MASSACHUSETTS RESIDENTIAL GUIDE TO SOLAR POWER

MASSACHUSETTS CLEAN ENERGY CENTER

JOIN THE INNOVATION REVOLUTION

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Flickr.com/mjmonty

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Introduction

Solar Electricity Today

Solar photovoltaics (solar PV) systems convert sunlight into electrical energy through an array of solar panels that connect to a building's electrical system and/or the electrical grid.

Massachusetts initiated its first incentive program for solar PV in 2001, funded through a small renewable energy charge on most electric utility bills. In April 2007, solar PV took off in Massachusetts when Governor Deval L. Patrick announced a goal of having 250 MW of installed solar power by 2017. To begin reaching this goal, which was significantly higher than the 3.5 MW of solar PV installed at the time, the state launched the Commonwealth Solar Rebate Program in January 2008. Since the start of this innovative program, thousands of solar PV projects have been installed throughout the state, providing clean, renewable energy to ratepayers of the Commonwealth. Massachusetts is known as a national-leader in solar with one of the best regulatory and incentive climates for solar energy. Since 2007, the number of solar installers in Massachusetts has grown from dozens to hundreds, and the Massachusetts solar market has enticed numerous businesses that make solar energy financially accessible for more people in the Commonwealth.

Residents who have already installed solar PV systems cite many different reasons for going solar, including:

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

For many residents and business owners throughout Massachusetts, installing a solar PV system is a smart investment that converts clean, free sunlight to electricity, reduces air pollution, reduces or eliminates monthly electricity bills, and contributes to the local economy by creating local jobs and supporting local businesses.

About this Guide

The aim of this guide is to assist Massachusetts residents who are considering using solar energy to generate electricity to power their homes. This guide can help you determine whether solar PV is right for you both technically and economically. It reviews the installation process and provides advice and resources on finding an installer and securing rebates, as well as other pertinent information about solar PV. This guide focuses on grid-connected solar PV systems; however, the use of solar PV for off-grid electricity generation can be cost effective in remote locations where it is impractical or uneconomical to connect to the electric grid.

While this guide is intended primarily for homeowners, many of the issues discussed apply to small-scale installations in general and may apply to businesses considering installing solar PV.

Some of the regulations and incentives discussed in this guide may not apply to certain customers of Municipal Light Plants (MLPs). Customers of MLPs should contact the MLP to determine whether they pay into MassCEC's Renewable Energy Trust (a prerequisite for receiving rebates from MassCEC's programs), whether the MLP allows 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.

The Massachusetts Clean Energy Center has developed this guide based in part on a prior version which was originally developed by the Solar Energy Business Association of New England (SEBANE) and funded by the Renewable Energy Trust, which at the time was administered by the Massachusetts Technology Collaborative (MTC).

Additional Resources

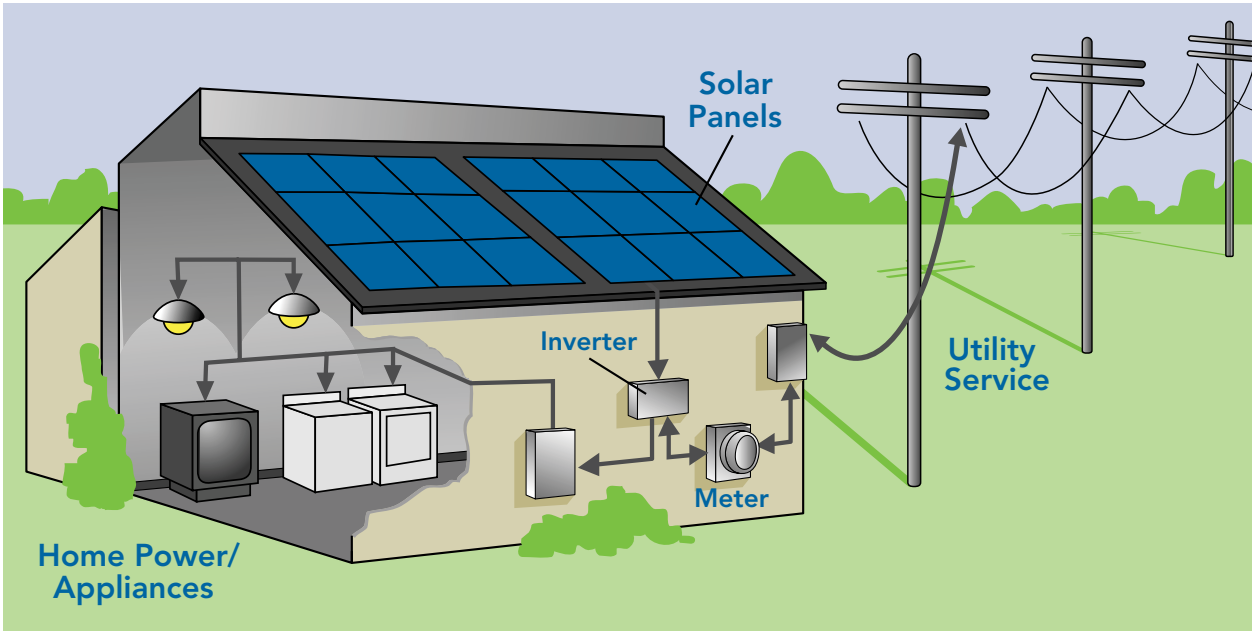
Visit www.MassCEC.com and www.MassCEC.com/AboutSolar for additional resources and information regarding solar PV and other clean energy technologies targeted at a broad range of clean energy consumers, producers, and stakeholders.

