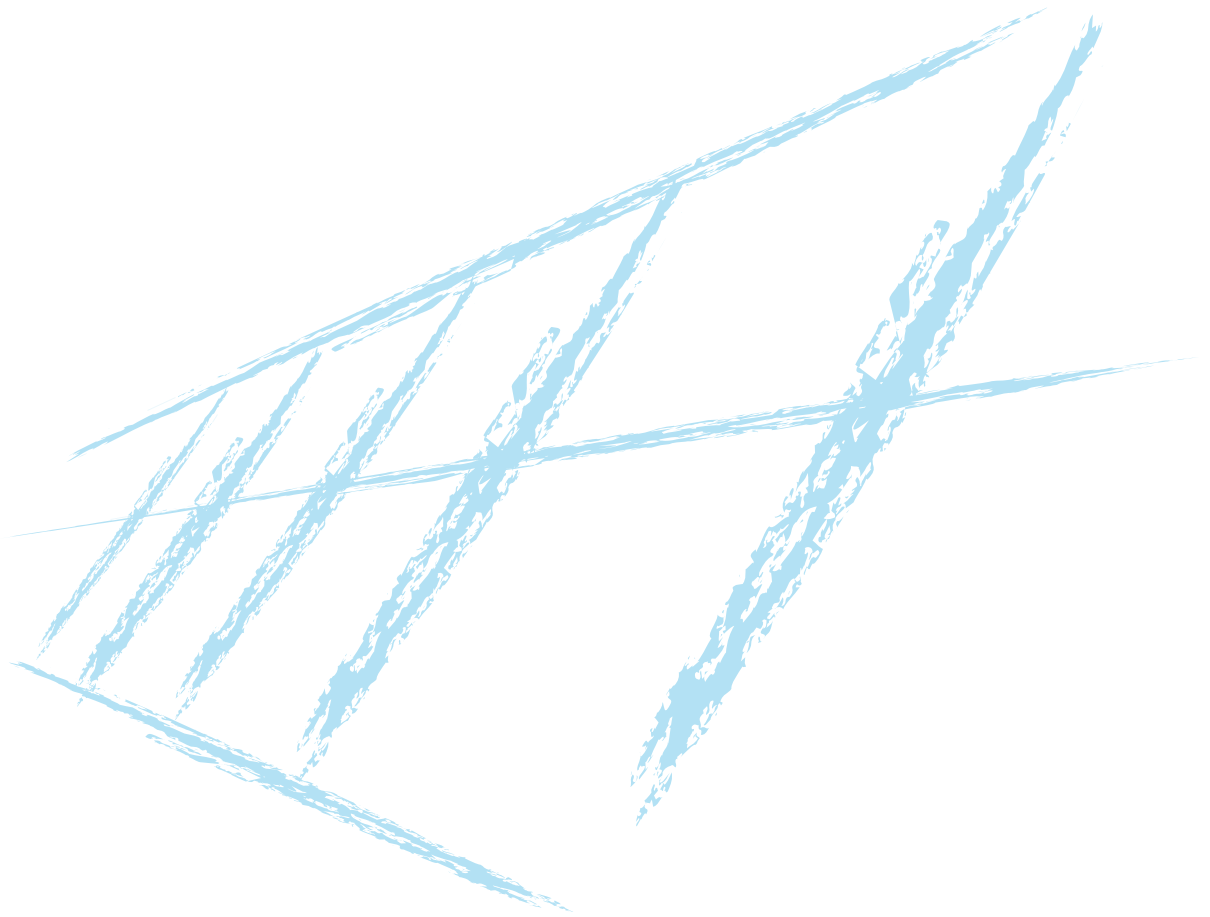




# SOLAR POWER PURCHASE AGREEMENTS: Identifying Risks for Municipalities in Massachusetts



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# Solar Power Purchase Agreements: Identifying Risks for Municipalities in Massachusetts

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Solar Panel installed in Massachusetts. from: <http://power-solar-energy.net/>



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# ABSTRACT

This report explores the perceived risks of 18 municipalities in Massachusetts throughout the negotiation of Solar Power Purchase Agreements (PPAs) with private-sector project developers. In addition to interviewing municipal officials, our report includes data collected from private developers, technical consultants, and state employees. We have also conducted an extensive literature review and analysis of the regulatory structure for PPAs in Massachusetts. Our findings suggest that municipalities are largely uninhibited by identified risks with PPAs. However, we find that breakdowns have occurred recently as a result of uncertainty in the Massachusetts Solar Renewable Energy Credit (SREC) market. The findings presented herein inform recommendations for overcoming objections and implementing successful solar photovoltaic projects. In particular, we make recommendations to the Massachusetts Department of Energy Resources to include information about PPAs online, and also to fund a new Technical Assistance Grant (TAG) specifically for solar photovoltaic projects. An additional recommendation is made regarding an alternative Cost of Energy structure within PPAs to offset uncertainty in the state's SREC market.

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# LIST OF ABBREVIATIONS

ACP- Alternative Compliance Payment

DOER- Department of Energy Resources

GIS- Generation Information System

kW-Kilowatt

kWh-Kilowatt hour

MW- Megawatt

MWh-Megawatt hour

NEPOOL- New England Power Pool

PPA- Power Purchase Agreement

PURPA- Public Utility Regulatory Policy Act

PV- Solar Photovoltaic

REC- Renewable Energy Credit

RPS- Renewable Portfolio Standard

SREC- Solar Renewable Energy Credit

UEP- Urban and Environmental Planning and Policy Department at Tufts University

WMECO-Western Massachusetts Electric Company

# EXECUTIVE SUMMARY

Federal and state policies supporting the renewable energy market have increased in recent years. Massachusetts has enacted laws to support the development of renewable energy. It is one of 29 states, along with Washington, D.C., that has adopted a Renewable Energy Portfolio Standard (RPS). In 2010, Massachusetts amended its RPS to include a Solar- Carve Out to build the capacity of solar photovoltaic (PV) energy in the state. The Solar Renewable Energy Credit (SREC) market associated with the Solar Carve-Out provides a substantial source of additional revenue for solar PV developers. Along with significant federal and state tax incentives, these policies have indeed successfully spurred solar PV development. The favorable market conditions created by these policies allow independent solar PV developers to offer third-party customers, such as municipalities, substantial energy savings at predictable prices, while assuming nearly all of the capital costs for system installation and maintenance. Solar Power Purchase Agreements (PPAs) are the contracts that facilitate this energy agreement.

The Cadmus Group, Inc. (Cadmus) is an environmental and energy consulting firm headquartered in Watertown, MA that is contracted by municipalities to represent their interest in negotiating PPAs. These contracts appear to offer significant benefits and little risk to municipalities. However, Cadmus has encountered resistance to these agreements, and has seen several negotiations break down completely. This project is the result of a partnership between Cadmus and a graduate student research team from Tufts University's Department of Urban and Environmental Policy and Planning (UEP) to identify the perceived risks of municipalities to PPAs and address breakdown

points throughout the process.

The project explores relevant aspects of the solar photovoltaic (solar PV) energy market in Massachusetts. We closely examine the structure of the state's RPS, other programs through which the state is supporting the renewable energy market, and the effectiveness of those regulatory mechanisms. We also examine how insurance policies necessary for risk management affect the outcome of solar PV projects by adding complexity and cost.

Our project team interviewed municipal officials, solar developers, private consultants, and state employees to evaluate solar PPA risks. In our interviews, we found that municipalities have considered risks that include: the price of conventional energy falling below the established price of energy within a PPA, breach of contract by the project developer, SREC market instability, damage to landfill caps (on relevant projects), unfavorable building codes (e.g. upfront costs), and the cost of system removal upon contract expiration, among various others presented herein.

We interviewed three municipalities that did not sign a PPA with a developer because negotiations were disbanded. However, it was not attributed to the municipalities' perceived risks, but rather the developer's concerns. The most prevalent issue raised was uncertainty over the price of SRECs. Industry specialists and the Department of Energy Resources (DOER) have confirmed that there will soon be a surplus of solar PV energy. It has been calculated that the surplus will push SRECs below their current value. Developers rely heavily on SRECs as a revenue stream and therefore are reluctant to move forward with projects in an uncertain market.

In order to address these concerns, we propose possible solutions for the DOER and Cadmus. To DOER, we propose that they take steps to make information about these contracts more readily available to cities and towns. This can be accomplished by the following: publishing a comprehensive PPA template online, developing an online searchable database of signed PPAs, and creating a solar Technical Assistance Grant to help cities and towns afford specialists to assist them with the process.

To Cadmus, we propose an alternative Cost of Energy (COE) structure for PPAs to attract developers weary of decreasing SREC revenue. In this model, municipalities agree to a higher electricity rate for the first three years of the contract term, which would enable developers to recoup potential losses. After this initial term, the price would drop to account for a predicted increase in SREC revenue. The compromise would still result in an overall savings on electricity payments for the town. With a higher initial COE, we expect developers to be more willing to follow through with proposed projects.

Our recommendations seek to increase transparency regarding PPAs and alleviate apprehension during the negotiation process. The result will facilitate successful solar PV projects.

# 1. INTRODUCTION

Energy generated from solar electric systems is increasing in Massachusetts. In 2008, the Commonwealth expanded the Renewable Portfolio Standard (RPS) as part of the Green Communities Act. In 2010, the regulations were updated to include a “Solar Carve-Out”, created to direct the development of solar photovoltaic (solar PV) energy toward a long-term goal of 400 megawatts (MW) of capacity in Massachusetts by 2020. In order to reach this goal, the Commonwealth has created a variety of incentive programs for solar PV developers, which are supplemental to federal programs. These incentives include tax benefits, a tradable energy credit market, and favorable changes to net metering laws. The incentives have stimulated solar PV development in Massachusetts, as residential, commercial, and public entities rush to take advantage of potentially short-lived policies.

Power Purchase Agreements (PPAs) are a contractual model that is mutually beneficially to both parties. PPAs are especially useful for tax-exempt public entities, such as municipalities, because it allows them to indirectly take advantage of extensive tax credits they would otherwise not qualify for. Municipalities are unable to benefit from enormous federal and state tax incentives. They do not pay taxes, therefore tax based relief does not apply to them. Solar PV developers, as private for-profit companies, can take advantage of tax incentives. By partnering with solar PV developers through the use of PPAs, municipalities can gain the benefits of affordable solar PV energy. PPAs are a “third-party” ownership model. It requires a separate, taxable entity (e.g., solar developers) to procure, install, and operate the solar PV system on the consumer’s (e.g., the municipality’s) property. Municipalities enter into a PPA to purchase the electricity generated by the



solar developer at a set rate estimated to remain below market value. The developer is able to undercut the price of commercially available electricity from the grid by taking advantage of a variety of government incentive programs.

Although the benefits of PPAs would appear to be mutual, the extraordinary complexity of the Commonwealth's solar PV market has the potential to cause a breakdown in negotiations between municipalities and solar developers. The Cadmus Group, an energy and environmental consulting firm based in Watertown, Mass., partnered with a graduate student research team from Tufts University's Department of Urban and Environmental Policy and Planning (UEP) to identify and analyze critical issues affecting solar PPAs. Researched topics include state renewable energy policies, federal and state incentive programs, and various contractual structures currently in use. We aim to determine the perceived risks of communities that are debating entering PPAs as well as what issues caused a breakdown in PPA negotiation. We aim to recommend ways to address and mitigate these municipal concerns. Additionally, solar developers and technical consultants were interviewed to determine the key issues affecting all stakeholders involved in the PPA process.



