9,600
		Subtotal	29.340

						Coinc. Factor		Panel Watts
First 8,000 Watts			8,000	x	1.0	=	8,000
Remaining Watts			21,340	x	0.4	=	8,536
Heat Pump HVAC (17A/240V)		Nameplate	4,080	x	1.0	=	4,080
30 Amp EV Charger (24A/240V)		EVSE Setting	5,760	x	1.25	=	7,200
Total counted Watts							27,816
Divide Watts/240 Volts							116 Amps

No! Exceeds panel capacity

Load Calculation: All Electric + Circuit Pauser on EV Charger

			Device Watts
General light and plug	2000	3 W/sq ft	6,000
2 Kitchen counter + 1 Laundry	3	1500 W/c	4,500
Refrigerator		Nameplate	1,200
Dishwasher + Garbage Disposal		Nameplate	1,800
15 Amp HPWH (12A/240V)		Nameplate	2,880
HP Dryer (14A/240V)		Nameplate	3,360
Induction Range (40A/240V)		Nameplate	9,600
		Subtotal	29.340

						Coinc. Factor		Panel Watts
First 8,000 Watts		8,000	x	1.0	=	8,000
Remaining Watts		21,340	x	0.4	=	8,536
Heat Pump HVAC (17A/240V)	Nameplate	4,080	x	1.0	=	4,080
30 Amp EV + **PAUSER (0A/240V)**	EVSE**+Pauser**	**0**	x	1.25	=	0
Total counted Watts						20,616
Divide Watts/240 Volts						86 Amps

Yes! Under panel capacity

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11 ways to free up physical panel space

1. Pick multi-function appliances
2. Free up furnace circuit
3. Choose shared circuit version 120V HPWH
4. Use tandem or slim breakers
5. Automatic circuit sharing devices (two appliances share one circuit)
6. Junction box (join two low-load circuits)
7. Square D breakers can hold 2 circuits
8. Pig Tail breaker can hold 2 circuits
9. Add subpanel for ~9 circuits
10. Line tap solar
11. Use a meter collar (bypasses the main panel and connects to the meter)

