MASSACHUSETTS CLEAN ENERGY CENTER®

Massachusetts Residential Guide to Solar Electricity

www.MassCEC.com/Solar

About this Guide

This guide is intended to assist Massachusetts residents who are considering installing solar on their homes. This guide can help you determine whether a solar electric system is right for you, both technically and economically. It reviews the installation process, provides resources for finding an installer, and explains available incentives and other pertinent information about solar electricity. While this guide focuses on grid-connected solar electric systems, the use of solar electric systems for off-grid electricity generation can be cost-effective in remote locations where it is impractical or uneconomical to connect to the electric grid. This guide is intended primarily for residential-scale projects. Additional resources for commercial entities can be found at **www.masscec.com/commercial-solar.**

The Massachusetts Residential Guide to Solar Electricity was published in March 2019 and updated in April 2022.

Some of the regulations and incentives discussed in this guide may not apply to certain customers of utilities that are owned by a municipality, known as Municipal Light Plants (MLPs). Customers in those territories should contact their MLP to determine whether they allow for net metering and interconnection, and whether there are any incentives or requirements in addition to or in place of those described in this guide. See www.masscec.com/municipal-lighting-plant-communities for more information.

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About the Massachusetts Clean Energy Center®

Created by the Green Jobs Act of 2008, the Massachusetts Clean Energy Center (MassCEC) is a state economic development agency dedicated to accelerating the growth of the clean energy sector across the Commonwealth to spur job creation, deliver statewide environmental benefits and to secure long-term economic growth for the people of Massachusetts. MassCEC is a partner, clearinghouse, and connector for people in the clean energy sector, making direct investments in clean energy companies, building a strong clean energy workforce, and supporting responsibly-sited renewable energy projects across the Commonwealth. MassCEC works with the entire clean energy community in Massachusetts to propel promising technologies from the drawing board to the global marketplace. For more information, visit **www.MassCEC.com**.

More Resources

Visit www.MassCEC.com/Solar for additional information about solar electric systems, including current pricing reported across the state. Visit www.masscec.com/get-clean-energy to learn about other clean energy technologies targeted at a broad range of residential, commercial, institutional and public energy consumers.

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Solar Electricity Today

Solar electric systems, also known as solar photovoltaics or solar PV, convert sunlight into electricity through an array of panels that connects to a building's electrical system and/or the electrical grid.

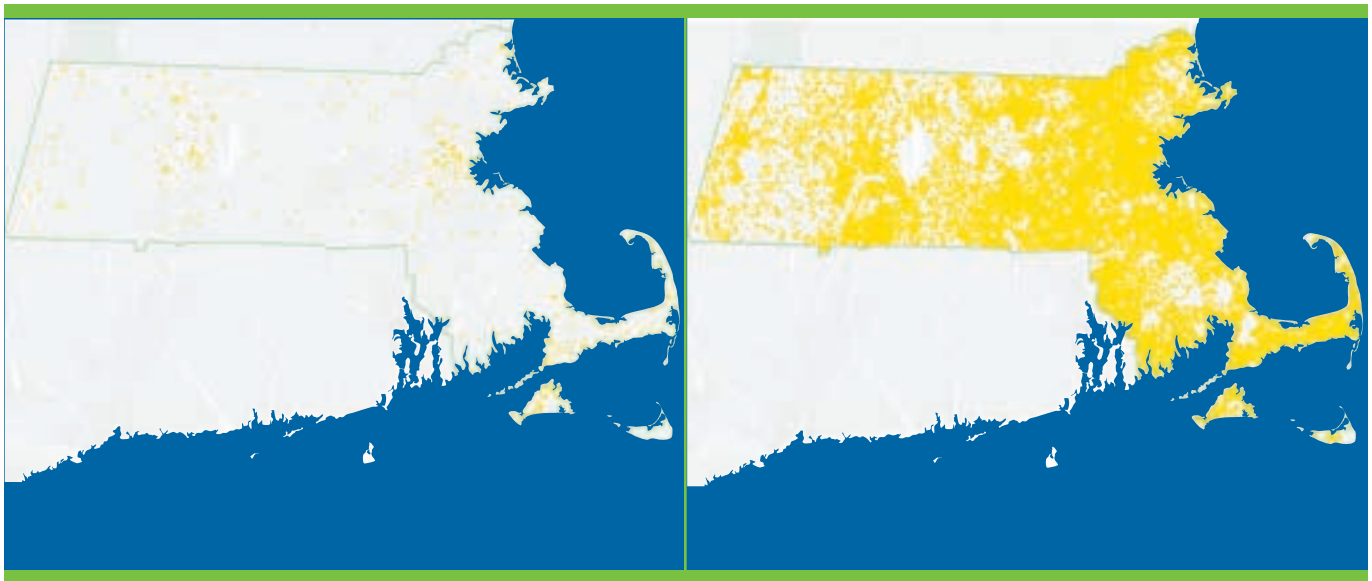
Massachusetts has seen tremendous growth in the adoption of solar electric systems across the Commonwealth, and over the past ten years has consistently been one of the top 10 states for cumulative solar capacity installed.

Massachusetts initiated its first incentive program for solar electricity in 2001, which was funded through a small renewable energy charge on most electricity consumers' utility bills. In 2006 there were fewer than 600 solar electric systems installed in the Commonwealth, totaling 3.6 megawatts (MW) of installed capacity. By the end of 2018, there were over 89,000 systems totaling 2,300 MW. In November 2018, the Department of Energy Resources (DOER) launched the Solar Massachusetts Renewable Energy Target (SMART) Program, an incentive program designed to support an additional 1,600 MW of solar across the Commonwealth.

Residents who have installed solar electric systems cite many reasons for going solar, including:

- Good financial investment and electricity cost savings;
- Concern about pollution, the environment, and climate change; and
- Desire for energy independence, increased control over energy choices, and price stability.

For many residents and business owners throughout Massachusetts, installing a solar electric system can be a smart investment that converts abundant, accessible sunlight into electricity, reduces air pollution, decreases or eliminates monthly electricity bills, and contributes to the local economy by creating jobs and supporting local businesses.



Solar electric system installations through 2006

Solar electric system installations August 2018

Solar Electric System Components

A solar electric system has several pieces of equipment that are wired together and connected to the power distribution network of a home.

Solar Electric System Life

Solar electric systems have few moving parts and are designed to produce electricity for at least 20 years. System life will be a function of the equipment selected, the environmental conditions under which the system is maintained, and overall system design.

Components Include:

Solar Electric Array

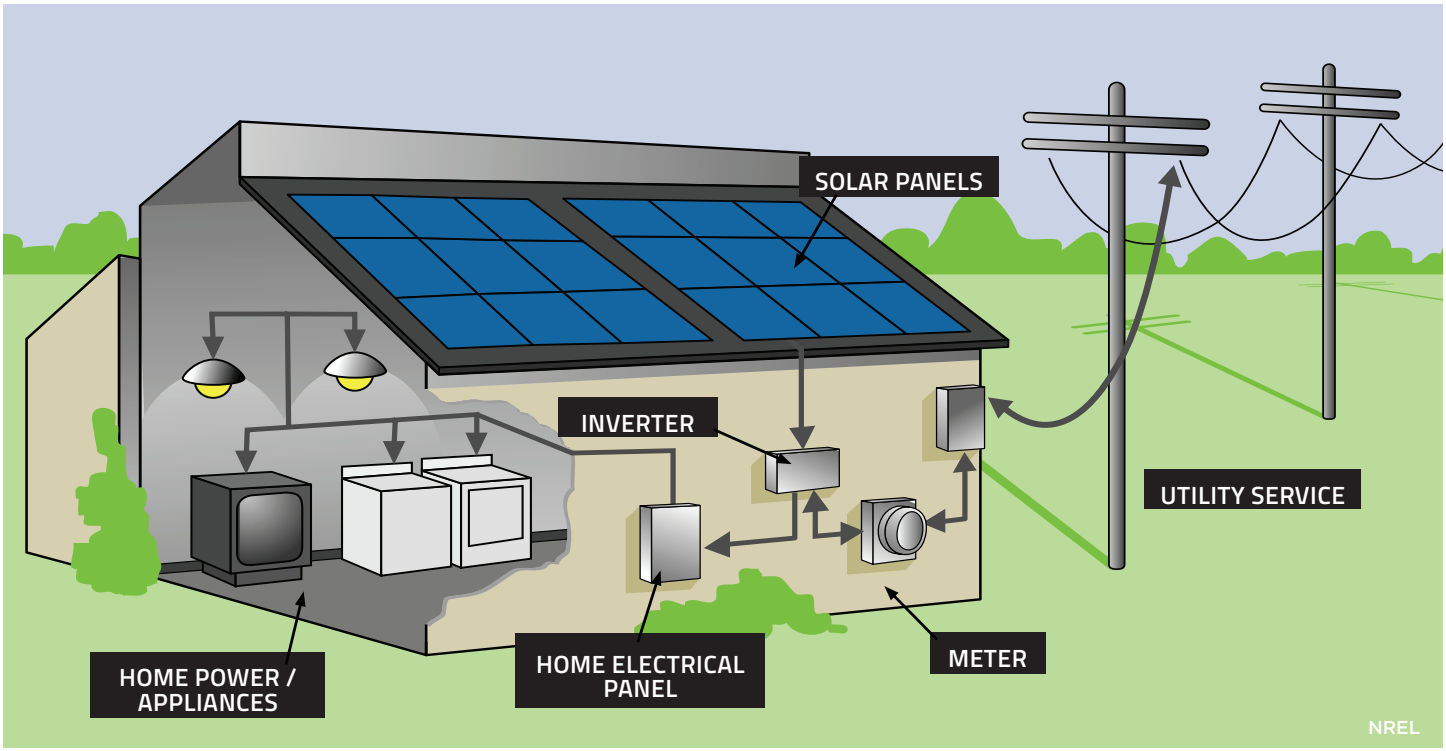
When sunlight strikes the semiconductor material inside a solar cell, it frees electrons that form an electric current in the cell. This process converts sunlight directly into electricity. The more intense the sunlight striking the cell, the greater the amount of electricity produced. Solar cells are aggregated together to form a panel or a module. A solar array generally includes several panels wired together to achieve the desired system size. While the electricity output of the solar electric panels will slowly reduce over time, the panel manufacturer production warranty typically guarantees that by year 20, the panels will still produce at least 80% of the electricity originally produced when first installed.