Solar panels on rooftops (left, from: <http://www.energyboom.com/>)  
landfill (center, from: <http://photos.masslive.com/photogallery/index.html>)  
and open land (right, from: <http://www.schraubfundamente.de/en/home/>)

# 2. METHODOLOGY

## 2.1 Background Research

The solar energy market is affected by both market forces and government subsidies. Though the gains and risks of entering into a solar power purchase agreement are contained by the terms of the contract itself, communities are entering into a complex market. We researched the factors affecting the solar market in Massachusetts in order to fully understand the complexities of the market communities are entering into. The Massachusetts market structure is complex and the state's tools to support it are unique. We divided research among the four members of the team and brought our findings to our weekly meetings to share with each other. We researched the regulatory framework of the solar market as well as economic analysis of market dynamics and trends. We also researched the insurance policies that would most likely be used in renewable energy projects in order to understand what types of environmental and general policies would apply to solar projects. In order to create valuable interview questions, we had to first have a solid grasp of the regulatory and market considerations of solar energy in Massachusetts.

## 2.2 Interviews

In order to understand the thought process of major stakeholders in the contracts, we conducted interviews with municipal officials, solar developers, industry specialists and state employees. We created three different interview scripts, one for municipal officials, one for developers and one for state/ industry specialists. We individually conducted interviews over the phone, which we audio recorded in order to transcribe them for analysis. After transcribing the interviews, we analyzed the transcripts by pulling out the major themes and trends prevalent in the responses. We use these trends to present a snapshot of solar development in the state.

## 2.3 Contract Review

We collected signed PPAs from the municipalities we interviewed, and compared and contrasted the language used in different contracts. Without performing a full legal analysis of the contracts, which is outside the purview of the project, we focused on sections related to major issues we found through our research and through stakeholder interviews.

# 3. FEDERAL AND STATE ENERGY POLICY

## 3.1 Federal Policy

The Public Utility Regulatory Policy Act (PURPA) was enacted as part of the National Energy Act of 1978, likely as a result of the energy crises occurring that decade. The purpose of PURPA was to reduce dependency on foreign oil by promoting alternative energy production and efficiency, specifically by diversifying producers of electric power. In effect, PURPA required utilities to buy power from independent energy producers at a price of the utility's avoided generation cost. Under PURPA, the avoided cost is calculated as the additional expense

IN FACT, SOLAR PV ENERGY IS ONE OF THE MOST EXPENSIVE PER KWH

that electric utilities would incur if they generated the additional power. This requirement enabled independent energy producers to receive income from the utility industry, and effectually, it incentivized this type of production by creating a tangible revenue stream.

Unfortunately, PURPA did not effectively incentivize renewable energy because the avoided cost rates were extremely low, especially compared to the extraordinary production cost of some renewables. In fact, solar PV energy is one of the most expensive per kWh. However, many of the benefits of renewable energy are not associated with the cost of production. The negative externalities of fossil-fuel electricity generation abound, including climate change and adverse human health impacts, all of which add to the true cost of non-renewable electricity (Georgakellos, 2010). In this sense, the avoided cost rates can be thought of as short-sighted because it does not take into

account these negative externalities, and thus the importance of the continually evolving renewable energy incentive programs is clear.

## 3.2 State Policy

### 3.2.1 Setting the Renewable Portfolio Standard

In 1997, Massachusetts passed a Renewable Portfolio Standard (RPS) to increase the production of renewable energy by requiring utilities to procure a small percentage of their energy from these sources. However, in 2008, Massachusetts passed the Green Communities Act, which was designed to promote green building practices and energy efficiency. An integral part of meeting the state's renewable energy goals was expanding the RPS, and this legislation increased the scope of the 1997 RPS. Under the revised RPS, the state increased the amount of electricity output that utilities must purchase from approved renewable energy sources.

Massachusetts is among 29 states in the U.S. that use an RPS to achieve renewable energy goals. This is shown in the map in Figure 1. In sum, all 29 fully-implemented RPS policies will cover 56% of total U.S. retail electricity sales (Wiser et al, 2010). RPS benefits include improving the environment, increasing the diversity of the energy supply, lowering reliance on resources requiring imported fuels, stabilizing renewable energy costs, and creating local economic development (EPA, 2009). The design of the RPS is meant to achieve these goals with minimal increase to energy ratepayers' utility

costs (EPA, 2009). There is an ongoing debate, however, relating to whether or not these policies yield the environmental and economic improvements advocates espouse (Lyon, Yin, 2009). Some studies have shown that RPS policies encourage the development of renewable energy at the expense of natural gas, and thus it is a less effective method at reducing carbon emissions than a direct carbon tax (Palmer and Burtraw, 2005). However, studies have shown that states with an adopted RPS produce more renewable energy than those without similar policies (Carley 2009).

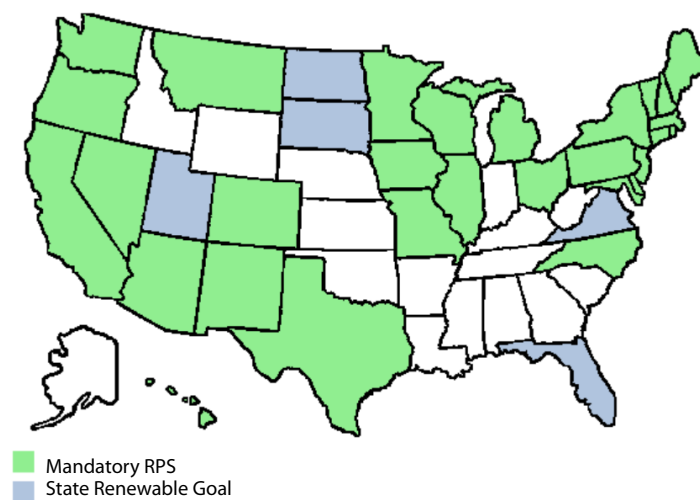


Figure 1. States with RPS.

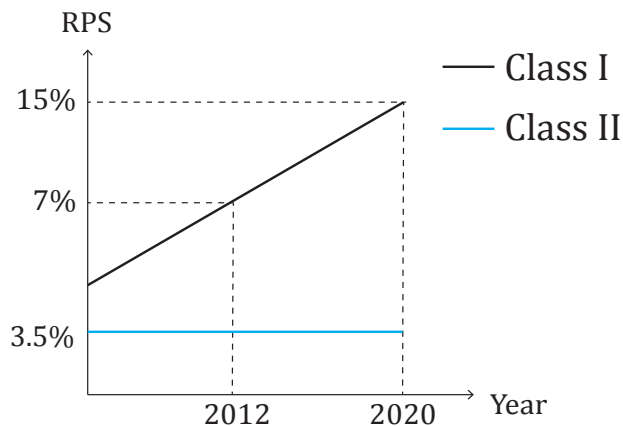
Source: Red, Green and Blue. <http://redgreenandblue.org/>

The RPS in Massachusetts divides renewable energy into categories and requires a specific percentage of production in each category. Class I renewables are generators that have been installed on or after January 1, 1998. The following renewable energy sources qualify as Class I: solar PV, solar thermal electric, wind energy, small hydro-power, landfill methane and anaerobic digester gas, marine or hydrokinetic (e.g., tidal) energy, geothermal energy, and eligible biomass

fuel. Class II renewables are the same sources that qualify for Class I, but from generators built before 1998, and also waste-energy generators. The difference of Class I and II could be seen on Table 1. Class I and Class II standards combine to meet the total RPS requirement. As described on Figure 2, in 2012, this requirement is 7% of total energy produced, and it will increase by 1% each year with a goal of reaching 15% by 2020. The minimum standard for Class II renewables is set at a rate of 3.6% of total energy produced and 3.5 % for waste energy. Class II rates do not increase annually, and therefore the RPS goal must be met by a continual increase in Class I renewable energy in the state.

*Table 1. Difference of Class I and Class II*

	Class I	Class II
Installed	After Jan, 1998	Before Jan 1, 1998
Example of sources	Solar photovoltaic, Solar thermal electric, Wind energy, Small hydropower, Landfill methane Marine or hydrokinetic energy, Geothermal energy, Eligible biomass fuel	Waste-energy generators in addition to Class I sources



*Figure 2. Class I, Class II and RPS*

Source: Massachusetts DOER.

UTILITY COMPANIES ARE REQUIRED TO FILE ANNUAL REPORTS TO SHOW THAT THEY OWN THE NECESSARY NUMBER OF RENEWABLE ENERGY CERTIFICATES (REC).

Investor-owned utility (IOU) companies in Massachusetts, such as NSTAR and WMECO, as well as other competitive suppliers such as Constellation and TransCanada, are required to file annual reports with DOER to show that they purchased, or generated, the necessary number of Renewable Energy Certificates (REC)<sup>1</sup>. One REC is equivalent to 1 MWh of renewable energy. All RECs are tracked through the New England Power Pool (NEPOOL) Generation Information System (GIS), which tracks all electricity that is generated within the

ISO New England area and fed into the grid. Once a REC has been minted, it can be purchased by utility companies. In order to enforce compliance with the RPS, DOER has established an annual Alternative Compliance Payment (ACP). As could be seen on Figure 3, if a utility company does not own or generate

enough RECs to meet the minimum RPS requirement, it must purchase more expensive ACPs to make up for lacking enough RECs. The ACP rate is established through regulations equal to the previous year's rate, adjusted by the Consumer Price Index. The price for Class I renewables in 2012 is \$64.02/MWh.

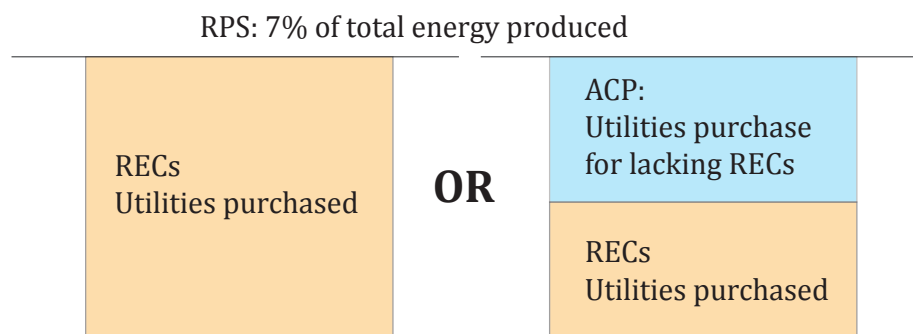


Figure 3. How Utilities comply with RPS (the RPS % is that of 2012)

<sup>1</sup> It is important to recognize the distinction between IOUs, competitive suppliers, and municipally-owned utilities that operate in Massachusetts, as the latter are not subject to RPS requirements.



### 3.2.2 The Solar Carve-Out

In 2010, Massachusetts' RPS was amended to include a requirement known as the Solar Carve-Out. The Solar Carve-Out specifically incentivizes the development of solar PV energy. Massachusetts is one of 16 states, as well as Washington D.C., that provides a specific provision within the RPS to support solar power. The design of most RPS policies is meant to be technology neutral (Wiser et al., 2010). However, from 1998 to 2009, wind represented 94% of RPS-motivated renewable installations in the country; solar represented only 1.5% (Wiser et al., 2010). Creating a specific set-aside for solar power helps to diversify renewable energy production. Supporting the development of solar power through the Solar-Carve Out is intended to build an economy of scale in the solar PV market.