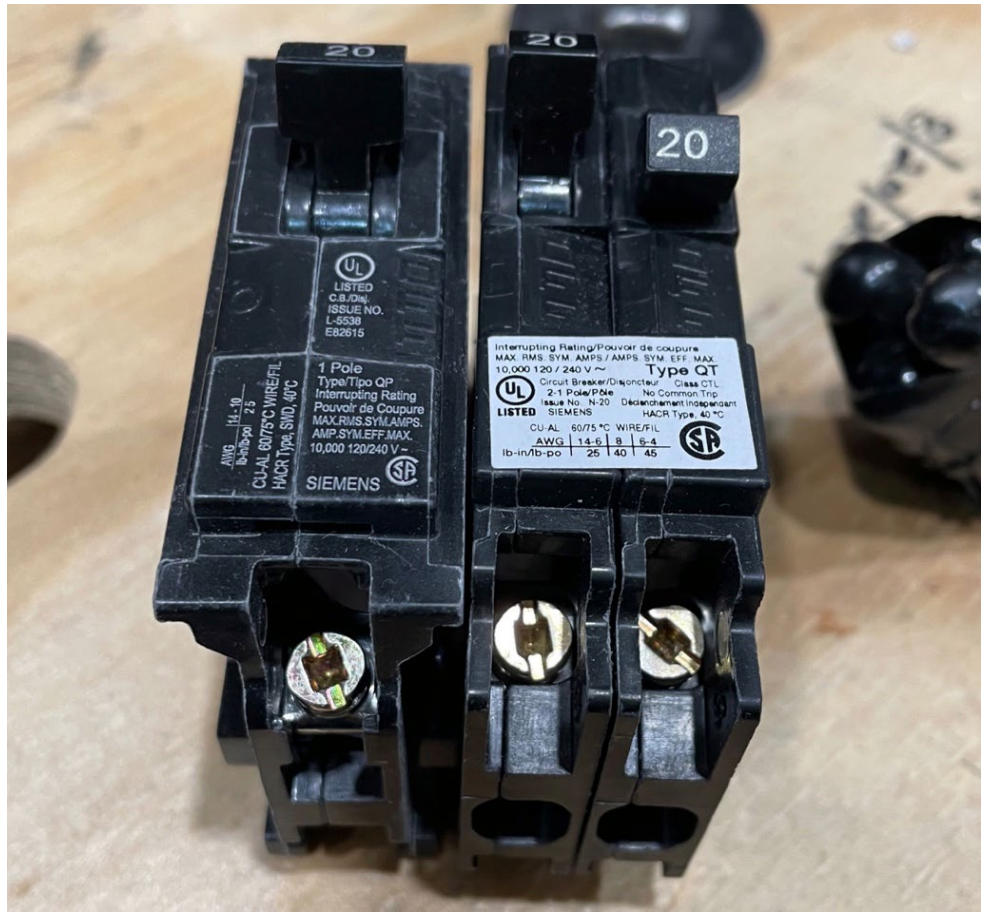
Examples of multi-function devices

- Combined slide-in range has oven and cooktop on one circuit
- Combined (All in one) Washer/Dryer has both washing and drying performed by the same machine
- Combined Space heat pump and water heat pump provide both space heating and cooling on the same circuit
- Umbilical fed mini splits and ductless mini splits power both the outdoor machine and the indoor machine from the same circuit

Free up the Furnace circuit w/ umbilical-fed central heat pump or a ductless heat pump

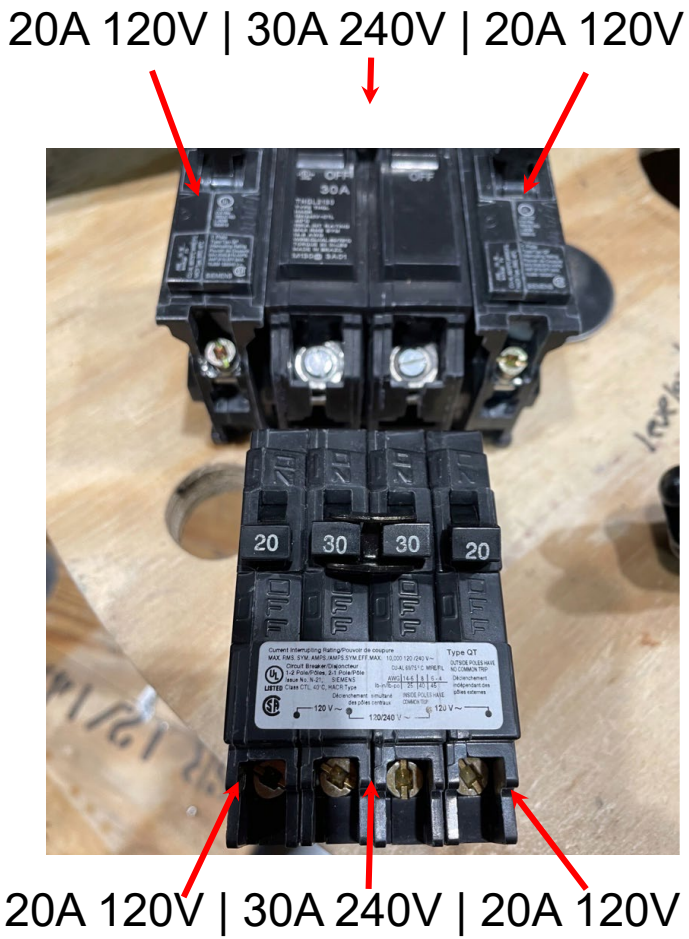
- Umbilical fed mini splits and ductless mini splits power both the outdoor machine and the indoor machine from the same circuit.
  - Central Examples: Mitsubishi Fujitsu, Mr. Cool
  - Any ductless heat pump.
- This frees up the typical 120V 15 Amp furnace circuit to be used as a 120V HPWH circuit, or for other use

