Solar Stimulus

Perceptions of banks and credit unions towards solar loans in Massachusetts

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Abstract

Access to finance for residential solar photovoltaic systems (PV) is an essential element of the clean energy economy. Perceptions about solar PV and solar loans among lenders at banks and credit unions shape the availability of lending products for residential solar PV. In March 2015, interviews were carried out among select informants and subsequently, between April and May 2015, a survey was conducted to gauge the perceptions of lenders in Massachusetts. Lenders have a range of concerns with the market and the provision of solar loans. These concerns can be grouped around risk, market size or viability and policy uncertainty. In summary, lending for this segment is not a priority for banks and credit unions in Massachusetts at this time. Recommendations are offered for the lending community and policymakers to improve adoption. Questions for further research are also presented.

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Background

Solar and climate

Climate change is a global problem.

Although established in 1988, it was only in early 2007, that the United Nations sponsored Intergovernmental Panel on Climate Change (IPCC) stated that humans, in no uncertain terms, were mainly responsible for the warming of the planet. In April of the same year, another IPCC working group released a document that reported humans as being responsible for many of the physical and biological changes occurring across the globe. It cited the release of billions of tons of greenhouse gases, annually by humans as being strongly related to these changes (Kerr 2007).

Since the release of the IPCC's report, several authors have discussed the adverse impacts of climate change. These studies have shown impacts of climate change on global food security (Carter 2013; Wheeler and Braun 2013), the world's marine ecosystems (Hoegh-Guldberg and Bruno 2010), on the terrestrial biosphere (Severinghaus et al. 2009) and most alarmingly on the acceleration of extinction risks across species (Urban 2015).

Climate change mitigation and adaptation

The most commonly accepted responses to climate change are broadly divided into adaptation and mitigation activities (Moss et al. 2010). Adaptation activities include responses of humans to 'adapt' to the changes in climate; and mitigation activities revolve around reducing net greenhouse gas (GHG) emissions from anthropological

activities (Moss et al. 2010). On mitigation, a concrete goal that has been adopted by several policy makers is to prevent the global mean temperature from rising above 2 degrees C, so as to reduce many of the risks associated with climate change (Hoffert 2010). The connection between GHG emissions and global temperature rise is well known. Hence one of the important ways to prevent this rise in global temperature is to reduce the net emissions released into the atmosphere.

Energy efficiency and renewable energy

Within mitigation, the role of energy efficiency and renewable energy are well documented as critical contributors towards the reduction of GHG emissions (Panwar, Kaushik, and Kothari 2011). At the same time, scholars have conducted extensive modeling studies to conclude that the "sources of the most threatening emissions have yet to be built" (Davis, Caldeira, and Matthews 2010, 1330). Other studies have shown that a scenario in which 100% of global energy is generated from renewable energy sources is not only technically feasible, but can also have positive socio-economic effects, compared to business-as-usual scenarios (Mathiesen, Lund, and Karlsson 2011). These findings make renewable energy central and critical to the reduction of carbon emissions in the future. This is more so on account of the significant growth expected in energy demand in the future (Armaroli and Balzani 2007), not only on account of a rising population, but also due to mass migration towards urban centers (Stephenson, Newman, and Mayhew 2010).

Solar PV

The role of solar energy in GHG emission reductions is well known. Any type of solar energy, passive or active; thermal or photo- voltaic; and concentrating or non-concentrating, does not produce any emissions in the process of energy production (Timilsina, Kurdgelashvili, and Narbel 2012). Moreover, the technical potential of solar energy is well beyond primary energy[1] demand (Timilsina, Kurdgelashvili, and Narbel 2012) and studies have shown that with the right combination of solar, wind and storage technologies, the U.S. grid can potentially be powered for 90-99.9% of the time with the shortfall being met by existing natural gas plants (Budischak et al. 2013).

Cost and feasibility

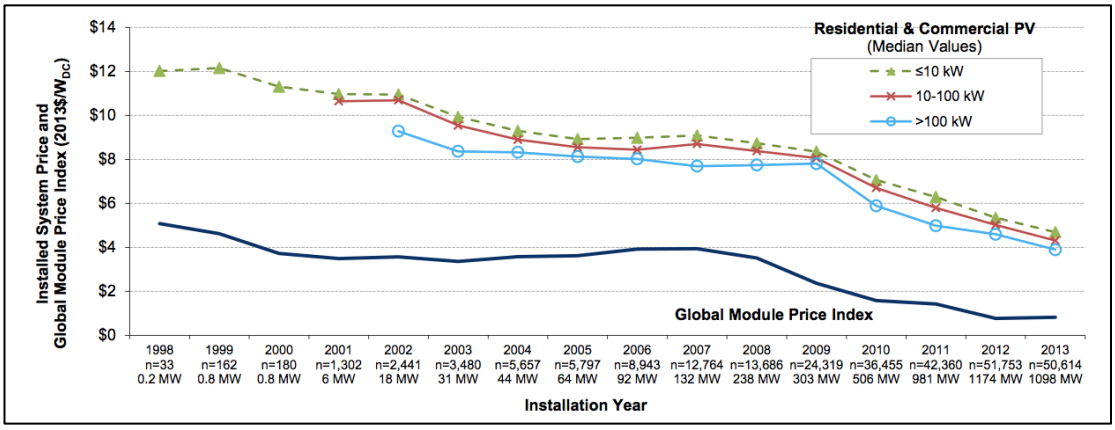
Cost of solar has been coming down globally, in the U.S. in particular