Inverter

Solar electric panels produce direct current (DC) power. An inverter is used to convert the DC power to alternating current (AC), the type of power supplied by electric utilities in the United States. Typically, the inverter is located near where the electric service from the local utility enters the house (close to the electrical panel). Alternatively, micro-inverters may be individually placed directly behind each panel, converting the electricity from DC to AC at the panel level. In grid-connected systems, inverters are designed to shut off automatically in the event of a power outage. This is an important safety precaution for utility workers, as the solar electric system will not restart until power has been restored to the grid. Typical inverter warranties average around 10 years for central inverters, and 25 years for micro-inverters. If using a central inverter, it is likely that the inverter may need to be replaced once during the life of the solar electric system.

External Shut-Off

Massachusetts utilities require solar electric systems to have an external shut off, often called a "disconnect," so the power company can shut down the system when workers are fixing the power lines.



Storing Solar Energy with Batteries

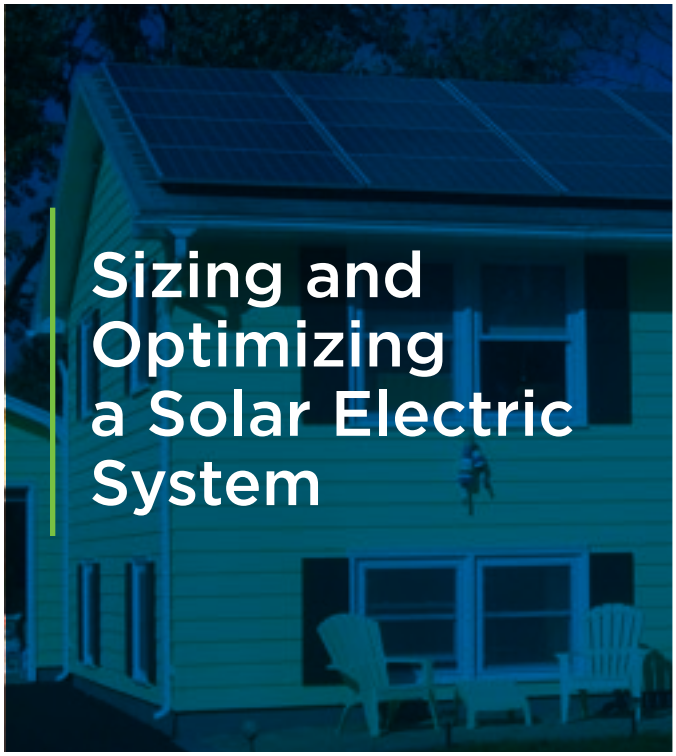
Historically, most solar electric systems installed in Massachusetts have not included a battery or other forms of energy storage. Batteries add cost to the system and with the presence of net metering (discussed later in this guide), owners of solar electric systems typically don't need storage to balance their load (matching electricity consumption in the home with electricity production from the solar electric system). However, as battery prices decrease, there is increased interest in storage at the residential level. Batteries provide resiliency to the owner, allowing the stored electrical energy to be released during grid outages. Opportunities for residential customers in this space will continue to increase as the market matures. Please see the "Battery Energy Storage" section for more information on how battery storage can be included as part of a solar electric system.

Meter(s)

A net meter is a bidirectional meter that spins backwards when the system is producing more electricity than what is being consumed on site, and will spin forward when energy is being used from the electric grid. A second, separate meter is also required to exclusively track cumulative production from the solar electric system for purposes of receiving the SMART incentive (the production-based incentive program discussed later in this guide).

Inverters installed outside of residence

More resources specific to this section can be found on Page 25 of this guide.



Sizing and Optimizing a Solar Electric System

Homeowners should understand their electricity usage so that the solar electric system can be appropriately sized.

Monthly utility bills include a summary of how much power a homeowner has used each month for the past year. The installer will need a recent bill to determine an appropriate system size based on the site's power needs, characteristics, and the homeowner's budget. Utilities charge residential customers for electricity consumption, measured in kilowatt-hours (kWh), which is shown on the electric bill. As an example, if a 40-watt light bulb is turned on for 100 hours, a total of 4,000 watt-hours or 4 kWh of electricity would be consumed. The average New England household uses 7,536 kWh of electricity per year,[1] though both higher and lower levels of consumption are common.

For residential solar electric systems, system size is measured in kilowatts (kW), the equivalent of 1,000 watts. The actual electricity generated by a solar electric system is a function of its size, efficiency, sun exposure, and a variety of other factors discussed on the following page.

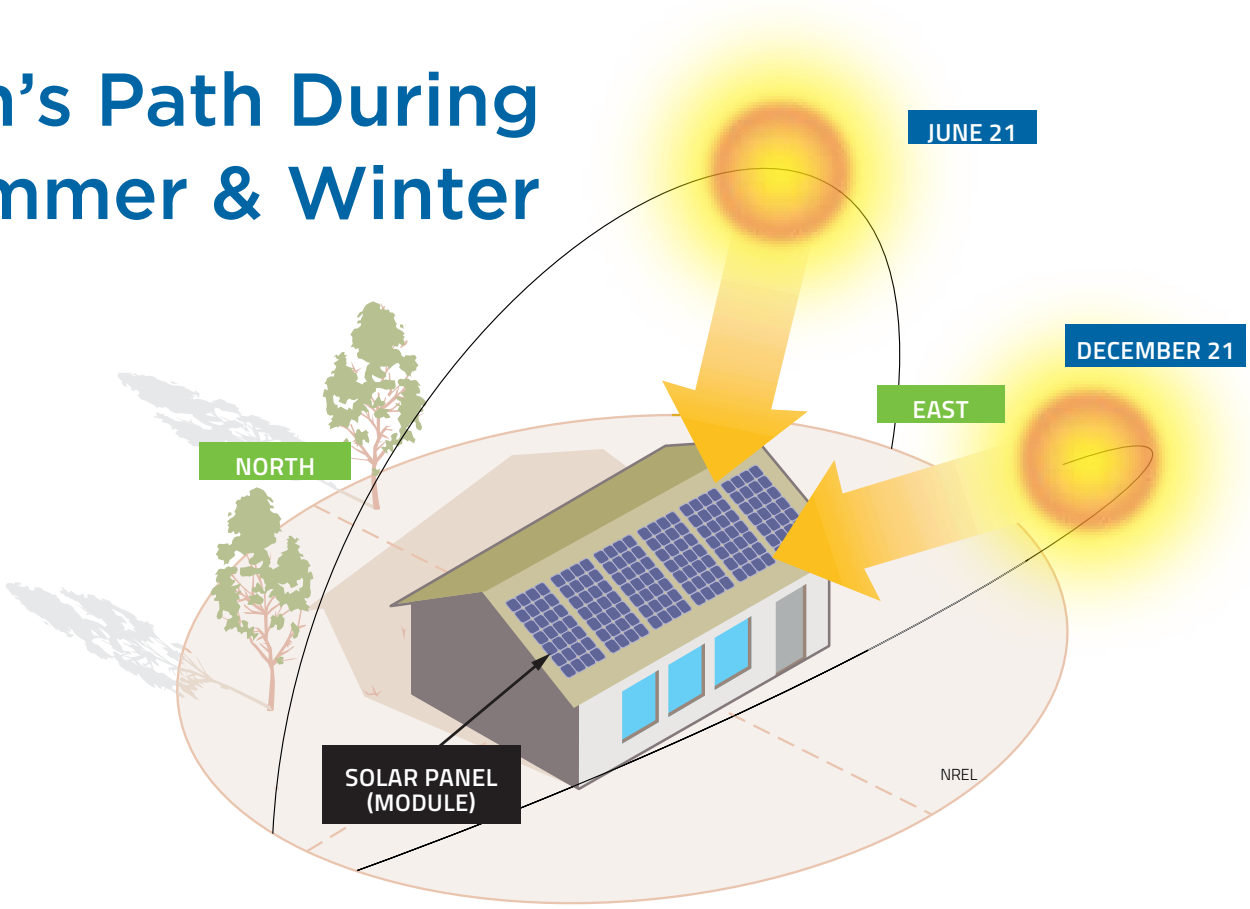
The average residential solar electric system size in Massachusetts is around 7 kW. In Massachusetts, a 1kW solar electric system will produce approximately 1,100 kWh of electricity per year, which means that a 7 kW system will produce roughly 7,700 kWh per year.[2] This example system could therefore produce enough electricity to cover 100% of the electricity consumption for an average New England household.