About MassCEC

Created by the Green Jobs Act of 2008, the Massachusetts Clean Energy Center (MassCEC) is dedicated to accelerating the success of clean energy technologies, companies and projects in the Commonwealth—while creating high-quality jobs and 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.

Wayne National Forest

Solar PV System Components



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A solar PV system consists of a few pieces of equipment wired together and connected to a home's power distribution network.

Components can include:

Solar PV Array

When sunlight strikes the semiconductor material inside a solar cell it frees electrons, which 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 PV panel or a module. A solar array generally includes several modules wired together to achieve the desired system capacity or power producing capability.

Inverter

Solar PV panels produce direct current (DC) power, which must be converted to alternating current (AC) power which is supplied by electric utilities in the United States. This is accomplished by an inverter. Typically, the inverter is located near where the electric service from the local utility enters the house (close to the electrical panel). In grid-connected systems, inverters are designed so that if power from the utility goes down, the solar PV

system will shut down as well. This is an important safety precaution for utility workers, and the solar PV system will not restart until power has been restored to the grid.

External Shut-Off

Some Massachusetts utilities require solar PV 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 or in any other necessary situations.

Battery

Most solar PV systems installed in Massachusetts do not have a battery. Batteries add to the cost of a system. Due to net metering (discussed later in this guide), owners of solar PV in Massachusetts do not need a battery to balance their load (the process of matching generation to consumption). However, systems without a battery will not perform when the electrical grid is offline.

Meter(s)

To utilize net metering, homeowners must have a special net meter, which spins backwards when the solar PV system is producing more electricity than is being consumed on site. A second meter is required to exclusively track production from the solar PV system for purposes of reporting production and receiving Solar Renewable Energy Certificates (SRECs—discussed later in this guide).

Data Acquisition System (DAS)

A data acquisition system automatically reports the amount of the electricity generated by a solar PV system. This facilitates the process of receiving SRECs, and is required for systems above 10 kilowatts to qualify to receive SRECs.

Solar PV system life

Solar PV systems have no moving parts and are designed to last at least 20 years. A number of systems installed in Massachusetts in the 1980s continue to produce power today. Solar panels are typically guaranteed by manufacturer warranties for 20 years. While the inverter's life is shorter than panel life, manufacturing improvements have extended the inverter life to 15 years or more for some equipment with warranties averaging around 10 years.

⚠ **Equipment life will be a function of the equipment selected, the environmental conditions under which it is maintained, and overall system design.**

More Resources

Solar PV System Components

Energysavers.gov: How Small Solar Electric Systems Work

www.energysavers.gov/your_home/electricity/index.cfm/mytopic=10720

National Renewable Energy Laboratory (NREL): Solar Research

www.nrel.gov/solar/

Flickr user SandTDesign

Sizing and Optimizing a Solar PV system

It is critical that a homeowner understand their electricity usage in order for a solar PV system to 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 want a copy of a recent bill to determine an appropriate system size based on the site's characteristics, power needs, and the homeowner's budget. Depending on the characteristics of the inverter, project site, and other equipment, additional panels may be added later as power needs increase or as budget allows.