Solar photovoltaic (PV)[2] costs have been declining consistently for over 20 years. At the same time, the industry has grown at an annual compounded growth rate of 30% during this time (Shah and Booream-Phelps 2015).

According to a National Renewable Energy Laboratory Report (Feldman et al. 2014), the installed prices of residential and commercial PV systems in the U.S. over the last 15 years (see Figure 1 below) have seen a significant and consistent decline. As the graph suggests, this tracks very strongly with the pricing of the PV module. For the purposes of this thesis, discussion that follows will be around rooftop solar PV.

[1] Primary energy demand is total energy use for all applications, including electricity, heat, etc.
[2] For a detailed review and comparison of the different solar technologies, readers are encouraged to see
[2] For a detailed review and comparison of the different solar technologies, readers are encouraged to see
(Chu 2011).

Figure 1: Installed Prices of Residential and Commercial PV Systems over Time



Technical & commercial potential for solar

The technical electrical capacity[3] potential of rooftop solar PV in the U.S. is 664 GW (Lopez et al. 2012). To put this in context, the U.S. electric capacity as of 2012 stood at about 1200 GW in 2014 (Edison Electric Institute 2015; SEIA 2014).

On the generation side, rooftop solar PV, at its technical potential, would generate over 818,000 GWh (gigawatt-hours[4]) of energy annually (Lopez et al. 2012). Again, to provide some context, the existing electric energy infrastructure generated over 4,000,000 GWh in 2012 (Edison Electric Institute 2015). So, in capacity terms,

[3] For the purposes of this discussion, it is important to distinguish between capacity and generation. Capacity is the maximum electric output an energy facility can generate when operating at 100% output. This is also regarded as the 'power' or 'nameplate capacity' of the facility and is denoted in kilowatt (kW) or megawatt (MW). Generation, on the other hand, is the actual energy that an electric energy facility produces over a period of time. The output is denoted in power over time or kilowatt-hour (kWh) or megawatt-hour (MWh). For example, a 5 kW solar PV facility operating at 100% output would generate 5 kWh of energy in an hour. However, in reality, solar PV systems usually have a capacity factor (due to module efficiency, weather and other conditions) of only 15-25%. So, a 5kW producing at 15% capacity would only generate 0.75 kWh in one hour.

[4] 0.01 TW (tera-watts) = 0.1 GW = 1 MW = 1,000 KW = 1,000,000 watts

technical potential for rooftop solar PV[5] alone can be over 50% of the existing electricity infrastructure, while in generation terms, the potential is over 20%.

Massachusetts (MA) is part of the New England electric grid, which is managed by the independent system operator, ISO-NE. The state of MA, with about 6.5 million residents comprises about 45% of the region's population and consumes about 46% of the electricity generation. The installed capacity of electrical generation plants in MA as of February 2014 was 13,150 MW (ISO-NE 2014). In terms of technical potential of rooftop solar PV, it has been reported that about 10,000 MW of solar PV can be installed in MA on rooftops (Lopez et al. 2012).

Solar PV is an intermittent source of energy. Of course, solar PV is only generating energy as and when the sun is shining. The term of art sometimes used is 'generation on demand', which solar PV does NOT do. This is important because for any energy facility to be of value it has to meet the 'load' or 'demand' of the grid in which the facility is present. Typically though, solar PV generation does coincide with the demand profile in the U.S. and in Massachusetts during an average 24-hour day across the year and even better during the summer months (Anjum 2013; NREL 2013). This means that solar PV is able to generate electricity during peak hours of the year, thereby displacing the most expensive, as well as the higher GHG emitting sources of electricity (Baker et al. 2013).

[5] Rooftop Solar PV includes residential as well as commercial solar PV.

Given the above context, a comparison of solar PV in the U.S. and Massachusetts with Germany, a leading economy in Europe, provides a striking contrast for the potential of Solar PV.

