Introduction to the Clean Energy Home

This guide provides an overview of technologies available to transition your home to clean energy, a framework for making those upgrades and links to more in-depth resources for each specific home upgrade.
Table of Contents

What is a Clean Energy Home? 4
Planning to Transition Your Home to Clean Energy 5
Understanding Your Home’s Greenhouse Gas Emissions 6
Efficiency First 7
When to think about energy efficiency 7
Upgrade Your Electrical Service (If Necessary) 8
Heating and Cooling 9
Hot Water 10
Clothes Dryer 11
Stove & Oven 12
Installing an Induction Stovetop 13
Transportation 14
Ways to Charge EVs 14
Solar PV 16
Offshore Wind 17
Battery Storage 18
What is a Clean Energy Home?

Solar Electricity
Solar PV Panel
Air Handling Unit
Vent
Induction Stove
Battery Storage
Electric Vehicle
Air-Source Heat Pump
Outdoor Unit
Air-Source Heat Pump
Indoor Floor Unit
Air-Source Heat Pump
Outdoor Unit
Hot Water Tank
Heat Pump Dryer

Clean Energy Lives Here
MASSCEC.COM/GOCLEAN
This guide covers multiple appliances, which would be expensive to replace all at once. Instead, we recommend prioritizing what makes sense for your home. All the appliances discussed in this guide will need to be replaced at some point. As you’re thinking of replacing each appliance, research the clean options and make a plan to switch.

Many appliances discussed in this guide run on electricity. Based on the current electric grid in Massachusetts, use of these appliances may result in some greenhouse gas emissions because a portion of the grid is powered by fossil fuels. Modern heat pumps are so efficient that with today’s grid mix they generate lower emissions than directly burning fossil fuels to achieve the same amount of heat. As the Commonwealth moves towards its goal of net zero carbon by 2050 and sources like solar and offshore wind increase the supply of renewables on our electric grid, electric appliances will have a lower carbon impact than appliances that run on fossil fuels.

MassCEC has developed a planning tool to help you transition your home to clean energy. Make your plan today.

For more resources on a clean energy home, visit: goclean.masscec.com/resources.
Understanding Your Home’s Greenhouse Gas Emissions

As discussed in the previous section, MassCEC recommends transitioning to clean energy appliances as your existing appliances reach the end of their useful lives. Homeowners motivated by reducing greenhouse gas emissions may also find it helpful to understand the relative climate impacts of different energy uses in their home. Of the greenhouse gas emissions generated in Massachusetts, 24% are from residential buildings (including the electricity used in those buildings), and an additional 26% are from passenger and light duty vehicles.

The chart below shows that heating makes up 54% of the greenhouse gas emissions from residential buildings in Massachusetts. While emissions vary significantly from household to household based on factors like number of occupants, efficiency of the home, and heating fuel, switching to clean heating will likely make a large impact on your home’s carbon footprint. The next single largest source of emissions in a typical home is hot water heating.

Outside of the home itself, transportation is a huge source of energy for the average household. For example, a vehicle that gets 25 miles per gallon and is driven 10,000 miles per year emits 3.7 metric tons of carbon dioxide per year. For comparison, the average Massachusetts household emits about 6.8 metric tons of carbon dioxide equivalent per year for their home’s building uses, including electricity.

If you are interested in better understanding your household’s carbon footprint, the Environmental Protection Agency (EPA) offers a [Household Carbon Footprint Calculator](https://www.epa.gov/energy/carbon-footprint-calculator).
Efficiency First

Making your home more energy efficient will help save on utility bills and reduce greenhouse gas emissions by lowering the amount of energy needed to heat or cool your home, regardless of your heating and cooling system’s fuel type. Adding insulation, doing air sealing, and replacing out your light bulbs with LEDs are all great ways to reduce the energy needs of your home and make you more comfortable today.

Energy efficiency measures will enable savings on the other home upgrades discussed in this guide. For example, a less leaky, better insulated home will let you buy smaller heating and cooling units and save money on both their upfront and operating costs.

When your roof needs to be replaced, add insulation while the roof is exposed.