Residential electric utility bills charge customers for actual consumption, measured in kilowatt-hours (kWh) of electricity consumed. As an example, if a 40 watt bulb is turned on for 10 hours, then an additional 400 watt-hours (0.4 kWh) of electricity is consumed. The average New England household uses 7,452 kWh per year[1], though both higher and lower levels of consumption are common.

A solar PV system's nameplate rating is a measure of the system's capacity to generate electricity under optimal conditions. For small systems, nameplate capacity is measured in kilowatts (one thousand watts). A system will produce 1 kWh of electricity per hour of operation under optimal conditions for each kilowatt of nameplate capacity.

The actual electricity generated by a solar PV system is a function of its size (nameplate rating), efficiency, sun exposure, and a variety of other factors discussed below. Residential solar PV systems are generally sized around 5,000 watts, or five kilowatts (kW). In Massachusetts, one kilowatt (kW) of an optimal solar PV system will generally produce 1,200 kWh of electricity per year, which means that a 5 kW system will produce roughly 6,000 kWh per year.[2] This means that a solar PV system of that size will produce enough electricity to cover about eighty percent of the average New England household's electricity usage every year.

Mounting

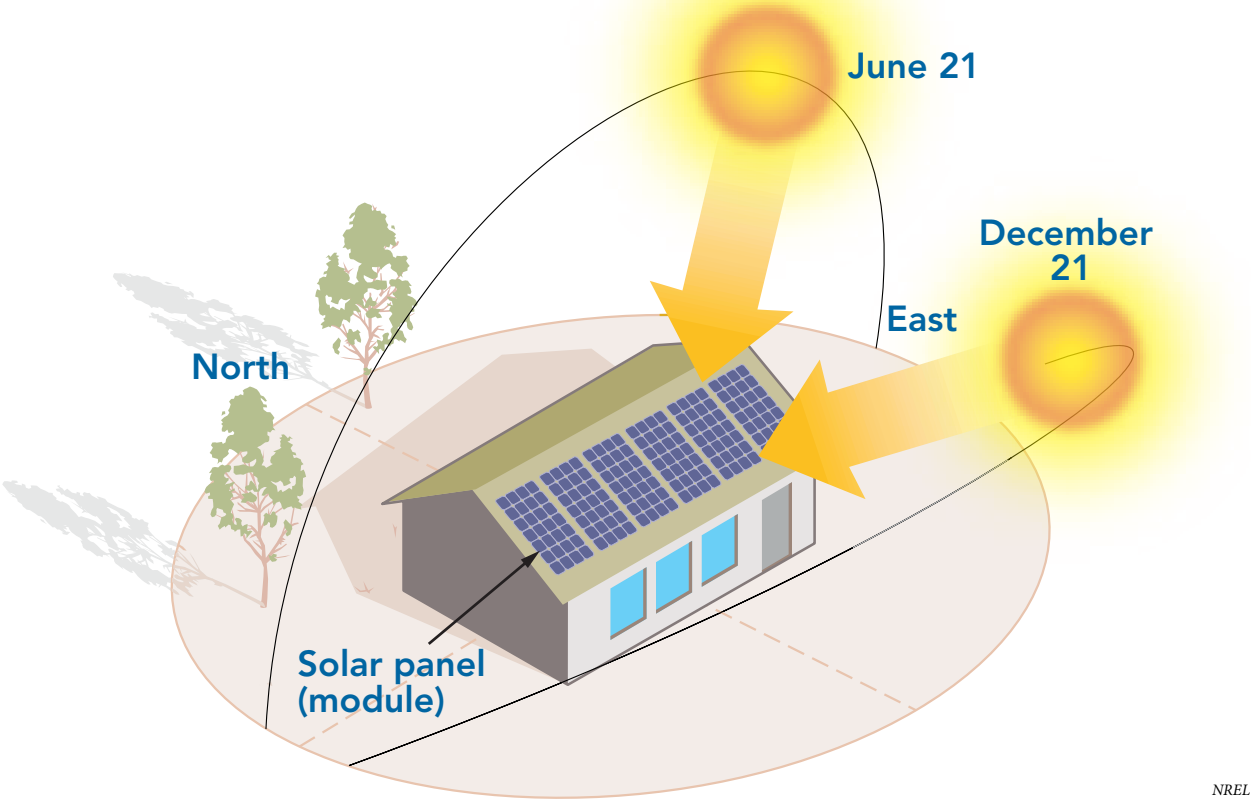
For most Massachusetts homeowners, rooftop installations are the easiest and most practical way to use solar PV to power their homes. Rooftops provide a ready location for solar PV arrays and are unlikely to have competing uses. Roofs in New England are usually tilted to shed water and snow, which helps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