Summary of electricity use on utility bill

[1] Energy Information Association, EIA-861- schedules 4A-D, EIA-861S and EIA-861U.

[2] Calculation using PVWatts Tool, National Renewable Energy Lab, based on 1 kW in optimal conditions, Boston, MA

Sun's Path During Summer & Winter



Mounting

For most Massachusetts homeowners, rooftop-mounted installations are the easiest and most practical way to use solar electricity to power their homes. Rooftops provide a ready location for solar electric arrays and are unlikely to have competing uses. Roofs in New England are usually tilted to shed water and snow, which helps to keep solar electric modules clear from debris. Roof-mounted systems also allow for a simple interconnection to a home's existing wiring. Additionally, a roof 's elevation could decrease the likelihood of shade falling on the array.

Massachusetts homeowners with open land on their property may choose to install a ground or pole-mounted solar electric system. These systems can be oriented to the optimal south-facing direction and at the ideal tilt to maximize electricity production. However, ground or pole-mounted systems typically have a higher cost than similarly sized roof-mounted systems due to the expense of the ground-based substructure, the racking that the panels are mounted to, and the potential for existing and future vegetation to cast shadows on a system.

Roof Orientation

The panels of the solar electric system should be installed on roof faces that are oriented as close to due south as possible to maximize annual power production. Solar panels that aren't facing south do produce electricity and may still provide an economic return. However, a north-facing system will have significantly less direct sun exposure, resulting in low electricity output.

Tilt

For maximum annual electricity production, a solar array should be installed at approximately a 30–45 degree angle to the horizon. Most homes in New England have roofs that are pitched at 33 degrees or more so that they can shed snow and ice. A solar electric system can also be installed at a shallower tilt, though it may produce slightly less electricity.

Residents seeking a visual representation of how panel orientation and tilt may impact their system production can use the online Solmetric solar exposure tool. [3]

[3] www1.solmetric.com/cgi/insolation_lookup/go.cgi

Shading

Even a small amount of shading on solar panels can reduce a solar electric system's productivity. Ideally, a system should have no shade for at least 6 hours a day. A system should be sited to maximize its direct exposure to sunlight and to avoid shading by a home's structural elements (such as dormers or chimneys), nearby trees and vegetation (including smaller trees that could later become obstacles), or other buildings. Technologies like micro-inverters or DC-Optimizers enable solar electric systems to be somewhat more shade tolerant, as the shading will only affect the panels that are directly shaded, rather than reducing the output of the entire system. A solar installer will present options to help a customer maximize solar production for their particular site.

The installer should conduct a thorough shading analysis of the roof or proposed location of a ground-mounted system, identifying the best location and configuration to avoid shading by trees and roof protrusions. Customers should ensure their solar installer fully explains the results of a shading analysis for their proposed system to be sure they have an accurate assessment of the amount of electricity that their system is likely to produce.

Paul Armstrong

This site is an ideal location for a solar electric system. The roof has a southern orientation, with minimal structural impediments on the roof, and no shading.

Flickr.com/RBerteig

This site presents challenges for installing a solar electric system. The east-west orientation and heavy shading are both impediments to solar electricity. These problems could be remedied, but would add cost to the project.

Roof Condition

With the guidance of a solar installer, homeowners should evaluate the structural condition of their roof and shingles before a system is installed to ensure that roof repairs or replacement will not be necessary in the near future. Removal of a solar electric system may add cost to a future roof replacement, as a solar installer or electrician would need to remove the panels and re-install them once the roofing was complete.

Ideally, any necessary roof repairs should be made before a solar electric system is installed. Although the panels may act as a shield for sun or rain directly hitting the roof, potentially prolonging the roof life, some installers recommend replacement if the roof has a remaining lifetime of eight years or less.

Seasonal Fluctuations

Depending on the season, the sun moves across the sky at varying heights from sunrise to sunset. Therefore, the amount of electricity generated by a solar electric system varies during the daylight hours and over the course of the year.

Residential solar electric installations are typically stationary, meaning they do not follow the track of the sun over the course of the day, and are generally fixed, meaning they are not adjusted to account for changes in sun angle from season to season. Design factors such as module tilt, orientation, and shading should be considered to maximize the electricity production from the solar electric system.

Important Regulations

Massachusetts has laws and regulations in place to ensure that solar electric systems are safely installed and seamlessly connected to the electricity grid.

Electrical Grid Interconnection and Net Metering

Most Massachusetts homes with solar electric systems can interconnect to the electrical grid, allowing the homeowner to purchase power from the electric distribution company when the solar electric system is not producing as much electricity as the homeowner is using. Utilities may require a special inspection prior to interconnection to ensure that the solar electric system complies with established technical, performance, and safety requirements.

Electricity customers with solar electric systems under 10 kW can sell any excess power they produce back to their utility and receive a credit on their electric bill valued at almost the full retail rate for the power produced. This practice is called net metering. As a solar electric system produces electricity, the net meter will spin backwards, just as it spins forward when the customer consumes electricity. At the end of each billing period, the customer is billed for the net electricity consumed over the entire billing period. This is the difference between the amount of electricity delivered from the electric grid and the electricity generated by the solar electric system and put onto the grid. Customers receive net metering credits for any net excess electricity, which can be applied toward future electricity bills. Residents installing systems over 10 kW may receive net metering credits at a reduced rate.[4] Your utility company will be able to confirm net metering rates dependent on system size. Customers considering systems over 10 kW should discuss with their installer the availability of net metering in their area, as some utility service territories may have reached net metering capacity caps for systems over that size.

Solar Massachusetts Renewable Target (SMART) Program

SMART is a solar incentive program that promotes cost-effective solar development in the Commonwealth. It is a production-based incentive that is paid directly by investor-owned electric utilities in Massachusetts to solar electric system owners, based on the amount of electricity produced. Once a system is approved to participate in the program and an incentive rate is calculated, a typical residential system will be eligible to receive incentive payments for 10 years. Incentives are issued by utilities on a monthly basis via check or electronic payment. For more information, see the "Ownership Options and Incentives" section of this guide.

Local Permitting

Installation of a solar electric system will require the same local approvals as any other building construction and electrical work. A building and electrical permit will need to be pulled by the installer, and inspections will be required to verify that the installation meets state and local code requirements.

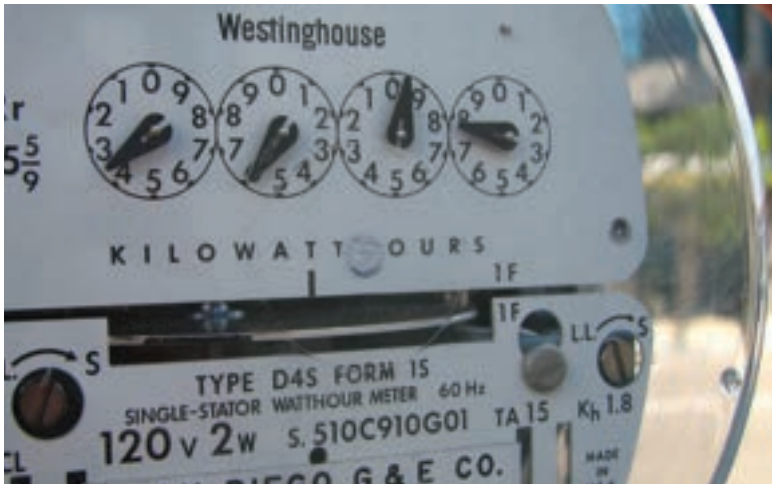
Licensing

Massachusetts law requires that solar electric systems be installed by Massachusetts licensed electricians. In addition, there are various training and certification programs which many installers go through, such as those offered by the North American Board of Certified Energy Practitioners (NABCEP).