Table 1: Comparison of U.S., Massachusetts and Germany for Solar PV (Bureau of Economic Analysis 2015; World Bank 2015a; SEIA 2015a; Edison Electric Institute 2015; World Bank 2015b; U.S. Census Bureau 2015; Fraunhofer ISE and Wirth 2015; Energy Information Administration 2015; US DOE 2015; Knoema 2015)

#	Descriptor	U.S.	Massachusetts	Germany
A	**Population**	318.8 million	6.75 million	80.89 million
B	**GDP**	$17.41 trillion	$424.99 billion	$3.85 trillion
C	**Per capita GDP (in $ '000)**	54.61	62.96	47.59
D	**Annual energy[6] Intensity per capita (million BTU / person)**	368 (2011)	211 (2011)	165 (2011)
E	**Total installed electric capacity**	1,172 GW	13.15 GW	182.16 GW
F	**Total electric generation**	4,047 TWh (2012)	55.26 TWh (2013)	519.13 TWh (2014)
G	**Total solar PV installed capacity**	20,000 MW	876 MW	38,500 MW
H	**Solar PV capacity as a fraction of total electric capacity**	1.7%	6.6%	21.1%
I	**Solar PV capacity per capita (watts / person)**	62.73	129.77	475.95

From Table 1 above, it can be seen that the while the state of Massachusetts is significantly higher in solar penetration (refer row H in table) in the U.S., it is only a

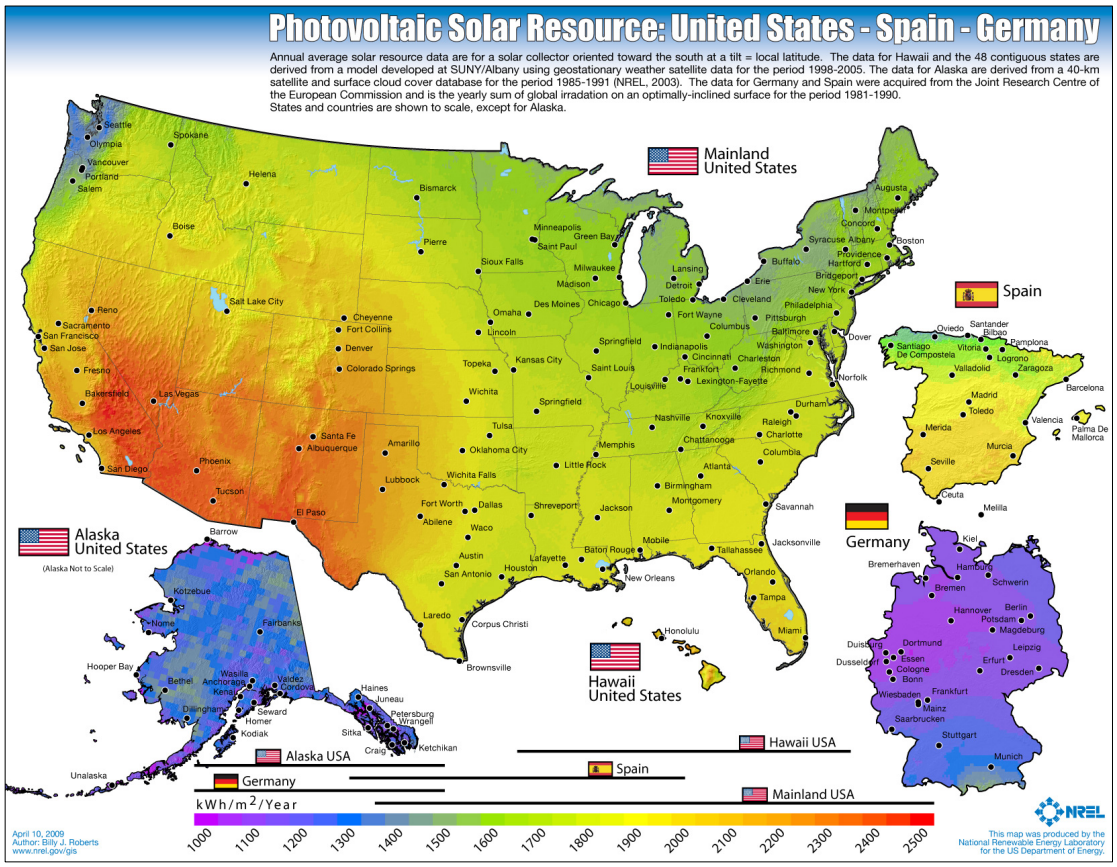
[6] Primary energy demand

fraction of the total solar PV capacity installed (row G) in Germany. This is more so, when measured as a fraction of total electric capacity (row H) or on a per capita basis (row I). Germany provides a useful contrast for a variety of reasons. First off, like the United States, it is a developed country. This is seen in the GDP per capita, which for U.S, Germany and Massachusetts are not very dissimilar.