The solar minimum standard is calculated separately from the RPS standard, but it is incorporated into the annual RPS goal. The Massachusetts DOER calculates the standard every year based on a combination of the installed solar capacity in the state, and the number of generated solar renewable energy credits (SRECs). In this sense, it is formulaically responsive to supply and demand fundamentals. The minimum solar standard for 2012 is 0.163% of total energy output in the state. The lack of pre-established targets by DOER may add to the uncertainty in the solar market. Figure 4 shows the past installed solar capacity and the aimed capacity to 2020.

THE SOLAR CARVE-OUT  
SPECIFICALLY INCENTIVIZES  
THE DEVELOPMENT OF SOLAR  
PV ENERGY

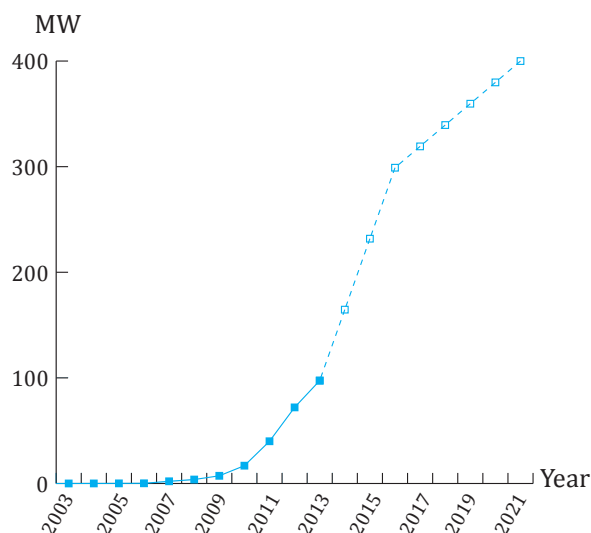


Figure 4. Installed solar capacity in MA 2002-2020

Source: Massachusetts DOER.

## 3.3 Incentives and Tax Credits

### 3.3.1 Solar Renewable Energy Credit Market

Although the Massachusetts SREC market is effectively attracting the interest of solar developers (Figure 5), the complexity of its structure also creates risk for investors. In fact, it was recently labeled “the country’s most complex REC market” by Bloomberg New Energy Finance (2011), a consulting firm specializing in clean energy market analysis. Like other SREC markets, Massachusetts’

THE MASSACHUSETTS SREC MARKET WAS RECENTLY LABELED “THE COUNTRY’S MOST COMPLEX REC MARKET”

RPS Solar Carve-Out sets a Solar Alternative Compliance Payment (SACP), which is an established price per MWh that electricity providers must pay if they cannot obtain enough competitively-priced SRECs to meet the required percentage of

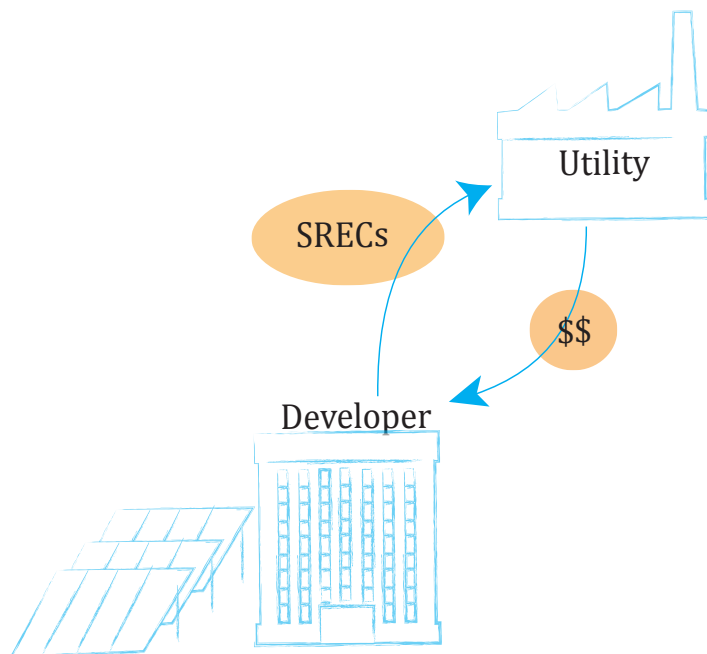


Figure 5. Basic Concept of SREC Market

solar energy generation (DOER 2011).

The SACP, which is paid when the market is undersupplied with solar PV energy, acts as a price ceiling for SRECs. The 2012 SACP is \$550/MWh, while the ACP for RECs is \$64.02/MWh, as mentioned in 4.2.1. This difference is shown on Figure 6.

While most states have implemented a Solar Carve-Out that increases at established intervals each year, Massachusetts calculates a new standard annually based on generation totals from the two previous years. Thus, the minimum standard can be either increased in response to oversupply or decreased in response to undersupply. The SREC market in Massachusetts differs from most others by implementing both a minimum SREC purchase requirement as well as a price floor to IOUs (Bird, 2011). Massachusetts implements a price floor mechanism through a Solar Credit Clearinghouse Auction, which allows electricity providers to procure and bank SRECs for future

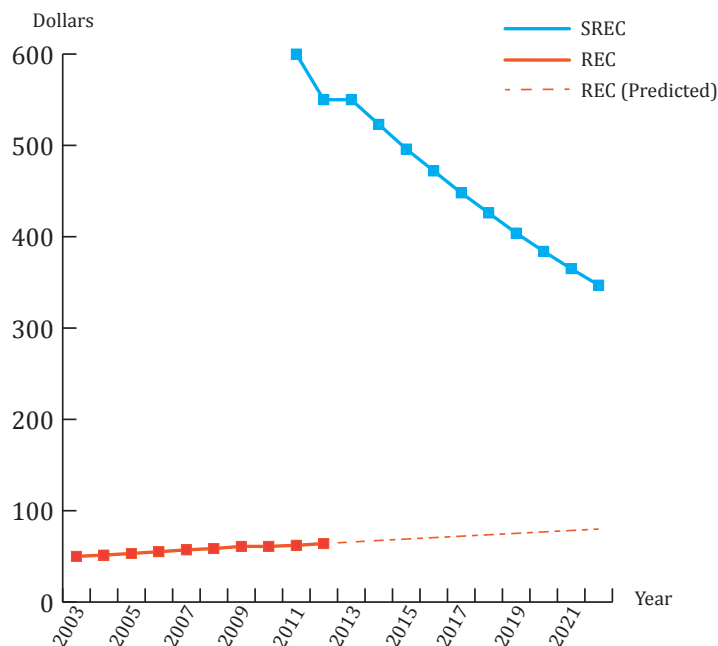


Figure 6. ACP Rate Adjustment for SRECs and RECs

ACP of RECs after 2013 is predicted through a linear regression based on 2003-12

Source: Massachusetts DOER.

years – particularly useful if SRECs are flooding the market in the current year. Banking SRECs is permitted for 2 to 3 years, depending upon when and if the SREC market clears for a given year. As a result, SRECs can be purchased at the minimum price.

## THE ABILITY TO FORECAST POTENTIAL SREC PRICES IS TREMENDOUSLY IMPORTANT

The ability to forecast potential SREC prices is tremendously important. In Massachusetts, it is generally assumed that SRECs will sell for no less than the price floor, which is currently the auction payout price of \$285/MWh. However, a recent report by Bloomberg New Energy Finance (2011) suggested that, due to projected oversupply of SRECs in the near future, a more accurate estimate of the price of an SREC is \$226/MWh. This is shown in Figure 7. This assertion is tremendously

important for solar energy developers and electricity providers, and may affect market decisions in the short term. For example, solar developers may be less willing to undertake the risk of building solar PV systems if SREC revenue streams decrease in value, and electricity providers may be less willing to establish long-term contracts with system owners to purchase SRECs if future prices are overvalued. The intricacies of the SREC market are therefore integral to the pace of solar PV development in Massachusetts.

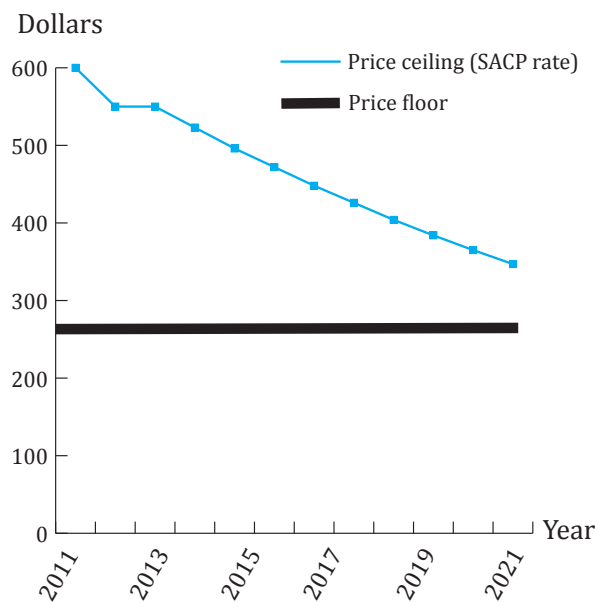


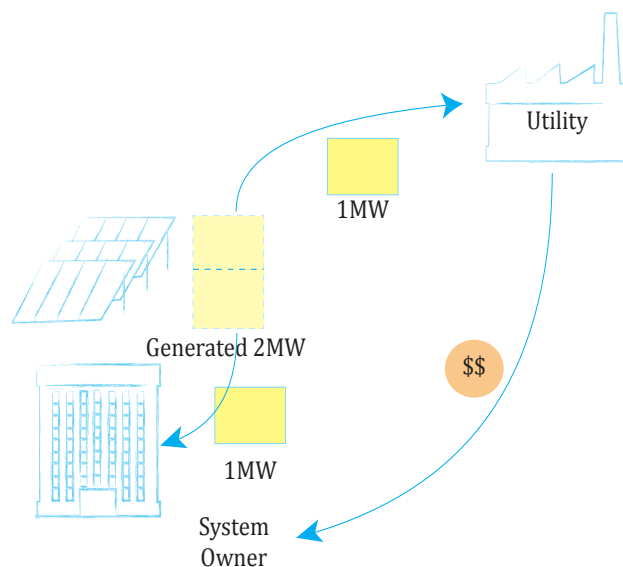
Figure 7. SREC Price Ceiling and Floor  
Source: Massachusetts DOER.

### 3.3.2 Net-Metering Agreements

Net-metering agreements, which is explained in Figure 8, allow solar PV system owners to sell back to the utility any unused electricity generated by the system. Net-metering stipulations can play different roles in PPAs. In some cases, system owners will retain all benefits from the sale of electricity, while other cases may allow the host (e.g.,

THE INTENT OF THIS PROGRAM IS TO ENCOURAGE SMALL POWER PRODUCTION FACILITIES AND DIVERSIFY ENERGY PRODUCTION IN THE STATE.

municipality) to essentially reverse their electricity meter for the conventional electricity needed to supplement the PV facility. The intent of this program is to encourage small power production facilities and diversify energy production in the state. In one sense, “Massachusetts net metering regulations require investor-owned utilities to



*Figure 8. Basic Concept of Net Metering*

*Above case shows when the solar PV Owner generated 2MW, used 1MW itself and sold 1MW to the Utility.*

credit the accounts of customers whenever a customer's eligible renewable energy facility generates more electricity than is being consumed" (Brailard, 2011). If it generates less than needed, it would have to pay the utility for the excess – at the utility's ordinary retail market price.