Tandem Breakers are Slim Breakers



- Fits two breakers on to one pole and one space

Comparing wide and slim breakers



Top set of 3 breakers is (left to right):

- 20A 120V 1 pole
- 30A 240V 2 poles
- 20A 120V 1 pole

Bottom breaker is also (left to right):

- 20A 120V 1 pole
- 30A 240V 2 poles
- 20A 120V 1 pole

Add a subpanel

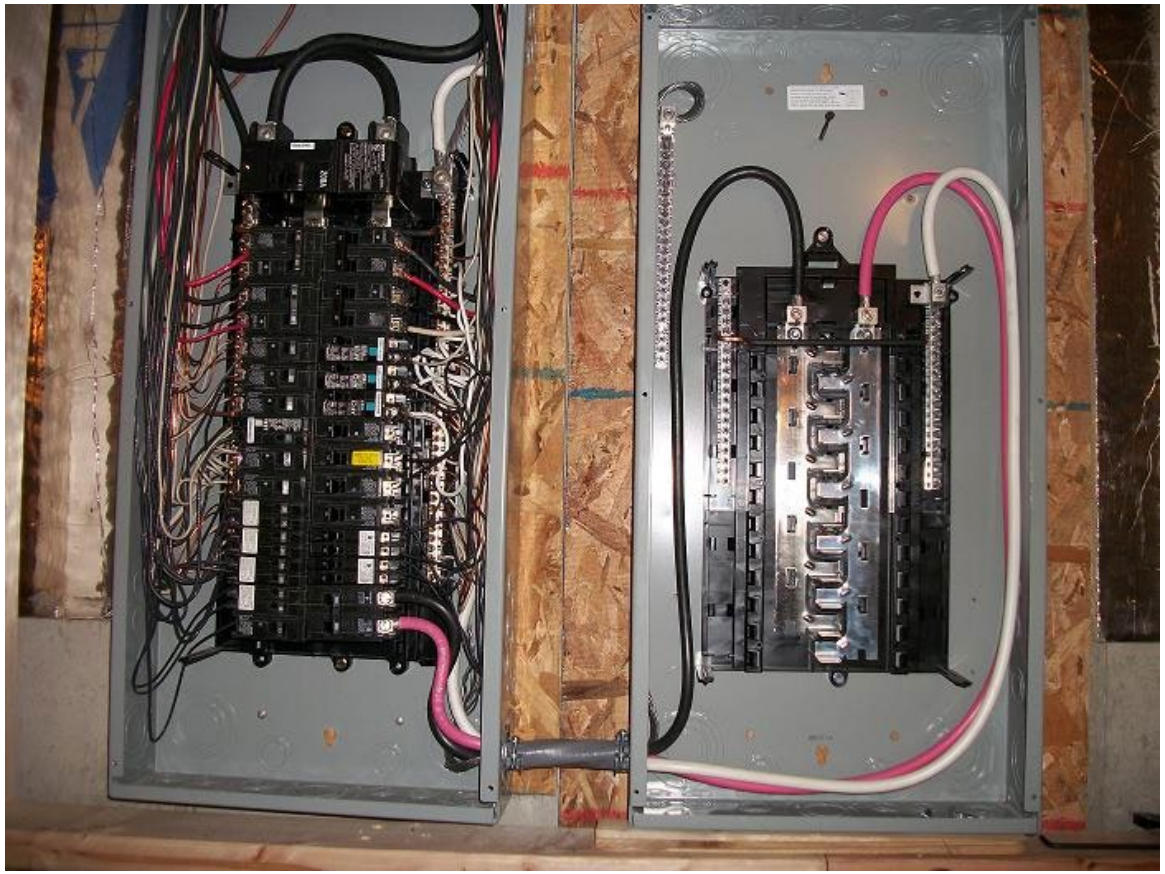


Image Courtesy of wiringdoneright.com

- Subpanels create physical space for new circuits

ConnectDER: Connects meter + panel

- Meter Collars
- Similar to Sempra Renewable Energy Collar

Using a few ‘tandem’ or ‘slim’ breakers

Top left breaker is normal 1” 1 pole breaker

Top two breakers on right are 2 tandem breakers filling the same sized space

Middle right 2” wide breaker has two-pole middle section for a 240V circuit and two more slim single-pole breakers on the outside