Germany is, however; significantly lower in insolation[7] than the state of Massachusetts. While Germany ranges in between 1000-1200 kWh / m2 / year, much of the east coast United States gets insolation in the range of 1400-1600 kWh / m2 / year (Roberts 2009).

[7] INcoming SOLar radiATION. This is the energy from the sun that any given area on the planet receives. Measured in kWh / m2 / year

Figure 2: Photovoltaic Solar Resource: U.S – Spain – Germany (Roberts 2009)



There are a number of reasons for the differences in solar penetration between Germany, Massachusetts and the rest of the United States. One of the primary reasons for the high penetration of solar in Germany has been its energy policy. In particular, Germany has adopted an aggressive feed-in-tariff (FIT) structure. In simple terms, a feed-in-tariff is a system by which retail customers that interconnect their solar PV systems to the grid are reimbursed at a certain rate for the solar energy that they are feeding into the grid (Burgie and Crandall 2009). While a detailed discussion of the FIT is beyond the purview of this paper, it is important to point out that in Germany retail customers have historically been offered a price for the solar energy at a rate that makes it economical for them to install solar PV (Weiss 2014). The FIT policy has also

been held responsible for what has led the German mega-utility RWE to record historic losses (Lacey 2014).

Although the benefits, drawbacks and viability of Germany's FIT policy are debatable, suffice it to state that it has been instrumental in increasing the adoption of solar PV in the country (Weiss 2014). Furthermore, the growth of solar PV in Germany is also attributed to the availability of innovative financial mechanisms like third-party ownership (Grigoleit, Rothacher, and Hildebrandt 2015) and historically lower solar PV installation prices as compared to the U.S. (Seel, Barbose, and Wiser 2013).

At the same time, studies have shown that the reliability of the German electric grid has not been impacted negatively due to the growing inclusion of intermittent sources such as solar PV and even wind (Weiss 2014).

In sum, Germany provides an interesting contrast to what is taking place in the U.S. and Massachusetts and the quick comparative analysis above underscores two points:

1. The potential for solar PV development in Massachusetts and more so in the U.S. is far from having been exhausted.
2. When economically rewarded, either through programs such as FIT, lower prices or innovative financial mechanisms, electricity consumers will choose solar PV as an energy choice.

The upfront cost of installing solar PV and innovative financial mechanisms are of particular importance to the arguments presented in this paper. Indeed, in MA today, homes and businesses can get a power purchase agreement, a lease or a loan for solar

PV, and it would be economically viable to do so (Shah and Booream-Phelps 2015). Some of the reasons for this economic viability are the incentives offered for solar. These incentives are covered in greater detail further below.

Deployment and support for solar

Solar PV is being deployed on the utility, commercial and residential scale[8] in various states in the U.S and particularly MA. Each scale is important because it serves different functions.

Utility scale projects are important for two reasons: firstly energy costs are lower due to economies of scale with PV system (capacity) and installation costs; second, they are large projects that speed up the transition to clean energy infrastructure (Shah and Booream-Phelps 2015). Commercial scale is also important for two reasons: firstly, they are also economical because of their system size, and they help large users transition to clean energy and become energy-independent (Shah and Booream-Phelps 2015; SEIA 2012) by using readily available roof space. Companies like Walmart and Kohl's are adopting solar PV (SEIA 2012). Large-scale (utility and commercial) solar PV projects, however, may be hindered by the availability of space or land and costs for interconnecting projects to the grid. Typically, utility-scale projects also have longer gestation periods due to permitting and interconnection procedures for such projects.

[8] Utility-scale projects have large megawatt capacity (usually upwards of 2 MW) that are connected to the utility via transmission lines and/or leaders and may need additional investment to make such connections; they are also often controlled by the utilities or the independent system operator (ISO) in order to maintain grid stability. Commercial projects are smaller than utility-scale projects (usually 100 KW or upwards) that are almost always connected to the existing transmission infrastructure and are installed typically on large commercial rooftops. Residential-scale projects are small (usually 3-25 kW) installed on homes and connect via the distribution network.

For example, utility-scale projects often have to undergo a grid impact study (done by the ISO), which may cost developers time and money.

Relative benefits of Residential Solar PV

Residential solar PV is important because of the several benefits it offers. Here are some of these benefits, listed below:

Avoided costs of transmission and generation

Even with energy efficiency improvements, overall consumption of energy in the U.S. has been trending upwards (EIA 2015b). Further the Independent System Operator New England forecasts that the state's overall electricity demand will grow at a rate of 1.2% annually over the next decade (ISO-NE 2014). This increase in energy consumption requires utilities to buy more energy from the energy market, which in turn leads to more capacity (power) installations. Currently, most of the energy is generated at centralized power plants that feed power to the grid via high-power transmission lines (Martin 2009). In this system, the generation of energy and its consumption are distinctly separate.