[4] www.mass.gov/guides/net-metering-guide

More resources specific to this section can be found on Page 25 of this guide.

Ownership Options and Incentives



The financial return on investing in a solar electric system in Massachusetts can be very favorable for homeowners with a suitable site.

Solar electric systems in Massachusetts often have a six-to-eight-year payback period and will continue to produce financial returns long after the system is paid off. The life of a solar electric system is typically 20 years or longer. Purchasing and owning a solar electric system generally requires an up-front investment, though for a site with good solar access, there are significant economic benefits that can be realized over time. Alternately, third party ownership options may also be available. An overview of different ownership options can be found below.

Ownership Options

Direct ownership

The customer is the owner of the system, and usually either makes an upfront cash purchase or finances the solar electric system through a loan. Both financing options are described further below.

- **Cash Purchase:** Direct ownership through the upfront purchase of a solar electric system typically provides the highest return on investment over time, as there is not a third party taking a portion of the system revenues, and the customer is able to take full advantage of tax and production incentives. This purchase option also requires the largest up-front cash investment.

- **Loans:** To assist with the up-front cost, there are a variety of loan or financing options that allow the customer to spread payments out over time. Options include home equity loans, personal loans, and a variety of solar-specific financing products. In reviewing loan options, customers should consider the interest rate, closing costs, early repayment options, and any potential fees that would change the price of the system compared to a cash transaction.

- **Mass Solar Loan**: MassCEC and DOER have partnered to offer the Mass Solar Loan program, which focuses on enabling lower cost financing for residents interested in purchasing a solar electric system. Customers using the program can pursue financing from a competitive market of lenders offering a standardized financing product. Additional incentives are available to reduce costs for income qualified customers. To learn more, visit www.masssolarloan.com.

Third Party Ownership

A third party company will own and operate the solar electric system and provide some portion of the benefits to the customer, often with little or no upfront cost to the customer. Under this model, customers are commonly offered a solar lease or power purchase agreement (PPA), described further below. Additionally, see the 'What to Look For in a Contract' section for additional considerations on third party owned solar electric systems.

- **Solar Lease:** Under a solar lease, a property owner agrees to pay a pre-determined fixed monthly fee to a solar company, which then installs, owns, and operates the solar electric system. The property owner then receives any electricity generated by the solar electric system at no additional cost. Solar leases typically have provisions that guarantee a pre-determined amount of electricity generation from the system each year.

- **Solar PPA:** Similar to a solar lease, under a PPA, the solar company will own and operate the system on the property owner's roof. Rather than a fixed monthly payment, however, the property owner agrees to purchase the electricity generated by the system at an agreed-upon per-kilowatt-hour price, often lower than typical utility rates. Like a solar lease, a PPA allows a home or business owner to begin saving money immediately, with little or no up-front cost. [5]

[5] www.mass.gov/files/documents/2016/12/pm/ma-homeowners-guide-to-solar-financing-final.pdf

Understanding Economic Benefits

Given the variety of ownership options, the range in upfront costs, and how savings and revenues are realized over an extended time frame, it can be complex to assess relative benefits when comparing proposals. There are both key financial inputs and methods to interpret the inputs that can be helpful when assessing economic benefits.

Important financial inputs to a solar project include:

- **Upfront cost:** The amount paid for the system at the time of installation.
- **Ongoing costs:** Costs paid over time, including financing or leasing costs and any operation or maintenance costs such as replacing an inverter.
- **Upfront revenues:** Benefits received initially, such as rebates or tax incentives.
- **Ongoing revenues:** Benefits received over time, including expected electricity cost savings and production-based incentives.

Using these elements, different methods exist to help consumers understand the economic benefits of installing a solar electric system. You may see the below variations on installer proposals:

Different methods to determine economic benefits:

- **Cash Flow:** An estimate of costs and savings and when they will be realized over the life of the system.
- **Total Savings:** An estimate for the total savings realized compared to the scenario without solar. This provides a sense of overall savings but may not differentiate future benefits from current benefits.
- **Payback Period:** The number of years it will take the savings realized from your system to equal the upfront costs.
- **Net Present Value:** An analysis that demonstrates how upfront costs and benefits compare to long-term costs and savings. To do this, future costs and savings are normalized into a net present value that recognizes the alternative of investing money. For example, the present value of receiving $10 next year would be $9, assuming the alternative exists to invest $9 and earn $1 in interest over the course of the year. The assumed investment rate, or discount rate, is an important assumption to understand when comparing options.

	Direct Ownership	Third Party Ownership
Who buys and owns the system?	Homeowner	Installer or third party owner
Are there any up-front costs for the home-owner?	Yes. May pay with cash or take out a home equity or other loan	Low or no upfront cost
Homeowner's Ongoing Financing Costs	Payments for loan, if applicable	If PPA, fixed or escalating rate to buy power generated by system, or monthly lease payment
Who takes advantage of State and Federal tax benefits?	Homeowner	Installer or third party owner
Who receives ongoing production-based incentives (SREC's or SMART)?	Generally homeowner [6]	Generally third party owner
Impact of solar electric system on property value	Can be part of the appraised value of the property.	Fannie Mae guidance: Cannot be part of appraised value of property
Responsibility for System Electricity Production	Homeowner (Optional production guarantees may be available from the installer)	Third party owner
Who is responsible for any maintenance and insurance?	Homeowner	Installer or third party owner
Homeowner's use of the system	Lifetime of solar electric system (20-30 years)	PPA or lease term (15 – 25 years)

As with any large purchase, it is important to understand how prospective installers are presenting the benefits and assumptions used in their quote. Therefore, seek quotes from multiple installers, ask them to explain any assumptions they are using, and request that they present the benefits in different formats as noted above. Request that the cost of the system be shown as total system cost and cost per watt ($/watt), so the numbers can be more easily compared across installer quotes. This can help residents understand potential costs and benefits from both a magnitude and timing perspective.

[6] Typically the system owner will take advantage of the ongoing production-based incentives. However, there may be some instances where this may not be the case. As part of a direct ownership system, a homeowner may elect to pre-sell their production-based incentive to a third party. For a third party owned system, a customer may opt to pay more up-front to maintain ownership of the production-based incentive.

Upfront Costs and Incentives

The cost of solar electric systems has declined considerably over the last decade. Actual costs will vary based on system size, site characteristics, permit fees and any optional equipment additions. To learn about current solar electric system pricing reported across Massachusetts, go to www.MassCEC.com/Solar. Upfront costs can be offset by the following:

- **Federal Tax Credit:** Most owners of new residential solar electric systems qualify for the Federal Residential Renewable Energy Tax Credit for 30 percent of total system costs.[7] Note that the Federal Tax Credit is legislated to decrease starting after December 31, 2019, to 26 percent for systems installed in 2020, then 22 percent in 2021. www.DsireUSA.org can be monitored for future updates.
- **Massachusetts Personal Income Tax Credit:** Most owners of new residential solar electric systems, located on their primary residence in Massachusetts, qualify for a state personal income tax credit for 15 percent of the total cost of the solar electric system, with a maximum of $1,000.[8]
- **Massachusetts Sales Tax Exemption:** Equipment purchased for a residential solar electric system in Massachusetts is usually exempt from state sales tax.[9]
- **Massachusetts Property Tax Exemption:** Homeowners with a solar electric system may be eligible for a property tax exemption on the value added by the system. Homeowners are encouraged to discuss this with their installer and the local tax assessor's office.

Homeowners considering installing a solar electric system are encouraged to talk to their installer and consult with a tax advisor on their eligibility to receive tax incentives, and any tax implications of other incentives.

Long-Term Costs, Savings and Incentives

- **Avoided Electricity Costs:** Electricity generated by a solar electric system displaces what would otherwise be purchased from the local utility. These avoided electricity costs are a fundamental benefit of owning a solar electric system. Fuel cost increases, rising demand for fuel or electricity, and fuel supply constraints can all cause the cost of purchasing electricity from an electric distribution utility to increase. Purchasing a solar electric system is the equivalent to paying for many years of electricity use in advance, at a fixed and stable price. Homeowners can get a very accurate projection of the cost they are paying for the solar power produced today and into the future, because the fuel price is stable (sunlight will always be free), solar resource (days of sunlight per year in a given region) is generally predictable, and little system maintenance is required.

- **Solar Massachusetts Renewable Target (SMART):** Launched in November 2018, SMART is the primary incentive program for solar electric projects at properties serviced by National Grid, Eversource and Unitil. Once a system is approved to participate in the program and an incentive rate is calculated, a typical residential system will be eligible to receive incentive payments for a 10-year term. The incentive is based on both the value of energy and the program funding block that the project applies under. A value of energy calculator is available on the program administrator's webpage to help interested homeowners calculate their expected incentive payment.[10] Small-scale projects can receive increased incentives for including battery storage or for qualifying with a low-income utility rate code. Residents who receive electricity service from their municipality are not eligible to participate under SMART, and should reach out to their utility or visit www.ee.ene.org/solar to determine whether their utility provides a separate incentive offering.