These agreements can allow solar developers to bring in more revenue. The Massachusetts net metering program was originally implemented in 1982 by a regulation issued by the Department of Public Utilities (220 C.M.R. Sec. 8.04(2)(C)). In 1997, the Department of Telecommunications and Energy (now DPU) amended the net metering program to increase the maximum allowable capacity from 30 kW to 60 kW and to provide that any net energy generated by a facility during the course of a month be credited to the next month's bill at a rate approximating the retail cost of conventional electricity sold by the utility (220 C.M.R. sec. 11.04(7)(C)) (Massachusetts Energy and Environmental Affairs, 2012). The 1997 amendments do not allow generators through net metering to carry credits from one year to the next.

On July 2, 2008, Governor Patrick increased the allowable net metering capacity to 2 MW for non-government entities, and 10 MW for government entities, including municipalities. Furthermore, the former may not exceed 1% of the electric utility's highest historical peak load, while the latter may not exceed 2% of this load (D.P.U 11-10-A.18.07). The Energy Cost Savings Bill passed by the State Senate would raise the cap to 3% for both public and private facilities, but it has not been enacted as law quite yet. This bill is now before the State House of Representatives. This is a positive sign for solar developers and other system owners. As of February 14, 2012, there

were 28,240 kW with net-metering service under the 1% limit, and another 10,049 kW with net-metering service under the 2% limit. This includes solar as well as all other types of energy facilities that are connected to the grid. Although state government has consistently increased net metering incentives, that could change in future administrations.

One aspect of net metering can potentially hamper PV arrangements among municipalities, PV developers and utilities. This involves interconnection and associated upgrade fees. The interconnection process, which allows power to be fed back into the grid from the PV array, can increase the cost of a PV project, as it requires the utility to upgrade its infrastructure. Negotiation over this process can be long and arduous, and thus may serve as a deterrent to net metering (Massachusetts EEPA, 2012). Considering net metering is an additional revenue stream for the solar developer, the absence of the program could mean that some PV projects will be financially infeasible.



### 3.3.3 Federal and State Tax Benefits

Solar PV systems have enormously expensive upfront capital costs and long payback periods (EPA Guide to Purchasing Green Power, 2010). Federal and state governments have created a variety of tax incentives and deductions to encourage solar PV development. Currently, the federal government offers a significant tax credit and depreciation deduction for commercial solar developers, and in Massachusetts, a state renewable energy property tax incentive is also available. Many other tax benefits are currently offered, particularly for residential and small-scale commercial projects in Massachusetts, but they fall outside the scope of the project and are not included in this report.

FEDERAL AND STATE GOVERNMENTS HAVE CREATED A VARIETY OF TAX INCENTIVES AND DEDUCTIONS TO ENCOURAGE SOLAR PV DEVELOPMENT.

The Federal Income Tax Credit (ITC) is the most significant tax benefit available to commercial solar developers. Under U.S. Code Title 26 (Section 48(a)(3)), businesses can receive an income tax rebate equal to 30% of the total capital cost of the project. In this case, there is no dollar-value cap on the project. For example, a \$10,000 system is eligible for a \$3,000 rebate, while a \$1 million system is eligible for a \$300,000 rebate. This program is set to expire in 2016.

The Modified Accelerated Cost-Recovery System (MACRS) program is a separate federal tax deduction designed to reward commercial solar

developers by adjusting their taxable gross income downward, which consequently lowers their net income and tax liability each year. Under U.S. Code Title 26 (Section 168(e)(3)(B)(vi)), businesses are allowed to obtain benefits based on the depreciation value of the solar PV system starting at its full cost, minus half of the ITC. For example, a \$1 million system's depreciation would start at \$850,000 – full cost (\$1 million) minus half of the ITC (\$150,000). The MACRS deduction lowers gradually over the five-year eligibility period. This offer has been available in various forms since 1986.

The Massachusetts Renewable Energy Property Tax Incentive is a property tax exemption for solar PV systems used as primary or auxiliary power for taxable properties. Under Massachusetts General Laws Chapter 59 (Section 5(45)(45A)), the value added portion of the solar PV system is exempt from local property taxes for a 20-year period. This includes any element of the system that is not part of an existing building or structure. However, the remainder of the property remains subject to property taxes. Therefore, currently property taxes are only exempt to solar developers for rooftop installations on already existing buildings.

The Energy Cost Savings Bill was passed in April 2012 by the Massachusetts State Senate. It is now under consideration in the Massachusetts House of Representatives. This bill would eliminate property taxes for solar developers and implement a premium charge of 5% of gross electricity sales to the municipality. This would apply to all types of installations, including open space and landfill projects, as well as buildings which are already exempt from paying property taxes. The Patrick administration continues to create policy aimed at making renewable energy more affordable in the Commonwealth.

The continued renewable energy push has led solar developers to approach communities with attractive project offers in the form of PPAs.

# 4. POWER PURCHASE AGREEMENTS

When considering on-site renewable power, some governments decide not to install solar PV systems because of the high capital investment, maintenance costs, and limited financial returns. In fact, government entities – within the scope of this project, municipalities – cannot take advantage of tax benefits due to their tax exempt status. To overcome these barriers, municipalities can host an on-site

MUNICIPALITIES CAN HOST AN ON-SITE SOLAR PV SYSTEM AND AGREE TO BUY ENERGY WITHOUT ACTUALLY OWNING THE EQUIPMENT, WHICH INCLUDES LITTLE TO NO UP-FRONT COST.

solar PV system and agree to buy energy without actually owning the equipment, which includes little to no up-front cost. This approach is negotiated through a contract known as a PPA, and it can greatly simplify the process of installation. To begin the process, municipalities first send out a Request for Proposals (RFP) to collect competitive bids for projects.

Energy services can be procured under the purview of two Massachusetts laws. Chapter 30B oversees basic competitive procurements for municipalities. The Office of the Inspector General oversees and reviews contracts procured under the guidelines of 30B. While energy contracts are exempt from the competitive process, if a municipal land lease is used (which most PPA agreements do), a competitive procurement process subject to review by the Inspector General's Office is required. Another procurement process is for an Energy Management Services under Chapter 25A. Competitive procurements under Chapter 25A are overseen by DOER. Municipalities can choose to

procure a PPA under either the guidelines of 30B or 25A, depending on their needs.

Under a PPA, a third party owns the renewable energy system and sells the power to the site host under a long-term contract (usually 10 to 20 years). The energy payments from the site host helps pay for the capital cost of the system. A third-party project developer typically handles all aspects of the project development, including site assessment, system configuration, installation, and financing. The project developer is also typically responsible for system operations and maintenance. A PPA project usually involves two contracts: 1) a site license or lease, and 2) a power purchase agreement. Site licenses or leases are negotiated on a case-by-case basis and can be vastly different. Some communities feel that leasing government land to a private company for the purpose of energy generation should be free, while others feel that the developers should be paying the property tax associated with leasing the land.

UNDER A PPA, A THIRD PARTY OWNS THE RENEWABLE ENERGY SYSTEM AND SELLS THE POWER TO THE SITE HOST UNDER A LONG-TERM CONTRACT

# 5. INSURANCE REQUIREMENTS

As with any large-scale, expensive development project, insurance policies are paramount to risk management. Solar PV projects may incur special environmental considerations due to the size of the installations and the environmental risks associated with siting projects on capped landfills. While developers are mainly responsible for securing these policies, the associated risks must be considered by municipalities entering into PPA agreements. In many cases, governmental entities themselves are able to self-insure. However, it is important to investigate the minimum insurance required by the concerned utility's interconnection rules. These requirements may necessitate additional coverage through private insurance. In this case, generally the developer (system owner) will be responsible for the insurance (Cory, 2009; Windustry, 2008).

The developer should be expected to carry at least both general liability and property insurance (NREL, 2011). In addition to the general liability and property insurance, PPA policies typically require environmental risk insurance, business interruption insurance, and builders' risk insurance. This section will introduce each type of insurance and their associated risks.

## 5.1 General Liability Insurance

General liability covers policyholders for death or injury to persons or damage to property owned by developers. Rooftop installations typically require additional liability insurance given the inherent risks in working on roofs and the higher likelihood of wind loading, which is pressure from the wind that creates a strong lifting effect on the

roof. Ground-mounted systems tend to be far from other structures and in less populated areas, which may reduce the cost of insurance premiums for general liability, and it may also reduce the requirement for additional insurance. General liability coverage is especially important for installers, as risk is greatest during the installation process. However, developers may also purchase builders' risk insurance in addition to general liability coverage to indemnify themselves from damage to other property or persons during the construction phase (Speer, 2010).

GENERAL LIABILITY  
COVERAGE IS ESPECIALLY  
IMPORTANT FOR INSTALLERS,  
AS RISK IS GREATEST DURING  
THE INSTALLATION PROCESS

## 5.2 Property Insurance

Property insurance covers damage to or loss of policyholders' property. It also protects the owner against "financial loss from theft of system components" (Speer, 2010), which insurance underwriters and brokers consistently identify as a concern, especially before the panels are affixed during construction. In addition, property insurance can indemnify system owners of "certain natural catastrophe risk" (Speer, 2010). If natural catastrophe risk is perceived to be too high, separate policies may be needed to provide additional risk coverage capacity (e.g., hurricane coverage in Florida (Cory, 2009)).

## 5.3 Environmental Insurance

Environmental damage coverage indemnifies system owners of the risk of either environmental damage done by their development or

preexisting damage on the development site. There are a variety of environmental policies that can cover an assortment of risks, such as: pollution liability policies, property transfer policies, cleanup cost cap or stop loss policies, or brownfields restoration and redevelopment policies (Speer, 2010).

## 5.4 Business Interruption Insurance

Business interruption insurance is often required to protect the cash flow of the project. This coverage ensures that policyholders can recover: (1) Lost sales as a result of the system not being operational and the subsequent loss of production-based incentives, as well as (2) the recapture of tax incentives lost because the project is not being rebuilt at all or in a timely fashion.

## 5.5 Builders' Risk Insurance

Because of the risks related to performance and safety, contractors and subcontractors are generally required to acquire a performance bond, which means to hold a surety bond to cover liens held for poor performance or misappropriated funds. Banks and insurance agencies provide contractor bonding. However, because of the limited track record for developing renewable energy systems, most contractors are often unable to obtain bonding. Project lenders almost universally require that all contractors and subcontractors be fully bonded relative to the value of work to be completed. Without adequate bonding, contractors may not participate in project development, thus lowering competition for contractor services.



## 5.6 Insuring Solar Photovoltaic Systems

### 5.6.1 Solar Photovoltaic Developers

The primary insurance requirements for project developers are property insurance and general liability insurance. Separate insurance products are required for the construction and operating periods. Property insurance protects the owner's investment in the system itself in the case of damage to insured property. Liability insurance protects against financial losses that result when an insured property damages other property or people. Some projects also acquire environmental insurance if preexisting conditions are associated with the facility site (Speer, 2010).

### 5.6.2 Municipalities

If the insurance is covered by the system owner, the cost of insurance will be included into the PPA cost of electricity. Therefore, a fairly recent realization is that it may be cheaper for the government agency to insure the system directly, although they do not actually own the system. Then, the system owner is named as an "additional insured party" on the policy and agrees to reimburse the government agency for the premiums. Insurance companies have agreed to this in previous PPAs (Cory, 2009). Usually, property owners are only responsible for business interruption insurance. This insurance product generally covers up to one year of business income due to significant property damage associated with the PV installation (Speer 2010).

