

Considering a Solar Photovoltaic Array for Your Home



This is one of a series of fact sheets designed to help Massachusetts residents incorporate energy efficiency and renewable energy into their day-to-day lives. For more information, visit the UMass Clean Energy Extension (CEE) website, <https://ag.umass.edu/clean-energy>.

Solar photovoltaic (PV) panels can generate renewable electricity for your home, while providing you with significant energy cost savings. *Note: The information provided in this fact sheet addresses small, residential-scale solar PV systems (capacity ≤ 10 kW). Larger systems may involve additional regulations or requirements.*

The Basics

The Massachusetts Clean Energy Center (MassCEC) [Residential Guide to Solar Electricity](#) covers all the basics of residential solar PV systems, including:

- System components, including solar panels, inverters, external shut-offs, batteries, meters, and data acquisition programs
- Sizing, siting and optimizing a solar PV system
- Important relevant regulations
- Economics, including tax credits and tax exemptions
- Financing options, including the Mass Solar Loan program, traditional home equity loans or other bank loans, and third-party ownership
- Environmental benefits of solar electricity
- Complementary technologies and alternatives to solar PV
- How to get solar PV installed at your residence

Sizing Your Solar Array

If your main objective is to generate sufficient electricity to cover your annual electricity usage, you can size your system based on your historic usage. You can estimate this value by totaling the usage from your monthly electricity bills for one year. Electricity usage should be listed in kilowatt-hours (kWh) on your bill. In order to estimate the capacity necessary for your array to meet your annual electricity consumption, divide your annual kWh usage by 1,200. This will give you a rough estimate of the capacity, or size, of the system necessary to meet 100% of your annual residential use. This value will be in kilowatts (kW).

You can also use the [PVWatts Calculator](#) to estimate the annual electricity generation from a system of a specified size (in kW). A solar PV installer can further help refine this value, based on the placement and efficiency of your array design and location.

Financial Considerations

The ultimate costs and benefits of a solar PV array on your property should be determined in consultation with a solar installer. This fact sheet provides an overview of some of the factors that come into play when determining the financial balance sheet for your solar array. On the cost side, consider upfront costs, as well as maintenance and component replacement needs. On the benefits side, consider property and income tax benefits, state incentives for solar PV electricity production, and avoided electricity costs realized through net metering.

Upfront Costs

A rough estimate of upfront costs can be obtained by multiplying the installed capacity (in kW) of your solar PV array by the cost per watt installed (\$/W) by a conversion factor (1,000 W/1 kW). You can get an estimate of cost per watt installed for your area from MassCEC: <http://www.masscec.com/solar-costs-performance>

Warranties & Maintenance

The performance warranty for a solar panel array will typically guarantee 90% of initial electricity production at 10 years and 80% at 20 or 25 years. System components, such as the inverter, are often under warranty for 10-12 years from date of installation, which means you may have to pay to replace certain components after this time. It is usually worth the investment in new system components, so long as the solar panels themselves are intact and functional.

Solar panels require little regular maintenance. The presence of snow, pollen and dust on panels can reduce electricity generation, but typically not enough to be concerned about. During the winter months, heavy snowfall can completely block light to the panels, cutting electricity production to zero. You have several options following a severe winter storm. You can simply wait for the snow to melt – solar panels face the sun and are usually installed at a significant pitch, so will shed snow faster than other surfaces. The loss of electricity production may be slight, since panels do not generate as much electricity in the short winter days as they do during the summer. If your panels are mounted on a horizontal surface, or otherwise accessible, you can clear snow from them using a roof rake with a special soft head designed for the purpose. Telescoping poles are available to reach more out-of-the-way locations. On warm winter days, or during the summer months, garden hoses can be used to remove snow, dust, or pollen.