Massachusetts homeowners with open land on their property may choose to install a ground-mounted solar PV system. The advantage of a ground-

1 Energy Information Association, 2005 RECS Survey.

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

Sun's Path During Summer and Winter



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mounted system is that it can be oriented to the optimal south-facing direction and at the ideal tilt to maximize electricity production, without the limitations of a roof's exposure or slant. It is also easier to remove snow and seasonally adjust the tilt of the array. However, ground-mounted systems typically have a higher cost than similar roof-mounted systems due to the expense of the ground-based substructure the panels hang on, the potential for existing and future vegetation to cast shadows on a system, and the potential for damage or vandalism.

Roof direction

Roof-mounted solar PV systems should be oriented as close to due south as possible in order to maximize annual power production. Systems whose orientation is not due south have less direct sun exposure, resulting in lower electricity output. Systems can still perform economically even if their orientation is not perfect.

Roof Condition

Since it is both time-consuming and costly to remove a system once it is in place, 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.

Make any necessary roof repairs before a solar PV system is put in place. Some installers recommend replacement if the roof has a remaining lifetime of eight years or less.

Paul Armstrong

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

Flickr.com/RBerteig

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

Cyclical Fluctuations

Because the sun moves across the sky at varying heights from sunrise to sunset and from season to season, the amount of electricity generated by a module varies during the daylight hours and over the course of the year.

Residential solar PV 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. Therefore, to maximize the production of electricity, the design of individual solar PV systems must optimize module tilt, orientation, and shading.

Tilt

For maximum annual generation in Massachusetts, 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 to shed snow and ice. A solar PV system can be installed at a tilt that is not optimal and still work, though it may be less productive. Alternatively, an installer may be able to design structural components to optimize tilt. The installer will help to determine if the added efficiency from optimizing the tilt of the panels will be worth the cost.

Shading

Even a small amount of shading on solar panels can reduce a solar PV system's productivity. Ideally, a system should have no shade for at least 6 hours a day. Systems should be sited to maximize their direct exposure to sunlight and to avoid shading by a home's structural elements (such as window dormers or chimneys), nearby trees and vegetation (including smaller trees that could later become obstacles) or other buildings.

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 shadows.

Bob Gaffney

Important Regulations

Massachusetts has laws and regulations in place to ensure that solar PV is safely installed and seamlessly connected to the electricity grid.

Electrical Grid Interconnection and Net Metering

Most Massachusetts homes with solar PV systems are able to interconnect with the electrical grid, which allows the home owner to purchase power from the electric distribution company when the solar PV 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 PV system complies with established technical, performance, and safety requirements.

Electricity customers with small solar PV systems can sell any excess power they produce back to their utility and receive a credit for the power produced. This practice is called net metering. As a customer 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 PV system and put onto the grid. Customers receive net metering credits for any net excess, which can be applied toward future electricity bills.

Investor owned utilities are prohibited from imposing special fees on net metered customers as long as the system meets the established interconnection standards. In rare instance when a homeowner has a particularly large system, minor charges may apply to the interconnection process.

Renewable Portfolio Standard: Solar Carve-Out

Load serving entities in Massachusetts (investor-owned electric utilities and competitive suppliers) are required to procure a certain amount of their electricity from solar PV generators. To comply with this requirement, load serving entities must purchase Solar Renewable Energy Certificates (SRECs) equivalent to their annual compliance obligation. SRECs are issued to owners of solar PV generating assets. For more information, see the "Economics of Solar PV" section of this guide.

Local permitting

Installation of a solar PV 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, and inspections will be required to verify that the installation meets state and local code requirements.

Licensing

Massachusetts law establishes specific licensing requirements for system installers, including a requirement that solar PV 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).

