



INTRO TO SOLAR

in Massachusetts

Mission Statement: Sunlight Solar Energy is dedicated to educating our customers and empowering them to make intelligent buying decisions.

Dear Solar Enthusiast:

Thank you for your interest in clean, renewable – and best of all – affordable photovoltaic (PV) solar electricity and solar thermal.

After reading this information, please call us at (781) 373-3263 to get started on your own solar system! Give our first contact a call and we will gladly schedule an appointment for a Systems Designer to come to your home and give you a free, custom proposal. We do not charge a fee for any preliminary proposals or site surveys.

Sunlight Solar is an innovative and creative company with an industry-leading philosophy and approach to photovoltaic design and installation.

We sincerely look forward to hearing from you!



Solar energy never
looked so good!

5.16 kW photovoltaic and 2-collector hot water arrays

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Part of an 18.63 kW Solar Array



At Work On A 4.6kW Solar Array

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I. ABOUT SUNLIGHT SOLAR ENERGY

- One of the leading solar design and installation companies in the United States
- Approved PV Solar contractors in Massachusetts, Rhode Island, Connecticut, Oregon, and New York
- Founded in 1988 by Paul Israel in Sacramento, California
- Full-time, in-house, professional installation teams
- Fuel-efficient hybrid company vehicles
- Portfolio of more than 300 installed residential systems and over two megawatts worth of solar systems
- Installed large commercial installations such as Yale University's 40,000 watt system and the Tip O'Neill Buildings 30,000 watt hybrid photovoltaic and thermal system, the first of it's kind to be installed on a U.S. Federal Building

Walking The Walk:
Sunlight Solar Energy in the community!



One of our fleet of company hybrid design cars!



Volunteering on Earth Day

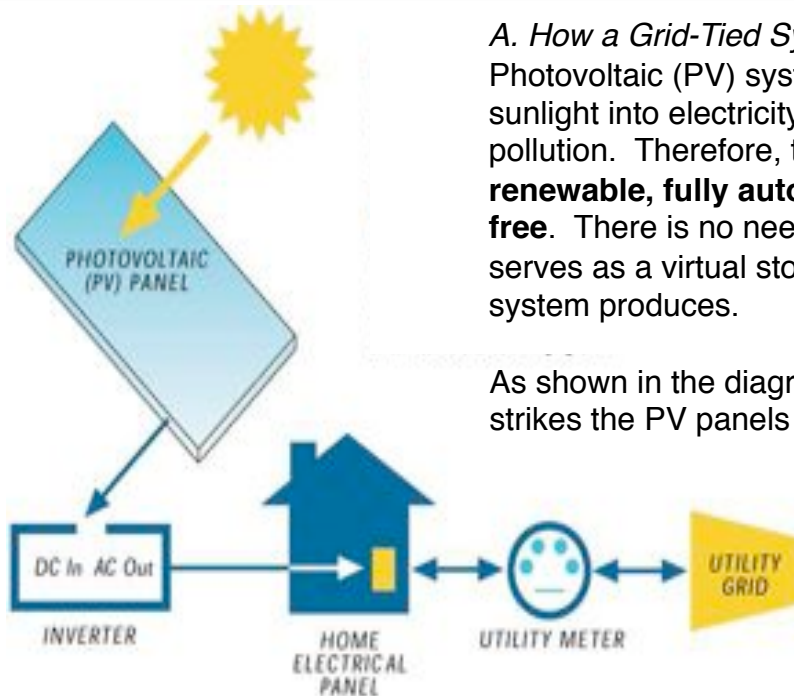


YouthBuild Solar Lab



4.92kW SunPower Integant Award Winning Array

II. SOLAR TECHNOLOGY



A. How a Grid-Tied System Works

Photovoltaic (PV) systems work by directly converting sunlight into electricity without noise, moving parts, or pollution. Therefore, the system is **simple, reliable, renewable, fully automatic, and virtually maintenance-free**. There is no need for batteries because the grid serves as a virtual storage facility for the clean energy your system produces.

As shown in the diagram to the left, energy from the sun strikes the PV panels (array) and produces DC energy.

An inverter changes the DC energy to AC energy and ties into your home's electric circuit breaker panel.

Appliances in your home that were once powered by the grid, can now run from the clean

energy produced by your system. Your utility company will install a new, bi-directional utility meter on your home to measure both electricity produced by your system and pulled from the grid. Your electric bill will be based on this new electronic meter reading and will look quite different than your current bill!