[7] 26 USC § 25D
[8] M.G.L. c. 62, sec. 6(d)
[9] M.G.L. c. 64H, sec. 6(dd)

[10] See resources tab on www.masmartsolar.com for SMART Behind the Meter Value of Energy Workbook

- **Home Value Appreciation:** Market conditions and the interests of particular buyers will ultimately determine the sale price of a home. However, recent research suggests a solar electric system can increase a home's market value if prospective buyers understand the financial benefits that the system creates. A 2015 study by the Lawrence Berkley National Laboratory found that prospective home buyers in Massachusetts and other states in the U.S. were willing to pay more for a property with a resident-owned solar electric system.[11] A similar price premium was also found as part of a separate study with real estate appraisers,[12] while a third study found no premium for solar electric systems owned by a third party.[13]

System Maintenance

As with any appliance, solar electric systems require some maintenance over their lifetime. This generally includes making sure the solar panels are receiving unobstructed sunlight, and likely replacing the inverter once during the life of the system (if it is a central inverter rather than micro-inverters). Installers should provide a minimum five-year labor warranty to protect the equipment against defective workmanship, component breakdown or significant degradation in electrical output. In addition, the solar electric equipment should have appropriate manufacturer's warranties. See the "Solar Installation Process" section of this guide for more information on warranties.

Solar electric system on multi-family flat roof building

[11] Selling into the Sun: https://emp.lbl.gov/publications/selling-sun-price-premium-analysis

[12] Appraising into the Sun: https://emp.lbl.gov/publications/appraising-sun-six-state-solar-home

[13] Leasing into the Sun: https://emp.lbl.gov/publications/leasing-sun-mixed-method-analysis

More resources specific to this section can be found on Page 25 of this guide.

What to Look For in a Contract

Installation Contract

The installation contract with an installer should present information about the project in a clear manner, laying out important information in the first few pages, such as system size, specifications for the exact equipment being installed, total system cost, cost per watt of system size ($/w), estimated production, and payment terms. It should also specify all applicable warranty information, the project's estimated start and completion dates, and a list of any subcontractors that are going to be used. It is recommended that an installer provide a minimum five-year workmanship warranty to protect equipment against defective workmanship, electric component breakdown or significant degradation in electrical output. In addition, the solar electric equipment should have appropriate manufacturer's warranties. The below section provides information on what to look for in a contract, for all ownership models.

- **Installation Timeline:** An installation timeline provides estimated dates for when important installation milestones occur, including an overview of the expected installation process.
- **Estimated Annual Production:** The installer should provide an estimate of annual system production, what the system is anticipated to produce over the life of the system, and what assumptions they used to develop the estimates. Some installers may offer production guarantees. Homeowners interested in a guarantee should consider the timeframe of the guarantee, who is responsible for monitoring, and what triggers a guarantee payment.
- **Customer Disclosure Form (SMART):** As part of the Massachusetts SMART program, installers are required to submit a Customer Disclosure Form that includes relevant project information for the resident, whether the contract is for a direct ownership, third party owned, or community shared solar electric system. This form should be filled out by the installer and provided to the customer prior to contract signature.

  A template version of the Customer Disclosure Form can be found at www.masmartsolar.com, under Resources.
- **Liability and Workers Compensation Insurance:** For liability protection, homeowners should insist that a vendor carry a certificate of insurance for general liability. A homeowner should also verify that workers' compensation insurance is carried to protect against liability for any on-site, work-related injuries. These are required to obtain a building permit.
- **Itemized Budget and Progress Payment Timeline (for direct ownership):** An itemized budget should have any exclusions or potential added costs. A payment timeline ensures that the resident knows the number, frequency, and size of payments, as well as when they are due. Any one-time or recurring fees that the installer charges as a part of their process should also be stated up front.

The contract should detail the process for resolving unexpected changes to the project that occur during permitting, installation, or inspection. Ensure that this covers timing, the process by which the installer should notify the customer for items outside the original scope, and any payment milestones that are not refundable. The contract should detail a process for dispute resolution, such as mediation or arbitration, if necessary.

Warranties

Homeowners should ensure that equipment and workmanship are covered under appropriate warranties. It is recommended that customers request equipment warranties that, at a minimum, meet the requirements outlined below. Equipment should be UL listed and should also be on the California Energy Commissions' list of approved equipment, found at www.gosolarcalifornia.ca.gov.

- **Photovoltaic Modules:** Minimum of one-year product warranty from date of sale to customer for product workmanship and materials. MassCEC recommends that the modules have a minimum performance warranty of 20 years. After 20 years, the modules should produce at least 80 percent of what they originally produced when at the time of purchase.
- **Inverters:** Minimum of a ten-year product warranty from date of sale to consumer for product workmanship and materials.
- **Mounting equipment:** Five-year product warranty.
- **Workmanship:** Minimum five-year labor warranty (largely applicable to direct-ownership projects) provided by the installer to protect the purchaser against defective workmanship, solar electric project or component breakdown, or degradation in electrical output of more than fifteen percent from their originally rated electrical output during the warranty period. The warranty must cover the solar electric project, including modules and inverters, and provide for no-cost repair or replacement of the solar electric project or system components, including any associated labor during the warranty period.

Additional Items to Consider for Third Party Owned Solar Electric System Contracts

When considering a solar lease or power purchase agreement, review the contract carefully to understand all terms and conditions. While contractual terms may vary, items to consider are:

- The length of the contract
- Who benefits from incentives like tax credits and production-based incentives
- Whether there is an option to buy the system at a later date
- Estimated annual utility rate increase
- The initial electricity price and any applicable price changes over time, such as a price escalator
- What happens at the end of the contract term
- What happens if you move out of the house or business prior to the end of the contract term

It is also important to discuss key contractual terms that may impact overall benefit. For example, a third party owned system may provide immediate savings without an upfront cost, but if the contract is canceled may carry significant fees that offset any prior savings. The Solar Energy Industry Association (SEIA) has developed model lease and Power Purchase Agreement documents for consumers that provide key system information and terms in a clear manner.[14] Residents can cross-compare these model documents with lease or PPA contracts that they receive.

[14] https://www.seia.org/research-resources/model-leases-and-ppas for more information.

Environmental Benefits of Solar Electricity

The use of solar electric systems dramatically reduces the environmental impact of personal, industrial, and commercial processes that rely on electricity.

Solar electric modules do not emit greenhouse gases or other pollutants, and do not require intensive mining operations to provide fuel. Compared to the mix of fossil fuel power sources typically used to produce power for New England consumers, every 1,000 kWh generated by a solar electric system avoids sending 0.17 pounds of sulfur dioxide, 0.35 pounds of nitrogen oxides and 747 pounds of carbon dioxide emissions into the atmosphere.[15] In addition, solar electric systems reduce the production of particulates that contribute to respiratory problems.

Can solar panels be recycled?

Solar panels typically consist of glass, aluminum, copper, and semiconductor materials.[16] By weight, more than 80 percent of what goes into a solar panel is glass and aluminum, which are both common and easy-to-recycle materials. At the end of their useful life, these materials can be successfully recovered and reused as part of new solar panels or other products. Organizations like the Solar Energy Industries Association are working in collaboration with manufacturers and installers to develop a network to repurpose or recycle solar electric system components that are at end-of-life.[17]

Alexey Sergeev

Traditional Power Sources, Per 1,000 kWh

0.17 lb OF SO_2 0.35 lb OF NO_x 747 lb OF CO_2

Solar Electricity, Per 1,000 kWh

0 lb OF SO_2 0 lb OF NO_x 0 lb OF CO_2

[15] 2015 ISO New England Electric Generator Air Emissions Report

[16] https://www.seia.org/sites/default/files/2018-09/SEIA-PV-Waste-101-Factsheet-2018-September.pdf

[17] See https://www.seia.org/initiatives/pv-recycling for more information

Battery Energy Storage

An increasing number of solar installers in Massachusetts are offering battery storage as an option to pair with residential solar electric systems, or as a retrofit to a previously installed system.

Consumers should evaluate the costs and benefits of installing batteries as part of their decision-making process.

In addition to the below information, Solar United Neighbors, a DC-based nonprofit organization, has published a Battery Storage Guide for Homeowners.[18] The guide offers a comprehensive overview of battery and energy basics and includes factors to consider when installing batteries, information on economics, what to ask installers, what should be included in a proposal, and homeowner stories.

How can batteries be used in residences?

The most common use of batteries in the home is for backup power in the event of a utility power outage.[19] When there is a utility grid outage, the battery system can isolate some or all of the household electricity needs (called loads) from the utility grid and continue to provide power to those loads. When utility grid power returns, the backed-up loads automatically reconnect to the grid.

