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.
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What is a Clean Energy Home?

In Massachusetts, residential buildings represent 24% of greenhouse gas emissions and will play a large role in helping the State reach its target of net zero greenhouse gas emissions by 2050. To this end, Massachusetts is aiming to retrofit and decarbonize 1 million residential buildings by 2030, through electrification and efficiency measures.

**Electrification** maximizes opportunities for emissions reductions, by favoring electric systems and appliances over fossil fuels in homes.

**Efficiency**, for example home weatherization, allows for lower heating and cooling costs, while making homes more comfortable.

A **Clean Energy Home** is electrified, efficient, and weatherized, which reduces its greenhouse gas emissions, eliminates on-site fossil fuels, can help reduce energy bills, and increases comfort. Each home is different — there is no “one-size fits all” approach. This guide is here to help you begin your transition to clean energy, and understand which options may be a good fit for your home.

Clean Energy Lives Here is a campaign run by the Massachusetts Clean Energy Center (MassCEC) to provide Massachusetts residents with educational resources on transitioning their homes to clean energy, including weatherization, heating and cooling, electricity, transportation, and appliances. Transitioning to clean energy can help reduce greenhouse gas emissions, save money, and increase home comfort.

**Introduction to the Clean Energy Home**

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**Electrification**

Electric systems and appliances have many benefits for your household and the planet. For example, modern heat pumps use less energy and generate less emissions than burning fossil fuels to achieve the same amount of heat. Based on the current Massachusetts electric grid, which uses some fossil-fuels to generate electricity, the use of these systems and appliances may still result in some greenhouse gas emissions. As the Commonwealth moves towards its limit of net zero greenhouse emissions by 2050, and sources like solar and offshore wind increase the amount of renewable energy on our electric grid, electric appliances and systems will have an even lower carbon impact. Additionally, you can contribute to a clean electric grid by installing solar PV, participating in community solar, or buying clean electricity.

**Weatherization**

Taking steps to air-seal and insulate your home will help you reduce your energy bills and your home’s greenhouse gas emissions. Air-sealing is the process of sealing gaps which would otherwise allow heated (or cooled) air in your home to escape and letting cool (or warm) air from outside into your home. Air-leakage can represent up to 40% of space conditioning costs in a leaky building. Professionals will be able to assess where air-leakage is occurring, and for example, seal windows, doors, and jammed or broken vents. Insulation slows heat transfer through the building envelope (walls, roof, floors, etc.). Heat transfer is the leading cause of heat loss in the winter. Insulating your roof, walls, and floors can help improve your home’s efficiency.
Planning your home’s transition to Clean Energy will help you maximize benefits and minimize costs when replacing systems and appliances in your home. Each system and appliance has its own life span and operating cost, which is why we recommend replacing systems and appliances as they near the end of their useful life. Advance planning will help you make the right decision when the time comes, rather than researching replacement options when an appliance has already failed. This guide covers multiple appliances and systems to help you transition your home to clean energy.

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

For more clean energy home resources visit: goclean.masscec.com/resources.
Homeowners motivated by reducing greenhouse gas emissions may find it helpful to understand the relative climate impacts of different energy uses by their household. Of the greenhouse gas emissions generated in Massachusetts, 24% are from residential buildings (including the electricity used in those buildings), and 26% are from passenger and light duty vehicles.

The chart below shows that heating makes up 54% of 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 greenhouse gas emissions. The next single largest source of emissions in a typical home is water heating.

While it occurs outside of the home, transportation is also a large contributor to a household’s energy use. In a year, a vehicle that get 25 miles per gallon and is driven 10,000 miles emits 3.7 metric tons of carbon dioxide. In 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.

1Source: MassEEA and MassCEC analysis of MassDEP 2017 Greenhouse Gas Inventory data and ARUP’s unpublished application of NREL’s EnergyPlus model to statewide buildings data
2MassEEA and MassCEC analysis of MassDEP 2017 Greenhouse Gas inventory data and EIA’s State Energy data
Weatherization and 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 your light bulbs with LEDs are all great ways to reduce the energy needs of your home and make you more comfortable.