Watch your utility meter spin backwards

B. Net Metering

Net Metering is a policy used to measure the net energy usage of a customer who produces her or his own electricity via a small renewable energy facility (like a PV system). Your utility meter will spin forward when you pull electricity from the grid and will slow down or spin backwards when your PV system is producing electricity. This allows your utility company to track, not only the energy you pull from the grid, but also the energy your PV system produces.

The utility company will charge you for your net consumption, which equals total electricity consumed minus total electricity generated.

If your net consumption is positive, you will receive a bill for the excess electricity used, however, if your net consumption is negative, you will receive a credit on your electricity bill for the excess electricity produced.



5.9 kW Solar Array

II. SOLAR TECHNOLOGY

C. SunPower Corporation

Our solar panel supplier is California-based SunPower Corporation. SunPower is one of the fastest growing solar manufacturing companies in the world and has developed the world's most efficient, commercially-available solar cell.

We highly recommend reading their Annual Report at www.sunpowercorp.com.

For a number of reasons, including cell efficiency, quality of construction, warranty, and aesthetics, we are proud to have been selected as a SunPower factory-direct integrator. This means solar panels come directly from the manufacturing plant to you. SunPower recognizes Sunlight Solar Energy as a *premier dealer* of SunPower panels.

Reliable, safe, and renewable

D. Solar Panels

i. Quality and Warranties

Solar panels have no moving parts or chemical reactions and are, therefore, very low maintenance.

Many solar panels are backed by Power Warranties, which range from 10 to 25 years (SunPower's Power Warranty is 25 years). Generally, a Power Warranty guarantees that the panel will produce at least 80% of its rated capacity for the warranty period. Beyond the warranty period, your system will continue to produce clean energy for many years.

Experts believe that solar panels will produce electricity for 35 years or more, with a degrading output of about 0.5% to 1% per year.

ii. Efficiency

One way to judge the efficiency of a solar panel is to compare the results of two tests that all solar panels must undergo: the PTC and STC panel tests. These tests measure the panels' performance under perfect conditions and realistic conditions, respectively.

If you look at the drop-off in power of the test results, you get an interesting story about efficiency. All things being equal, you want to purchase panels which have a high PTC/STC ratio. For example, a SunPower solar panel has an STC rating of 225 watts and a PTC rating of 207.1 watts. This gives a drop-off of 17.9 watts or a percentage loss of 92%. This is very good. Call us and we can help you compare different manufacturers' solar panel efficiencies.



5.74 kW Roof Mounted Solar Array

II. SOLAR TECHNOLOGY

Empower your building



North Haven Health & Racquet Club, 190kW Solar Array

E. Inverters

i. General Information

Inverters are a vital component of your solar system. The inverter(s) will convert solar DC energy into household AC energy.

In a grid-tied system, if utility electric power becomes unstable or is lost, your PV system will automatically turn off and your home will not produce solar electricity. This is to protect utility workers from live energy flowing into the grid, while the grid is being serviced. Every five minutes, however, the inverter automatically

tests the utility power for stability and turns back on once power is restored. The system works seamlessly and automatically.

Inverters are designed to be installed outdoors, protected from southern or western direct sun, but can also be installed in the basement, garage, or other areas depending on owner preference and site-specific conditions.

ii. Efficiency

Translating solar DC energy into household AC electricity uses some energy. For this reason, each inverter has a published efficiency rating. The SunPower 5000m inverter has an industry-leading 96.8% conversion efficiency. Call us and we can help you compare different manufacturers' inverter efficiencies.



2.05kW PV Electrical Board

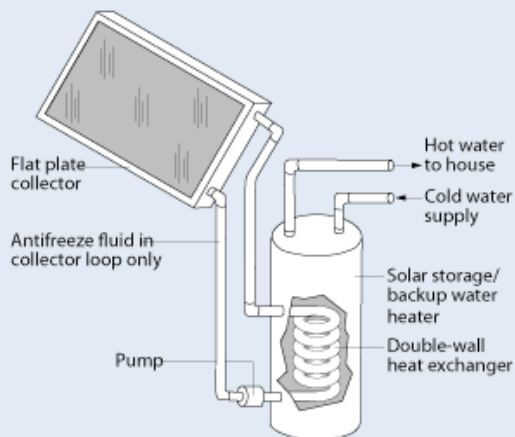
F. Grid-Tied Battery Back-up System

For people who have concerns about power outages, we can design systems with an automatic battery back-up. If the power grid goes down, the back-up system will automatically detect the power loss and immediately switch electric loads to the batteries.

