






# Home Electrification and Electric Panel Upgrades

On August 2022, President Biden signed the Inflation Reduction Act into law marking the most significant action Congress has taken on clean energy and climate change in the nation's history.

One aspect of the Inflation Reduction Act is providing many incentives to support the transition to all-electric homes. A key barrier associated with electrifying is electrical panel capacity. Homeowners need to understand their electrical panel capacity

when considering electrifying. This resource will help individuals gain a deeper understanding of their electric panels and their options to create the easiest path towards electrifying their future.

## Common Electrification Upgrade Triggers

Electrification Upgrade	Description	Benefits	Cost
 Electric Dryer	Clothes dryers might be one of the easiest appliances to switch to electric. Electric dryers include ventless heat pump dryers, condensing dryers, and all-in-one washer dryers.	<ul style="list-style-type: none"><li>• Energy efficiency</li><li>• Convenience</li></ul>	\$
 Electric Oven and Cooktop	Moving from a mixed-fuel residential kitchen to an all-electric kitchen is fully achievable today with induction range tops and electric resistance ovens. Induction technology uses a magnetic field to heat pots and pans for cooking.	<ul style="list-style-type: none"><li>• Better indoor air quality</li><li>• Reduced asthma risk</li></ul>	\$
 Electric Water Heating	Heat pump water heaters (HPWHs) use electricity to pull heat from the surrounding air and transfer it into a hot water tank.	<ul style="list-style-type: none"><li>• Energy efficiency</li><li>• Better air quality</li></ul>	\$\$
 Electric Space Heating	A heat pump is a single electric appliance that can replace both your traditional air conditioner and home heating system. Heat pumps use electricity to move heat from one place to another. For cooling, a heat pump moves the heat from inside your home to the outside.	<ul style="list-style-type: none"><li>• Energy efficiency</li><li>• Better air quality</li></ul>	\$\$
 Electric Vehicle Charger	EV chargers pull electricity from your home and delivers it to an electric vehicle.	<ul style="list-style-type: none"><li>• Reduced operating and maintenance costs</li><li>• Better for the environment</li></ul>	\$\$\$



## Electric Meter

An electric meter is typically located outside and is the device that measures the amount of electric energy consumed by a residence. Electric panel size is determined by the current rating of the main breaker and typically ranges between 100-400 Amps.

## Understanding Your Electrical Panel and Its Important Parts

An electrical panel is responsible for safely delivering electricity from the utility's power lines to your home. The electric panel controls how much current and power are allowed in and apportions the electricity into different areas of your home via switches and breakers. The panel capacity determines the maximum amount of power that your lights and appliances can be drawing at any given time.

**Circuit Breaker:** a switch used in more modern systems.

- **Single Pole Breaker:** a circuit breaker that runs most of your smaller electricity needs as it handles up to 120 amps.
- **Fuse:** found in older systems similar to a circuit breaker.
- **Double Pole Breaker:** a circuit breaker that runs your larger appliances, such as your dryer or water heater, as it handles up to 240 amps.

**Expansion Slots:** an area where a new circuit breaker can go at a later date, such as when adding an addition to your home.

**Service Disconnect Switch:** a switch that allows you to turn off all the power to your home.



## Most Common Types of Electrical Panel

The size of the panel is usually based on when your home was constructed. Two common types of electrical panel are:

**Medium-Sized Service Panel:** This is at least a 100 amp service panel and is common in many older homes that have not had a major renovation or home addition. The National Electric Code, or the NEC, requires that a service panel must be at least 100 amps.