A home battery system can serve a similar purpose as a traditional fossil fuel generator, but unlike a traditional generator, there is no fuel to be purchased and stored during an outage. When paired with a solar electric system, the battery will be charged by solar energy.[20] Loads that are backed up by the battery system can range from small (lights, plug loads from electronics, small appliances) to large (refrigerator, well pump). Both the size of the loads tied to backup battery power, and the duration of time that the loads would be isolated from the grid will influence the size of the battery system installed. Powering an entire home with a battery system is still relatively expensive, which is why a homeowner may elect to install a smaller battery system to power pre-designated critical loads.

Outside of resiliency, battery storage systems can also help maximize self-use of the energy generated by a solar electric system. For commercial-scale customers, battery storage can provide savings by mitigating the higher costs of using energy at times when electricity from the grid is expensive (high 'time of use' rates), or when a commercial property is using significant amounts of power in a short period of time (demand charges). Currently in Massachusetts, residential customers are largely not impacted by demand charges or time of use rates, though this could change in the future.

Battery system sizing considerations

When sizing a battery system, the resident and solar installer should consider the following:

- **Types of 'critical loads' that would continue to receive power during an outage:** The installer will review what lighting, appliances, and other loads are in the residence and will determine how much energy they require. A larger combined load will necessitate a larger battery system to meet the energy needs of the load.

[18] Battery Storage for Homeowners, Solar United Neighbors, Published November, 2018. www.solarunitedneighbors.org/wp-content/uploads/2018/11/Solar-United-Neighbors-Battery-Guide.pdf

[19] Without a battery backup system installed, a solar electric system will not operate in the event of a power outage, if installing a battery system without a solar array, the battery will charge and recharge with electricity from the utility grid. In the event of a utility outage, this can limit the usefulness of the back-up power, as the battery would only be able to discharge one time before needing the utility electrical grid to be restored for it to recharge.

[20] https://cleantechnica.com/2017/12/11/batteries-keep-getting-cheaper/

Time duration the battery system can power the load without being re-charged: The size of the battery system is also dependent on how many hours or days it would need to provide power to the load. This is without taking into consideration that the solar electric system may also charge the battery during a utility outage.

- **Customer budget:** Although costs continue to decline, battery systems can be expensive, which is why there may be benefits to considering sizing the battery system to power only critical electrical loads when utility power is unavailable. An installer can assist residents in considering all factors as part of properly sizing a battery storage system.

When receiving quotes from installers, two metrics that can be compared between proposals include the price per unit of power ($/kW) and the price per unit of usable energy ($/kWh).

Battery types and components

There are currently two common battery chemistries used residentially: lead acid and lithium ion.

- **Lead Acid:** Lead acid batteries have been available for decades, and are most commonly offered as 'sealed lead acid' batteries. Depending on how often they are used (or 'cycled'), they can last 5–10 years. There is an established market for recycling lead acid batteries.
- **Lithium Ion:** Although the upfront cost of lithium ion batteries is higher than lead acid batteries, prices for lithium ion batteries are decreasing, they have a higher density of energy (more energy per unit of space), and can be cycled more often during their lifespan. This longer lifespan (around 10 years) may lead them to have a lower lifetime cost than a lead acid battery counterpart. As a newer product that is growing rapidly, recycling options are still being created for lithium ion batteries.

Battery warranties: Battery product warranties may take the form of a guaranteed number of operational years, or number of guaranteed cycles or times that the battery is discharged and then re-charged. A typical product warranty for lead acid batteries is between 2 – 5 years, while a typical product warranty for a lithium ion battery is about 10 years. It is likely that the battery storage system will need to be replaced at least once during the life of the solar electric system. [21]

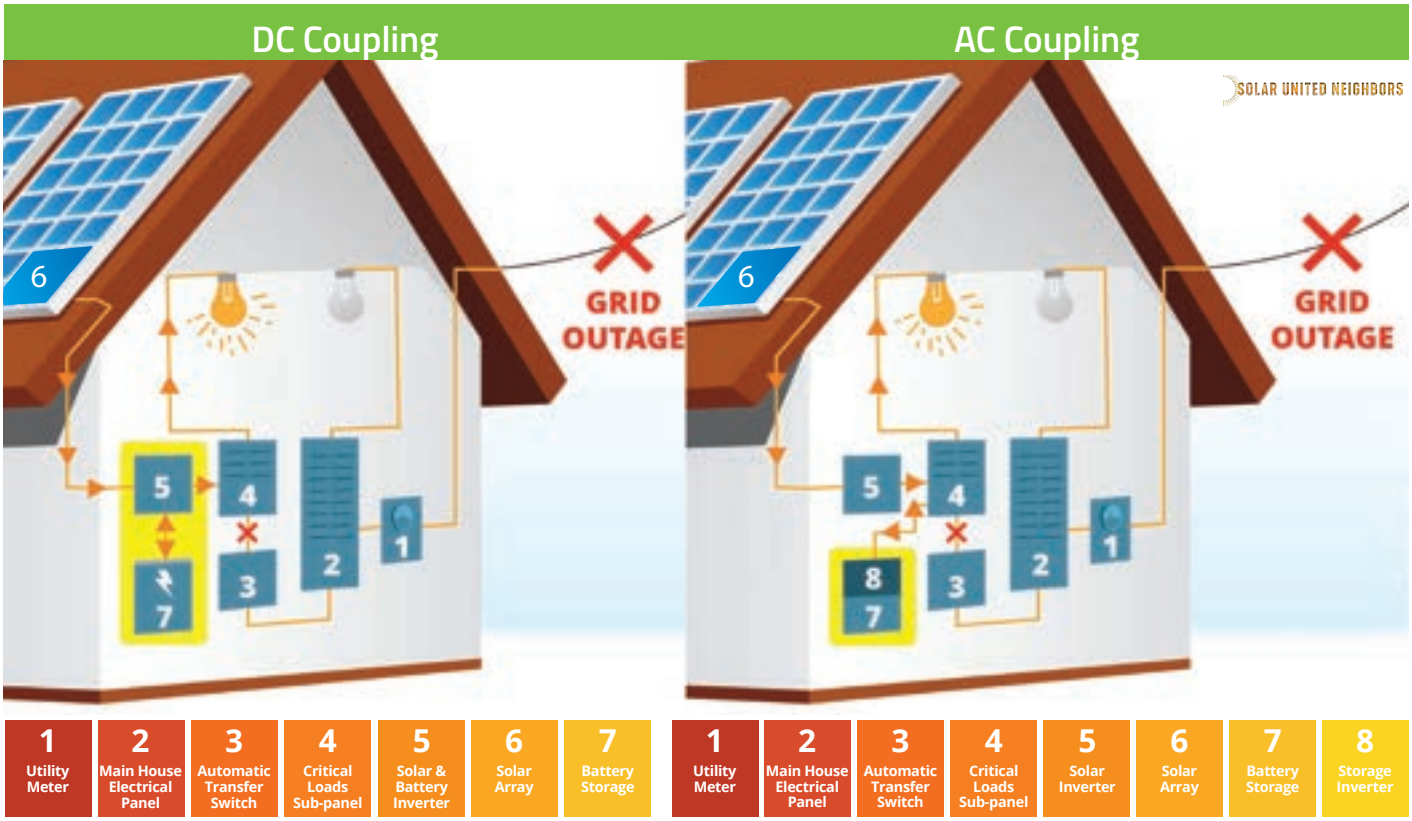
Additional components may include an electrical sub-panel that includes all 'critical loads,' an automatic transfer switch that will isolate the critical loads from the main house's electrical panel, and a battery inverter. If storage is installed at the same time as a solar electric system, it is likely that a single inverter will be connected to both the solar electric system and the battery system. If storage is installed as a retrofit to an already existing solar electric system, it is likely that an additional inverter for the battery system will be installed. The battery inverter may be physically integrated into the battery or may be a separate piece of equipment.

Difference between DC and AC coupling

Similar to a solar electric system, a battery system produces direct current (DC), while the home's electrical system and appliances operate using alternating current (AC).

- **DC Coupling:** Battery storage systems that are installed at the same time as a solar electric system installation may share a single inverter and be DC coupled, where the solar electricity is fed directly into the battery system. As part of this configuration, the battery is generally only charged by solar electricity (as opposed to electricity from the utility grid). This can be an important factor if applying for the Federal tax credit. See the Ownership Options and Incentives section below for more information.
- **AC Coupling:** If a battery storage system is installed as a retrofit to an existing solar electric system, it will often be AC coupled. The solar electric system and the battery system are independent and connected to two separate inverters (the original inverter tied to the solar electric system, and a separate battery inverter). This is generally done to allow the solar electric system to maintain the existing inverter and wiring. Electricity generated from the solar electric system typically enters the electrical subpanel where it is used to meet the load, and excess

[21] See Battery Storage for Homeowners for examples of warranties for commonly available battery types www.solarunitedneighbors.org/wp-content/uploads/2018/11/Solar-United-Neighbors-Battery-Guide.pdf



electricity not used is then stored in the battery. Note that this configuration can make it easier for the storage system to be charged from both the solar electric system and the grid, which can add complexity if applying for the Federal tax credit.