By installing solar PV on the roofs of homes, the homeowner is able to generate energy where it is needed. Moreover, the excess energy can be fed back into the grid by connecting the solar PV system to the energy distribution[9] system. The effect of such distributed energy being installed is that it reduces the demand that the home places on

[9] Distinction between transmission and distribution: Transmission lines carry energy large distances and are rated typically from 69KV up to 765KV. Distribution lines connect the distribution substation to the end-users and are rated between 4KV to 46KV (Enernoc 2015; OSHA 2015).

the grid. All of these distributed generation installations can add up, creating a downward push on the need for new centralized power capacity.

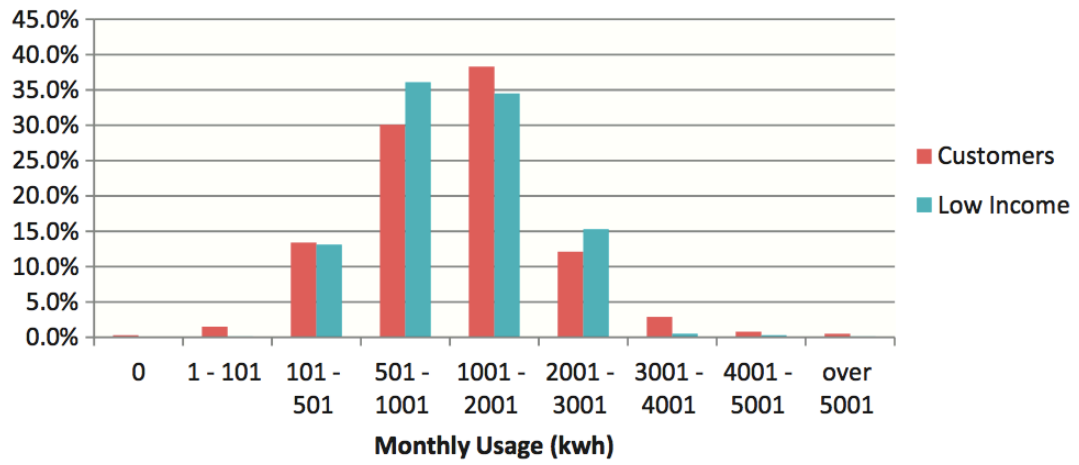
Additionally, the centralized power plants (even if they are large scale solar PV or other forms of renewable energy sources) need to have transmission lines installed, so as to interconnect the installation to the grid.

With distributed generation resources being installed, new centralized generation and its corresponding transmission costs can be avoided (Mills and Wiser 2013; Pater 2006).

Equity

Residential rooftop solar has strong implications for certain economic strata of society. This is because energy is a significant fraction of income for low- and moderate-income (LMI) households. A recent study also shows that low-income households do not differ significantly in electricity usage patterns compared to the general population (Karier 2015). Although from another city in the U.S., Figure 3 below provides insight and in simple terms underscores the case for solar PV. The figure shows that electricity usage among the low-income group is not significantly different from the overall 'customers' group, which means that electricity costs, as a percentage of income in the low-income group, is higher.

Figure 3: Distribution of Customers by Usage Rate at a Medium-Sized Public Utility in Oregon (Karier 2015)



In many of the largest cities in the U.S. (including Boston), solar PV as an energy source can cost less than drawing energy from the grid (Kennerly and Proudlove 2014). For example, in Boston, consumers can save up to US$ 0.07 per kWh on a 5 kW solar PV system[10] (Kennerly and Proudlove 2014), which translates to US$ 630 per year. This is particularly important to the LMI community, because, by installing solar PV, homeowners can lower their electric bills as a fraction of their income, making more disposable income available for other expenses.

Further, solar PV (when owned) locks in the price of the electrical energy for at least the life of the system (usually 20 years). On the other hand, utility electricity prices are expected to increase over time. In Massachusetts, for example, homeowners expect electricity prices to be 58% higher in 25 years (Kennerly and Proudlove 2014). For a low-income household, therefore, today and into the future, solar PV can help ease the economic burden. It is important to point out, however, that solar PV has a high upfront

[10] Assumed as 100% loan financed at 5% interest.

cost, and in the absence of cash (for money-down), when financing options (loans, and PPAs or leases, explained in further detail below) are available to homeowners, they can potentially become more accessible to the LMI community. This is because the monthly fee paid to PPA providers or the monthly repayment paid to the bank is typically lower than the electricity bill.

Siting

In a recent study, it was found that siting utility scale solar PV could be problematic on account of NIMBYism (Not In My Back Yard) (Carlisle et al. 2015), which is defined as "*protectionist attitudes of and oppositional tactics adopted by community groups facing an unwelcome development in their neighborhood*" (Dear 1992, 288). Further, the study found that on a national level (U.S.), there is a strong belief that utility-scale solar PV projects will decrease property values and that solar developers are acquiring land at low costs (Carlisle et al. 2015).

