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Solar Incentives in Massachusetts

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Solar Energy Incentives in Massachusetts

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Abstract

The United States is pushing more for use of renewable sources for electricity, and state policymakers are figuring out the best ways to reach the set goals. The goal of this project is to determine if the current policies and incentives in Massachusetts are sufficient to support the growth of the solar industry while allowing all parties to benefit. We gathered information through interviews with experts, surveyed Massachusetts residents, and reviewed comments of the most recent incentive proposals. We were able to conclude that although the current incentives effectively push for more solar panel installations, the newest incentive proposal will work better for long-term, consistent, and controlled growth of the solar market.

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Sincerely,
Logan Mendelson

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Executive Summary

Global warming is an issue that is not only affecting us but other species as well. In order to combat this problem, we are slowly transitioning to alternative sources of energy called renewable energy, which reduces the main driving force of climate change: greenhouse gases. States set renewable energy goals to help the companies and residents get involved in the process while providing incentives. One example of such an incentive is the large loans the government is willing to give to solar companies, but many believe that over-incentivizing is also causing companies to go into debt or bankruptcy. Our project aims to focus on the incentives the government provides to aid consumers of the solar industry; are the current policies and incentives in Massachusetts are sufficient to support the growth of the solar industry while allowing all parties to benefit?

In order to get a background on the industry we researched about it, and the different incentives available. We learned that in 2015, 67% of the electricity generated in the United States came from burning fossil fuels, which significantly impacts the our environment. The electricity sold by utility companies tend to fluctuate in prices due to the change in demand during the day. This price includes the cost of electricity and many charges such as Customer, Distribution, Transition, Transmission, Renewable Energy, Energy Conservation and Supplier Services charges. The electricity itself only costs about $0.08, but due to these charges the average consumer in Massachusetts pays about $0.192/kWh (Massachusetts State Energy Profile," 2017). When switching to solar, not only would the consumer not need to pay for these charges, the cost of electricity would actually be less compared to electricity bought from a utility company.

We were also able to learn about the different types of ownerships of solar panels: Full

Ownership, Third Party Ownership or Community Ownership. Full ownership allows the consumer to take advantage of the all the benefits while Third Party and Community Ownership allows the companies to have most of the financial benefits from the government while the lessees benefit from a reduced price of electricity. In order for consumers to take full advantage of the benefits, we researched about the different incentives involved in purchasing solar panels and found that they are net-metering, the Solar Renewable Energy Credit (SREC), the Mass Loan program, and a $1000 state tax credit currently and a new program called the Solar Massachusetts Renewable Target (SMART) program being developed for 2018. The SREC program essentially gives one SREC to the owner of a solar panel system for every one MW of electricity produced. This SREC would be sold on the market, typically using a middleman, to utility companies that need to meet their Renewable Portfolio Standard (RPS) before the deadline, or else the company is penalized. The price of SRECs can fluctuate depending on the supply and demand while the new SMART program will offer a fixed incentive rate for a fixed term length making the payback period and savings easier to calculate. The SMART program is a mixture between a Feed-in Tariff, an incentive based on the amount of electricity produced from the solar panels and a declining block model. This program monitors the capacity size of solar panels being installed overall in Massachusetts, and the government correlates the total capacity of installed solar panels to the incentive level. The declining block model shows that for every 200 MW total capacity of solar panels installed in Massachusetts, the incentive level will decrease about 4%.

We interviewed solar experts and solar company representatives to gather additional information. We also gathered information about how they perceive the current incentives in place and the possible incentive the government plans to put into effect in the future as well as get their opinions on other subject matters such as net metering, SREC vs. SMART, or third-party

ownership.

We interviewed Jonathan Morrone, a solar consultant from Direct Energy and learned that the prices of solar panels have decreased about 60% in the last 3-4 years to the point where the cost of electricity generated from solar panels is the same price as electricity generated from carbon based sources. He recommended that solar panels be purchased outright rather than being leased if the owner has to pay federal tax and also because there is enough financial help for purchasing solar panels that they become relatively inexpensive. People who lease solar panels usually misunderstand the terms as solar panel companies legally advertise that the solar panels are free but are not actually. The solar companies still have full ownership and the homeowner pays the company in some form (power agreement or leasing of the solar panels). Even with the incentives and different options available for solar panel, recently there has been a decrease in the number of people purchasing solar panel which may be due to political indecisiveness. It could also be due to the fact that prices of SRECs have decreased, making consumers think that there is less financial support when it is only decreasing because the cost of solar panels are also decreasing. We were also able to find out that originally there was plans for a SREC III program, but the DOER decided to transition to a Feed-in Tariff instead. This may be because the SREC program allows people to "double dip" where they can take advantage of the income the SRECs provide as well as the net metering. The Feed-in Tariff has more control in its incentive, making it less profitable to consumers but more fair in giving out a more appropriate incentive level than the SRECs. This interview gave us a good background and led us to research more about the new incentive programs as well as the benefits of owning solar panels as we walked through the cost of purchasing solar panels.

We were able to create a survey and spread it through social media in order to collect some data and opinions from people who do and don't own solar panels. From the 94 respondents from Massachusetts, we determined some of the main positive and negative factors that go into making the decision to go solar. We were also able to get a sense of the certain demographics that typically get involved with the solar industry.

We also reviewed the comments submitted to the DOER about the Straw proposal. Through the comments, we will be able to see that the new SMART program, which is the revised version of the Straw proposal, reflected most of the concerns written in the comments such as land restriction, voluntary program for municipals, capacity blocks and a less aggressive timeline for the implementation of the new program.

From all the information we gathered, we were able to conclude that the current incentives are sufficient to support the growth of the industry but the SMART program will be able to support it more effectively since it will allow the growth of the solar industry as it will fairly allocate the money to where it is needed. SRECs typically required a middle man to find buyers to owners of SRECs, while the SMART program does not require a middle man; the money will only be profiting those they are targeting. With the new program, the incentive level reflects a variety of factors such as the size of the solar panel system, location of the installation, income level, and the total capacity of solar panels installed in Massachusetts. In the SREC II program, the prices of the SRECs on the market fluctuates, and making it hard for consumers to calculate the profit made in the long run and sometimes the pricing of the SRECs did not clearly reflect the incentive level intended. The SMART program will fix this as the incentive level is a fixed rate for at least ten years, making it easier for consumers to calculate their profit and payback period.

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  - All helped in editing.
- Executive Summary
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Introduction

The worldwide demand of electricity is met by burning the ever-depleting fossil fuels, which not only endangers our current lifestyle but also negatively affects the climate and the environment. In 2015, approximately 67% of energy generated in the United States came from burning fossil fuels showing that we are still heavily reliant on them (EIA, 2016). We can reduce our dependence on fossil fuels and our carbon footprint by using alternative sources of energy. In order to help aid the movement towards renewable energy, states set up requirements for a percentage of the energy generated to be from renewable energy sources. One of the remarkable pushes can be seen in the solar industry as the state and federal government provide incentives for homeowners to get involved in using a clean source of energy that does not affect the environment.

In order to encourage more people get involved into solar industry, the governments set goals while offering many financial incentives to make solar become more affordable and accessible. According to Solar Energy Industries Association (SEIA), the Governor of Massachusetts set a goal of 1.6GW of energy to be generated from solar energy sources by the year of 2020 ("Solar State Policy," n.d.). To help reach the state goals and make solar panels more affordable, the government offers a federal tax credit of 30% of the solar installation-based cost and the state offers production-based incentives such as net metering and the Solar Renewable Energy Credit (SREC). While the government is pushing for consumers to purchase solar panels, companies like SolarCity find themselves in debt and other companies, like SunEdison, are filing for bankruptcy (Cardwell & Creswell, 2016). These situations of financial crisis beg the question, does the government provide the right incentives and subsides to allow the growth of the solar industry by supporting solar companies and its consumers?

The purpose of the project is to determine if the appropriate policies and incentives in Massachusetts are in place to support the growth of the field so it can reach the renewable energy goals. In order to accomplish this task, we need to research the different options of installing rooftop solar panels, and the incentives and subsidies involved for each. Specifically, with incentives and subsidies, we will look at the costs of energy, how excess generated energy is used, and the government policies, tax credits, and consumption goals. Then, we will interview solar companies to understand who their typical customers are and what they project their company growth to be. Surveying current and potential customers of solar panels will help us assess the factors that go into a customer's decision to invest in solar panels and what they believe is the advantage and disadvantages of investing in solar panels. The information collected will help us determine if the new incentive in development is appropriate and beneficial to all parties involved, as well as propose any changes we think are suitable.

Background

In order to understand the solar industry, we must first understand that the power industry is comprised of three parties when it comes to generating and consuming energy: power generation companies, transmission/utility companies, and the consumer. While they aren't explicitly involved, the federal and state government is another part of this process. The job of power generation companies is to generate energy to power the grid typically using fossil fuels and renewable energy sources. The transmission/utility companies purchase power from many different generation companies, and they are responsible for maintaining the power grid and sending the electricity out. Consumers buy electricity from the utility company, and their monthly bill represents how much energy they used as well as other factors. The government regulates procedures in almost all of these parts. Not only are there taxes and policies involved, but some states mandate a percentage of the grid to be from renewable sources. This is a reason that utility companies are interested in increasing popularity of solar power. When homeowners install solar panels, the roles of each party change a little bit, but we will go more in-depth later on.

Power Generation

In this age, we heavily rely on electricity to power items we use in our daily lives. In 2015, it was estimated that 67% of the electricity generated in the United States was from burning fossil fuels such as coal, natural gas and petroleum (EIA, 2016). They are considered to be effective and relatively inexpensive but they are a limited source, thus called nonrenewable energy. According to a study done by Shahriar Shafiee and Erkan Topal (2009), the reserve depletion year for oil, coal and gas will approximately be in the year of 2040, 2112 and 2042 respectively.