Economics and Incentives

The costs associated with battery storage include the system components, such as the battery and inverter, soft costs like installation, permitting, and system design, and long-term maintenance costs. The upfront cost of a battery storage system will largely be determined by the size of the battery. Additionally, if the battery system is being installed as a retrofit to a solar electric system, an additional battery inverter would likely need to be purchased and installed. These costs can vary by installer, so requesting multiple quotes is recommended.

Battery Storage Incentives

- **Federal tax credit:** Under certain circumstances, battery storage systems that are installed in connection with a solar electric system installation may be eligible for the federal tax credit. Residents should review information about this tax credit at www.DsireUSA.org,[22] and consult a tax professional to understand whether their installation might qualify.
- **Solar Massachusetts Renewable Target (SMART) Program:** The SMART program includes an 'Energy Storage Adder' that increases the incentive amount for solar electric systems installed under the SMART program that are co-located with storage. The incentive is based on a formula that considers both the duration of the storage and the ratio of storage to solar capacity. Your installer will work with you to determine a proposed project's eligible incentive amount and confirm that it meets the SMART program eligibility requirements. It is important to note that after the first year of system operation, the system owner, installer, or other designee will need to report data to Massachusetts Department of Energy Resources from the battery system to demonstrate that the energy storage system reduces on-site customer peak demand, or increases self-consumption of onsite generated solar energy.

Summary

Adding a battery to a solar electric system will increase the upfront cost of a solar electric system. As technology innovations continue, the cost of battery storage decreases, and state and federal incentives are made available, storage will likely become an increasingly economical investment for homeowners.

[22] https://programs.dsireusa.org/system/program/detail/1235

Complementary Technologies and Alternatives

Whether due to shading, roof obstructions, or other constraints, there are some residences where a solar electric system may not be feasible on site.

Some homeowners considering a solar electric system may be wondering what more they can do to save money and reduce their energy footprint.

Consider Energy Efficiency First

Energy efficiency is generally considered to be the "low hanging fruit" when it comes to making fiscally sound, environmentally friendly choices about a home's energy use, and it is the most cost-effective way to reduce a home's total electricity use and cost. Massachusetts utilities offer free energy efficiency audits, advice and services to customers. Call Mass Save at 1-866-527-7283 or visit www.masssave.com for more information. Residents who receive electricity service from their municipality should contact their utility directly to determine if they offer a free residential energy audit. By making energy efficient improvements, your home will use less energy, and you can save money upfront by needing a smaller solar electric system to meet your home's needs.

Consider other Clean Energy Technologies

There are several technologies that may be a good fit for your residence that can be paired with a solar electric system, or be installed if a solar electric system is not an option. These technologies include:

- **Solar Hot Water:** A solar hot water system captures heat from sunlight and circulates the thermal energy to your water tank. Additional state incentives may be available to residents who install a solar hot water system by itself or in addition to a solar electric system.

Solar hot water system

Air source and ground source heat pumps are highly efficient heating and cooling systems that work by moving heat into or out of a building. Heat pumps require electricity to operate, so they pair well with solar electric systems.

- **Air Source Heat Pump:** In the winter, air-source heat pumps take naturally-occurring heat from the outside air and distribute it throughout a building. In the summer, they remove heat from warm indoor air and distribute the cool air throughout a building. Air-source heat pumps can be a solution for a single room or a whole home.

Air source heat pump external unit

- **Ground Source Heat Pump:** Ground-source heat pumps use the nearly constant temperature underground to transfer heat, and are the most efficient type of heat pump. Ground-source heat pumps require a trench or well to operate.

Ground-source heat pump indoor unit

- **Biomass Heating:** Biomass heating technologies can use wood pellets or chips to provide heat to an entire home or business. Biomass pellet heating systems are fully automated central heating systems and can often integrate into existing heating systems.

Biomass heating indoor unit

- **Electric Vehicles:** Electric vehicles use onboard storage devices to power the vehicle, which can be charged from external electricity sources. When paired with solar electric systems, electric vehicles can use the clean solar electricity as a power source, creating an emissions-free mode of transportation.

Electric vehicle charging

Community Shared Solar Model

Community Shared Solar (CSS) is a solar electric system built at a remote site that provides benefits to multiple participants. A CSS project is hosted by an entity with a suitable roof or parcel of land and is supported by participants who invest in the project and purchase the electricity, and receive net metering, bill credits or other incentives.[23] The CSS model is supported by the state through the SMART Program.

More Resources:

MassCEC Clean Energy Technologies and Incentives
www.masscec.com/get-clean-energy/residential

Energy Efficiency
www.masssave.com

Electric Vehicles
www.mor-ev.org/resources

Community Shared Solar
https://blog.mass.gov/energy/renewables/community-shared-solar-101/

[23] For more information, see www.nrel.gov/docs/fy12osti/54570.pdf

Solar Installation Process

Residents interested in solar will typically go through multiple steps from installer selection, to completion of the project and production of electricity.

1. Installer Selection

- **How to Find Installers**

  MassCEC maintains online resources to learn more about solar and finding solar installers, found at www.MassCEC.com/Solar.

- **Multiple Quotes**

  As with any home improvement project, a homeowner should seek multiple quotes to find someone they are comfortable working with. Ask for a written description of what the installer will be doing, the proposed timeline, pricing, and potential expenses not included in the price. Homeowners can also contact the Massachusetts Attorney General's office at 617-727-8400 to determine if prospective installers have any complaints on file.

- **References and Licenses**

  Potential solar electric customers should ask for references from previous customers, call, and if possible, visit one or more of the installer's previous installations. According to Massachusetts law, the solar installer must be a professional installer licensed to conduct business in the state, and must have a Massachusetts licensed electrician either on staff or subcontracted to do the electrical work.[24] If the installer plans to use subcontractors, get their references as well.

- **Installation Contract**

  After receiving multiple quotes, the customer will contract with a selected installer. See the "What to Look For in a Contract" section for more information on the contracting process.

[24] http://www.mass.gov/ocabr/

2. Design

Prior to installation, the installer will prepare a design for the solar electric system. The design can range from a simple site plan and electrical diagram to a more detailed set of plans and specifications, depending on the nature of the solar electric project and site. Where a solar electric system is being incorporated into new construction, it is advantageous to integrate the solar electric design process into the overall site planning and building design process to realize certain construction efficiencies and ensure optimal orientation and tilt of the system.

3. Apply to SMART program

The installer will submit an application for the SMART incentive on the customer's behalf towards the beginning of the solar process to reserve a spot in the program's current funding block. See www.MASMARTSolar.com for more information.

4. Permitting

All solar electric installations must comply with the requirements of the Massachusetts Electric Code. In addition, when an installation results in a structural change in an existing building, a solar electric system is subject to the Massachusetts Building Code. Solar electric installations require local permits and inspections by a local inspector. The licensed electrician on the job is responsible for ensuring that the installation meets state electrical code requirements.

The installer must secure all necessary approvals from local permitting officials prior to putting the system into service.

5. Interconnection Application

The utility will need to grant permission to allow the solar electric system to be connected to the electrical grid. The approval process includes an application, meeting technical specifications for the interconnection, and meeting inspection requirements. The installer will be responsible for securing the approval to interconnect the solar electric system from the utility. In most cases, where the residence does not already have a net meter in place, the utility will need to install a new meter that will credit the customer for power sent back to the grid.

The utility will install the production meter for systems participating in the SMART program, in addition to the net meter. This upgrade would take place after the system is installed, but before it is turned on.

6. Inspection and Interconnection

Once a solar electric system is fully installed, a municipal wiring inspector will come to the project site to review the system and make sure it was installed in accordance with national electric code requirements. Once that is determined to be the case, the inspector will sign off on the project electrical permit and sign a utility certificate of completion (which is provided to the utility in the interconnection process). The building inspector may also require a separate inspection.

Commissioning is not complete until the system is satisfactorily inspected by the wiring inspector and the utility has confirmed that the system can interconnect to the power grid.

7. System Testing, Warranties and Customer Instruction

When the installation is complete, the installer should test the equipment to confirm that it is operating properly. Homeowners should also ensure that the installer provides them with copies of any technical material, such as a copy of the system design and electrical diagram, system commissioning test results, and information about the system equipment and warranties. The installer should also register the equipment warranties. Finally, the installer should educate the resident about safety, operations and any maintenance requirements.

8. Complete SMART Incentive Process

The installer should submit completion paperwork so that the solar electric system can begin receiving SMART incentives. Homeowners should begin receiving monthly incentive payments from the utility within 3 months of the SMART completion process being finalized.