Although, it would take a large number of residential rooftop solar PV installations to match up in size to a single utility-scale project, rooftop projects may not face NIMBYism to the extent that utility-scale projects have. In MA, the success of programs such as Solarize Massachusetts[11], managed by the Massachusetts Clean Energy Center provides an idea of how communities are adopting residential rooftop solar PV (MassCEC 2015).

[11] From MassCEC's website: Solarize Mass seeks to increase the adoption of small-scale solar electricity in participating communities through a competitive tiered pricing structure that increases the savings for everyone as more home and business owners sign contracts. Visit: http://www.masscec.com/solarizemass

Solar PV and the value of the home

Solar PV is also known to increase the value of the home. A recent study conducted by the Lawrence Berkeley National Laboratory revealed that homes that have solar PV installed can add as much as US$ 4 / watt (Hoen et al. 2015). As per the study, for an average installation of 3.6 kW, this translates to almost US$ 15,000. The study used a hedonic pricing model to determine how much value a PV system added to a home. The basic concept underlying the hedonic pricing model is well established in the literature. It is based on the idea that the value of a home (or any asset) is based on the sum of its characteristics. By analyzing the price data over a number of home sales, the researchers, using a (theoretical) hedonic regression model, were able to estimate the value of contribution to the price from solar PV (Rosen 1974; Freeman III 1979; Sirmans et al. 2006).

Incentives and support for solar

Solar PV has seen financial incentives and various types of support on the federal and state levels. Furthermore, the private sector, lending industry in particular, is also supporting solar PV. Digital Credit Union and Sungage Financial, both Massachusetts-based organizations have come together[12] to offer US$ 100 million in loans for solar PV (Doom 2014). This capital can potentially support the deployment of about 4,000 residential solar PV installations.

[12] Digital Credit Union is headquartered in Marlborough, MA and has over 500,000 members in all the 50 states. Sungage Financial is a Boston-based company that is focused on providing direct-ownership finance solutions (loans) exclusively for residential solar PV.

Federal level support for Solar PV

On the federal level, the U.S. government, under the Energy Policy Act of 2005 has provided a 30% income tax credit[13] for the installation costs of solar PV since 2006 (DSIRE 2015b). Further, the Department of Energy's Sunshot program supports the growth of solar PV in three areas: lowering manufacturing and deployment costs, increasing efficiency and performance, and improving reliability of PV technologies. Currently, the Sunshot program has a portfolio of investments in the aforementioned areas amounting to about US$ 200 million (DOE 2014).

Of particular note within the programs funded by the Sunshot Initiative is the Solar Outreach Partnerships (SolarOPs). The SolarOPs program is "designed to help accelerate solar energy adoption on the local level by providing timely and actionable information to local governments." (SolarOPs 2015) The program achieves its goals and removes barriers to the adoption of solar PV through a mix of educational workshops, peer-to-peer sharing opportunities, research-based reports, and online resources (SolarOPs 2015).

[13] The Federal Income Tax Credit (ITC) for solar PV is currently slated for discontinuation in Jan 2017.

Massachusetts' support for Solar PV

The state of Massachusetts supports solar PV in a number of ways:

State income tax credit

The state offers a tax credit of 15% of the cost of the installation or up to a maximum of US$ 1000 for residential solar PV project. This credit is applied toward the state income tax obligation of the homeowner (DSIRE 2015a).

Renewable Portfolio Standard and Solar Renewable Energy Credits

The renewable portfolio standard (RPS) is a regulatory mandate that requires energy suppliers (both regulated distribution utilities and competitive suppliers) to have a certain fraction of their energy supply from renewable energy sources, such as wind, biomass, solar, etc. The term RPS is also interchangeable with Renewable Electric Standard (RES) (NREL 2015; MA DOER 2015b).

In Massachusetts, the RPS started in 2003 at 1% and reached 4% in 2009. In 2009, as a part of the Green Communities Act of 2008, the RPS was broken into RPS Class I and RPS Class II and the Class I annual obligation was set to increase by 1% every year. The 'Classes' are differentiated based on different technologies. Solar PV is part of the Class I technologies, along with solar thermal electric, wind, small hydropower, landfill methane and anaerobic digester gas, marine or hydrokinetic energy, geothermal energy and some eligible biomass fuels. In 2014, 9% of energy supply was required to be from Class I technologies (MA DOER 2015b). This regulatory mandate creates a demand for energy from renewable sources.

Further, the New England Power Pool Generation Information System (NEPOOL GIS) tracks the renewable energy generated and delivered to the grid. NEPOOL GIS then issues certificates for each MWh of energy generated to qualifying renewable energy facilities. These Renewable Energy Certificates (RECs) fulfill the 'supply' side of the market for renewable energy, as they can be used by energy suppliers to fulfill their RPS obligation (NEPOOL GIS 2015).