A battery back-up system is much more expensive than a standard grid-tied system because of the extra components. A back-up system may add approximately \$10,000 to your system cost and will require additional maintenance throughout your system's life. It is important to note that Commonwealth Solar does not grant rebates to cover the extra cost of back-up systems.

II. SOLAR TECHNOLOGY

Active, Closed Loop Solar Water Heater



A Solar Hot Water System

G. Solar Thermal

Solar Thermal refers to any type of technology that uses the sun's energy to heat something. Solar Heating can be used in many different applications.

Primarily, Solar Heating is used for Domestic Hot Water—the hot water for faucets, showers, and appliances in your home. It can also be used for space heating if the home uses hot water heat such as radiant floor heating. Pools and hot tubs can also be heated using solar thermal technology. Solar water heating has existed for centuries and has been used for bathing, hand washing, and home heating. It has always been a very effective method to heat water, but modern materials and knowledge have made the process far more efficient.

Our domestic hot water systems start with a flat plate solar collector. Coils of copper pipe inside the collector heat up and transfer liquid (typically a non-toxic, food grade propylene glycol) slowly moving inside them. With the newest collectors, the temperature of that liquid can reach up to 200 degrees!

When the liquid is hot enough, it flows down to heat the water for the house through a heat exchanger (see diagram). The fluid is then circulated back up to the collectors to heat up again; it never comes in contact with the hot water for the home. The heated water is kept in a large storage tank, so even a morning shower can be solar heated from the previous day.

The entire process is essentially a high tech version of a garden hose sitting in the sun. This system can provide up to 80% of a home's hot water needs. And because hot water heating can account for around 20% of utility bills, these systems can bring you big savings!

All of the systems we install always have a back-up heat source so you are never left with a cold shower.



Ask us about Hybrid Solar Electric and Solar Thermal Systems!

III. FINANCIAL INCENTIVES

Solar within reach

A. *Commonwealth Solar*

Commonwealth Solar is a program that was launched by the Massachusetts Technology Collaborative in January 2008 and provides rebates for the installation of grid-tied PV systems.

Rebates are available to customers of the following MA electric utilities: Fitchburg Gas & Electric Light (Unitil), National Grid, NSTAR, and Western Massachusetts Electric. Customers of select municipal light plants may be eligible for rebates.

i. Commonwealth Solar Rebate Calculation

The rebate is based upon the system size and specifications, as well as on the quality of the site. Residential rebates are subject to a cap based on the lesser of a 5 kilowatt (kW) system or \$8,500 rebate total. The current rebate levels are:

- Base Incentive: \$0.75/watt
- MA Company Components Adder: \$0.10/watt
- Moderate Home Value Adder: \$0.85/watt or
- Moderate Income Adder: \$0.85/watt



2kW Roof Mounted Solar Array

During your site survey, we will examine your site conditions and show you the projected efficiency of your system. The site survey is critical in determining your true rebate. If a contractor does not go on your roof to determine site conditions, you should question the accuracy of the projected rebate amount.

B. *Federal Investment Tax Credit (ITC)*

By purchasing a PV system, you will be eligible for a tax credit from the Federal Government in the amount of 30% of your out-of-pocket investment. For example, a \$55,000 PV system with an \$8,500 rebate would be eligible for an ITC of \$13,950. If your tax liability is not that great, it is possible to spread the ITC over a number of years to be able to take full advantage of it.

C. *State Tax Credit*

The installation of a PV system will also enable you to take advantage of a 15% tax credit, capped at \$1,000, if the system is installed on your primary residence. The 15% tax credit will be calculated by looking at the net expenditure of the system (after subtracting the state rebate and federal tax credit from your total investment). Most systems will be eligible for the full \$1,000 state tax credit.

III. FINANCIAL INCENTIVES

D. Solar Renewable Energy Credits/Green Tags

Solar Renewable Energy Credits (SRECs) are tradable commodities used in the energy industry and are, essentially, the free market value of the “clean energy attributes” (not the electricity) of your solar energy. For every megawatt hour of electricity your system produces, you will earn one SREC, which will sell at the base price of \$300 less any aggregation processing fees. The Massachusetts SREC market is quite strong, and SRECs have historically sold well above \$300.

E. Cost and Energy Production

A typical installation is 24 SunPower 225 watt solar panels – a total of 5,400 watts (5.4 kW). This installation, including all taxes and permits, costs approximately \$37,000 (before any rebates or incentives), with variability depending on difficulty.