More Resources

Regulatory, Net Metering, and Interconnection Resources

Massachusetts Department of Energy Resources (DOER)

www.mass.gov/doer

Massachusetts DOER: RPS Solar Carve-Out

www.mass.gov/eea/energy-utilities-clean-tech/renewable-energy/solar/rps-solar-carve-out/

Massachusetts Department of Public Utilities

www.mass.gov/dpu

Massachusetts Distributed Generation and Interconnection

sites.google.com/site/massdgic/

Net Metering websites by utility

National Grid: www.nstar.com/business/rates_tariffs/netmetering-faq.asp

NSTAR: www.nstar.com/business/rates_tariffs/netmetering-faq.asp

Unitil: www.nstar.com/business/rates_tariffs/netmetering-faq.asp

Western Massachusetts Electric Co.: www.nstar.com/business/rates_tariffs/netmetering-faq.asp

Interconnection websites by utility

National Grid: www.nstar.com/business/rates_tariffs/netmetering-faq.asp

NSTAR: www.nstar.com/business/rates_tariffs/interconnections/

Unitil: www.nstar.com/business/rates_tariffs/netmetering-faq.asp

Western Massachusetts Electric Co.: www.nstar.com/business/rates_tariffs/netmetering-faq.asp

Flickr.com/brutalworks

Economics of Solar PV

The financial return on investing in a solar PV system in Massachusetts can be very favorable for homeowners with a suitable site. Solar PV systems in Massachusetts often have a five to eight year payback period, and will continue to produce financial returns long after the system is paid off. The life of a solar PV system is 20 years or more.

Purchasing a solar PV system often requires upfront installation and equipment costs, but there are significant economic benefits that are realized over time.

Homeowners considering solar PV are advised to consult a professional to determine if the potential project would be eligible for available tax incentives, how these tax incentives may impact one another, and the taxability of any rebates or revenues received for a project. System paybacks will vary depending on the net system cost. Homeowners are encouraged to discuss the financial aspects of owning a solar PV system with their installer and any other expert.

Upfront Costs and Incentives

The cost of solar PV systems has declined considerably over the last few years. Actual costs will vary based on system size, site characteristics, permit fees, and any optional equipment additions. Systems that receive a MassCEC rebate are monitored for costs. Up to date cost information can be found at MassCEC.com/solar under "Installers, costs, etc."

Upfront costs can be offset by the following:

Federal Tax Credit: Most owners of new residential solar PV systems qualify for the federal Residential Renewable Energy Tax Credit for 30 percent of total system costs.[3]

Massachusetts Personal Income Tax Credit: Most owners of new residential solar PV systems in Massachusetts qualify for a state personal income tax credit for the lesser of 15 percent of the total cost of the solar PV system or $1,000.[4]

Massachusetts Sales Tax Exemption: Equipment purchased for a residential solar PV system in Massachusetts is usually exempt from the sales tax.[5]

Massachusetts Property Tax Exemption: Homeowners with a solar PV 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.

3 26 USC § 25D

4 M.G.L. c. 62, sec. 6(d)

5 M.G.L. c. 64H, sec. 6(dd)

MassCEC's Commonwealth Solar II Rebate Program: MassCEC offers a capacity-based rebate for residential and small-scale commercial installations in Massachusetts. Rebates are paid upon project completion (requires approval prior to beginning the installation). MassCEC program guidelines set minimum requirements for warranties, equipment, site selection, and other relevant topics. Rebate levels and participation guidelines can vary. For up to date information, see www.MassCEC.com/Solar and review the most recent Program Manual and Minimum Technical Requirements.

Long Term Costs, Savings and Incentives

Solar PV system owners will also realize long term economic benefits such as:

Avoided Electricity Costs

The most fundamental benefit a homeowner will receive from a solar PV system is the electricity generated which directly displaces electricity that the homeowner would otherwise purchase from an electric distribution utility. 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 PV 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 of power a solar PV system produces now and in 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 there is little system maintenance required. Due to net metering, solar PV system owners can realize the value of all of the electricity they generate.