Not only are the fossil fuels depleting, our methods of accessing and generating electricity are negatively affecting the environment and climate. An article from K. L. Lerner, B. W. Lerner, and K. J. Edgar. (2012) explains how the different sources of energy are collected to generate electricity and how they affect the environment. By digging into the landscape, we can gain access to fossil fuels and in the process destroy the land and animal habitats. Burning of these fossil fuels leads to air pollution, acid rain and climate change. This climate change is due to the greenhouse gases (CO_2, methane, and nitrous oxide) produced when fossil fuels are burned which traps heat on the planet causing the Earth's temperature to rise. Scientists from Woods Hole Research Center calculated the rate of carbon transfer and their results are shown in Figure 1, which depicts that the amount of carbon dioxide released to the atmosphere is increasing with the biggest factor being due to fossil fuels and destruction of land. These negative outcomes not only affect us but also other animals as their habitats get destroyed. In order to combat these problems, movements have been made to use an alternative source of energy such as solar, wind, and hydroelectric energy.

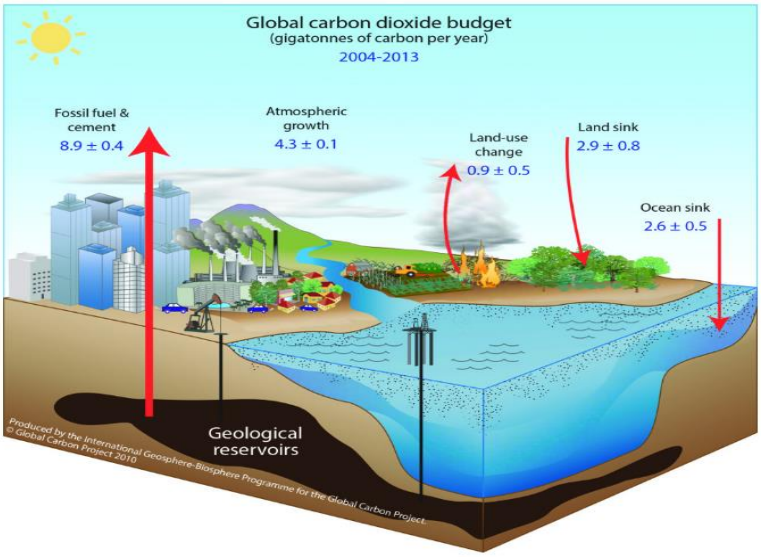


Figure 1: A Diagram showing how much carbon is being released and consumed

(Global Carbon, 2016)

Utility Companies

In order to understand the potential development and expansion of solar consumption, we must understand the output of utility companies, the breakdown of the billing systems, and different charge for consuming electricity throughout the day. This information provides a critical look on conventional energy industry. With this, we can compare the production and consumption of traditional energy to the solar-based energy.

In the New England region of the U.S, energy is provided by Investor Owned Companies (National Grid, Eversource. etc.) or Municipal Companies (owned by the local government). These utility companies earn a lot of money each year by exploiting fossil fuels because they are inexpensive compared to other forms of energy. Based on the U.S Energy Information Administration (EIA) statistics, in 2015 64% Massachusetts National Grid (NG)'s electricity output came from natural gas, 7% came from coal while only 9.4% came from the renewable energy resources such as solar, wind and biomass ("Massachusetts State Energy Profile," 2016). Also according to latest EIA's statistics, the electricity rate for residential in MA in the last month of 2016 is $0.192 /kWh, which is 57% higher than average rate in the U.S ($0.122/kWh) ("Massachusetts State Energy Profile," 2017).

By increasing and stimulating clean energy consumption, we can save money on our electricity bills, potentially power the grid using excess energy generated and help combat climate change.

Electricity Bill

The breakdown of the electricity bill which is distributed by utility companies need to be analyzed so that it could be applied to the billing system of solar energy consumption. For example,

Eversource includes the wholesale price of electricity and the following components in its electric bill ("Understanding My Bill," 2016):

- Customer Charge: This charges for customer services that the company provides throughout the year, including but not limited to billing, maintenance, metering, etc… This charge is a fixed cost and doesn't correlate with the used amount of electricity in each bill.
- Distribution Charge: This charges consumers for the cost of sending the electricity to them.
- Transition Charge: This charges for plant generations and power contracts in the past investments
- Transmission Charge: This charges for the expense of sending electricity over high-power lines to Eversource's service area from a generating plant.
- Renewable Energy Charge: This charges the amount of money the company has to pay Massachusetts Renewable Energy Trust Fund in order to increase renewable energy availability.
- Energy Conservation Charge: This charges for energy efficiency programs.
- Supplier Services: This charges for the costs that are affiliated with electricity supply. Hence, this cost on the bill may vary considerably since the power is bought from open markets.

Besides a basic fee for distribution, transition, and transmission energy, each customer is also billed for the "Renewable Energy Charge", which represents a charge from MA Renewable Energy Trust Fund to develop the availability and affordability of the renewable energy. This means that customers who are consuming the conventional energy are also charged this extra fee

to aid in the production green energy while not even using it.

The knowledge of the electricity bill from conventional sources is necessary for us to compare the traditional power cost to the renewable energy, and the solar-based energy in particular. From this breakdown, we can understand why the billing system for clean energy consumption is more beneficial. If a homeowner's solar panel produced all the energy for the household, they would not be paying for electricity from a utility company and if they only produced a portion of their electrical consumption they would still be saving money each month.

Billing Rate

The difference in the billing rate for consuming electricity during different times of the day is a concept called "residential time-variant electricity pricing". It is mentioned in a report on the official website of Environmental Defense Fund (EDF), a United States based nonprofit environmental advocacy group known for working on environmental issues (Badtke-Berkow, Centore, Mohlin, Spiller, 2015).

The price of electricity used between the low demand hours and peak hours has a significant gap. A term of "critical peak" is applied for the highest requirements of electricity consumption throughout the day. There are many different types of time-variant pricing. All reflect the implemented cost for the electricity bill including:

- Real-Time Pricing (RTP): Over the day, electricity rates vary frequently in short intervals (i.e. an hour), for each of which there's a different price signal. This price signal represents the cost of electricity generation during that time interval
- Time-of-Use Pricing (TOU): In this type of pricing, there are usually two/three intervals

per day, for each of which there's a different price signal. These prices can be separated into 3 groups: off-peak prices (midnight to early morning), semi-peak prices (during the day and evenings) and peak prices (when reach the highest demands)

- Critical Peak Pricing (CPP): Customers would be informed (i.e. email, text) about the peak time of electricity price in upcoming days or hours. This helps customers be proactive with the amount of electricity they use during those sessions and take advantage of slightly lower pricing in off-peak times (compared to the regular rate.)

- Critical Peak Rebate (CPR): Similar to CPP, but CPR rewards the customers for each KWh of electricity they use less than they normally would during periods with high electricity demands.

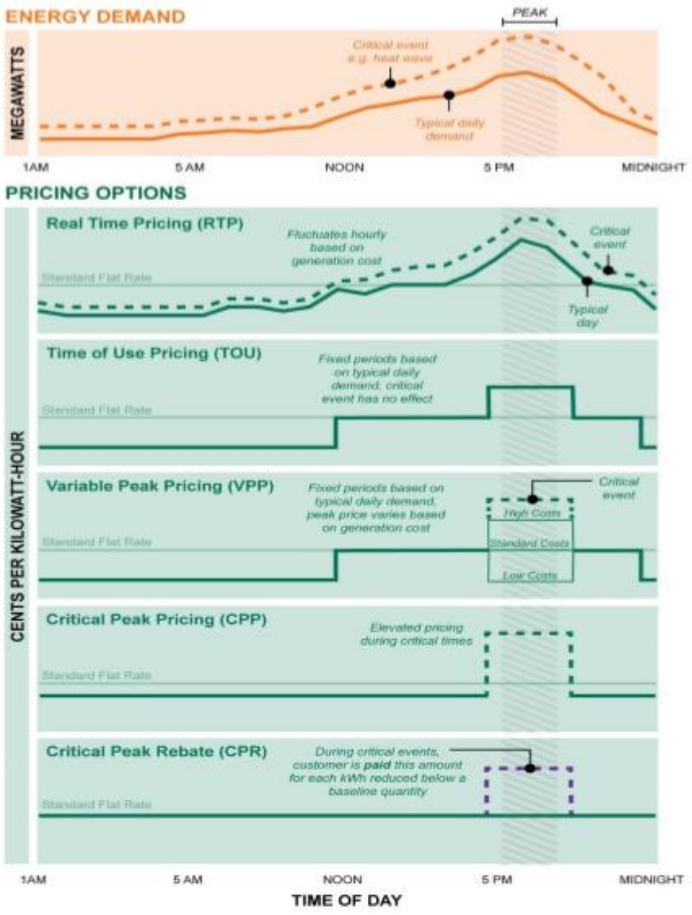


Figure 2: Different time-variant price options (Badtke-Berkow, Centore, Mohlin, Spiller, 2015).

Typically utility companies buy electricity at the lowest price, which is normally from fossil fuels, but if the demand was greater than the amount available for that price, they must find other sources of electricity that is sold at higher prices to buy from. Electricity prices increase during the critical peak periods because more people are using electricity so the utility companies must buy more expensive electricity to meet the demand of consumers. The abundance of renewable energy, such as solar energy, can help with increased electricity demand during peak hours and it can help to create high production and reduce costs during critical hours.

Solar Panels

Sunlight can be converted into clean, renewable energy that we can use to power our houses and termed as solar energy. It is harnessed and converted into electricity by using a series of photovoltaic cells (PV) called solar panels. A solar panel consists of several individual PV cells, each with a positive and a negative layer. The sunlight strikes the cell, and the energy frees some electrons in the semiconductor, which is typically a silicon material (N-type). The electrons create a current, which is harnessed by wires connected to the positive and negative sides of the cell in the P-type material. The electricity created is multiplied by the number of cells in each panel and the number of panels in each solar array. Combined, a solar array can create a very significant amount of energy as a typical rooftop PV systems have either a 3.9 kW or 6 kW capacity ("Incentivizing Solar Energy", Consumer Energy Alliance, 2015). For comparison, a typical house in Massachusetts uses around 18 kWh per day ("Household Energy Use in Massachusetts," 2009). The amount of energy production can vary due to the position of the solar panels but they are usually pointed towards the south if in the northern hemisphere to maximize the amount of sunlight hitting the solar panel.