Distributed solar PV has been given a special status within the Class I of the RPS by way of a 'Solar Carve-out'. As the name suggests, a certain portion of energy supply is mandated to come from **distributed** solar PV sources. This mandate has created the Solar Renewable Energy Credit program, which has effectively generated a revenue stream for distributed solar PV resources (MA DOER 2015a). For the homeowner (when the PV system is owned), this means that every MWh (1000 kWh) of energy generated will bring additional revenue from the sale of SRECs and mitigate the overall costs of investing in solar.

Net metering

Part of the current energy policies in Massachusetts, net metering is another benefit offered to homeowners for installing solar PV on their home. With net metering, homeowners with solar PV get credit on their bill for generating energy on site. A special 'net meter' is installed at the residence, which runs backwards when energy is generated and a credit for the energy exported to the grid, appears on the electric bill from the utility. Homeowners can reduce their electric costs with net metering (MA DPU 2015). It may be important to point out the difference in net metering and a feed-in-

tariff program. Net metering differs from feed-in-tariff in that it involves offsetting energy use and any excess any energy generated is sent to the grid. With feed-in-tariff, the generating unit enters into a long-term contract with the a utility and the utility agrees to pay a fixed price per unit of energy exported to the grid (Maehlum 2014).

MA's Solar Loan Program

Massachusetts' Department of Energy Resources, in partnership with the Massachusetts Clean Energy Center has launched a program in December 2015 that incentivizes banks and credit unions (lenders), as well as borrowers for providing loans to homeowners for installing solar PV (MA DOER 2015c). The incentives include an interest rate buy down (IRBD), loan loss reserve (LLR) and an income based loan support (IBLS). The IRBD, as the name suggests, 'buys down' the interest that a lender would charge borrowers by paying them upfront when a loan is disbursed. The LLR is a limited financial safety net to lenders in case of defaults on the loans they disburse. The IBLS offers an additional incentive to borrowers from the LMI community. This program is also open to community-shared solar PV projects. For homeowners, the program will effectively reduce the cost of owning solar PV, by offering loans at 3% interest or lower (MA DOER 2015c).

Barriers to Residential Solar PV

In spite of the importance of solar to climate change mitigation and the economic benefits to the homeowner of installing solar PV, the penetration of solar PV is significantly low[14]. Some of the barriers to the adoption of residential rooftop solar PV are provided below and classified as barriers to homeowners and the business in general.

Barriers to homeowners

High upfront costs

As with most renewable energy solutions, Solar PV is expensive to install. This is, as seen in above, despite the cost of solar PV coming down significantly in recent times. For the typical homeowner in Massachusetts, a 6 kW solar PV system can cost between US$ 22,000 and 27,000. High upfront costs can be a deterrent to adoption (Rao and Kishore 2010; Bazilian et al. 2013). Although, innovative third-party ownership models (explained in greater detail in below) exist to address the high upfront costs, this paper focuses on direct ownership (due to its greater economic value to the homeowner) and barriers to the same.

Access to finance (loans)

Currently, there are only a few solar PV-specific loan products available from lenders and most lenders offering loans for solar PV consider them to be home

[14] The state's fuel mix comprises of 2% 'other renewables', which includes solar PV, wind, biomass, geothermal etc.; so solar is well within 2% of the state fuel mix (ISO-NE 2014).

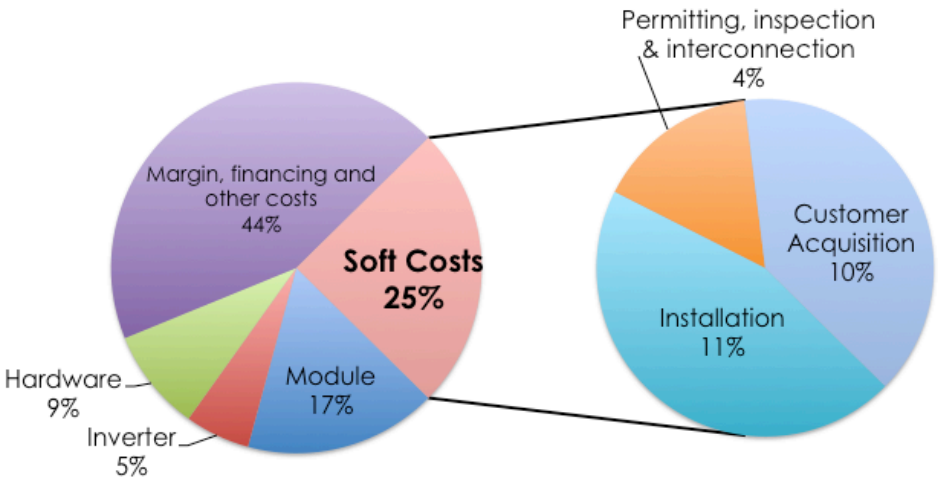
improvement loans or are offering them with home equity as collateral (per interview with key informants).