**Large-Capacity Service Panel:** This 150—or 200 amp panel is found in many newer homes and some older larger homes.

The difference between breaker box “sizes”

- The amount of electricity the panel can handle
- The number of circuits a panel can handle

## Do I Have Room on My Panel or Do I Need to Upgrade?

Before making any electrification upgrades, it is important to know the amp capacity of your current electrical panel. Many modern homes have 200 amp panels, but it is not unusual for older homes to have 100 amp units. You can tell how many amps of service your panel receives by:

1. Inspecting the utility's meter box for a label with an amperage rating
2. Inspecting your electrical panel for a label with its amperage rating
3. Checking the size of the main breaker on the panel

## Physical Space vs. Electrical Space

There are two reasons you may need to increase your electrical panel size. There may not be enough physical space for additional breakers or, there may not be enough electrical space. Breakers will typically add up to more than the capacity of the panel so you cannot add up the breakers and subtract them from the panel rating to determine electrical space. This is because the appliance load is usually less than the breaker load, and not everything in the house operates simultaneously. Electricians use the nameplate load for load calculations to calculate the maximum possible amount an appliance will use. Usually, the actual load from the appliance is significantly lower. For example, properly sized heat pump water heater will never draw full amperage.

## How to Calculate Electrical Capacity?

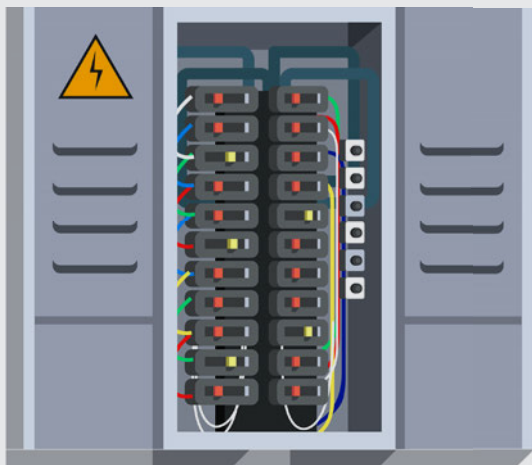
Electrical load capacity is defined as the total amount of power that your main source of electricity provides for your home. This is used by all of your home's circuits and all outlets, appliances, or lights connected to these circuits. The total capacity of your home's electrical system is measured in Amperage or Amps. Calculating how much power your home needs involves calculating the amperage load of all the various appliances and fixtures, then building in a margin of safety. Electricians recommend that the load never exceeds 80 percent of the electrical service capacity.

### Relationship between watts, volts, and amps:

These terms have a mathematical relationship that can be expressed in a couple of ways:

- Voltage (Volts) x Current (Amps) = Power (Watts)
- Watt/Volts = Amps

The National Electric Code provides two different methods for calculating the minimum size of residential electric panels, the Standard Method (NEC 220.40) and the Optional Method (NEC 220.80). This factsheet focuses on the two Optional Methods. Optional Method One which utilizes the current utility bill is both easier and more accurate than Optional Method Two which calculates the existing load based on the number and type of appliances and receptacles.



### OPTIONAL METHOD ONE

Determining existing loads can be completed by using utility records. Based on the National Electrical Code (NEC 220.87), this code-based method is one of the most accurate ways to calculate the electrical load. The utility record can be used to establish maximum annual demand in kWh and be converted to amps.

**Example:** Maximum demand in kWh from electricity bill X 125% / (240V X 1 hr) = Ampacity of existing load.

If the ampacity of the existing load plus any new potential loads you may want to add is less than the ampacity of your homes electrical panel, the electrical panel does not need to be upgraded.

## OPTIONAL METHOD TWO

The National Electrical Code (NEC 220.83) describes the steps to determine if an electrical service can safely accommodate new loads.