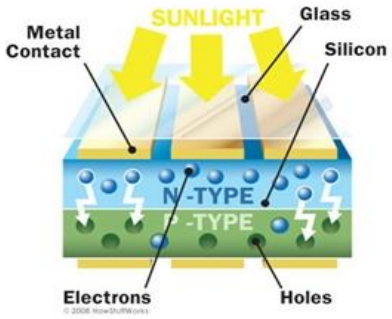


Figure 3: The internal components of a solar panel are shown. Sunlight hits the panels and releases electrons from the N-type layer to the P-type layer creating a current. (Turner, 2017)

Solar energy is a great resource for energy with little to no repercussions on the environment. The benefits of protecting our environment, saving money on the electric bill, and potentially making a profit over time are some of the reasons why investing in solar panels is important in the short term and long term.

Different types of ownership for solar panels

When choosing rooftop solar panels, there are three main options the solar companies offer: Full Ownership, Third Party Ownership and Community Ownership. Each type of ownership means there are different incentives for the homeowner and the company to take advantage of.

A customer can choose Full Ownership in which he or she purchases the solar system outright. The customer owns the panels and the generated energy. There are many government incentives for installing rooftop solar panels, including tax credits and sales tax exemption. By staying connected to the power grid, the customer could purchase energy if they don't produce enough from the solar panels alone. When excess energy is generated, a contract can be worked out with the utility company to sell the excess energy produced and put it in the grid. The downside is that purchasing the system is very expensive, but there are programs that offer special loans or long-term financing of solar panels. Full ownership of the panels allows for the most return on the investment sooner.

The second option is Third Party Ownership (TPO) where a solar company essentially leases the solar panels through power purchase agreement or solar leasing. Power purchase agreement allows the owner to pay the solar company for the amount of electricity they consumed while solar leasing allows the homeowner to lease the solar panels monthly from the company.

This method does have upfront costs and had less risk than full ownership as the solar company is fully responsible for maintenance of the panels. However, rather than the customer receiving the tax benefits, the solar company claims those incentives. One problem with this ownership is that it is typically falsely advertised to potential consumer as the solar panels are "free" but they are actually the property of the company.

The third option is community ownership. This basically means that a few neighbors or a local light department purchases the system and finances it together. This is a great way to get involved in the solar community while lessening your individual investment. The energy is shared between customers with wires to multiple houses.

Another method of getting involved with the solar industry without installing solar panels is to buy electricity generated from renewable energy sources. Level Solar is introducing a new option to get involved in the solar community by signing a contract to buy solar power from Level at a low cost ("How much do solar panels cost," 2017). The price of clean energy is the same price as regular energy produced from fossil fuels meaning that homeowners and renters can help support the solar industry at no additional cost to them. (J. Morrone, personal communication, December 12, 2016)

Incentives and Subsidies

Now that we know the different ways to own solar panels, we must look into the incentives that a homeowner would receive for each method of ownership. To understand the government's efforts on expanding clean energy in general, we focus on goals which government has set up for all levels: federal and state, as well as the requirements for the utility companies.

During the period of the Obama administration, the president had some important goals for renewable energy. As mentioned in the State of the Union address in 2011, President Obama proposed the goal of obtaining 80% of America's electricity to come from clean energy sources by 2035, and he also pushed the Climate Action Plan's target by cutting 6 billion metric tons of energy waste by 2030 ("FACT SHEET," 2015) ("Advancing American Energy", n.d.).

President Obama did have the right moves in pointing out the negative impacts to habitats traditional energy sources cause**,** and the positive impacts about the accessibility of clean energy. They have put in place actions to develop and grow the renewable energy industry. It is important that we understand the state and federal government policies that are intended to help push solar installation, exploitation and consumption.

Massachusetts Solar Goals

In Massachusetts (MA), the goal is that 1600MW of solar energy should be installed by 2020, which could account for 25% of MA energy consumption (set by the Patrick administration) ("Profile Analysis," 2016). MA is always one of the pioneers in approaching green energy. A released report by Solar Energy Industries Association (SEIA) stated that in 2015, MA installed a total capacity of 340 MW in PV systems, which ranked fourth among all the states for 2015 installations ("Solar State Policy", n.d.).

As shown in Figure 4.1 and 4.2 below, the PV installations in Massachusetts are consistently higher than the years previous. At the end of 2016, the total capacity of installed PV in Massachusetts was 1395 MW. The projection shows that Massachusetts should reach 1600 MW by 2018, and by 2020 it will be almost 2000 MW according to the extrapolated data. This brings

up questions of whether the goals set are too conservative, or if the industry is just growing faster than expected. On the other hand, it's possible that incentives have caused this growth spurt and are too aggressive for consistent long-term growth.

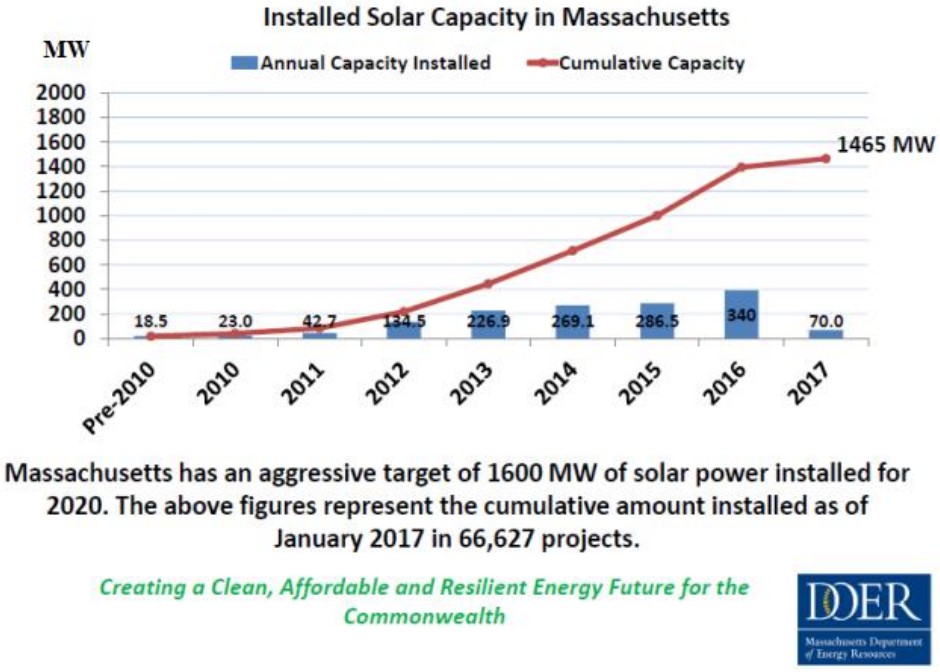
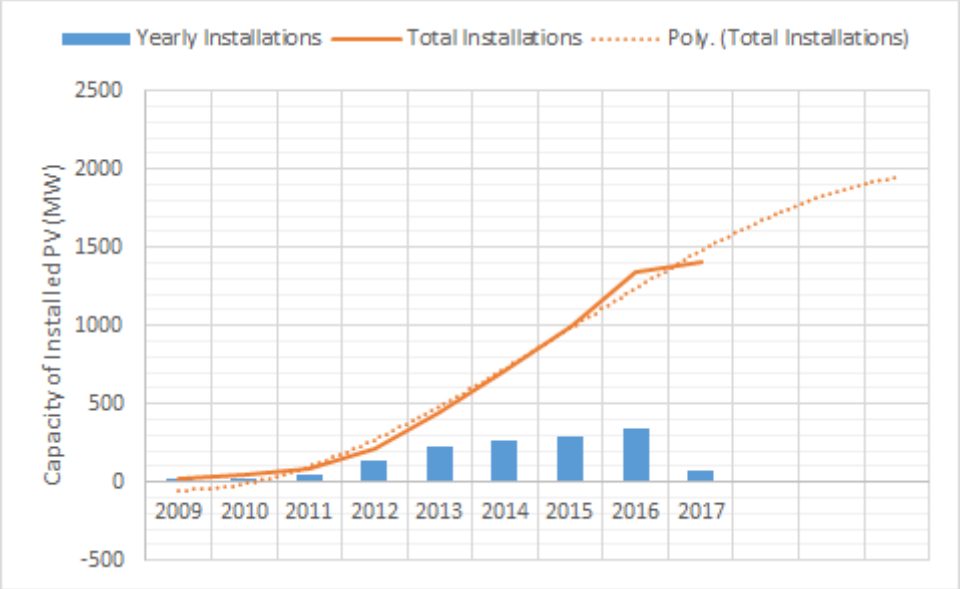


Figure 4.1: Installed Solar Capacity in Massachusetts. The red line shows the summation of those values. Currently we are at a total of 1465 MW ("Installed Solar Capacity," 2017).



Figures 4.2: The extrapolated version of the Installed Solar Capacity in Massachusetts in the next few years.

Beside those decisive goals, state government also proposed some mandates for utility companies that requires them to acquire clean energy. The Massachusetts Renewable Energy Portfolio Standard (RPS) is a statutory obligation that suppliers (both regulated distribution utilities and competitive suppliers) obtain a percentage of electricity from renewable energy. As the information from Massachusetts Energy and Environmental Affairs (EEA) explains, the RPS began with an obligation of one percent in 2003, and then increased by 0.5% percent annually until it reached 4% in 2009 ("RPS and APS Program Summaries," 2016). The latest RPS and APS Annual Compliance Reports for 2014 announced the RPS requirement was 9% and this number should be 12% in the current year (DOER, 2016). The goals for solar from federal and state, and the RPS requirement for utility companies will make them support the solar industry by investing in solar farms or purchasing electricity generated from solar panels. Either way, the RPS makes utility companies invest more and more each year into solar while decreasing how much they rely on traditional energy generated from fossil fuels.

Incentives

In order to reach solar goals, the U.S government and state authorities have created many incentives and subsidies that aim to make solar panels more affordable and accessible for the customers. The federal government provides a tax credit that reduces the total cost of installing solar panels until the end of 2020. Massachusetts also has some incentives such as the net-metering, the Solar Renewable Energy Credit (SREC), the Mass Loan program, and a maximum of $1000 state tax credit. The state is also considering the new incentive named Feed-in Tariff which actually has been applied in many other developed countries and some states in U.S.