Tax Incentives

Federal Income Tax Credit: If you pay income taxes, you should be eligible to claim the federal Residential Renewable Energy Tax Credit for a new residential solar electric system. Systems installed through the end of 2019 can qualify for a tax credit equal to up to 30% of total system cost. The credit declines to 26% of system cost for projects installed in 2020, and 22% for systems installed in 2021. If your tax liability during the year you install the system is less than the tax credit you are eligible for, you are allowed to carry excess tax credit forward as long as the tax credit exists.

See: https://www.energystar.gov/about/federal_tax_credits/2017_renewable_energy_tax_credits

Massachusetts Personal Income Tax Credit: If you pay income taxes and install the solar PV system at your primary residence, you should be eligible for a state personal income tax credit of the lesser of \$1,000, or 15% of total system cost. If your tax liability during the year you install the system is less than the tax credit you are eligible for, you are allowed to carry excess tax credit forward for up to 3 years.

Massachusetts Sales Tax Exemption: Equipment purchased for a residential solar electric system in Massachusetts is typically exempt from state sales tax.

Massachusetts Property Tax Exemption: Under a law that dates back to the 1970s, a property tax exemption applies to solar PV systems that are “utilized as a primary or auxiliary power system” for a taxable property. The exemption explicitly applies to off-grid solar PV systems, but over the years, it has generally been interpreted to include grid-connected systems sized to meet the electricity demand of the buildings or property they are associated with. Your residential solar PV system should be exempt from property tax for 20 years, but check with your local tax assessor if you have questions.

State Solar PV Electricity Production Incentives

From 2010-2018, homeowners could take advantage of solar PV incentives available through the state [Solar Carve-Out](#) and [Solar Carve-Out II](#) programs (SREC I & SREC II). Under these programs, homeowners earned credits known as **Solar Renewable Energy Credits (SRECs)** for every kilowatt-hour (kWh) of electricity generated by their arrays. Homeowners could then work with an SREC aggregator to sell the SRECs at auction. *If you have inherited or purchased a property with a solar PV array installed under the SREC program, or are having a solar PV array installed in 2018 under the SREC II program, please see our fact sheet [Purchasing a Home with a Solar Photovoltaic Array](#) for more information about SRECs.*

The SREC II incentives program is expected to be replaced by a new program, known as the [Solar Massachusetts Renewable Target \(SMART\) program](#), beginning in late 2018. The Massachusetts Department of Energy Resources (MA DOER) has finalized the SMART regulation, which will take effect once the Department of Public Utilities (DPU) has reviewed and approved the final regulation. The SMART program will regulate incentives associated with new solar PV facilities installed in Massachusetts. Under the SMART program, residents and businesses can qualify to receive incentives for solar PV installations in the form of what are known as “tariffs,” which are credits that appear on the electricity bill of the system owner. For small residential PV systems (≤ 25 kW in capacity), the program provides a fixed credit for every kilowatt-hour (kWh) of electricity that is generated by the system for a period of 10 years.

It is important to note that the SMART program does not provide incentives to the following: 1) off-the-grid PV systems, 2) solar PV systems installed in areas served by a municipal utility, 3) solar PV systems larger than 5 MW in capacity, or 4) solar thermal systems (which heat water rather than generating electricity).

Interested in estimating the SMART program incentives associated with installing a residential solar PV array for your home? See *Calculating SMART Incentives for New Residential Solar PV* on our website.

Avoided Electricity Costs & Net Metering

In addition to SMART program incentives, installing a solar array will allow you to benefit from avoided electricity costs. Massachusetts requires utilities to credit residential solar PV system owners for electricity generated by the solar array through a process called *net metering*. Under net metering, you still receive a monthly electricity bill, but you are only charged for your net electricity consumption. You can calculate your net monthly electricity consumption using this formula:

$$\text{Net monthly consumption} = (\text{total electricity consumed in a month}) - (\text{total electricity generated in a month})$$