When your house needs to be re-sided, add insulation while the siding is off.

When you are considering replacing windows and doors, install more energy efficient windows and doors.

Get a home energy assessment and learn about energy savings opportunities for your home today, including air-sealing and blown-in insulation.

If a showerhead, faucet, or toilet needs to be replaced, install one with a lower water flow. Look for WaterSense fixtures.

If a dishwasher or clothes washer breaks and needs to be replaced, install an energy- and water-efficient model.

When light bulbs go out, replace them with LEDs.

When to think about energy efficiency

These common home improvement scenarios are ideal times to make energy efficient choices:
Two hundred amp electrical service is usually required for homes with heat pumps and electrical appliances. If your home has less than 200-amp electrical service, talk to an installer or electrician about whether you should upgrade. Check out this site for instructions on how to determine the amperage of your home’s electric service. This Old House also has a helpful video that shows what an electrician will do to upgrade your electric meter and panel. Upgrading your home’s electrical service can be a good investment, especially if you think you may install an electric vehicle charger or other new electrical appliances in the future. This upgrade typically takes one day to complete, and usually costs $2,000 to $3,500. A licensed electrician will perform the upgrade and will also coordinate with your electric utility and your local permitting agency to ensure the job is code-compliant.
Heating and Cooling

Most heating and/or cooling systems last 15-20 years; if your heating and/or cooling system is approaching the end of its life, replace it with a clean energy option, such as air-source heat pumps, ground-source heat pumps, or automated wood heating. A clean heating and cooling system can significantly reduce your environmental impact while delivering a higher level of comfort than a fossil fuel or electric resistance system. There are clean heating and cooling options available that meet the comfort needs of homes of all shapes and sizes.

Air-source heat pumps and ground-source heat pumps both use electricity to operate. They transfer heat from the outdoor air or ground to provide heating and cooling. Automated wood heating systems burn locally sourced, sustainable wood pellets instead of fossil fuels to provide heating.

MassCEC’s Technologies for Your Clean Energy Home gives a detailed overview of different clean heating and cooling technologies provides the steps to install a clean energy system. MassCEC’s Clean Energy Ready gives homeowners information on how to make a plan and prepare your home for clean energy transitions.
When planning to replace your hot water heater, consider a clean and renewable option. Like clean heating and cooling systems, a clean hot water system can reduce your monthly energy bills, reduce your greenhouse gas emissions, and lower your dependence on fossil fuels. Most hot water heaters last 10 years; if your hot water heater is approaching the end of its life, consider replacing it with a clean energy option, such as solar hot water, heat pump water heaters, or an electric tankless water heater.

**Solar hot water systems** use heat from the sun to heat a fluid in solar collectors that is then circulated to a hot water tank where the fluid transfers heat for home hot water use. **Heat pump water heaters** use electricity to move heat from one place to another to heat your hot water.

MassCEC’s [Clean Energy Ready Guide](#) outlines a couple of hot water options for homeowners. Choose which hot water system is right for you. Then take steps to transform your current system to a new clean and renewable hot water system.
Some clothes dryers burn natural gas or propane to generate heat to dry your clothing. Switching your clothes dryer to run on electricity can reduce your home’s greenhouse gas emissions. Most clothes dryers last 10–13 years; if your clothes dryer is approaching the end of its life, replace it with a clean energy option, such as an electric clothes dryer or a heat pump clothes dryer.

Traditional electric clothes dryers use electricity to generate heat to dry your clothes. Another option is a heat pump clothes dryer. These run similarly to a heating or cooling heat pump, except that all components are inside the dryer and no connection to the outdoors, not even a vent, is needed.

Heat pump clothes dryers use 40% to 50% less electricity than an electric dryer but will take slightly longer to dry your clothes and you will need to occasionally empty a secondary lint filter. Heat pump clothes dryers are great in spaces where it is not easy to vent to the outdoors.

For more information, Green Building Advisor outlines the components of a heat pump clothes dryer and This Old House describes how heat pump clothes dryers operate.