The federal tax credit, aka the Solar Investment Tax Credit (ITC), is the most significant policy that the US government has established to support solar installation. Based on the information from SEIA, the ITC is currently 30 percent federal tax credit claimed against the tax liability of residential (Section 25D) and commercial (Section 48) and utility investors in solar energy property. The 25D residential ITC allows the homeowner to apply the credit to their personal income taxes. To simplify this, the homeowners can claim a tax credit of 30% of the total cost of the installation of the solar panels when they purchase the solar panels outright and have them installed on their homes.

The next set of incentives come from the state government as Massachusetts authorities created some incentives to help make solar panels more affordable. One of the programs that Massachusetts uses to encourage customers go solar is net metering. In this part, we are going to see what is net metering and how it works, and from this we will able to understand how important this program is in encouraging customers go solar.

According to the information on the official website of the Executive Office of Energy and

Environmental Affairs ("Net metering," 2017), net metering has been available in MA since 1980s and regulated by Department of Public Utilities. Net metering allows customers of certain electric distribution companies to generate their own electricity in order to offset their electricity usage. Customers of all classes are eligible for net metering. It is not only limited to electricity generated from solar panels but also from other renewable energy sources, such as wind turbines. Installations like these require a special retail meter, which will measure the quantity of electricity that the customer uses and produces. The retail meter spins forward when the customer uses electricity from the distribution company, and it spins backward when the customer generates electricity (thereby "exporting" electricity to the electric grid). However, the pricing of the electricity used and generated differ. Homeowners in Massachusetts typically pay about $0.192 per kWh used, which we learned earlier is a combination of fees along with the price of electricity ("Massachusetts State Energy Profile," 2017). If electricity is generated by the homeowner and sent back to the grid, they are paid the wholesale price of electricity, which is typically $0.07.

Each state law sets a different net metering caps for utility companies. In aggregate, municipal or governmental facilities' production is capped at 8% of the utility' peak load, and private facilities' production is capped at 7% of the peak load. Systems that are 10kWh on a single phase circuit and 25 kWh and under with a three phase circuit do not fall under this limit. This means that the typical homeowner does not have to worry about having a limit placed on their net metering.

Net metering can lower a customer's electricity bill by reducing the amount of electricity that the customer buys from the distribution company while possibly getting paid for the excess electricity they produced. Some customers get involved in net metering because of an interest in the environment and renewable energy. Overall this is a system that tries to allow for some profit

for consumers while decreasing the reliance on fossil fuels. This incentive will change later on as the SMART program will modify how this system works which will be explained later on.

The following table shows the caps for private net metering facilities such as homes and private schools and public net metering facilities such as hospitals and public schools; effective April 11, 2016.

Distribution Company	Private Net Metering Cap (7%)	Public Net Metering Cap (8%)
National Grid Massachusetts Electric Company	359.17 MW	410.48 MW
National Grid Nantucket Electric Company	3.183 MW	3.638 MW
NSTAR Electric Company d/b/a Eversource Energy	348.46 MW	398.24 MW
Western Massachusetts Electric Company d/b/a Eversource Energy	59.78 MW	68.320 MW
Unitil d/b/a Fitchburg Gas and Electric Light Company	7.14 MW	8.160 MW

Table 1: The caps for private and public net metering in Massachusetts ("Net Metering," 2017)

On December 17th, 2015, the Massachusetts Administration announced the launch of a $30 million residential solar loan program. Mass Solar Loan is a program that offers a loan up to three units with all lenders offering loans between $3,000 and $35,000 and some lenders offering loans up to $60,000 with very low interest. This makes solar installation and consumption of solar energy become more accessible on single-family homes and residential buildings than ever ("Solar Loan

Program," 2015).

SRECs are Solar Renewable Energy Certificates, which are units of value for each unit of solar energy produced. One SREC is equal one MWh of solar electricity that has been generated. The price of one SREC is dependent on the market of demand and supply, meaning that the price fluctuates. The utility companies will buy SRECs in order to meet the RPS requirement as an obligation. If the utilities do not have enough SRECs as a requirement, they need to pay a penalty to the state. The price of SRECs are typically less than the penalty fee which is known as the Alternative Compliance Payment ($488 for each MWh below the RPS requirement) ("Alternative Compliance Payment Rates," 2017). Customers can hold on to the SRECs and decide to put them in the market when they think the price is high enough for them which will help them offset the cost of installing the solar panels. Companies like SRECTrade are called an "aggregator" as they buy SRECs from customers and sell them to the utilities by setting their own prices dependent on the market. While this is a good way to introduce buyers to sellers, they have a service fee. This means that the system that the government intended to help consumers is also profiting 3rd party companies.

Feed-in-Tariff (FIT) is an incentive that is designed to encourage the development of renewable energy sources that have been applied in many other developed countries such as Germany, Ireland and also adopted successfully by some states in US such as California, Florida and Hawaii. It is a government program similar to net metering as renewable energy generators are paid a set price that is higher than the cost of electricity for each kWh of energy produced and is guaranteed for a certain length of time. This program was created with a purpose of compensating the cost of the renewable energy system installation hence making it more affordable and accessible compared to the conventional sources of power.

There are three main points in the FIT program that can be deployed to the renewable energy generators: a guaranteed grid connection requiring utilities or transmission system operators to connect eligible generators to the grid; a guaranteed long-term contract, typically ranging from 10 to 25 years; and a fixed or predictable price (tariff) paid for all of the electricity produced. Building on these elements, a FIT program also provides standardized program rules, prices, and contracts to generators ("A Policymaker's Guide, "2010). Massachusetts is working on a modified version of this program called the SMART program.

The Department of Energy Resources (DOER) says that the market risk and uncertainty resulted in higher incentives than are necessary and proposed the Straw Proposal on September 23, 2016 for the 2017 year. This proposal is a mixture between a FIT and a declining block model. This program monitors the capacity size of solar panels being installed overall in Massachusetts, and the government correlates the total capacity of installed solar panels to the incentive level. For example, soon MA will reach 1600MW and this correlates to a fixed price of $0.30/kWh for systems less than or equal to 25 kW for 10 years. As the number of solar panels installed increases, the incentive level will decrease. Figure 5 shows an example of a declining block model where the red represents the incentive and the blue represents net metering. Although the chart shows the base incentive starting at $0.25, the actual proposal has a base incentive of $0.30 for consumers who purchase a system of less than 25kW. This program moves away from the SRECs with fluctuating prices to a steadier source of income which can be seen in Figure 6. While this a good change, changing the incentive level to correctly reflect the need of consumers will be hard and may not be accurate. This program takes into account more variables such as the location where the solar panels are installed, offtaker based (consumer signs a PPA or leases solar panels) and storage of energy, all of which can add to the initial incentive level. For example, if a homeowner

installed a 20kW solar panel system on their roof, they are entitled to a $0.02 adder value for mounting the solar panels on their roof making their incentive level $0.30/kWh.

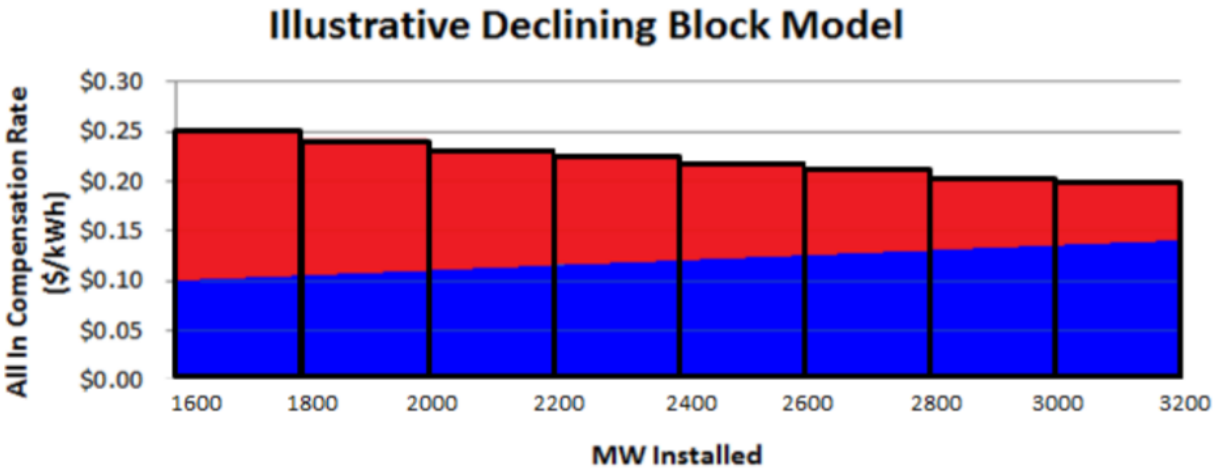


Figure 5: Example of Declining Block Model, actual rate starts at $0.30 (DOER, 2017).

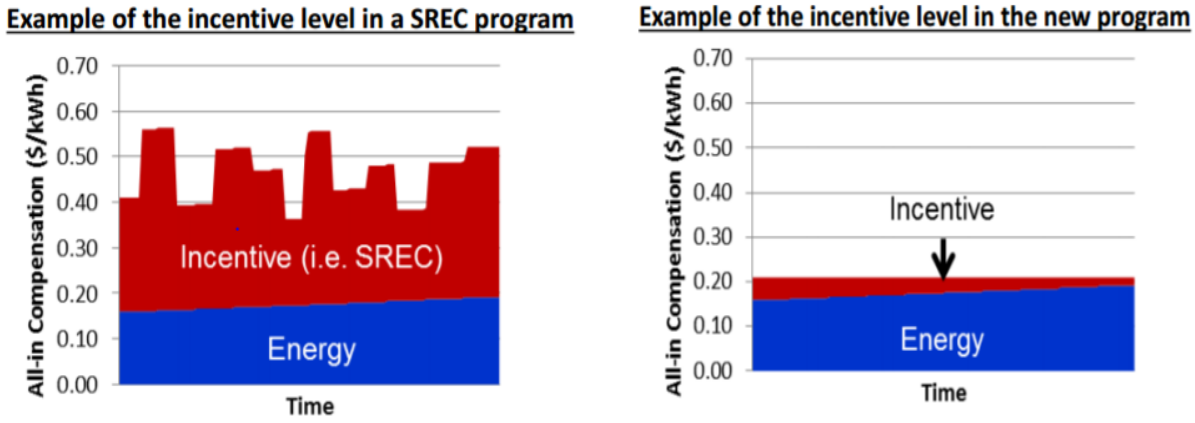


Figure 6: Comparison of the incentive level between the current SREC program and the newly proposed program (DOER, 2017).