Solar Renewable Energy Certificates

Solar PV owners can generate income from the sale of Solar Renewable Energy Certificates (SRECs), which are the positive environmental attributes of the clean energy produced by a solar PV system. SRECs are tradable certificates that are issued to owners of solar PV systems at a rate of 1 SREC per megawatt-hour (1,000 kWh) generated. Installers will guide customers through the process of qualifying with the Massachusetts Department of Energy Resources (DOER) so that the homeowner can sell SRECs, and the installer will assist customers in finding an aggregator or broker who will facilitate the sales process. SRECs create a way to obtain long-term financing for solar PV systems, and are intended to be one of the primary financing methods to help pay for the installation of a residential solar PV system.

Home Value Appreciation

Market conditions and the interests of particular buyers will ultimately determine the sale price of a home. However, recent research[6] suggests a solar PV system can increase a home's market value if prospective buyers understand the financial benefits that the system creates.

System Maintenance

As is the case with any appliance, solar PV systems require some maintenance over their lifetime. This generally includes making sure the solar panels are clean, ensuring the panels are receiving unobstructed sunlight, and replacing the inverter generally once during the life of the solar PV system, which should be at least 20 years. 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 PV equipment should

6 Hoen, B., R. Wiser, P. Cappers and M. Thayer. LBNL-4476E. April 2011, **An Analysis of the Effects of Residential Photovoltaic Energy Systems on Home Sales Prices in California**

have appropriate manufacturer's warranties. See the "How To Go Solar" section of this guide for more information on warranties.

Financing Options

Massachusetts' vibrant solar industry offers a variety of ownership and financing options for residents and businesses looking to install solar PV. One way to use solar electricity on a home, but avoid the large upfront cost, is to work with a company that will own the solar PV system and either sell the homeowner the electricity generated on a dollar per kilowatt hour basis through what is called a power purchase agreement (PPA), or lease the system to the homeowner for a monthly rate. Companies like these will generally be responsible for the installation work, and any ongoing operation and maintenance work on the system. Many different forms of this third-party ownership model have emerged to respond to increasing demand from consumers.

In addition, many solar PV owners in Massachusetts utilize traditional financing mechanisms, such as home equity loans, to finance their system. When considering a PPA or leased solar PV system, review the contract carefully to fully understand the terms and conditions. While contractual terms will vary, items to consider are the length of the contract, whether there is a buy-out option, the initial price and any applicable price escalators, who will be responsible for system operation and maintenance, which party is entitled to any applicable incentives, and what happens at the end of the contract term.

More Resources

Economics of Solar PV

MassCEC: Commonwealth Solar II Rebate Program

www.MassCEC.com/Solar

MassCEC: Financing Clean Energy Projects

www.masscec.com/index.cfm/page/Financing-Clean-Energy-Projects/cdid/12742/pid/11163

Database of State Incentives for Renewables and Efficiency (DSIRE)

www.dsireusa.org

Flickr.com/knile

Environmental Benefits of Solar PV

Use of solar PV systems to generate electricity dramatically reduces the environmental impact of the myriad personal, industrial, and commercial processes which rely on electricity. Solar PV 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 PV system avoids sending 2.03 pounds of sulfur dioxide, 0.54 pounds of nitrogen oxides, and 1,102 pounds of carbon dioxide emissions into the atmosphere.[7] In addition, solar PV systems reduce the production of particulates that contribute to respiratory problems.

Alexey Sergeev

Flickr.com/Knile

7 New England, Inc., 2004 New England Marginal Emissions Rate Analysis, 2006

Julie Chen

How to Go Solar

1) Energy efficiency

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. The Commonwealth Solar II Rebate Program requires homeowners to schedule an energy audit before receiving a solar PV rebate. 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.

2) Contractor selection

How to find a contractor

MassCEC maintains a list of online resources for finding solar PV installers, which can be found at www.MassCEC.com/AboutSolar.

Multiple bids

As with any home improvement project, a homeowner should seek multiple bids to find someone he or she is 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.

References and licenses

Potential solar PV 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 primary vendor must be a registered home improvement contractor, have a licensed construction supervisor on staff, and have a Massachusetts licensed electrician either on staff or subcontracted to do the electrical work. If the installer plans to use subcontractors, get their references as well.

Liability and Workers Compensation Insurance

For liability protection homeowners should insist that a vendor carry a certificate of insurance for general liability insurance. 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.

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, regardless of whether or not they receive a rebate through a MassCEC program.

Projects that receive a rebate under the Commonwealth Solar II Rebate Program must meet the following warranty requirements.