While thinking about your clothes dryer, you may be wondering what you can do to transition your clothes washer to clean energy. Washing your clothes in cold water is an energy-saving strategy for any washing machine given the considerable energy input required to create hot water. If you must wash your clothes in hot water, upgrading to non-fossil fuel hot water system will reduce the greenhouse gas emissions from hot water washing. Investing in the most efficient clothes washer when your old one fails is another great way to use less energy in your laundry activities.
As long as you have a gas stove, you will need a gas pipeline to your home. By switching your cooking range to be fueled by electricity instead of gas, you can further electrify your home and eliminate the need for a gas hookup. Gas stoves emit pollutants, including greenhouse gases and chemicals, that are bad for your health. Switching your stove to run on electricity will reduce your greenhouse gas emissions and your dependency on a gas pipeline to your home. If you’re in the market for a new stovetop or oven, consider a clean energy option, such as an electric stovetop or a high-precision induction stovetop.

Traditional electric stovetops use electric coils to provide heat to cook food. An induction stovetop uses magnetic fields to generate heat instead of generating heat from an electric resistance coil. All magnetic pots and pans (including cast iron and most stainless steel) can be used on an induction stovetop. Food will cook more evenly because the heat is spread out over the entire bottom of the pan. Many chefs find induction stovetops preferable to gas.

**Benefits of Induction Stovetops:**
- Cooks food faster
- More energy-efficient
- More precise temperature control
- Stovetop is not hot to touch (great for cooking with kids!)
- Easier to clean (just wipe with a wet sponge or rag)
- Safer (no open fire flames, and less exposure to harmful chemicals)
Installing an Induction Stovetop

Induction stovetops look similar to an electric stovetop; they feature flat glass surfaces, usually with designated spaces to place pots and pans. To indicate that an induction stove is turned on, some manufacturers have added images of flames that appear when the stove is on.

Considerations when installing an Induction Stovetop:

- Placement of cooktop: Induction stovetops have similar dimensions to a standard stove or electric stovetop. If replacing an old stovetop, you can replace it with the same size induction stovetop or customize the induction stovetop to meet the dimensions in your home.

- Electrical Requirements: Induction stovetops require a 240-volt circuit. If you are unsure whether your electrical circuit will work, check the manufacturer specs or ask an electrician. You may also need a cable to connect the stovetop to your home wiring. We recommend hiring an electrician for any electrical circuit questions or installation.

- Closing gas hookup: To shut off your gas hookup to your stove, check the gas code in your area. Contacting your gas provider is the best way to find out the steps to cut off your gas line. In most cases, your gas provider will come out and disconnect the gas line to your house.

If your oven is separate from your stovetop, you can also transition your oven to electricity. Most ovens last 10-20 years; if your oven is approaching the end of its life, replace it with an efficient electric oven. Ovens with a convection fan are more efficient and they cook food faster and more evenly.

Another kitchen appliance to consider is your dishwasher, which either uses your home’s hot water or creates its own hot water using electricity. Buying the most efficient dishwasher when your old one fails and only running your dishwasher when it’s full are great ways to save energy.
Transportation

In addition to reducing your home’s greenhouse gas emissions, you can also switch to an electric vehicle to decrease transportation pollution. Electric vehicles use electricity to charge a battery, which then discharges its energy to propel the vehicle. Instead of requiring gasoline fill-ups at a gas station, electric vehicles are plugged into electric chargers, either in a public place or at home. Most gasoline-powered cars last 8–15 years; if your car is approaching the end of its life, replace it with an electric vehicle.

Ways to Charge EVs

**Charge at Home:** Homeowners can install charging stations at home. There are two types of charging units to charge an EV at home.

**Level I** charging units use a regular household outlet (120-volt) and charge about four miles of range per hour of charging. While this may sound like a slow charging option, homeowners who plug in their car for 8–10 hours each night will charge a car’s range by 32–40 miles, about as many miles as the average commuter drives per day. If you already have an outlet near where you park your car you can use that outlet for Level I charging without any additional upgrades.