The DOER asked for feedback on the Straw proposal and received 139 comments which they reviewed to revise into a finalized proposal from DOER (2017) that was released on January 31, 2017, named Solar Massachusetts Renewable Target (SMART). There were a few changes made in the new version such as changes in the land restrictions, creating a voluntary program that

municipals could join, pushing the time the program is supposed to go into effect, adding reducer values for the incentive level and the capacity blocks are divided proportionally among National Grid, Eversource, and WMECO. These will be addressed in more detail in the results section.

Understanding the current incentives and subsidies helps us in our project and allows us to see how beneficial these incentive programs are, discuss their current status, and analyze the accessibility of solar energy based on those incentives. From that, we could recommend some new policies that may help encourage more residents within the US to get more people involved in the solar industry.

Methodology

The purpose of the project is to determine if the policies and incentives in Massachusetts are sufficient to support the growth of the solar industry while allowing all parties to benefit. In order to do this, we needed to determine if the current incentives and subsidies for solar panels are appropriate and will allow the growth of the solar industry while allowing all the parties involved to benefit. We wanted to get a sense of community interest in the solar industry using surveys, conducting interviews with solar and utility companies to see how successful current policies and incentives are, and look at how incentives drive solar installations**.**

First we researched background information to learn more about the solar industry and how it is helping the environment compared to the energy produced using fossil fuels. We researched what a typical homeowner that does not own solar panels pays for in their electric bill. Once we learned what they pay for, we know that it's also potential money they could save by investing in solar panels. We did a more in-depth research on the different incentives that homeowners in Massachusetts could use to help pay for solar panels. While this information gave us a solid background of the industry, we did not know what people currently think of solar panels and what their concerns were so we had to develop a way to reach out to them and gather information.

We created a survey that was distributed through email and social media to reach out to as many people as possible. We also found solar users with a sort-of “snowball method” in asking the users we were in contact with if they knew anybody else who would be willing to talk with us and take the survey. We realized we needed to gather information from a lot of people, and we tried to focus on Massachusetts homeowners. Anybody could take the survey whether they had solar panels or not. If they did have solar panels, we asked questions like their monthly electricity

consumption and the amount of excess electricity their system produces per month. We asked everybody about the reasons why someone would go solar, reasons why someone wouldn't go solar, and how important the tax incentives would be in making the decision. We created the online survey through Qualtrics because it was an easy-to-use university website for writing and distributing, and we were able to add the logical statements into the survey so that anybody could take the survey and it would ask the appropriate questions depending on previous answers. The questions for this survey can be found in Appendix 1.

We interviewed solar experts and solar company representatives as well. We also gathered information about how they perceive the current incentives in place and the possible incentive the government plans to put into effect in the future. We wrote an interview protocol and for each person we met with we had organized questions we were hoping they could answer for us, as well as get their opinion on other subject matters such as net metering, SREC vs. SMART, or third-party ownership.

We also reviewed the comments submitted to the DOER about the Straw proposal. Through the comments we will be able to see if the SMART proposal addresses the different concerns, learn what people thought of the policy change, what factor were important to them and any problems with the proposal. We will mention the major problems and what the majority of the commenters mentioned in their comments in the next section.

The information gathered from these surveys, interviews and comments on the Straw proposal helped guide our research on policies that we have not learned about yet as well as learning information that would not be online. We gathered a great deal of information about the changing incentive programs, and will use these surveys to provide recommendations on which is better. Using this information, we can decide if the current incentives in place sufficiently allow

the owners of solar panels, the utility companies and the solar companies to profit.

Results

In this section we will review the information we gathered from the steps mentioned in the methodology. We researched information which was documented in the background section. Key information gathered from the interview, survey and the comments on the Straw proposal will be mentioned as well.

The Interviews

We interviewed various people to gather information about the solar industry and about the different perspectives they had on solar. We interviewed J. Morrone, a solar consultant from Direct Energy and learned that the prices of solar panels have decreased about 60% in the last 3-4 years to the point where the cost of electricity generated from solar panels is the same price as electricity generated from carbon based sources. Originally utility companies were not allowed to own power generation assets, but now they are able to install solar panels on transmission lines, bringing in more renewable energy to the grid. He recommended that solar panels be purchased outright than being leased if the owner has to pay federal tax and also because there is enough financial help for purchasing solar panels that they become relatively inexpensive. People who lease solar panels usually misunderstand the terms as solar panels companies legally advertise that the solar panels are free but are not actually. The solar companies still have full ownership and the homeowner pays the company in some form (power agreement or leasing of the solar panels). Even with the incentives and different options available for solar panels, recently there has been a decrease in the number of people purchasing solar panel which may be due to political indecisiveness. It could also be due to the fact that prices of SRECs have decreased, making consumers think that there is less financial support when they are only decreasing because the cost of solar panels are also

decreasing. We were also able to find out that originally there were plans for a SREC III program, but the DOER decided to transition to a Feed-in Tariff instead. This may be because the SREC program allows people to "double dip" where they can take advantage of the income SRECs provide as well as the net metering. The Feed-in Tariff has more control of the incentive, making it less profitable to consumers but more fair in giving out a more accurate incentive level than the SRECs. This interview gave us a good background and led us to research more about the new incentive programs as well as the benefits of owning solar panels as we walked through the cost of solar panels with him.

We were able to interview a customer that chose to lease instead of purchasing solar panels because he wanted to avoid maintaining the system as well as saving money, even though he would not be saving as much money if he purchased them. The solar company first inspected the roof to make sure there are no structural issues and wanted the last 3 electricity bills to determine what size solar panel system to install. He ended up with a 3kW system running at 106% of their total electricity consumption. They offered him a fixed rate of $0.15/kWh or a variable rate of $0.12/kWh that can increase a max of 3% a year for electricity. From this information we were able to find out that you can lease a system by paying the company monthly to use the electricity generated from the solar panels or do a solar power purchase agreement (PPA) where the owners pays the company at a rate for the electricity they use.

Talking to Professor Fred Looft, we learned that he not only owns solar panel but also purchases electricity from a solar farm. The main reason he went solar was to save money in the long term by purchasing solar panels and locking in a fixed rate with the solar farm to avoid the increasing costs of electricity (increases about $0.04 per year). He had originally calculated that the payback period for him was 7 years but due to the changes in SREC prices, it ended up paying

for itself in 4.5 years. We learned that the total cost of the solar panel installation mainly comes from the installation of the solar panels rather than the panels themselves because the panel prices have dropped significantly over the years. Consumers should purchase solar panel systems that meet their energy consumption level. If homeowners purchased a system greater than their consumption level, it would take a longer payback period to recover from the cost of a larger system since net metering returns about $0.07/kWh while purchasing electricity is about $0.192/kWh ("Massachusetts State Energy Profile," 2017). However, with the new incentive program, with a larger solar panel system they will be generating more electricity and thus be generating more income from them. The most important note with the new SMART program would be that if a larger system increases the payback period greater than 10 years, homeowners would lose out on the incentive the SMART provides as it will only cover them for ten years. While it is possible to purchase a larger system and make profit in the short term, homeowners should pay attention to the payback period. The transition to a feed-in tariff takes out the middleman which typically take about 10% of the SREC price.

The Survey

From the survey we had spread through social media and email, we had 94 respondents from Massachusetts out of 102 total responses. Of those 94, 88 were homeowners and 6 were considered renters.

For the current customers, there were 19 Massachusetts homeowners who utilize solar energy; 17 who have PV systems installed and 2 who have signed a contract to purchase solar energy from their electricity companies. Ten out of the 17 respondents have full ownership of their PV system. Also, 16 out of the 17 still rely on their electric company for some power, and 90% of

the respondents choose to sell excess power back to the grid. When asked, "On scale from 1-10, what is the importance of the tax benefits and incentives?" the average ranking was 7.5.

The top five factors for why to go solar, as ranked by Massachusetts homeowners with installed PV systems, are 1) preserve our natural resources, 2) increase the value/marketability of your home, 3) long-term financial return, 4) saving money short-term on electricity bill, and 5) protect yourself from changing electricity prices.

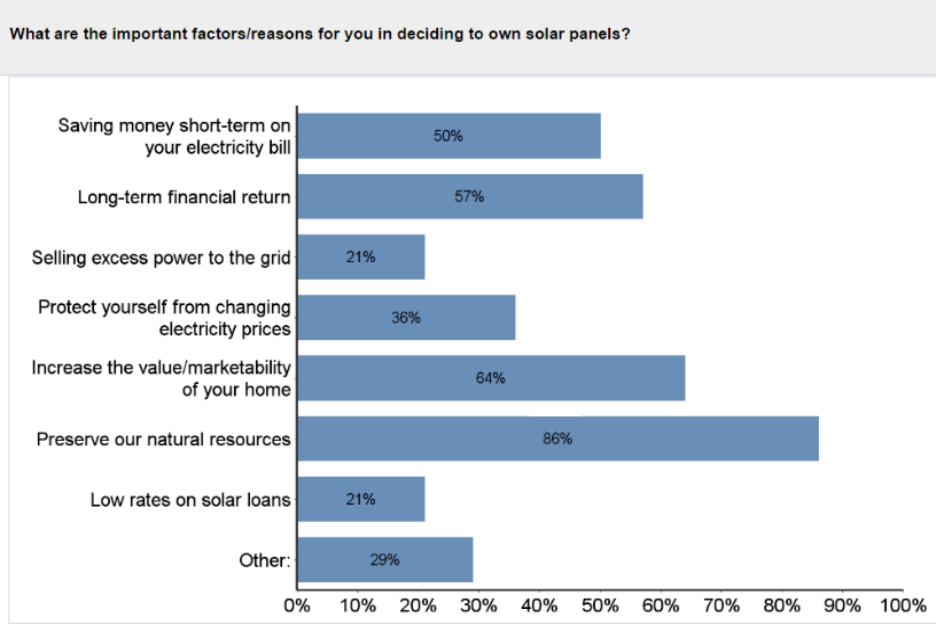


Figure 7: Statistic of the important factors in owning solar panels from homeowners that responded to our survey

We had 69 Massachusetts homeowners respond to our survey that did not have installed solar panels. Of those 69 "potential users", 31.4% are interested in owning solar panels, 29.4% would maybe consider it, and 39.2% are not interested.