- **Workmanship:** Minimum five year labor warranty provided by the installer to protect the purchaser against defective workmanship, solar PV 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 PV project, including modules and inverters, and provide for no-cost repair or replacement of the solar PV project or system components, including any associated labor during the warranty period.

- **Photovoltaic Modules:** Minimum of one year product warranty from date of sale to first consumer purchaser for product workmanship and materials, plus a minimum performance warranty of 20 years within which time the module will produce, under standard test conditions, a minimum of 80% of the product's minimum rated power at time of sale.

- **Inverters:** Minimum of 10 years product warranty from date of sale to first consumer purchaser for product workmanship and materials

- **Revenue grade production meters:** 2 year product warranty.

- **Mounting equipment:** 5 year product warranty.

Written contract

The written contract with an installer should, at minimum, specify the exact equipment to be installed, all applicable warranty information, the project's start and completion dates, the itemized budget with any exclusions or potential adders, a list of any subcontractors that are going to be used, and a progress payment schedule. It is recommended that an installer provide a minimum five-year labor warranty to protect your equipment against defective workmanship, PV component breakdown, or significant degradation in electrical output. In addition, the solar PV equipment should have appropriate manufacturer's warranties. Contracts should include contingencies for approval of rebates and other relevant incentives.

3) Design

Prior to installation, the contractor will prepare a design for the solar PV 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 PV project and site.

Where solar PV is being incorporated into new construction, it is advantageous to integrate the solar PV 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.

4) Permitting

All solar PV 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 PV system is subject to the Massachusetts Building Code.

Solar PV 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 installation contractor must secure all necessary approvals from local officials prior to putting the system into service.

5) Rebate application

MassCEC's Commonwealth Solar II Rebate Program will only pay rebates for project applications approved prior to commencing construction. Rebate applications are submitted on the system owner's behalf by the installer. For more details on the procedural, technical, and other requirements of the Commonwealth Solar II Rebate Program, visit www.MassCEC.com/Solar.

6) Interconnection application

State regulations govern the procedures for the interconnection between a solar PV system and the serving electrical distribution company. This includes the application process, technical specifications for the interconnection, and inspection requirements.

The installer will be responsible for securing the approval to interconnect from the utility. In some 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. This upgrade would take place after the system is installed, but before it is turned on.

7) Construction

Once a contract is signed, the necessary permits have been issued, and rebate approval has been received from MassCEC (if applying for a Commonwealth Solar II rebate), the installer can proceed to install the solar PV system. Installation typically involves delivery of materials to the site, site preparation, electrical work (wiring, inverter installation, etc.), and installation of the solar PV array. Solar PV installations can occur over a short period of time relative to other construction projects. As noted above, the written contract should be clear about the timeline of the project.

8) Inspection and interconnection

Once a solar PV system is fully installed, a local wiring inspector will come to the project site, review the system, and make sure it was installed properly, and sign a certificate of completion (a copy of which is provided to the utility). The building inspector may also require a final 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.

9) System testing and warranties

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 copies of any technical equipment manuals and warranties. Many installers will provide a copy of commissioning test results to the owner and register the warranties. Finally, the installer should educate the owner about safety, operations, and maintenance requirements.

10) System monitoring

Solar PV systems that participate in the SREC Program are required to report production to MassCEC's Production Tracking System. Systems up to 10kW in nameplate capacity can report manually or automatically. Systems over 10kW will be required to report automatically via a Data Acquisition System (DAS) in order to participate in the SREC program. A DAS can add to the total system cost for a solar PV project and may require periodic fees.

Bigstock

Homeowner's Solar PV Checklist

Preliminary Questions

- ☐ Do I know how much electricity I currently consume and how much it costs?
- ☐ Do I have a south-facing roof? If not, do I have property with open space that might accommodate a ground-mounted solar PV 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?
- ☐ Do I want to purchase and own the solar PV system, or do I want to work with a third-party company and either buy the electricity generated through a power purchase agreement or pay a monthly lease payment?

Purchasing and Contracting

- ☐ Am I comfortable with the installer's knowledge and experience?
- ☐ 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?
- ☐ Do I want or need a DAS installed to measure, track, and record power produced, or do I want to track system production manually?
- ☐ 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

- ☐ 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?

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