**Level II** charging units charge EVs at a faster rate but require some household upgrades. Level II charging units use a 240-volt outlet, which entails an electrician to install. Homeowners will also need an additional cable to connect the outlet to the car, and a cable box to monitor the amount of current the EV is drawing from the outlet and a cable to connect the car to the charging station. Installing a Level II home charging station will typically cost between $600 and $1200, although it could cost more if your home requires an electrical upgrade to install the Level II charging station.

**What Homeowners Should Consider when Installing a Charging Unit at Home:**

- How much charging capacity they will need (to determine installing a Level I or Level II charging unit)
- Placement of charging station (in a garage or with a protective cover is best)
- The charging cord is long enough to reach the car
- Any household upgrades that are needed prior to installation (such as increasing the home’s electrical service or expanding its electrical panel)

During the winter, general battery range and efficiency will decrease. Drivers will also use more cabin heat and/or heated seats, which will increase the draw on the battery. Using cabin heat uses more power than using a heated seat. Having a Level II charger can be convenient. In addition to faster charge time, it can help extend battery range when you want to “precondition” (heat or cool the vehicle’s cabin) prior to a trip, by using grid power for the heating or cooling. For owners with a Level II charger, when you precondition, once you are ready to use your car, you will leave with a fully charged and heated battery and cabin. Most EVs will allow you to set the time that your car starts to precondition, so your car is ready when you leave in the morning. For some vehicles, Level I chargers do not provide enough power to fully precondition and the battery will be used to do so when the car is first turned on, reducing its range. This will make the battery less than fully charged when you are ready to leave in the morning.

For more information on installing electric vehicle charging at home, check out the Green Energy Consumers Alliance’s Installing Electric Vehicle Charging at Home, and Winter Driving.
Public Charging: Public charging units are available in many public parking garages, retail parking lots, car dealerships, and some town centers. These chargers can be free or require a small fee to use. Public charging units are either Level II chargers, or even faster Level III chargers, where EV’s can reach 80% charge in 30 minutes. If readily available, public charging eliminates the need to install charging units at home. Phone apps and websites are available to homeowners to find open charging stations nearby.

Workplace Charging: Some companies now provide electric car chargers in their garages or employee parking lots. Workplace charging also eliminates the need for homeowners to install charging units at home and allows employees to charge their cars while at work.
Installing a Solar Photovoltaic (PV) system on your home can provide renewable energy for some or all of your electrical load. Solar PV systems convert sunlight into electricity through an array of panels that connects to a building’s electrical system and/or the electrical grid. Based on the size of your Solar PV system, it can provide electricity for your lights, heating, cooling, hot water, all appliances, and car charging.

A solar PV system has several panels that are wired together and connected to the power distribution network of a home. Collectors are typically mounted to the roof of a building, but they can also be mounted to the ground if there is adequate ground space near a building. Due to Massachusetts’ latitude, panels are most efficient if mounted as close to due south as possible, at a 30-45 degree angle tilt to the horizon, and receive at least 6 hours of unobstructed sunlight a day.

MassCEC’s Massachusetts Residential Guide to Solar Electricity provides information to Massachusetts residents who are considering installing solar on their homes.
Homeowners have a number of options to supply their home’s electricity with clean electricity. Installing solar electricity (photovoltaics or PV) on your home is a great way to transition your home’s electricity to clean sources. If you are not ready or able to invest in a solar PV system, buying clean electricity or participating in community solar are two other great ways to start your electricity transition to clean energy. When you purchase clean electricity, your home’s electricity will usually come from solar, onshore wind, or offshore wind.
Battery Storage

Home battery systems enable the storage of energy during periods when energy production is readily available. The charged battery then becomes an energy source when other energy production is scarce. Installing battery storage in your home can be paired with existing renewable energy generation, such as solar PV. A home battery system can serve a similar purpose as a backup fossil fuel generator, but without the need to purchase and store fuel. When paired with a solar PV system, the battery will be charged by solar energy. Additionally, battery storage systems can further offset the energy you would have purchased from your utility by storing and later using the energy generated from your solar PV system, reducing the times you need to draw power.