## 5.7 Insurance Issues Surrounding Power Purchase Agreements

### 5.7.1 Cost of Premiums

Insuring a PV system can be difficult and expensive for a developer, since insurance underwriters view renewable energy systems as high risk (MAPC, 2011). Insurance underwriters charge fairly high premiums for PV installations. These premiums can represent approximately 25% of the annual operating budget and may be as large as 0.25% to 0.50% of the project installed costs (Cory, 2009; Speer, 2010). The cost of insurance can increase energy prices by 5–10%. This is because of the lack of a long operating history, and relatively low numbers of projects do not allow to average risk across a large number of installations (Cory, 2009). Therefore, insurance carriers set high premiums. This is what causes higher energy costs for the consumer. Therefore, it is likely that the cost would decline as more systems are built. This could be explained by “the law of large numbers” theory, which means the larger the group, the more likely that premiums paid by the policyholders will cover losses and provide the insurance company with a profit.

### 5.7.2 Risk Assessment

Different contract structures applying the PPA model allocate the array of risks to the associated parties in different ways. The strength of the contract between the system host, the developer, and the tax equity investor is very important for determining the types and degrees of risks involved. Also, contracts vary greatly in content, which can complicate their risk assessment of the project (Cory, 2009).

### 5.7.3 Long-term vs. Short-term Costs

A PPA presents a particular challenge to developers when they try to estimate the contracted energy prices for their customers. Insurance products are generally offered for one-year periods, while PPAs are usually offered for 15 to 20 years. Developers cannot determine the cost of insurance two years out, let alone 20. Also, insurance rates can rise on an annual basis during project construction or, even more likely, during project operation. They typically increase to take into account perceived increased risk and inflation. The increased cost of insurance over time negatively affects project economics. Under these conditions, developers might find it difficult to competitively price their projects to potential customers (Cory, 2009).

### 5.7.4 State-funded Umbrella Insurance Policy in Massachusetts

Insurance requirements can complicate the installation of solar PV systems on public buildings and properties. As part of the interconnection agreement, utility companies can require owners of solar PV systems to obtain additional general liability insurance, and its cost can reduce the economic viability of the project. Under a PPA, it is the developer that must obtain property insurance for the solar PV systems hosted by the public agency; but, as with other costs associated with the PPA, the host will bear this cost. This insurance can be expensive and has the potential to result in higher-than-expected cost, and it

IF ADDITIONAL LIABILITY INSURANCE REQUIREMENTS ARE UNAVOIDABLE, AN UMBRELLA POLICY MAY BE A MORE COST-EFFECTIVE APPROACH THAN ONE-OFF POLICIES FOR EACH PROJECT

could potentially result in abandoning potential projects (Cory, 2009).

If additional liability insurance requirements are unavoidable, an umbrella policy may be a more cost-effective approach than one-off policies for each project. An umbrella policy provides “extra liability insurance coverage that goes beyond the limits of the insured’s insurance. It provides an additional layer of security to those who are at risk for being sued for damages to other people’s property or injuries caused to others in an accident.” Net-metering laws in Massachusetts apply to systems up to 60 kW. Additional insurance requirements are triggered for projects greater than 60 kW (Shirley, 2007), which is often the case (Cory, 2008).

Therefore, according to Cory (2008), the DOER is exploring the concept of an umbrella policy for public-sector solar PV facilities as a way to lower insurance costs on a per-project basis. For example, one particular 425 kW PV project in Massachusetts triggered the need for a \$1 million insurance policy, which carries an annual premium of \$14,000 (\$33/kW). If additional solar PV projects are aggregated under an umbrella policy, costs will decrease on a per \$/kW basis (Cory, 2008).



# 6. INTERVIEWS WITH MUNICIPALITIES ENTERING PPAS

The main objective of this project was to determine the risks associated with entering a PPA from a municipality's point of view, as well as to determine any breakdown points that are occurring during the PPA negotiation process. These risks and breakdown points were determined by interviews with municipal employees who had intimate knowledge of the solar PV project in their city or town. The list of questions can be found in Appendix A. We interviewed Department of Public Works Directors, Mayors, Environmental Coordinators, Town Administrators, Planning Directors, and Town Finance Directors in 18 cities and towns in Massachusetts. Due to confidentiality restrictions, the names of municipalities and employees will not be mentioned.

## 6.1 Solar Initiatives in Massachusetts

There is a consensus among municipal contacts regarding their outlook on the solar power initiative in Massachusetts. The ambition

“I THINK THE SOLAR POWER INITIATIVE THAT MASSACHUSETTS IS STRESSING IS ONE OF THE MOST AGGRESSIVE IN THE COUNTRY, AND ALL IN ALL, I SEE IT AS VERY POSITIVE”

of the federal and state governments, specifically with regard to the RPS, Solar Carve-Out, and SREC payout schedule, is viewed in an extremely positive context. For example, one interviewee remarked, “I think the solar power initiative that Massachusetts is stressing is one of the most aggressive in the country, and all in

all, I see it as very positive.” The notion of its aggressiveness is echoed throughout almost all of the answers from the contacts. Only one of the municipal officials interviewed did not support the mandate by Massachusetts to expand solar power. They remarked that, “Energy issues should be up to the consumer, the utility company, or the town, and not the state.” However, most officials believe that Massachusetts is leading the country in solar development and that the Solar Carve-Out is the step that is needed to wean the U.S. off non-renewable, foreign resources used for energy production. Furthermore, nearly all contacts felt that there was money to be saved by municipalities through the state’s solar initiative.

“ENERGY ISSUES SHOULD BE UP TO THE CONSUMER, THE UTILITY COMPANY, OR THE TOWN, AND NOT THE STATE”

## 6.2 Motivations for PV Installation

The motivations for municipalities to install solar PV were very clear for all interviewees. Nearly every contact first mentioned the fact that the municipality would save money each year by switching a portion of their energy profile to solar power under a PPA. There was a wide range in the scale of the solar projects, as some facilities aimed to power one small building, while others supplied energy to a town hall complex or water treatment facility. Several municipalities claimed to save significant portions of their budget from a solar PV installation contracted through a PPA. One contact that entered into a 20-year PPA with a \$0.085/kWh starting price, which included an escalator

of \$0.05 every three years, commented on substantial cost savings.

“Due to the solar facility, we will be able to bring our annual \$400,000 municipal electric bill almost down to \$0.” The second most common

“DUE TO THE SOLAR FACILITY,  
WE WILL BE ABLE TO BRING  
OUR ANNUAL \$400,000  
MUNICIPAL ELECTRIC BILL  
ALMOST DOWN TO \$0”

response was that the municipality wanted to be seen as progressive by using renewable energy as a type of demonstration project. Solar power was specifically chosen either because wind power was not desired by the community, or because solar developers approached them and gave them an economically sound option to save taxpayer money

through what is seen as a relatively reliable form of energy.

## 6.3 SREC Market

The SREC market did not appear to persuade or dissuade the municipalities’ decision to enter into a PPA. The market was seen as something the solar developer had to deal with, even though the price of electricity was affected by the SREC market. However, there did

THERE DID APPEAR TO BE A BREAK-DOWN POINT RELATED TO THE SREC MARKET, ALBEIT NOT ON THE MUNICIPAL SIDE.

appear to be a breakdown point related to the SREC market, albeit not on the municipal side. Two municipalities stated that they needed to acquire a new solar developer to complete feasible projects because

the instability in the SREC market caused the solar developer to walk away. Municipalities were simply concerned with the cost of elec-



tricity throughout the life of the contract, and were not necessarily worried about how the long-term price was calculated. Therefore, as long as the price was below projected market value for conventional energy generation, municipalities did not seem to be concerned with how the SREC market (or anything else for that matter) affected the cost of electricity. Municipal officials did not seem to be aware of the issues related to how the cost of energy was determined, but rather they viewed this as a job for hired technical consultants.

MUNICIPAL OFFICIALS DID NOT SEEM TO BE AWARE OF THE ISSUES RELATED TO HOW THE COST OF ENERGY WAS DETERMINED, BUT RATHER THEY VIEWED THIS AS A JOB FOR HIRED TECHNICAL CONSULTANTS

## 6.4 Benefits of Net Metering and Power Purchase Agreements

Municipalities all agreed that the benefits of a solar PPA were that energy costs would be cut significantly with little up-front capital to the city or town. The price of energy (and its associated stability)

was seen as the largest factor in determining whether or not the municipality was going to enter the PPA. Some of the municipalities tried to obtain benefits from a net metering agreement (four of which have been agreed), but most were still in process of nego-

THE PRICE OF ENERGY WAS SEEN AS THE LARGEST FACTOR IN DETERMINING WHETHER OR NOT THE MUNICIPALITY WAS GOING TO ENTER THE PPA

tiating the agreement. Net metering is seen as a bonus to accrue revenue for the developer, and therefore some of the cost savings are passed on to the municipality. Most of the solar PV facilities were not built to accommodate the entire load needed to run all municipal buildings, and therefore there are not many net metering agreements signed within the data set.

## 6.5 Risks of Net Metering Agreements

There was little perceived risk in entering a net metering agreement as the major cost savings and exposures are realized through the PPA. The main risks seen in the net metering process are the ability to secure a fair price for energy after the interconnection process is finished, as well as the accuracy of metering the electricity flowing between the utility, the solar PV system, and the municipality. The interconnection process is seen as a potentially expensive and long-lasting endeavor. Several municipalities have had to rework budgets multiple times to accommodate the extended proceedings, and therefore they have not realized cost savings from their project in the projected time period given to them by their technical consultants. Additionally, the fees associated with the interconnection upgrades are seen as a risk, mainly because the town feels that the utility is purposefully delaying these projects.

## 6.6 Risks of Power Purchase Agreements

The summary of this section is shown in Figure 8. The major risks of entering PPAs cited by interviewees were solar developer breach of contract (either during or after construction of the solar PV system), the unlikely decline of conventional electricity prices, and the price escalation of solar PV electricity generation over time. Municipalities have a general fear that solar developers will leave the site after 5-10 years, and therefore many clauses are put into the PPA contract to mitigate these fears. These clauses are put into the contract because municipal budgets can change dramatically due to the loss of energy savings from a PPA, and could therefore dramatically affect municipal budget forecasts. Another risk mentioned was that the leased government land will be tied up and unable to be used for other purposes. Obviously, for rooftop or landfill projects, the land is not being used for anything else, but open space projects can be considered riskier in some instances because of the forfeited opportunity cost. Many of the projects are located on landfills, and therefore the liability associ-

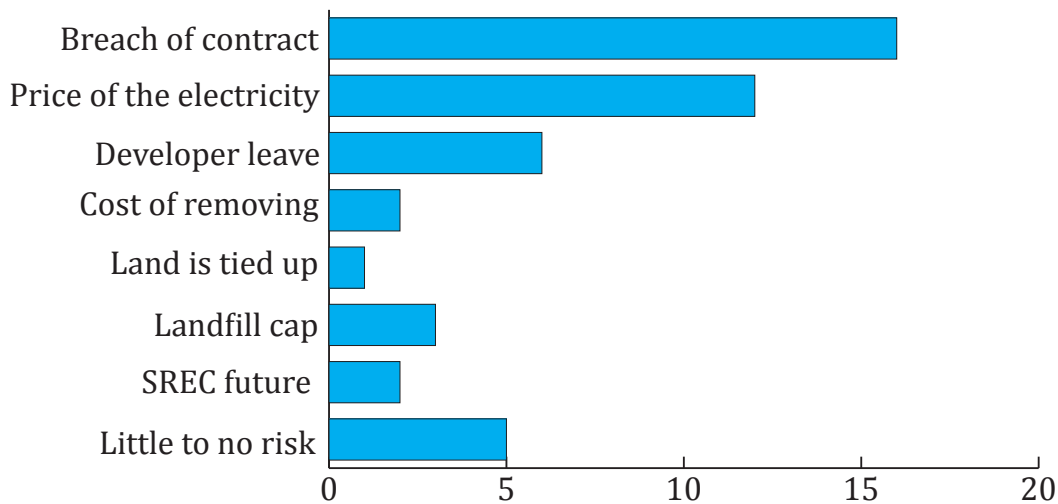


Figure 9. Interview Results: Risk of PPAs

ated with damage to the landfill cap as a result of the solar PV system is viewed as a significant risk. However, this is seen as a risk for the project itself, and not a risk for entering a PPA.