The top five concerns from going solar, as ranked by Massachusetts homeowners without PV systems, are 1) too much money/investment, 2) complicated process, 3) house itself is not

suitable for solar panels, 4) decrease the value/marketability of your home, and 5) other. Below is a chart breaking this information down further by interest in owning a PV system.

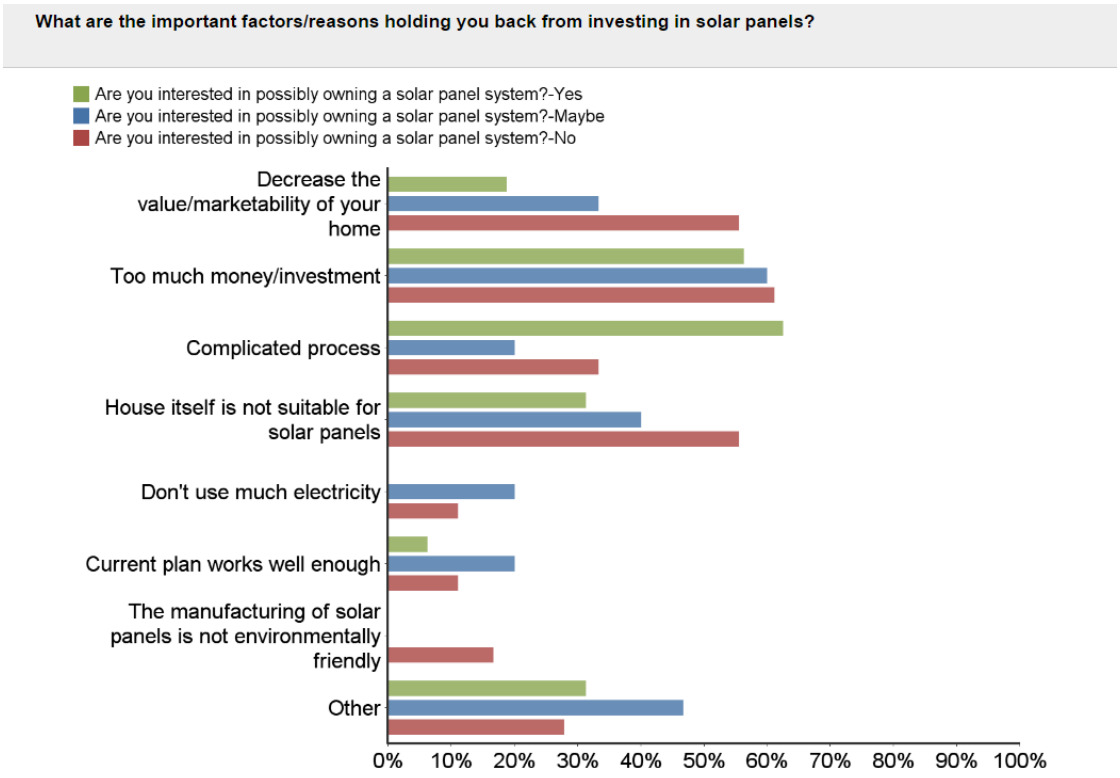


Figure 8: Statistic of the reasons why people have not invested in solar panels according to people who responded to our survey

Comments made on the Straw Proposal

On September 23, 2016, the DOER presented its vision for the next generation of solar incentives to the public under the name of "The Next Generation Solar Incentive Straw Proposal" and asked for community comments. The Straw proposal used a declining block model to correlate the incentive value (for every 200 MW block, the incentive decreases approximately 4%). There were 131 comments received and these comments were taken into consideration in the finalized proposal called Solar Massachusetts Renewable Target (SMART) Program.

Reviewing the comments found on the EEA's website for Development of the Next Solar Incentive, we concluded that majority of the people agreed with the proposal but wanted certain parts of the program to be changed. Many called for a less aggressive timeline for the change in the solar incentives because it will allow for a better transition while calling for an extension in the SREC program so consumers will not lose out on the incentives during the transition period between the SREC program and the SMART program. The SMART program was originally supposed to be implemented in the summer of 2017 but will now be implemented in the beginning of 2018. This also decreases the amount of uncertainty in the market for those considering to purchase solar panels.

The Straw proposal called for very strict restrictions for the usage for solar panels. Many people wanted it to be less strict so there would be more opportunities for the installation of solar panels. One of the interesting comments was that someone wanted floating solar to be included in the definition of solar canopies in the program. This land restriction is also bad for certain towns due to their remoteness. For example, in the town of Nantucket, they do not have industrial structures with adequately engineered roof areas, nor capped landfills that are encouraged and incentivized for development. Also, because of Nantucket's isolated location, construction costs increase by 50% and electricity costs increase 5% each year. In the SMART program, the definition of solar canopies was changed so that it includes installation "on top of a parking space, pedestrian walkway, agricultural land, or canal in a manner that maintains the function of the area beneath the canopy." They added another variable that can change the incentive level, called an incentive reducer. If the project is ground mounted and impacts the land, as much as 1/10 of one cent per acre can be reduced, as seen below in Table 2.

Project Type	Ground Mounted and not C&I Zoned	Ground Mounted, C&I Zoned, and NOT Previously Developed	Ground Mounted, C&I Zoned, and Previously Developed	Rooftop	Brownfields	Landfill	Parking Lot Canopy
Compensation Rate ($/kWh)	X - $0.001/acre	X - $0.0005/acre	X	X + $0.02	X + $0.03	X + $0.04	X + $0.06

Table 2: This chart shows how the incentive level can change depending on the location the solar panels (DOER, 2017).

Another problem that we realized during our search is that the declining block model includes the capacity of ALL the solar panel systems installed in MA, including those for companies. This means that companies can take advantage of the incentive early on while pushing the total amount of kW installed further. This means that homeowners can lose out on the incentives quickly. Also, another problem with this proposal is that it relies on the amount of solar panels installed and not the actual pricing for the installation of solar panels. If many people started to install solar panels on a large scale, the incentive levels will decrease quickly and will not accurately offset the pricing of solar panels. In the SMART program, the capacity blocks are divided proportionally among National Grid, Eversource, and WMECO (having 8 blocks with a 4% decrease) and Unitil and Nantucket could have less blocks. All of these blocks will have a minimum of 20% reserved for projects less than 25kW AC.

The program seems to include in municipals light plants which some were against since the solar bill was not intended for them. Some had called for an adder for the municipalities or for the program to exclude them. For this problem, the new SMART program created a voluntary program that municipalities can join if they want. While they stated there will be one, there is currently no details on the program yet.

Conclusions

From the information and research gathered during this project through research, interviews and surveys, we are able to conclude on our evaluation of the new and current incentive, and on the survey. We have also made recommendations for parties involved such as the prospective customers, the government and the further researchers.

We conclude that the SMART program will be better than the SREC II program since it will allow the growth of the solar industry as it will fairly allocate the money to where it is needed. SRECs typically required a middle man to find buyers for the owners of SRECs, while the SMART program does not require a middle man; the money will only be profiting those they are targeting. With the new program, the incentive level reflects a variety of factors such as the size of the solar panel system, location of the installation, income level, and the total capacity of solar panels installed in Massachusetts. In the SREC II program, the price of SRECs on the market fluctuates, making it hard for consumers to calculate the profit made in the long run and sometimes the pricing of the SRECs did not clearly reflect the incentive level intended. The SMART program will fix this as the incentive level is a fixed rate for at least 10 years, making it easier for consumers to calculate their profit and payback period.

The result from the Qualtrics survey offered some helpful information gathered from both current and prospective customers. The outstanding result from the survey is the top two concerns that holding back people go solar are the financial reason and the complicated process which account for about 70% of all the reasons. The survey results also help in forming our recommendations in the next part. Although we had 92% of our respondents from Massachusetts,

the relatively small sample size means we cannot draw broad conclusions for either situation (with PV systems or without PV systems).

From all the information and data we gathered, we would like to make recommendations to a wide variety of people who may be interested in this project including the potential customers who are considering solar power, the policy makers who need more comments on the new incentive program, and the future researchers who may continue or work on the related projects.

Recommendations

For the prospective customers who are interested investing in solar panels, they can refer to Massachusetts Residential Guide to Solar Electricity for more information. We highly recommend getting involved in the solar industry because not only is it saving our environment, it is also saving money in the long term. Although their concerns are understandable, the reality of installing solar panels is not as mind-boggling as it may seem. We will go into the 5 main concerns people have with investing in solar panels: 1) too much money/investment, 2) complicated process, 3) house itself is not suitable for solar panels, 4) decrease the value/marketability of your home, and 5) others.

1) We've outlined a lot of financing plans. The Mass Solar Loan is a great program where customers won't have to pay any out-of-pocket money upfront, and some low-income homes could qualify for a loan with an even lower interest rate. There are also other options available to pay for the solar panels that don't involve the Mass Loan that have a lower interest rates.

2) Hopefully with the explanations and resources provided through this report, the process seems a little less complicated. Solar company salespeople are very helpful as well, although their information has the potential to be biased. There is a transition between SREC II and SMART

program at this moment hence it may cause some hesitations in go solar at this time. However, the DOER and the legislature have already provided the detailed guidance of "SREC II Extension Program" which can be found in the official website of Commonwealth of Massachusetts Executive. Even if this sounds troublesome, consumers can purchase the solar panels after the SMART program goes into effect.

3) If after a solar quote it is decided that the house itself is not suitable for solar panels, whether it's because of structural issues, roof direction, or the current electrical wiring, there are other ways to get involved with solar. For example, one can either sign a contract with their utility company to purchase a certain percentage from solar sources.

4) In general, having a PV system actually increases the marketability of your home. As stated in an informational packet by the Massachusetts Clean Energy Center, "A 2014 study by the Lawrence Berkeley National Lab 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. The average premium across various states, housing markets, electricity markets and home types was $4 per watt. This equated to a premium of about $15,000 for a typical electric system of 3.75 kW." **(**"Massachusetts Residential Guide," n.d**)**

5) Some of the other responses included worries about tree removal, roof replacement, and the long-term commitment. While it's understandable to not want to interfere with your property, we interpret the "long term commitment" response to mean in debt for too long. The typical payback period for a Direct Energy PV system is planned to be between 7 and 10 years, not considering the solar loan. (J.Morrone, personal communications, December 7, 2015).