Buying or Selling a Home with Solar

When buying or selling a home with solar, it is important that all parties understand who owns the solar electric system and how it will be included in the home sale process.

When interviewing a real estate agent to market and sell your home, or to assist you in the home-buying process, ask about their experience selling properties with solar installed, and whether they have taken a course on how to list and sell homes with solar.[25] A real estate agent that is knowledgeable about solar electric systems will be well equipped to assist you through the home sale transaction process. Residents should also ask their real estate agent to request a qualified appraiser who has completed a training course on how to appraise homes with solar.[26] Additionally, there is a resource called 'Appraised Value and Energy Efficiency: Getting it Right,' created by the Appraisal Institute and other partners, which includes guidance for home buyers on how to request a qualified appraiser for homes with energy efficiency and clean energy features.[27]

If selling a home with solar

The resident selling the home should maintain solar electric system documents provided by the installer, including the contract and any technical documents like the system design and electrical diagram. These documents, and information about the system equipment, warranties, and when the system was installed will be helpful for the future buyer. If available, information about the amount of electricity the system has produced over time can be useful in the process of marketing the solar electric system. Some of the solar electric system information may also be listed in the Multiple Listing Service (MLS), or in the MassCEC Production Tracking System (PTS) database of solar electric systems.[28] If unavailable through other means, basic solar electric system information for a specific address may be available, and can be requested by contacting MassCEC at CS@MassCEC.com.

[25] Solar training course examples include Elevate Energy national course (https://learninglibrary.com/Elevate/A/Product/Details/1251) and Massachusetts-specific course for real estate agents (https://ma.keepmecertified.com/selling-the-sun). These examples are not meant to be exhaustive, and additional solar training courses may be found by conducting an online search.

[26] Solar training courses for real estate appraisers can be found at https://licensing.reg.state.ma.us/public/ra_ceu/ra_ce_courses.asp

[27] www.appraisalinstitute.org/appraisal-institute-building-codes-assistance-project-offer-green-appraisal-guidance

[28] 'See 'Solar PV systems in MA' report. www.masscec.com/data-and-reports

If the solar electric system is owned by the seller:

- In addition to maintaining system documents, if receiving ongoing state production-based incentives such as SREC or SMART payments, the seller should clarify to the real estate agent the remaining duration that the incentive payments are available, and how electricity production has been reported to receive those incentives. Ongoing production-based incentive payments can be included as part of the negotiation and sales transaction process.[29]
- As noted previously, a solar electric system may add value to the property. Discuss with your real estate agent how to best include the solar electric system in the sales process. Knowledgeable real estate agents and appraisers often use a tool to add contributory value to the comparative market analysis, found at www.pvvalue.com.
- Let your real estate agent know if the solar electric system was financed with a loan that is still in place at the time of sale. If the loan uses the solar electric system as collateral, there may be a UCC-1[30] filing on the property.

Although not recommended, the seller may elect to move the solar electric system to their new property. Note that having the system removed and re-installed may void equipment warranties.

If the solar electric system is a Lease or Power Purchase Agreement:

- With your real estate agent, carefully read the part of your contract that outlines what options are available if you sell your home. Options may include the ability to transfer the agreement to the buyer, buy-out the remainder of the lease, or pay a termination fee to have the system removed. It is important that everyone on your sales team understands the options available prior to marketing the home.
- If there is a UCC-1 filing on the property, you and your real estate agent will need to work together with the third party owner to have it removed during the sales process, to ensure a smooth closing.
- Fannie Mae guidance clarifies that a third party owned system cannot be part of the appraised value of the home.[31] However, you can work with your realtor to develop talking points to show the solar electric system as an asset that can support the sale of the home.

If purchasing a home with solar

Request information about the solar electric system and review available system documents with your real estate agent. Ask if a record of electricity production is available, how the system is monitored, and whether there have been any maintenance issues with the system. Clarify the age of the system inverter(s) to determine the remaining warranty, and when replacement may be needed. Note that some of the solar electric system information may also be listed in the Multiple Listing Service (MLS), or in the MassCEC Production Tracking Systems (PTS). Take into consideration whether trees or other structures are shading the solar electric system, which can impact system electricity generation.

If the solar electric system is owned by the seller:

- Request from the seller and review with your real estate agent any ongoing state production-based incentives, remaining duration of the incentive, and how system production is reported. Ask for a history of past production-based incentive payments, if available. If the buyer wishes to receive any remaining incentives, clarify with the seller the process of transferring ownership of the incentives to the new system owner.

If the solar electric system is a lease or Power Purchase Agreement:

- With your real estate agent, carefully read the contract for terms of transfer, the cost of the electricity generated by the system being offered through the contract, any rate escalators, and other terms.
- If there is a UCC-1 filing on the property, the seller, seller's agent, and third party owner will work together to have it removed temporarily during the sales process, to ensure a smooth closing.

[29] For information on how to transfer an ongoing state production-based incentive to a new owner, for solar projects receiving an SREC incentive, contact DOER.SREC@Mass.gov, and for solar projects receiving a SMART incentive, contact DOER.SMART@Mass.gov

[30] A UCC-1 filing is a legal form that a lender may file to give public notice that it has a security interest in the personal property of the solar electric system owner.

[31] https://www.fanniemae.com/content/guide/selling/b2/3/04.html

Homeowner's Solar Electricity Checklist

Preliminary Questions

- ○ Do I know how much electricity I currently consume and how much it costs?
- ○ Do I have a south, east or west-facing roof?
  If not, do I have property with open space that might accommodate a ground-mounted solar electric system?
- ○ Do I know where there is shading on my roof (or on my property) during different times of the day and at different times of year?
- ○ Will the installer be using subcontractors? If so, for which part of the project?
- ○ Do I want to purchase and own the solar electric system, or do I want to work with a third party company and either buy the electricity generated with a power purchase agreement or pay a monthly lease payment?
- ○ Does the installer have standard licenses, such as a Home Improvement Contractor or Construction Supervisor License, or any additional industry certification, such as OSHA 40 or NABCEP?

Purchasing and Contracting

- ○ Am I comfortable with the installer's knowledge and experience?
- ○ Have I checked how many installations they have done in the region?
- ○ Does the installer have credible references?
- ○ Is the installer adequately insured to protect me, as well as the company's employees and subcontractors?
- ○ Does the contract include performance specifications for the system being installed, including an estimate of the power that will be produced annually or under different conditions?
- ○ Does the installation contract clearly lay out what is included and what is not included in the price?
- ○ Does the proposed payment schedule protect me by allowing payment to be withheld until the system:
  1) passes local code inspections,
  2) receives utility interconnection approval and
  3) is shown to be operating properly?
- ○ Are all warranties clearly stated with information on how to exercise them?

Post Installation and Operation

- ○ Has the installer tested and activated the system?
- ○ Have all necessary inspections occurred?
- ○ Has the installer left descriptive materials and equipment operating manuals as reference materials?

  Examples of this include a system design and electrical diagram, equipment warranty information, and installer contact information for any future operations or maintenance questions
- ○ Upon installation, has the installer given me a walk-through of all the different parts of the system, and shown me how to monitor the system, and turn it on and off?
- ○ Has the installer assisted me with qualifying for the SMART program, or if I live in a Municipal Lighting Plant community, any available rebates?
- ○ If I plan to take advantage of state and federal tax credits, have I completed this when filing my taxes?

Additional Resources

MassCEC Learn About Solar | www.MassCEC.com/Solar

Online resource that provides expanded information on system pricing statewide, incentives, how to find an installer, and frequently asked questions.

Solar Electric System Components

Energy.gov: Solar PV Energy Basics

www.energy.gov/eere/solar/articles/solar-photovoltaic-technology-basics

Important Regulations

Massachusetts Department of Energy Resources (DOER)

www.mass.gov/doer

Massachusetts DOER: Solar Massachusetts Renewable Target (SMART) Program

www.mass.gov/info-details/solar-massachusetts-renewable-target-smart-program

SMART Program Administrator Page

www.masmartsolar.com

Massachusetts Department of Public Utilities Net Metering Guide

www.mass.gov/dpu

www.mass.gov/guides/net-metering-guide

Massachusetts Distributed Generation and Interconnection Information by Utility

www.sites.google.com/site/massdgic

Ownership Options and Incentives

DOER EnergyCENTS: Consumer Energy Tool for Savings

http://public.dep.state.ma.us/Doer/mesa/#/home

What to Look for in a Contract

Massachusetts DOER Residential Financing Guide

www.mass.gov/files/documents/2016/12/pm/ma-homeowners-guide-to-solar-financing-final.pdf

Notes

MASSACHUSETTS CLEAN ENERGY CENTER®

294 Washington Street Suite 1150
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e. info@masscec.com

Massachusetts Residential Guide to Solar Electricity

www.MassCEC.com/Solar