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

Start by getting a home energy assessment through MassSave or your Municipal Light Plant (MLP) and learn about energy savings opportunities for your home.

When to think about energy efficiency

These common home improvement scenarios are ideal times to make energy efficient choices:

- 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.
- 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.
As you plan your transition to clean energy, think about your home’s changing electric needs. If you are switching out fossil fuel systems or appliances for upgraded clean energy options, you may need to upgrade your electrical service.

Two hundred amp electrical service is usually required for homes with heat pumps or solar systems. If your home has less than 200-amp electrical service, talk to an installer or electrician about your options for upgrading. Use this site to learn how to determine the amperage of your home’s electrical service. Check out our electrical service upgrade page for more information about the upgrade process. 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 $2,500 to $4,500. 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.
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 electric grid. Depending on the size of your solar PV system, it can provide electricity for your lights, heating, cooling, hot water, car charging, and all other appliances.

A solar PV system has several panels that are wired together and connected to the power distribution network of a home. Panels 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.
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 from the electric grid.
Homeowners have a number of options to supply their home with clean electricity. Installing solar electricity (also called photovoltaics or PV) on your home is a great way to transition your home’s electricity to clean sources. However, if you aren’t 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 transition to clean energy. When you purchase clean electricity, your home’s electricity will usually come from solar, onshore wind, or hydroelectric power.

Community solar allows you to purchase electricity at a discounted rate by subscribing to a solar farm. This gives you the benefits of clean energy without having to install solar panels on your property! Find a solar farm that has subscriptions available in your electric utility territory. Once enrolled, you will receive net metering credits or offsets towards your electric bill from the community solar farm.
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. Our guides on air-source heat pumps, ground-source heat pumps, and automated wood heat provide details about these options.
When planning to replace your 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 water heaters last 10 years; if your water heater is approaching the end of its life, consider replacing it with a clean energy option, such as solar hot water or a heat pump water heater.

Solar hot water systems use radiation from the sun to heat a fluid in solar collectors that is then circulated to a hot water tank where the fluid transfers the heat to a tank for home hot water use. Heat pump water heaters use electricity to move heat in the air to a tank to heat your water.
Clothes Dryer

Some clothes dryers burn natural gas or propane to generate heat to dry your clothing. Switching your clothes dryer to run on electricity reduces 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 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 and 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, get our Heat Pump Clothes Dryer guide. In addition, Green Building Advisor outlines the components of a heat pump clothes dryers, 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 a 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.
Induction Stove & Electric Oven

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 reduce your dependence on natural gas, a fossil fuel. 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 an induction cooktop or an electric oven. You can also buy them together as a set in a range configuration.

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 cooking over gas.

Benefits of Induction Stovetops:
- Quicker cooking times
- 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)
Induction Stovetops

Induction stovetops feature flat glass surfaces, usually with designated spaces to place pots and pans.

Planning for 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 choose a different size 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:** If you are switching from a gas to electric stovetop, a plumber can cap the gas line to your previous stove. If you are also eliminating all natural gas service to your home, call your gas utility to discuss next steps.

If you have a fossil fuel-powered oven, you can replace it with an electric one. Most ovens last 10-20 years; if your oven is approaching the end of its life, replace it with an electric oven that has a convection fan. This enables it to cook food faster, more efficiently, and more evenly. See the advice above about closing the gas hookup if the oven you’re replacing is natural gas-fueled.

Another kitchen appliance to consider is your dishwasher, which either uses your home’s hot water system 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 an electrician must install. Homeowners will also need an additional cable to connect the charging unit to the car and a cable box to monitor the amount of current the EV is drawing from the outlet. 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 You Should Consider when Installing a Charging Unit at Home:

- How much charging capacity will you 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 should be long enough to reach the car
- Identify 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 want to leave. 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.

For more information on installing electric vehicle charging at home, check out the Green Energy Consumers Alliance’s Installing Electric Vehicle Charging at Home.
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 Level II chargers or even faster Level III chargers, where EVs 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 helpful in finding 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.
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