### Calculation to determine the appropriate size for your electrical service:

1. Start by identifying the square footage of the home to determine the estimated lighting and receptacle loads:	3 VA/ft x _____ = (house finished square footage)	<b>1</b>																																														
2. 20A small appliance and laundry branch circuits	1500 VA x _____ = (20A small appliance and laundry branch circuits (minimum 3))	<b>2</b>																																														
3. Add in all permanent appliances— Code states 1500 VA per 2-wire 20A small appliance branch circuit and laundry branch circuit, and nameplate rating of all appliances fastened in place:	<table border="0"> <tr><td>Oven</td><td>_____</td><td>_____</td></tr> <tr><td>Cooktop</td><td>_____</td><td>_____</td></tr> <tr><td>Fixed Microwave</td><td>_____</td><td>_____</td></tr> <tr><td>Dishwasher</td><td>_____</td><td>_____</td></tr> <tr><td>Disposal</td><td>_____</td><td>_____</td></tr> <tr><td>Electric Clothes Dryer</td><td>_____</td><td>_____</td></tr> <tr><td>Electric Clothes Washer</td><td>_____</td><td>_____</td></tr> <tr><td>Well Pump</td><td>_____</td><td>_____</td></tr> <tr><td>Sump Pump</td><td>_____</td><td>_____</td></tr> <tr><td>Garage Door Opener</td><td>_____</td><td>_____</td></tr> <tr><td>Hot Tub</td><td>_____</td><td>_____</td></tr> <tr><td>Other</td><td>_____</td><td>_____</td></tr> <tr><td>_____</td><td>_____</td><td>_____</td></tr> <tr><td>_____</td><td>_____</td><td>_____</td></tr> <tr><td><b>TOTAL:</b></td><td>_____</td><td>_____</td></tr> </table>	Oven	_____	_____	Cooktop	_____	_____	Fixed Microwave	_____	_____	Dishwasher	_____	_____	Disposal	_____	_____	Electric Clothes Dryer	_____	_____	Electric Clothes Washer	_____	_____	Well Pump	_____	_____	Sump Pump	_____	_____	Garage Door Opener	_____	_____	Hot Tub	_____	_____	Other	_____	_____	_____	_____	_____	_____	_____	_____	<b>TOTAL:</b>	_____	_____	<b>3</b>	
Oven	_____	_____																																														
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_____	_____	_____																																														
<b>TOTAL:</b>	_____	_____																																														
4. Adjust appliance loads:	a. Sum all above loads	<b>4a</b>																																														
	b. Take the first 8000 VA at 100%	<b>4b</b>																																														
	c. Take the remainder at 40%	<b>4c</b>																																														
	d. Add 4b and 4c to get the general load	<b>4d</b>																																														
5. Add the wattage of your AC or heating appliances (furnace + space heaters), whichever is greater—Don't add both	a. Cooling Load Outdoor Unit _____ Air Handler _____ <b>TOTAL COOLING:</b> _____	<b>5a</b>																																														
	b. Heating Load Heat Pump Outdoor Unit _____ Air Handler _____ Backup Electric Heat _____ Electric Baseboard/Space Heaters _____ <b>TOTAL HEATING:</b> _____	<b>5b</b>																																														
6. Add load and divide by 240V (add 4d + 5a or 5b (whichever is greater))	_____ ÷ 240V = (load total)	<b>6</b>	suggested amperage needed to power your home																																													

## Other Options Besides Electrical Panel Upgrades When Considering Electrifying

1

### Panel Optimization

Choose power-efficient appliances and circuit-sharing devices.

2

### Technology

(smart panels or smart circuit breakers)

Smart panels or smart circuit breakers that control individual circuits to regulate a home's peak electricity demand.

## Additional Sources

1. [Efficiency First CA](#)
2. [Rewiring America](#)
3. [Rewiring America Inflation Reduction Act Calculator](#)
4. [Redwood Energy Watt Diet Calculator: Electrifying the home without upsizing the electric panel](#)
5. [Pecan Steet](#)

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New Buildings Institute (NBI) is a nonprofit organization working to advance energy efficiency and decarbonization in the built environment. Our efforts are imperative to keeping energy costs affordable, cutting emissions that are fueling climate change, and delivering on improved health, safety, and resiliency for everyone. Throughout its 25-year history, NBI has become a trusted and independent resource helping to create buildings that are better for people, communities, and the planet. Learn more at [newbuildings.org](https://newbuildings.org).

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