IV. PERMITTING AND INSTALLATION

A. Site Surveys and Proposals

Before your site survey, our First Contact will gather some preliminary information on your home and any PV system requirements you may have. She will also look at a satellite photo of your house to observe shading conditions and determine the home’s orientation.

With this information, she can prepare a preliminary proposal for you to consider. Our final proposal typically does not vary much from our preliminary proposal unless the actual site survey reveals significant discrepancies from the initial information. The most common discrepancy is usually related to shading: most people underestimate the amount of shade affecting their roof throughout the year. *Therefore, please be conservative when providing shading estimates.*

After carefully evaluating the preliminary proposal, many people decide Sunlight Solar Energy is the right choice for them. If the proposal, including system components and cost, is satisfactory to you, we can then schedule a Systems Designer to come to your house to conduct a detailed site survey.

Solar made simple



7.3kW Roof Mounted Solar Array



3.22kW Roof Mounted Solar Array

IV. PERMITTING AND INSTALLATION

The rebate agency, Massachusetts Clean Energy Center, requires eligible installers to perform a site survey prior to approving a rebate application. While some companies charge \$80 to \$120 for this service, Sunlight Solar believes this service should be free of charge.

During the site survey, our Systems Designer will take several measurements and photographs of your site and analyze a number of important issues including:

- Roof design, shingle age, and condition
- Orientation, height, and pitch of roof(s)
- Available roof space for solar panels; roof vent locations; skylights; etc.
- Distance from solar panels to the circuit breaker panel and electric meter
- Electric service panel suitability, including extra space for a breaker
- Tree shading and other factors that will affect PV system output
- Proposed location of inverter
- Possible ground mount location
- Any other factors impacting system price, energy production, etc.
- Discuss proposal and answer homeowner's questions



The Solar Pathfinder tool helps us determine the amount of shading at your site

After the site survey, our Systems Designer will prepare a final proposal for you to consider.

B. Permitting and Interconnection

SSE will obtain an electrical building permit and the utility interconnection approval for you. These services are included in your system price. Once your system is installed, it cannot be turned on until it has been inspected by your local wiring inspector and your utility company has granted "authority to interconnect."

Solar done right



AC Disconnect



Inverter and DC Disconnect



PV Combiner Box

IV. PERMITTING AND INSTALLATION

C. Wiring and PV System Components

The wiring on your solar electric system serves as the conduit for the flow of your solar electricity. Sizing the wire properly is a requirement of the National Electric Code (NEC) and allows your system to be most efficient. We oversize your wires, usually exceeding Code, to maximize your solar panels' efficiency.

Managing the wiring on an installation is very important. In all SSE installations, wires do not touch the roof and all "strings" of solar panels will be properly fused with outdoor-rated warning labels.

All secondary components can be installed inside your home except the AC Disconnect, which must be installed within three feet of the exterior utility meter. This is a standard requirement of utility companies. All disconnects and components are labeled to code. Labeling and wiring will be inspected by your wiring inspector.



Back View of Tilted Panels



Saybrook Point Inn, 43.92kW Array

What has your roof done for you lately?



9.23kW Roof Mounted Solar Array

C. Post Installation

Once your solar array has been installed, we will do a "walk through" of your system with you. We will show you each of the meters, explain the components, and teach you how to turn your new PV system on and off. We will also present you with an Owner's Manual that has specification sheets, technical schematics, warranties, etc. Sunlight Solar coordinates all necessary inspections and tests.

Sunlight Solar backs every PV installation with a 10 year labor warranty.

V. INSTALLATION CONSIDERATIONS

A. Orientation

While a southern-facing roof is ideal for a solar array, you may be surprised to learn that southeast, southwest, and even east and west roof orientations can also work. Tilting panels may enable solar production on east or west facing roofs that might otherwise produce about 20% less electricity than a south-facing roof.

Designed to meet your needs

B. Roof

i. Age and Weight Load

Your present roofing material should have at least 15 years of life remaining. This ensures that your PV system will not be compromised by a deteriorating roof.

Local building codes usually allow a maximum of two layers of asphalt shingles on your roof. Codes dictate this because the additional weight of a solar array may lead to structural problems. Occasionally, older roofs may need to be strengthened by adding larger rafters. We work with a structural engineer on every project to be certain that your roof can support the proposed PV array.