“I REALLY DON’T SEE THE TOWN HAVING MUCH EXPOSURE. WE’RE SIMPLY A LANDLORD IN THIS SITUATION, LEASING UNUSED SPACE TO GET MONEY OFF OUR ELECTRIC BILL.”

PPAs are generally not seen as a risky venture by municipalities. As one municipal official noted, “I really don’t see the town having much exposure. We’re simply a landlord in this situa-

tion, leasing unused space to get money off our electric bill.”

## 6.7 External Consultants

Fifteen out of the eighteen municipalities used legal or other outside consultants to negotiate the PPA with a solar developer. Of the municipalities that used legal or other technical consultants to negotiate the contract, all found them invaluable and absolutely necessary. The few municipalities that did not need additional outside counsel were special cases. These municipalities had either access to legal or energy experts within local government, or ran their own municipal utility company and were very familiar with PPAs and net metering agreements.

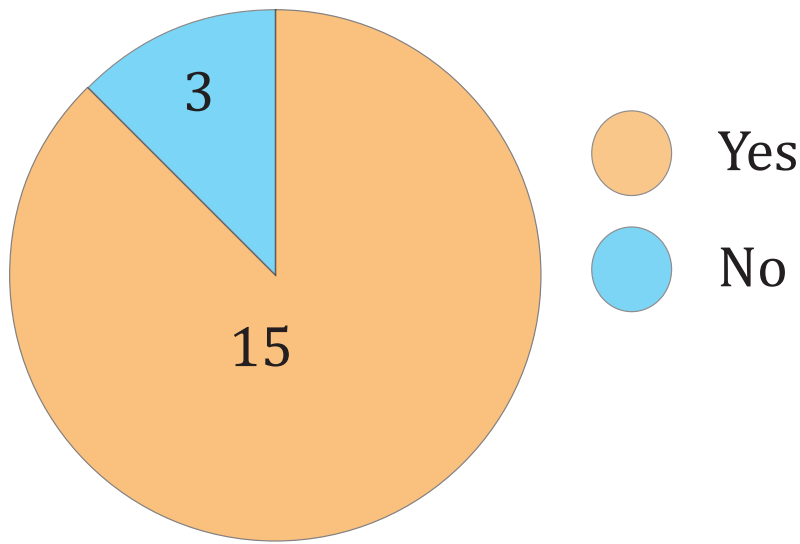


Figure 10. Municipalities using External Consultants

Many interviewees cited the complexity of the regulatory structure – the RPS, Solar-Carve Out, and SREC market – along with net metering, insurance, and various other contract terms as highly technical and confusing. While this is certainly a valid assertion, none addressed

these complexities as causing a breakdown in their project, but rather they reinforced their trust in the technical consultants advising them on project specifics.

SEVERAL TECHNICAL CONSULTANTS REVEALED THE POSSIBILITY THAT THESE COMPLICATIONS ARE INDEED THE REAL BREAKDOWN POINTS IN GETTING PROJECTS DONE

However, it is interesting to note that interviews with several technical consultants revealed the possibility that these complications are indeed the real breakdown points in getting projects done. For example, one legal consultant noted, “Whether it be the solar REC program or net metering program, while they’re all beneficial, they all suffer from a problem where they’re extremely complex, and the rules

are less than certain or still in the process of being developed... and that's caused a lot of problems in Massachusetts getting things done.”

## 6.8 Additional Insurance

Municipalities do not feel they would benefit from a state-run umbrella insurance policy regarding general liability insurance requirements. Nearly all municipalities feel that it is the developer who needs the insurance, and that additional insurance would simply be another cost to the city or town. Any fears that municipalities are feeling are mitigated through each of the negotiated PPAs. The performance bond has also been brought up as a type of insurance policy in case the developer cannot finish the project. The general consensus of our interviewees is that since the city or town in most cases is simply leasing land, there is little risk and therefore an additional insurance policy is not warranted. This is an interesting finding, given that one of the main concerns of the municipalities was that the developer may go out of business or abandon the system before 2020.



# 7. REVIEW OF SIGNED POWER PURCHASE AGREEMENT

Of the eighteen municipalities interviewed, six signed PPAs were reviewed for the following information: length of the contract, cost of electricity over the life of the project, performance bond, size of the facility, buyout options, SRECs, and contract default.

## 7.1 Length of Contract and Cost of Electricity

The length of the signed PPAs ranged from 10-30 years, with a term of 20 years being the most common (Figure 11).

As could be seen on Figure 12, the cost of electricity and the price escalation throughout the life of the contract varied greatly between PPAs. The range of electricity prices for the first year of production were between \$0.01 and \$0.10, with the average being \$0.0563. This is more than 50% lower than the average cost of conventional, fossil-fueled generation of electricity. The escalation of the cost of electricity ranged from 0% over the life of the project to 800%. Four of the escalators are between 1-3% per year, with the fifth escalator appearing to be overwhelmingly large at 800%. This is seen as such a large increase over the life of the project because in this case, the first year's price of electricity starts at \$0.01 and ends at \$0.09. The average cost of electricity for all the PPAs reviewed over the length of the entire contract is \$0.0776. This was determined by taking the cost of electricity for



each year of the PPA and dividing by the number of years for each contract.

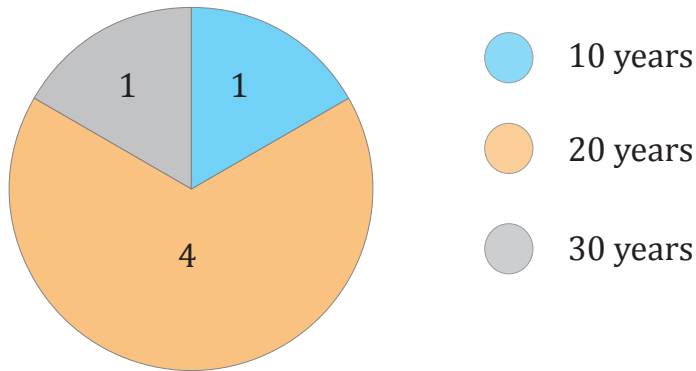


Figure 11. Contract Duration

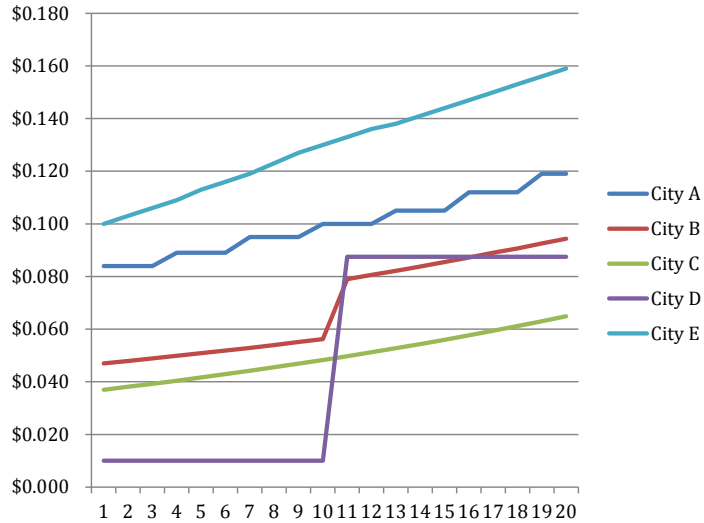


Figure 12. Cost of Electricity in Five Different PPAs

## 7.2 Performance Bond

Only one PPA mentioned a performance bond, and it was rather low at \$12,500. It appears to be so low because the facility is one of the smallest PV arrays within the municipal contact group and therefore the cost of finishing the project was not seen as a large risk to the municipality. Chapter 25A Section I, subsection I states that the performance bond must be filed before the signing of the PPA. This is most likely the reason why a performance bond is not noted in nearly all of the PPAs we reviewed.

## 7.3 Facility Electricity Generation

Five of the PPAs outline the ownership of the SRECs to stay with the system owner and therefore the only way the municipality would be able to receive them would be to buy the system at some point during the life of the contract. One of the PPAs reviewed has the developer owning the SRECs for the first seven years of the contract, and then a 50/50 split of ownership of the SRECs would be realized throughout the final years of the contract.

## 7.4 Buyout Options

Due to the range of facility sizes, the buyout options prices vary significantly and will not be discussed. Four of the PPAs mention buyout options, with three of the contracts stating that the host of the system may buy the solar PV array and all its infrastructure associated with it at any time during the life of the contract. Only one of the PPAs does

not allow a buyout until after year 5. Two of the contracts explicitly say how much the facility would be worth in a given year, while the other two only mention that the fair market price of the facility would be incurred by the host.

### 7.5 Ownership of SRECs

The size of the facilities ranged in nameplate capacity from 109kW to 2,700 kW. There are guaranteed levels of electricity generation projected for each year of the project for all the facilities, which is a fundamental aspect of chapter 25A stated above. However, most of the system owners state in the contract that the municipality acknowledges that solar power is an intermittent resource and that the output of the system will constantly vary. Typically, if the system does not meet approximately 75% of the estimated annual production of electricity, the system owner will pay the difference between the agreed upon price for solar PV energy and conventional electricity provided by the utility.

# 8. RECOMMENDATIONS

Upon completing interviews with eighteen municipalities across Massachusetts regarding Solar Power Purchase Agreements (PPAs), it is clear that a ubiquitous level of confusion exists alongside a resolute eagerness to complete solar PV projects. In this sense, municipalities are remarkably proactive about implementing PPAs despite a lack of procedural knowledge, which leads them to rely heavily on paid technical consultants to assist with evaluating potential projects, developing Request for Proposal (RFP) documents, and negotiating contractual agreements with solar developers. All municipalities expressed a high level of trust in their technical consultants and attributed breakdowns in potential PPAs to solar developers. Given these data, our recommendations are directed toward both The Cadmus Group, Inc. (Cadmus) and the Massachusetts Department of Energy Resources (DOER) to respectively overcome objections posed by solar developers and provide easier access to technical information.

## 8.1 Recommendation to The Cadmus Group

Two municipalities that experienced a breakdown during PPA negotiations with solar developers identified the reason to be uncertainty in the SREC market, which has purportedly caused hesitation by solar developers because SRECs comprise a major revenue stream in their financing assumptions. This assertion was also confirmed in a separate interview with a legal consultant who has assisted several municipalities with PPA negotiations. Furthermore, an interview with

DOER confirmed the agency's concern with how current SREC market dynamics could dissuade solar developers from pursuing projects in the short term. This fact has been described in detail by Bloomberg New Energy Finance (2011), and in short, they predict that the current price floor – or the auction payout price – is not \$285, but rather approximately \$226. This prediction causes hesitation for solar developers by devaluing the revenue stream for SRECs by more than 20% through the next 2-3 years.