For the policy makers, we recommend that they make separate declining block models for residential size systems and for large scale constructions. Large scale productions will quickly reduce the amount of incentive for homeowners and the 20% of the block available to them may be too little. We would also like to see that the incentive level reflects the cost of solar panels, not the amount of solar installations in MA. If the amount of solar installations increased, it would not proportionally mean that the pricing of solar panels decreases. We want the incentives to adequately support buyers. There was no mention of how the RPS for utilities would change with this program so clarification for this is also recommended.

The goal of 1600 MW installed solar capacity by 2020 is still very humble. MA will soon reach the goal by 2017 according to the projection in Figure 4.2. We recommend that along with the extension of the SREC II to smoothen the transition while finalizing the ultimate SMART program, the state regulators should raise the goal of the total installed solar capacity to about 2000 MW by 2020 since the current goal will soon be reached within another year. The new SMART program and the raised goal will not just encourage the continuous growing of the solar industry but also lower the cost of electricity bills and reduce the effect of climate change in the long run.

For the next researchers, we would like to suggest to keep updating the policy and evaluate the contents of the new details in that proposed policy. DOER always appreciates any comment from community so contributing our voices is necessary and valuable.

These incentives are what cause people to really start considering installing solar panels. A person will not choose to go solar because of a state mandated RPS. They will look at how reasonably they can finance the project, realize how they can save money in the long-term, and be pleased that they are contributing to the reduction of our carbon footprint.

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Appendix 1: Layout for Interviews/Surveys

1. Brief Description
    a. What is our project
        i. Potentially mention how long we will be working on the project?
    b. How we are going to accomplish our task of checking for the feasibility
        i. Don't need to go in-depth on the analysis
        ii. How the interviewee will be aiding us in the project

2. Questions to be asked
    a. Current Customers (with panels): We will e-mail the WPI faculty to find if any of them own solar panels and ask to interview them. The second method would be to ask a solar company if they will provide us with a list of current and prospective customer. Lastly, we will use the Snowball Method to find other current customers through others.
        i. What year was the system installed?
        ii. Which company did you get the solar panels from?
        iii. What type of ownership do you have for the solar panels?
            1. Full Ownership - Homeowner owns the system and its energy
            2. Third-Party Ownership - Solar Company owns the panels, homeowners lease their roof space and purchase energy at cheap rates
            3. Community Ownership - A few neighbors or a local "light department" purchases the system and finances it together, the energy is shared
            4. Not sure
        iv. How long will it take to recover from the cost of the solar panel?
        v. How much money are you saving on average on your monthly electricity bill?
            1. $0 - $25
            2. $25 - $50
            3. $50 - $75
            4. $75 - $100
            5. $100+
        vi. What is your average monthly energy consumption?
            1. 0 kWh - 200 kWh
            2. 200 kWh - 400 kWh
            3. 400 kWh - 600 kWh
            4. 600 kWh - 800 kWh
            5. 800 kWh - 1,000 kWh

6. 1,000kWh +

vii. Are you producing more than enough electricity for your house? (greater than your monthly energy consumption)
    1. Yes
        a. How much electricity are you producing in excess?
            i. 0 kWh - 250 kWh
            ii. 250 kWh - 500 kWh
            iii. 500+ kWh
        b. What are you doing which extra electricity?
            i. Charge large battery?
            ii. Gaining money through net metering or SREC?
                1. Are you satisfied with how much you are getting paid for the excess energy production?
            iii. Other: _____
    2. No
        a. How much is the monthly bill from the electrical company? (how much do you rely on the utility?)
            i. $0 - $50
            ii. $50 - $100
            iii. $100 - $150
            iv. $150 - $200
            v. $200+

viii. What kind of benefit do you have?
    1. Federal, State, Both, wasn't able to take advantage due to….

ix. How satisfied are you with the PV system? (what kind of satisfaction)

x. Are you satisfied with the cost of the PV system and the tax benefits received?
    1. Any complaints or comments about the process, etc.

b. Potential Customers: Create a survey on WPI Qualtrics to be distributed through social media and e-mail. Everyone is welcomed to participate but we will be focusing on those who are homeowners and live in MA. We will also use the Snowball Method if possible.
    i. Are you a homeowner?
    ii. What state are you located in?
    iii. What is the name of your electric company?
    iv. Monthly electricity bill?
        1. $0-$100
        2. $100-$200...

v. Level of consumption?
    1. 0 kWh - 200 kWh
    2. 200 kWh - 400 kWh
    3. 400 kWh - 600 kWh
    4. 600 kWh - 800 kWh
    5. 800 kWh - 1,000 kWh
    6. 1,000kWh +

vi. Are you interested in installing solar panels?

vii. Which type of ownership would you consider?
    1. Full Ownership - Homeowner owns the system and its energy
    2. Third-Party Ownership - Solar Company owns the panels, homeowners lease their roof space and purchase energy at cheap rates
    3. Community Ownership - A few neighbors or a local "light department" purchases the system and finances it together, the energy is shared
    4. I'm not sure

viii. What are the important factors for you in deciding to own solar panels?
    1. Saving money short-term on your electricity bill
    2. Long-term financial return
    3. Selling excess power to the utility company
    4. Protect yourself from changing electricity prices
    5. Increase the value/marketability of your home
    6. Preserve our natural resources
    7. Low rates on solar loans
    8. Other:_____

ix. What factors are holding you back from investing in solar panels?
    1. Decrease the value/marketability of your home
    2. Too much money to get involved
    3. Complicated process
    4. The house is not suitable for solar panels
    5. Current plan works well enough
    6. Don't use much electricity
    7. Manufacturing of the solar panels is not environmentally friendly
    8. Other: _____

x. Are you familiar with the tax benefits?
    1. Are they enough to incite you to consider solar panels?
    2. I'm not sure what the tax benefits are

xi. Do you know anyone that has gone solar already? (contact information)

c. Solar Companies
    i. Are there benefits you receive?
    ii. How many potential customers talk you?
    iii. How many current customers do you have?
    iv. How does the number of customers change year to year?
        1. Stable? Growing? -- Basically projection of growth of field
    v. What typical characteristics of customers(or homes) that purchase the system?
        1. What are the strategies for lower level and high level end?
        2. Who are good candidates for a PV system?
    vi. Is there any changes you would like to see in state policies?

d. Utility Companies - National Grid and Eversource
    i. What is the RPS requirement?
    ii. What are you currently doing to achieve the requirement?
    iii. How are you going to deal with SREC?
    iv. How solar affects their company?
        1. How does it negatively and positively affect the company?
    v. Ask if they own or operate solar farms?

e. Government people/Solar-related organizations
    i. What happens after 2020?
        1. Tax credits will be gone so what plans do you have for after 2020
    ii. Any current incentives you are working on?
    iii. How important are the tax benefits in your industry
    iv. Have tax policies been essential to the growth of the industry?
    v. Would you lobby to maintain the policies after 2020?
        1. Are they sufficient currently?
        2. Do you need more?

3. Follow-up
    a. If they have any questions, they can contact us by _____

Appendix 2: Survey Results: MA Homeowners with PV

Using the standard divisions, what is your expected household income (gross)?

#	Answer	Bar	Response	%
1	less than $10,000		0	0.00%
2	$10,000 - $19,999		0	0.00%
3	$20,000 - $29,999		0	0.00%
4	$30,000 - $39,999		0	0.00%
5	$40,000 - $49,999		0	0.00%
6	$50,000 - $59,999		0	0.00%
7	$60,000 - $69,999		0	0.00%
8	$70,000 - $79,999		2	11.76%
9	$80,000 - $89,999		0	0.00%
10	$90,000 - $99,999		1	5.88%
11	$100,000 - $149,999		6	35.29%
12	More than $150,000		5	29.41%
13	I prefer not to answer		3	17.65%
	Total		17	100.00%

Other
I also have a contract to buy an additional 5kw of solar from a community solar system
Lease the panels and have first usage rights of any power produced before it's contributed to the grid; surplus power added to grid is credited to power bill

What type of ownership do you have for the solar panels?

#	Answer	Bar	Response	%
1	Full Ownership - Homeowner owns the system and its energy		10	58.82%
2	Third-Party Ownership - Solar Company owns the panels, homeowners lease their roof space and purchase energy at cheap rates		4	23.53%
3	Community Ownership - A few neighbors or a local “light department” purchases the system and finances it together, the energy is shared		0	0.00%
4	Other		3	17.65%
	Total		17	100.00%

Do you still rely on an electric company for some power?

#	Answer	Bar	Response	%
1	Yes		16	94.12%
2	No		1	5.88%
	Total		17	100.00%

What is the amount of your average monthly electricity bill that you pay?

#	Answer	Bar	Response	%
1	less than $50		3	25.00%
2	$100-$200		3	25.00%
3	$200-$300		1	8.33%
4	$300-$400		0	0.00%
5	$400-$500		0	0.00%
6	more than $500		0	0.00%
7	$50-$100		5	41.67%
	Total		12	100.00%

What is the amount of your average monthly electricity usage (in total)?

#	Answer	Bar	Response	%
1	less than 200 kWh		1	10.00%
2	200-400 kWh		2	20.00%
3	400-600 kWh		4	40.00%
4	600-800 kWh		1	10.00%
5	800-1,000 kWh		1	10.00%
6	more than 1,000 kWh		1	10.00%
	Total		10	100.00%

How much electricity is being produced excess to your requirement?

#	Answer	Bar	Response	%
1	I'm not producing excess electricity		7	58.33%
2	less than 250 kWh		3	25.00%
3	250-500 kWh		1	8.33%
4	more than 500 kWh		1	8.33%
	Total		12	100.00%

Other
one should NEVER have excess

If you have excess electricity produced by your solar panels, what do you choose to do with it?

#	Answer	Bar	Response	%
1	Charge a large battery		0	0.00%
2	Sell it to be put on the power grid		9	90.00%
3	Other		2	20.00%
	Total		11	100.00%

What types of benefits have you utilized?
For example: federal tax credit, state tax credit, state solar loans, solar renewable energy credit (SREC), net metering, etc...