At Work on a 5.16kW Solar Array

Solar panels are designed and installed to withstand severe weather conditions including hurricane-force winds and 50 mph hail storms. In addition to our own rigorous installation standards, your system will be reviewed, inspected, and approved by your municipality, utility company, and Commonwealth Solar.

| Number of 225W Panels | Area of Roof (sq. ft.) | System's Total Wattage |
|-----------------------|------------------------|------------------------|
| 12 | 156 | 2,700 |
| 14 | 182 | 3,150 |
| 18 | 234 | 4,050 |
| 21 | 273 | 4,725 |
| 24 | 312 | 5,400 |
| 27 | 351 | 6,075 |

ii. Square Footage

To the left, is a chart of the minimum square footage needed for varying numbers of SunPower 225 watt panels. After approximating the square footage of your roof (length multiplied by width), you can compare it to the chart. Remember: pipe vents, skylights, and other obstacles limit available space. If there is not enough roof space, Sunlight Solar can install a ground mounted solar array, as seen above.

V. INSTALLATION CONSIDERATIONS

iii. Angle

The sun's daily path in the sky changes throughout the year. In the winter, the sun is low to the horizon, while in the summer it is higher.

During the spring and fall seasons, the sun is somewhere in between. The diagram to the right depicts the sun's arc traversing the Massachusetts sky during the winter and summer months.



PV systems on roofs steeper than 36 degrees will product more electricity in the winter, while roofs with lower pitches or angles will work better in the summer, when the sun is higher overhead. A 36-degree tilt of the roof is the optimum overall angle for PV panels in Massachusetts, however we can work with any roof pitch.

Let the sun work for you

C. Shading

Shading has a significant impact on solar panels' production. It is one of the prime reasons that properties are not suitable for solar. A site should not be shaded more than 10-25% throughout the day (6am to 6pm), throughout the year. Ideally, an array should be un-shaded between the hours of 9am and 3pm, the times of peak PV electricity production ("solar noon").

Shading can be caused by soft sources (snow, leaves, bird droppings) or hard sources (trees, dormers, chimneys). Problematic trees can be pruned, topped off, or replaced with shorter-growing trees and bushes to reduce shading, if necessary. Shading caused by chimneys and dormers are more permanent obstructions.

Take a close look at your home and notice how much sunshine falls on your roof during the day. Imagine your roof in the summer. Do soft or hard sources cast shade on the roof? What about in the winter, when the sun is low over the horizon? Seasonal changes in foliage and sun angle are extremely important.



8.28kW Array Follows the Shading Rules of Thumb
(see following page)

Shading Rules of Thumb:

Trees to the east and west of your roof should be more than twice as far from your house as they are tall. Trees to the south should be at least three times as far as they are tall. These general criteria will help you to begin assessing potential shading issues.

During our site survey we will climb on your roof and take Solar Pathfinder measurements to accurately identify potential shading challenges.

V. INSTALLATION CONSIDERATIONS

D. Aesthetics

When designing your system, we typically suggest using the natural pitch of your roof. Our standard installation method is a high quality UniRac SunFrame racking system. This system “frames” out the panels with no spaces between and creates the most aesthetic installation on the market.

If you are concerned about panel color, SunPower offers black panels, which are sleek, yet discrete, creating an aesthetic suitable for any home.



1.68kW Solar Array

Produce your own power



East Facing Roof with Southern Tilt Mounts



3.1kW Array Mounted on Metal Roof

E. Special Conditions

i. Tilt Mounts

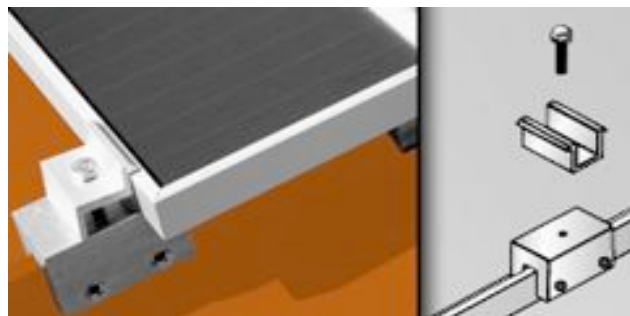
Tilt mounts make solar possible when a roof is flat or east or west facing.

We suggest keeping the panels at a five-degree tilt towards the south to maximize aesthetics.

However, tilting the panels 36 degrees to the south will maximize solar production.

ii. Metal roofs

For customers with metal roofs we use clips that attach to the standing seams; the panel is then bolted onto the clips, removing the need to penetrate the roof.