As an owner's agent providing technical assistance to municipalities, Cadmus can provide value by overcoming objections to signing PPAs posed by solar developers in the short term. Since the primary hesitation for solar developers has been linked to uncertainty in the SREC market, we recommend a two-prong approach: 1) establishing a database and relationships with solar developers in Massachusetts and 2) formulating an innovative financing arrangement to make up for SREC revenue lost in the short term due to diminishing SREC prices. In this sense, Cadmus can help its clients move projects forward by prospecting more potential solar developers, and subsequently proposing a PPA structure that can recover the 20% of SREC revenue lost in the short term, while still providing energy savings for municipalities throughout the length of the contract.

Figure 13, for example, displays the cost of electricity over the length of the PPA for one municipality in Massachusetts. The graph shows that energy savings for municipalities are front loaded, as electricity prices paid to solar developers increase over time. This approach was universal across all PPAs our group reviewed. Over the length of the PPA, electricity prices increase in pre-determined intervals set by price escalators established by contractual agreement. We recom-

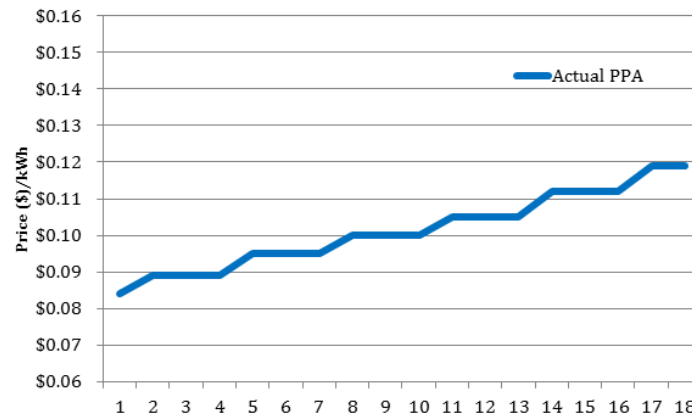


Figure 13. Cost of Electricity Comparison over Time; Case of an Actual PPA

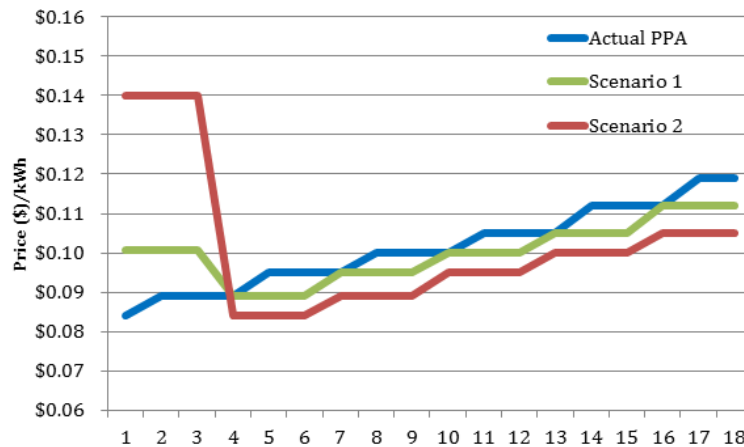


Figure 14. Cost of Electricity Comparison over Time; Actual Case and Two Scenarios

mend an alternative financing arrangement that takes into consideration diminishing SREC prices over the next 2-3 years. In this case, municipalities would initially grant solar developers higher electricity prices for a 2-3 year period, and then receive a discount over the subsequent 2-3 years to make up for any lost energy savings. After the discounted period, electricity prices would be subject to price escalation throughout the remainder of the PPA, similar those shown in Figure 13. Figure 14 displays two alternative scenarios in comparison to the traditional PPA model in Figure 13.

For example, the price of electricity in Year 1 of the PPA in Figure 13 is \$0.084 per kWh, and the solar developer guarantees the solar PV system will generate at least 1,995,000 kWh of electricity annually. In this case, the solar PV system will produce 1,995 SRECs. At \$285 per SREC, the solar developer would make \$568,575 in additional revenue, while at \$226 per SREC they would only make \$450,870. The goal of the alternative energy cost structures in Figure 14 is to at least partially recoup the \$117,705 in potential lost SREC revenue, which will provide an extra incentive for solar developers to implement projects in the short term. Both alternative energy cost structures are financially beneficial to the municipality in the long term, as the net change in energy savings over 20 years only changes slightly from the example in Figure 13. Figure 15 displays the annual net change in energy savings for municipalities for each alternative scenario compared to the baseline PPA in Figure 13.

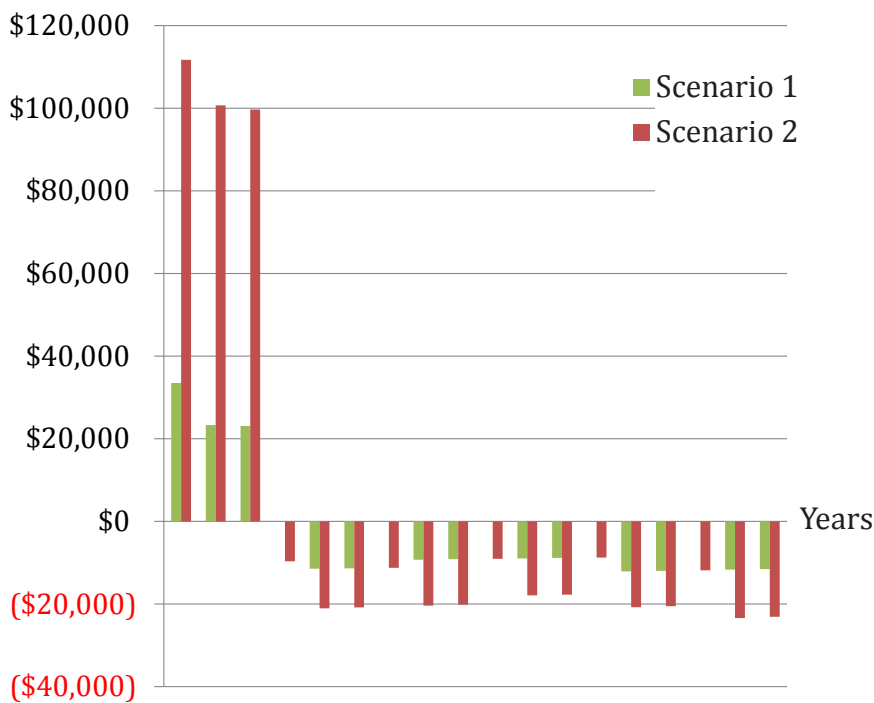


Figure 15. Change in Energy Revenue for Solar Developer

Our recommendation to Cadmus is to pitch a variation of either alternative scenario based on contextual factors arising during negotiations, which can include ownership of SRECs, net metering credits, etc. For example, Scenario 1 includes a 20% increase in electricity prices in Year 1. This would provide an additional \$33,516 in revenue to the solar developer, but it would not fully internalize the potential lost SREC revenue. Scenario 2 includes a price increase from \$0.084 per kWh to \$0.14 per kWh, which would provide \$111,720 in additional revenue to solar developers and nearly internalize lost SREC revenue. Both scenarios will still provide some energy savings for the municipality in the short term, which is currently paying \$0.145 per kWh. The determination of how much to increase initial energy prices should be made based on the municipality's need, and likely result in an initial increase in Year 1-3 somewhere between the two scenarios.



## 8.2 Recommendation to DOER

DOER provides oversight and guidance to municipalities who are procuring energy services under the guidelines of Chapter 25A.

Multiple references provided by DOER cite the existence of a Model PPA contract that is available to municipalities for their use. Template PPAs are available to the public,

such as the one distributed by

Tioga Energy, Inc. However it is in a community's interest to consult a template that has not been

compiled by industry representatives. DOER does an excellent job of providing easy to find model

documents on their website for the procurement of energy management services. We suggest that DOER also supply their comprehensive model PPA on their website. The document should be easily found with little navigation through the website. Our interview results suggest that while some cities and towns did consult with DOER to obtain the model PPA, some were unclear as to whether the document was available for public use.

All signed PPAs are filed with DOER. Another useful online tool would be a sortable database of signed PPAs. The database could simply be an Excel spreadsheet

organized with identifying information about the project, such as size of the installation, location site (e.g. landfill or building), and length of contract. Installing solar

WE SUGGEST THAT DOER ALSO SUPPLY THEIR COMPREHENSIVE MODEL PPA ON THEIR WEBSITE

ANOTHER USEFUL ONLINE TOOL WOULD BE A SORTABLE DATABASE OF SIGNED PPAS

projects and entering into PPAs is still a relatively new process for municipalities. The ability to look at signed contracts with similar characteristics to a town's proposed PPA would only increase a town's understanding of complex contractual pieces. Different projects raise different issues, and if cities and towns can look at contracts with similar considerations, then the process could move forward more smoothly. Since the strength of the contract is the most important tool for ensuring that minimal risk is assigned to municipalities, the greater number of resources they have to aid their understanding will increase the chance most contracts will be strong and fully comprehensive, minimizing possible issues down the road.

Our interview results show that fifteen out of the eighteen municipalities contracted an outside source and found them invaluable throughout the process. The nascent solar industry in the state, combined with the complex and technical nature of the issues, puts municipalities at a disadvantage during negotiations with developers.

## WE SUGGEST THAT THE STATE CREATE A SPECIFIC GRANT TO ASSIST WITH SOLAR ENERGY PROCUREMENT PROJECTS

A separate agent who is fully versed in the issues of the industry and in negotiating PPAs is necessary in most cases. In order to assist municipalities with the cost of hiring a consultant, we suggest that the state create

a specific grant to assist with solar energy procurement projects.

DOER currently has a technical assistance grant for energy management services, but only designated Green Communities are eligible.

While the goals of increasing solar installation in the state fit in with the design of the Green Communities Program, there are communi-

ties who may want to explore PPAs who have not yet achieved Green Community designation. A solar technical assistance grant will help to achieve the goal of 400MW installed by 2020 and will insure that the contracts signed in the process are properly covering the communities' interests.

We believe these recommendations will streamline the PPA evaluation process for municipalities and attract solar developers hesitant to proceed because of uncertainty in the SREC market. While our recommendations to DOER and municipalities can be easily implemented, the alternative model of energy savings for municipalities may be problematic. We believe many municipalities may be skeptical of receiving less immediate energy savings than others have recently received. However, as project implementation continues to slow due to uncertainty in the SREC market, and municipal budgets continue to be strained after the recent recession, we believe the alternative model provides a way to push solar developers to implement projects now rather than wait out the market. This benefits municipalities by achieving immediate, albeit smaller, savings over the short term, while not sacrificing the net energy savings over the length of the contract.

# 9. CONCLUSION

Our research shows that municipalities are eager to enter into PPAs with project developers. The prospect of reducing energy costs with little capital investment and risk is extremely attractive to municipal officials grappling with shrinking budgets. Due to the complexity of regulations and contractual terms in PPAs, most municipalities commented on a reliance on advice from paid technical consultants. Although the complexity of implementing projects has slowed projects down, the breakdowns in PPA negotiations are largely attributed to solar developers.

In two instances, the solar developer backed out due to uncertainty in the SREC market. Our additional research, specifically our literature review and interviews with technical consultants, has also confirmed that there is uncertainty surrounding the SREC market. While there has been a consistent undersupply of SRECs since the inception of the RPS and Solar Carve-Out, the number of permitted and completed projects in the state has increased. This has caused a new scenario of SREC oversupply, which may drive SREC prices lower than the auction benchmark of \$285 per credit – perhaps as much as 20% lower. To address the market uncertainty surrounding SRECs, we have proposed that the Cadmus Group, Inc. pitch clients an alternative cost of energy model. In this case, municipalities will pay higher energy premiums (per kWh) in the short term (2-3 years) in order to attract developers to implement projects now.