Bottom right shows 2” wide 2-pole breaker for comparison

Examples of combining old under-loaded circuits

- Junction box
  - (combines two 15 amp circuits into one 15 amp wire to a 15A breaker)
  - (combines two 20 amp circuits into one 20 amp wire to a 20A breaker)
- Square D brand has breakers allowing two wires held in one jaw
- Can use a “Pig Tail” in the panel combining two wires into one wire fed by the same amperage breaker
- Can use a Sub Panel fed by one big breaker and a feeder wire.
  - The sub panel can feed up to ~10 circuits
  - Useful for replacing knob and tube wiring or for shortening the branch wire paths

Exciting NEW products for electrifiers

120V Washer/Dryer:
GE Profile 4.8 cu ft combo unit w/ heat pump dryer 11 amps / 120 volts

120V HP Water Heater:
AO Smith Voltex 120V Plug-in Hybrid Electric Heat Pump 10 amps / 120 volts

120V HP Water Heater:
Rheem Proterra 120V Plug-in Hybrid Electric Heat Pump 4 amps / 120 volts

Equipment silver bullets

1. 120-volt heat pump water heaters or 240-volt 15-amp hybrid water heaters
2. Upsizing water heater and adding a mixing valve to accommodate slower recovery time
3. 17-amp inverter-driven heat pump HVAC systems that are not just power efficient and energy efficient but also extremely quiet
4. Centrally ducted heat pumps w/ air handlers on same circuit, or multizone ductless
5. Split heat pump water heaters for tight spaces (consider combo washer/dryer to make space)
6. Heat pump dryers or combo washer/dryers (single 120-volt machine that washes and dries)
7. Wallbox Pulsar EV charger with adjustable current (6 to 32 amps)
8. Circuit-sharing devices like Neocharge and SimpleSwitch
9. Circuit pausers like DCC9, SimpleSwitch 240M and EV Duty, Emporia Smart Charger
10. Smart electric panels like Span.io

Resources:

- Watt Diet Calculator (Redwood Energy):

  https://redwoodenergy.net/watt-diet-calculator/
- Home Electrification Retrofit Guide (Redwood energy):

  https://redwoodenergy.net/wp-content/uploads/2021/11/SF-Retrofit-Guide-2021-09-08.pdf
- NEC Online

  https://www.nfpa.org/codes-and-standards/all-codes-and-standards/list-of-codes-and-standards/detail?code=70
- Main Panel Basics:

  https://www.youtube.com/watch?v=UBERduCp3Wo
- ZeroCarbon-Home:

  https://www.zerocarbon-home.com/

Societal Benefits of Panel Optimization

- Preserves workforce for more rapid electrification
  - Electricians, Utility line crews, Utility project planners, Distribution engineers
- Leaves more neighborhood space for electrification on distribution wires
- Keeps electric rates low by reducing and delaying transformer upsizing etc.
- Starts a virtuous cycle of rate reduction and electrification
- Long low duty cycles help support solar power usage
- Reduces use of fossil peaking plants

Questions?

Closing

- Coming to Your Inbox Soon!
  - Slides, Recording, & Survey – Please Take It and Help Us Out!
- Upcoming Courses:
  - Home Electrification Planning Class 3: Developing and Electrification Plan (9/5)
  - Getting Past Heat Pump Objections (9/8)
  - Introduction to Passive House Retrofits (9/11)
  - Installing Heat Pumps: Lessons from the Field (9/13)

Thank you!

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