VI. FINANCING SOLAR

Sunlight Solar Energy tailors each proposal to your energy and financial needs. We are proud to partner with several organizations to offer you some of the best financing options available.

A. SunRun Power Purchase Agreement

Sunlight Solar Energy has partnered with SunRun, the nation's leading home solar company, to remove the barrier of high installation costs, providing monitoring, maintenance, and insurance on the solar power system for 20 years, at little to no upfront cost for the homeowner.

Sunlight Solar designs and installs the system, while SunRun owns the system and thereby takes on the burden of ownership, providing a 20-year performance guarantee. Homeowners will be able to have solar panels installed on their roof for a little as \$0 upfront, and typically begin seeing immediate savings of 10-15% on their total monthly energy bills.

SunRun allows homeowners to lock-in their monthly energy costs at a pre-determined rate for a period of 20 years, after which homeowners have the option to purchase the array for fair market value.



B. SunPower 20 Year Loan

Sunlight Solar Energy, a premier dealer of SunPower Solar Panels, is now offering, in conjunction with SunPower, a 20 Year Unsecured Loan. Homeowners interested in installing solar on their homes can do so for a very small upfront payment. The loan, which is unsecured, meaning it requires no home equity, features a low interest rate and the option to re-amortize in the first 18 months.



VII. OTHER CONSIDERATIONS

A. Maintenance

Our best maintenance suggestion is to visually inspect the panels and wiring at least once a year. If anything looks amiss, just give us a call. It is also good to keep the panels and equipment clean from dirt, dust, salt, pollen, and debris. In Massachusetts, rainfall will generally provide all of the cleaning that your panels need: naturally, gently, and effectively. You may hose the panels down with water and can use a soft brush or squeegee to scrub off bird droppings, pollen, dirt, etc. A mild non-abrasive detergent can be used to take care of persistent dirt. It is important to note that scratching the panels may void your warranty, so please ensure that any device you use to clean your panels will be gentle.

A common question customers have is how long it takes for snow to melt off the panels. The answer depends on a number of factors including the amount of snowfall, temperature, cloud cover, shading, orientation, and tilt of the solar panels. Generally, if you have six inches of snowfall overnight, snow on panels tilted 22 degrees will melt off by the early afternoon, provided there is full sunshine. The greater the tilt on the panels, the faster the snow will melt off. However, snow could remain on the panels for several days during heavy snowstorms and cold overcast conditions.

B. Homeowner's Associations and Historic Commissions

Some homes are located in communities where there are active and stringent Homeowner's Association regulations. Associations typically have the power to approve or deny solar panels on a homeowner's roof prior to obtaining any required permits.

Historic District Commissions also present challenges to solar installations as they have an eye towards protecting the historic character of the buildings. However, most Historic Commissions have allowed PV systems to be installed on homes.

You will want to contact your Homeowner's Association or Historic Commission to get a sense if your application will be considered for approval. Our staff will help support your application and attend any necessary meetings. A number of our customers have received Historic Commission and Homeowner's Association approvals for solar panels on their homes.

A new kind of classic



2.1kW Roof Mounted Solar Array

VII. OTHER CONSIDERATIONS

C. Insurance

PV systems are typically covered under your homeowner's insurance policy. However, you may have to increase your coverage because of the replacement value of your solar array. We recommend you check with your insurance agent regarding coverage.

D. Property Taxes and Property Values

Many homeowners ask whether installing solar panels on their home will increase their property taxes. You will be happy to know that the General Statutes of Massachusetts address this issue: any municipality may exempt, by ordinance, Class I Renewable Energy Facilities [such as solar PV systems] for single-family houses or multi-family dwellings of two to four units. (M.G.L. ch. 59 § 5 (45, 45A)).

If you haven't
already scheduled
your free site survey,
call us today!

(781) 373-3263



3.8kW Roof Mounted Solar Array

For additional information, please feel free to give us a call or visit these valuable online resources:

More on Solar Technology:

[Solar Basics from www.sunlightsolar.com](http://www.sunlightsolar.com)

[Net Metering from www.mass.gov](http://www.mass.gov)

[SunPower from www.sunpowercorp.com](http://www.sunpowercorp.com)

More on Incentives:

[Rebates from www.commonwealthsolar.org](http://www.commonwealthsolar.org)

[Federal Tax Credits from www.energy.gov](http://www.energy.gov)

[State Tax Credits from www.mass.gov](http://www.mass.gov)

[SRECs from www.srectrade.com](http://www.srectrade.com)