Our recommendations for DOER are aimed at streamlining the PPA evaluation process. Most municipalities did not perceive that the community assumes significant risk by entering into PPAs, but rather

they believe the majority of issues could be attributed to the contract language. In order to expand the accessible knowledge available to communities regarding PPAs, we have recommended simple actions that can be performed by DOER: make information easily accessible online. Access to a comprehensive template and other signed PPAs will better inform communities, especially during the RFP process.

Massachusetts wants to encourage solar PV development and has created a market structure that makes these projects financially feasible. Municipalities want to save money by reducing their energy bills. Declining state assistance during the recession has forced communities to tighten budgets and make difficult choices. An opportunity to save money on electricity reduces the strain on municipal budgets. We have provided recommendations that will expand communities' understanding of complex issues regarding PPAs and make it easier for them to access specialized knowledge of the industry. Easier access to information, as well as some creativity relating to upfront pricing during negotiations to account for SREC market uncertainty, will be important additions to the effort of reaching 400MW of installed solar power by 2020.

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# APPENDIX A.

# QUESTIONNAIRE FOR MUNICIPAL OFFICIALS

1. What is your position within the city/ town?
2. How long have you worked for the city/ town in your current position?
3. What are your thoughts about the solar power initiative in Massachusetts?
4. Do you have a signed power purchase agreement with a solar developer? (if not, did they ever start the process?) If yes, ask for a copy of the PPA.
5. What were the town's motivations for installing solar PV arrays? (prompt: net metering regs, SREC market, tax incentives, general green energy initiatives, citizen advocacy)
- 5a. Do you understand how the SREC market functions? If yes, did the market affect your decision to enter a PPA?
6. Why did you consider entering into a solar power purchase agreement?
- 6a. Did you consider trying to obtain benefits from a net metering agreement?
7. What do you understand to be the potential benefits of entering into a solar power purchase agreement?
8. What do you understand to be the potential risks of entering into a solar power purchase or net metering agreement? Is one more risky than the other?
9. Did you use any sources to aid your understanding of the contract? (prompt: state, federal, private consulting, counsel, etc)
- 9a. Did you find this source(s) helpful? Why or why not?

10. Do you think the municipality would benefit with its own additional insurance policy regarding contract default? such as a state umbrella policy...

11. Do you know of any other towns that have looked into PPAs?

**PPAs started but did not finish**

12. How long was the project going before it was terminated?

13. What were the major problems that led to termination of the project?

14. What could have been done on either side of the negotiation that could have made the project a success?

15. Would you like a copy of our final report?

# APPENDIX B.

# MEMORANDUM OF UNDERSTANDING

MEMORANDUM OF UNDERSTANDING  
BETWEEN  
TUFTS UNIVERSITY FIELD PROJECTS TEAM NO. 3  
AND  
THE CADMUS GROUP, INC.

## I. Introduction

Project (i.e., team) number: Team #3

Project title: **How Communities Can Identify and Mitigate Risk under Solar Energy Power Purchase Agreements**

Client: **The Cadmus Group, Inc.**

This Memorandum of Understanding (the “MOU”) summarizes the scope of work, work product(s) and deliverables, timeline, work processes and methods, and lines of authority, supervision and communication relating to the Field Project identified above (the “Project”), as agreed to between (i) the UEP graduate students enrolled in the Field Projects and Planning course (UEP-255) (the “Course”) offered by the Tufts University Department of Urban and Environmental Policy and Planning (“UEP”) who are identified in Paragraph II(1) below (the “Field Projects Team”); (ii) The Cadmus Group, Inc., further identified in Paragraph II(2) below (the “Client”); and (iii) UEP, as represented by a Tufts faculty member directly involved in teaching the Course during the spring 2012 semester.

## II. Specific Provisions

(1) The Field Projects Team working on the Project consists of the following individuals:

1. Kaitlin Kelly email address: kaitkelly@gmail.com
2. Ben Mendelson email address: Benjamin.mendelson@tufts.edu
3. Takayuki Suzuki email address: apday73@yahoo.co.jp
4. Brian Szekely email address: brian.szekely@gmail.com

- (2) The Client's contact information is as follows:

Client name: The Cadmus Group, Inc.  
Key contact/supervisor: Erin Sweet  
Email address: Erin.Sweet@cadmusgroup.com  
Telephone number: 617-673-7101  
FAX number: 617-673-7301  
Address: 57 Water Street, Watertown, MA 02472  
Web site: www.cadmusgroup.com

- (3) The goal/goals of the Project is/are:

Determine perceived and actual risk for all stakeholders involved, including municipalities, system owners, and consumers. Risks associated with contract default, net metering regulatory process, the SREC program, and developer bankruptcy should be discussed. Additionally, quantifying money lost from the solar developer due to the initiation without completion of the project. The main goal of the project is to propose an advocacy or educational tool for the cities, states and regions that would aim to allow solar Power Purchase Agreements to flourish in Massachusetts, and to propose a comprehensive risk-reduction measure for public entities entering into solar Power Purchase Agreements

- (4) The methods and processes - including the methodologies -- through which the Field Projects Team intends to achieve this goal/these goals is/are:

A large portion of the research will be stakeholder feedback in the form of interviews with municipalities, possible investors, and solar developers in order to build an educational or advocacy strategy to determine and mitigate problems within the PPA contract process. In conducting municipal interviews, the team will include the following disclaimer during the scheduling process:

*NOTE: Information provided during these interviews may be made public through publication, on-line publication, or otherwise disseminated by the project team. Interviewees names and identities will be kept confidential upon request.*

Literature review of other educational or advocacy tools used either in the renewable energy industry or outside of the field should be explored. Additionally, an examination of current state insurance programs for development projects will be performed.

- (5) The work products and deliverables of the Project are (this includes any additional presentations for the client, and may list project elements in order of priority):
- A report outlining our findings is the primary deliverable. A presentation at Cadmus is a low priority depending upon if the client can come to the Field Projects presentation at Tufts.

- (6) The anticipated Project timeline (with dates anticipated for key deliverables) is:

MOU: Feb 10  
Project Outline: Feb 15  
Interview Finished: March 14  
Mid term Presentation: March 14  
Draft Report: April 6  
Presentation: May 2  
Final Report May 15

- (7) The lines of authority, supervision and communication between the Client and the Field Projects Team are (or will be determined as follows): Erin Sweet is the only client contact we will be using for the Project. Kaitlin Kelly will be the Field Projects Team primary contact with Erin Sweet

- (8) The understanding with regard to payment/reimbursement by the client to the Field Projects Team of any Project-related expenses is:
- Receipts of all project related expenses shall be submitted to the UEP administrative office for reimbursement.

### **III. Additional Representations and Understandings**

- A. The Field Projects Team is undertaking the Course and the Project for academic credit and therefore compensation (other than reimbursement of Project-related expenses) may not be provided to team members.

B. Because the Course and the Project itself are part of an academic program, it is understood that the final work product and deliverables of the Project (the "Work Product"), either in whole or in part, may be shared with others inside the Tufts community (other students, faculty and staff) and possibly outside the Tufts community (released to community groups, or published (in hard copy or electronically). The Field Projects Team shall not refer to the Client or use the Client's logo without the express written permission of the Client. If the final work product is posted online or otherwise publicized, the following disclaimer shall be printed:

*Disclaimer: Employees of The Cadmus Group, Inc. participated in this Project as a Project Sponsor. No financial or material gain was acquired as a result of the sponsorship role, which primarily included reviewing the methodology of the Project Team and mentoring team members. The views, findings, or opinions expressed here are not necessarily those of Cadmus, its employees or representatives.*

C. The Field Projects Team and Tufts University may seek grant funds or similar payment to further the Project or support distribution or publication.

D. As of the time of signing, there are no perceived or apparent conflicts of interest or issues regarding confidential or proprietary information relating to this Project. Client shall not provide names, contact information, or any other information pertaining to Cadmus' clients and customers to the Field Projects Team or Tufts University. If any potential conflicts are identified, the Field Projects Team, Tufts University, and Client shall work together to quickly identify and mitigate any such issues.

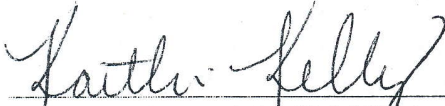
E. Client's responsibilities may include reviewing the research plan, findings and results, and final report (as provided by the Field Projects Team) and providing review, input and feedback on the Project materials. Research data and notes may be included as part of this review. Raw data of the interview, including names of interviewees, municipalities, and companies shall be redacted from the materials shared with the Client so as to avoid any potential breach of confidentiality or conflict of interest between the Client and Client's customers. The Client may alter the final report and shall notify the project team if the final report is altered.

F. Nothing contained in this document or in the deliverables resulting from the Project shall be interpreted or construed as Client endorsement of the Field Project Team findings or report. If requested by the Client, a disclaimer to this effect shall be included in any public dissemination, in whole or in part, of the Report.


#### IV. Signatures



For The Cadmus Group, Inc.  
By: Erin Sweet  
Date: Feb 22, 2012



Representative of the Field Projects Team  
By: [PRINTED NAME - *only one team member's signature is necessary*]  
Date: Feb 22, 2012



Tufts UEP Faculty Representative  
By: Robert Russell  
Date: FEB. 24, 2012





# APPENDIX C. IRB DETERMINATION



OFFICE OF THE VICE PROVOST

Social, Behavioral, and Educational Research  
Institutional Review Board  
FWA00002063

Title: Power Purchase Agreement Risk in Massachusetts

March 5, 2012 | Notice of Action

IRB Study # 1202043 | Status: EXEMPT

PI: Brian Szekely  
Study Coordinator: Benjamin Mendelson  
Co-Investigator(s): Kaitlin Kelly, Takayuki Suzuki  
Faculty Advisor: Robert Russell  
Review Date: 3/5/2012

The above referenced study has been granted the status of Exempt Category 2, 3 as defined in 45 CFR 46.101 (b). For details please visit the Office for Human Research Protections (OHRP) website at: [http://www.hhs.gov/ohrp/humansubjects/guidance/45cfr46.html#46.101\(b\)](http://www.hhs.gov/ohrp/humansubjects/guidance/45cfr46.html#46.101(b))

- The Exempt Status does not relieve the investigator of any responsibilities relating to the research participants. Research should be conducted in accordance with the ethical principles, (i) Respect for Persons, (ii) Beneficence, and (iii) Justice, as outlined in the Belmont Report.
- Any changes to the protocol or study materials that might affect the Exempt Status must be referred to the Office of the IRB for guidance. Depending on the changes, you may be required to apply for either expedited or full review.

IRB Administrative Representative Initials:

Handwritten initials in black ink, appearing to be "BMS" or similar, written over a horizontal line.

Social, Behavioral, and Educational Research

Institutional Review Board

FWAOUUOZOG3

Title: Power Purchase Agreement Risk in Massachusetts

March 5, 2012 | Notice of Action

IRB Study 1202043 | Status: EXEMPT

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research participants. Research should be conducted in accordance with the ethical principles, (i) Respect for Persons, (ii) Beneficence, and (iii) Justice, as outlined in the Belmont Report. - Any changes to the protocol or study materials that might affect the Exempt Status must be

referred to the Office of the iRB for guidance. Depending on the

changes, you may be required to apply for either expedited or full review. -

IRB Administrative Representative Initials

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