If your net consumption is positive, and you use more electricity than you generate, you must pay an electricity bill to your electric company for the excess consumption at the end of the monthly billing period. If your net consumption is negative, you will receive a net metering credit on your electricity bill instead. Net metering credits appear in the form of a dollar amount (not kilowatt-hours) on your bill, equal to the value of electricity during that month (\$/kWh) multiplied by the number of excess kilowatt-hours your system generated. The utility company will not pay you directly for the electricity generated by your system, but this dollar value credit will roll over to the next billing period and will be credited towards any future bills. These credits never expire. It is worth noting that utility companies are typically allowed to charge a small monthly customer fee. Therefore, if your net consumption were exactly zero, you might still receive a small electricity bill from the utility. However, any accumulated net metering credits would go towards covering the cost of this fee.

If the solar PV system installed on your property ends up generating more electricity than you use annually, net metering credits will begin to accumulate in your account. You have the option to submit a revised Schedule Z, which can assign a percentage of your net metering credits to another electricity account located in the same load zone as yours.

For more details on net metering, what it means, and how it works, see the MA DOER **Net Metering Guide**: <https://www.mass.gov/guides/net-metering-guide>.

Simple Example Calculations for Solar PV Array Purchase (Cash Purchase, No Loan)

Note that these calculations are provided as an example only, and do not necessarily reflect values applicable to a project on your property. Consult with a solar installer or installers regarding the costs and benefits of a solar PV array to power your home.

Upfront Cost

Upfront cost = installed capacity * cost per watt installed * 1000 W/1 kW

Example: Upfront cost = 5 kW * \$4/W * 1,000 = \$20,000

Maintenance and System Component Replacement

Example: Solar inverter replacement = \$3,500

Federal Income Tax Credit

Tax credit = 30% of upfront cost

Example: Tax credit = 0.30 * \$20,000 = \$6,000

State Income Tax Credit

Tax credit = Lesser of \$1,000 or 15% of upfront cost

Example: $0.15 * \$20,000 = \$3,000$; $\$3,000 > \$1,000$; Tax credit = \$1,000

State Solar PV Incentives

Total solar incentive = solar incentive payment (\$/kWh) * annual electricity generation (kWh/year) * 10 years

Example: Total solar incentive = \$0.11221/kWh * 6,000 kWh/year * 10 years = \$6,732

Avoided Electricity Costs

Total electricity costs avoided = value of energy (\$/kWh) * annual electricity generation (kWh/year) * 20 years

Example: Total electricity costs avoided = \$0.19905/kWh * 6,000 kWh/year * 20 years = \$23,886

COSTS AND BENEFITS

Total cost = Upfront cost + Maintenance & system component replacement

Total benefits = Tax credits + Total solar incentive + Total electricity costs avoided

Example: Total cost = \$20,000 + \$3,500 = \$23,500

Total benefits = \$6,000 + \$1,000 + \$6,732 + \$23,886 = \$37,618

Additional Financial Resources

Massachusetts Solar Loan Program - Low-interest, fixed-rate loans to help residents purchase solar photovoltaic systems: <http://www.masssolarloan.com/>

Massachusetts Homeowner's Guide to Solar Leases, Loans, and PPAs:

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

CESA Homeowner's Guide to Solar Financing – Guide to financing options, including leases, power purchase agreements, solar loans and direct purchases:

<https://www.cesa.org/assets/2015-Files/Homeowners-Guide-to-Solar-Financing.pdf>

U.S. DOE Homeowners Guide to Financing a Grid-Connected Solar Electric System - An overview of the financing options that may be available to homeowners who are considering installing a solar electric system on their house: <https://www1.eere.energy.gov/solar/pdfs/48969.pdf>

Reporting Monthly Electricity Production

In order to receive monthly incentive payments, the electricity generated by your system must be logged through the MassCEC Production Tracking System. If your system has a Data Acquisition System (DAS), it will automatically report electricity generation to the Production Tracking System. If you do not install a DAS, you will need to manually report electricity generation via the Production Tracking System:

<http://www.masscec.com/production-tracking-system-1>