Text Entry
SREC, rebate (state or federal, not sure which), tax credits (federal), net metering, low interest loans
Federal tax credit, state tax credit, SREC, net metering
None - solar company installed and maintains system
all listed
SREC, Fed and state tax credits
will be using federal and state tax credit when filing 2016 taxes. earning SRECs but not yet received a payment. Net metering. I got a loan through Mosaic which is solar specific, but not state funded.
Solar loans, tax credit, SREC
Will be using Federal tax credit and SREC. Not sure if there are state tax credits available in MA.
federal tax credit state tax credit state rebate SRECs
Federal and state tax credits

Other:
The right thing for our country
Cleaner environment
Putting my money where my mouth is. 8-)
take advantage of tax breaks

What are the important factors/reasons for you in deciding to own solar panels?

#	Answer	Bar	Response	%
1	Saving money short-term on your electricity bill		7	50.00%
2	Long-term financial return		8	57.14%
3	Selling excess power to the utility company		3	21.43%
4	Protect yourself from changing electricity prices		5	35.71%
5	Increase the value/marketability of your home		9	64.29%
6	Preserve our natural resources		12	85.71%
7	Low rates on solar loans		3	21.43%
8	Other:		4	28.57%
	Total		51	100.00%

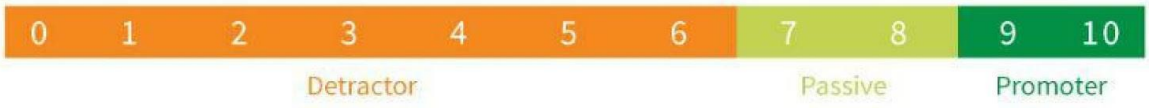
Other

What factors would hold someone back from investing in solar panels?

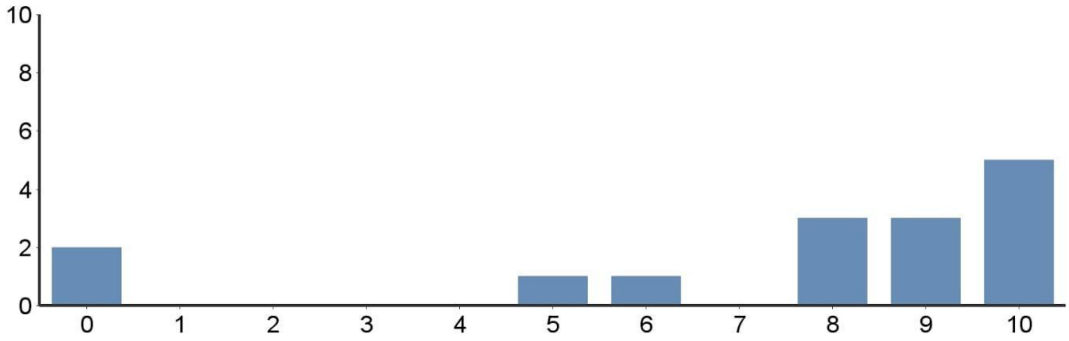
#	Answer	Bar	Response	%
1	Decrease the value/marketability of your home		2	15.38%
2	Too much money/investment		9	69.23%
3	Complicated process		3	23.08%
4	House itself is not suitable for solar panels		12	92.31%
5	Don't use much electricity		7	53.85%
6	Current plan works well enough		3	23.08%
7	The manufacturing of solar panels is not environmentally friendly		2	15.38%
8	Other		0	0.00%
	Total		38	100.00%

How important are the various tax benefits available in your decision to go solar?

Detractors	Passive	Promoters	NPS®
4	3	8	26.67%



% PROMOTERS - % DETRACTORS = NPS (NET PROMOTER SCORE)



Min Value	Max Value	Average Value	Total Responses
0	10	7.47	15

Appendix 3: Survey Results: MA Homeowners without PV

Using the standard divisions, what is your expected household income (gross)?

#	Answer	Bar	Response	%
1	less than $10,000		0	0.00%
2	$10,000 - $19,999		0	0.00%
3	$20,000 - $29,999		0	0.00%
4	$30,000 - $39,999		0	0.00%
5	$40,000 - $49,999		2	3.08%
6	$50,000 - $59,999		0	0.00%
7	$60,000 - $69,999		1	1.54%
8	$70,000 - $79,999		7	10.77%
9	$80,000 - $89,999		1	1.54%
10	$90,000 - $99,999		8	12.31%
11	$100,000 - $149,999		23	35.38%
12	More than $150,000		10	15.38%
13	I prefer not to answer		13	20.00%
	Total		65	100.00%

What is the amount of your average monthly electricity bill that you pay?

#	Answer	Bar	Response	%
1	less than $50		2	4.00%
2	$100-$200		21	42.00%
3	$200-$300		4	8.00%
4	$300-$400		1	2.00%
5	$400-$500		0	0.00%
6	more than $500		0	0.00%
7	$50-$100		22	44.00%
	Total		50	100.00%

What is the amount of your average monthly electricity usage (in total)?

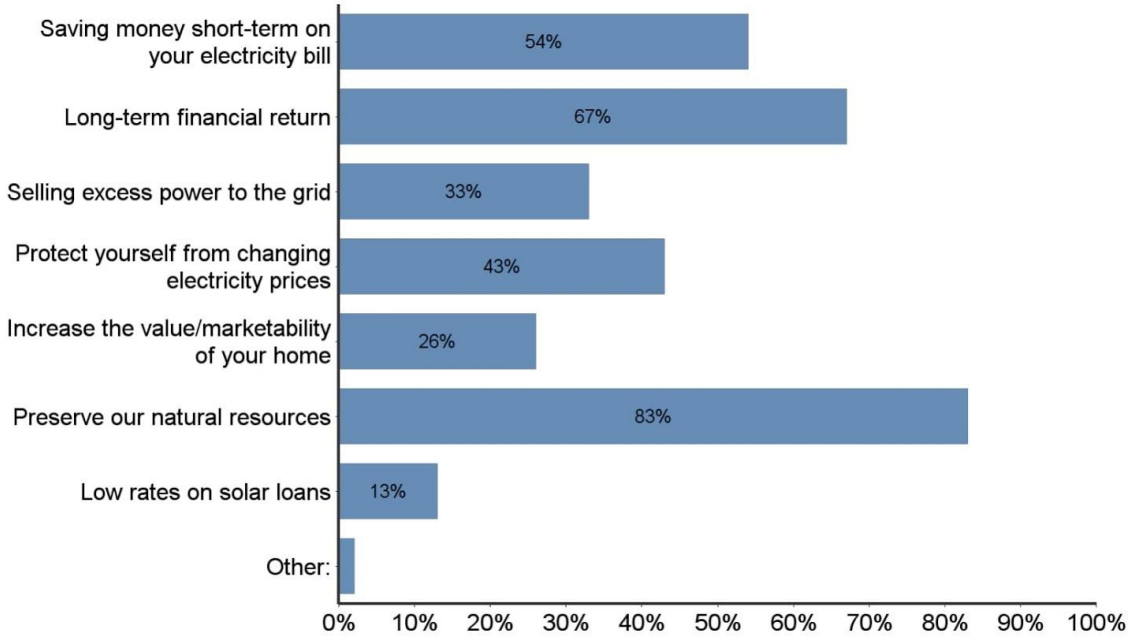
#	Answer	Bar	Response	%
1	less than 200 kWh		0	0.00%
2	200-400 kWh		8	25.81%
3	400-600 kWh		14	45.16%
4	600-800 kWh		5	16.13%
5	800-1,000 kWh		4	12.90%
6	more than 1,000 kWh		0	0.00%
	Total		31	100.00%

No, because
There is no safe disposal plan that I am aware of
My house doesn't have good solar exposure. In addition, there is much local historic district red-tape to inhibit the addition of solar panels.
It would detract from the look of the house
I live in Massachusetts. It's dark as hell here. Also, I have no idea what my average monthly usage is in kWh

Are you interested in possibly owning a solar panel system?

#	Answer	Bar	Response	%
1	Yes		16	31.37%
2	Maybe		15	29.41%
3	No, because		20	39.22%
	Total		51	100.00%

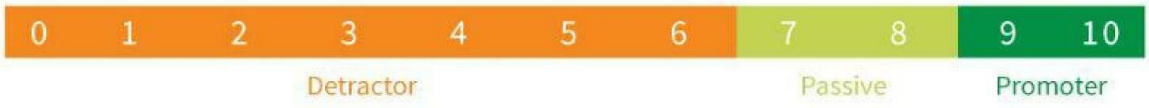
What are the important factors/reasons for you in deciding to own solar panels?



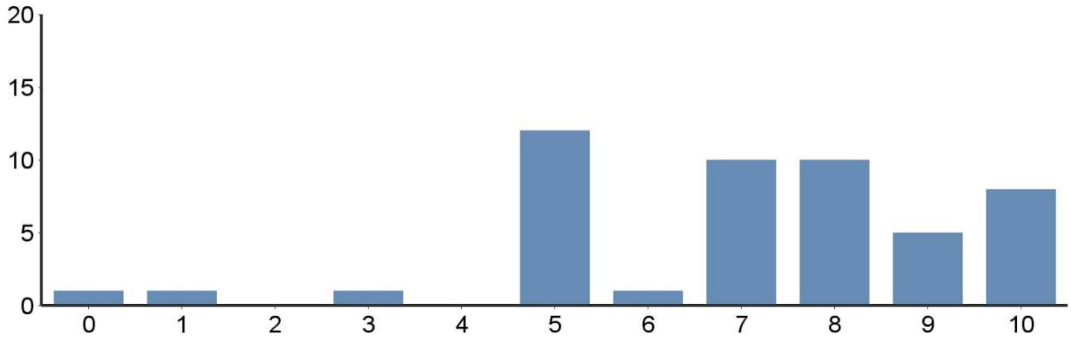
Other:
reduce climate change

How important are the various tax benefits available in your decision to go solar?

Detractors	Passive	Promoters	NPS®
16	20	13	-6.12%



% PROMOTERS - % DETRACTORS = NPS (NET PROMOTER SCORE)



Min Value	Max Value	Average Value	Total Responses
0	10	7.04	49