Barriers to solar business

High soft costs

Another aspect of the economics of residential rooftop solar PV and a significant driver are the soft costs of the system. Soft costs include the non-hardware components of the overall cost of installing a solar PV system. According to a recent report by the Rocky Mountain Institute, soft costs in the U.S. make up to 25% of the overall costs of solar PV systems under 10 kW (Calhoun et al. 2014). Figure 4 below shows a breakdown of costs of installation of a sub-10kW rooftop solar PV system. Within soft costs, installation and customer acquisition are significant components. High soft costs keep the installed prices up of solar PV up and eventually make it more expensive for homeowners.

Figure 4: Cost per component and breakdown of soft costs for Residential Rooftop Solar PV (<10 kW) systems in the U.S. (Calhoun et al. 2014)



Why Solar Loans?

In this section, the different ownership approaches to solar PV and the rationale for solar loans as a viable option are discussed. Finance for residential solar PV has been studied extensively in the scholarly literature and energy-focused media (Feldman and Lowder 2014; IRENA 2015; Tweed 2015b; Litvak 2015; Tweed 2015a; Munsell 2015). In general, there are two ways to finance solar: direct and third party ownership.

Direct vs. third-party ownership

With direct ownership, the homeowner either uses their own money or takes out a loan from a lending institution on a secured or unsecured basis, depending on their credit profile and a variety of other factors that lenders may use in disbursing a loan.

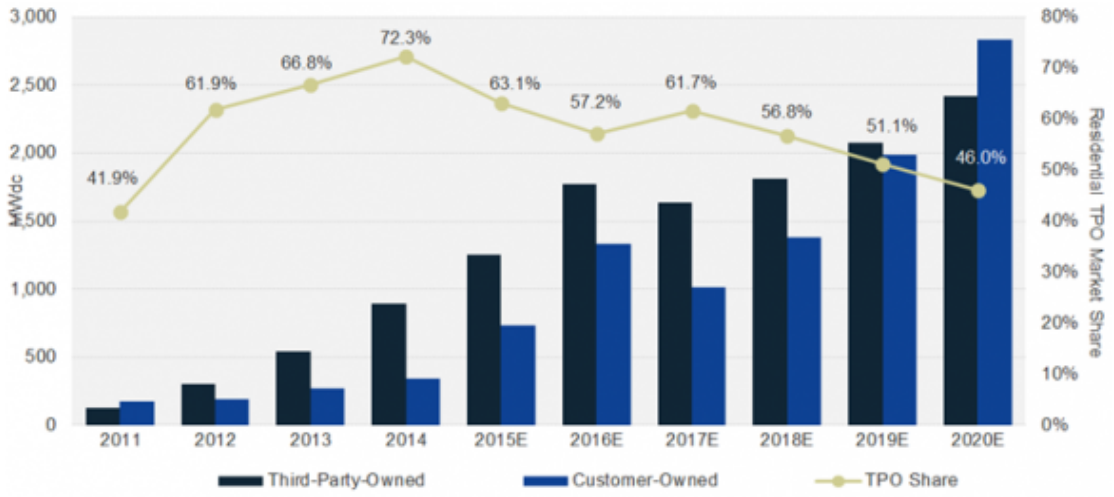
With third-party ownership, as the name suggests, the homeowner does not own the system, and contracts with another party that agrees to install a solar system on the homeowner's roof. The homeowner compensates the third party based on either a periodic fixed fee (lease) or a price for the energy consumed (power purchase agreement [PPA]) by the homeowner.

Third-party ownership can be very effective in overcoming some of the key barriers to adoption of solar PV, as noted earlier. Particularly, the problems of high upfront costs of solar PV or unwillingness/inability to access loans are some of the barriers that can be overcome with third-party ownership models like PPAs and leases. However, the soft costs component of solar PV (as discussed above) is passed along in the monthly lease or PPA charges to the homeowner.

Power purchase agreements are an innovative financial tool, based on which a solar company will install rooftop solar PV at no upfront cost to the homeowner. The homeowner will only pay for the energy consumed by the solar PV system, which is measured with a special meter. Solar leases work in a similar way, in that the system is installed at no upfront costs to the homeowner. However, in this case, the homeowner is required to pay a fixed monthly fee to the solar company, irrespective of the consumption. The unique selling proposition with third-party ownership (PPA or lease) is not only the lack of a need for upfront costs, but also that the homeowner will see a marginal reduction in the electricity costs of the home after allowing for periodic payments to the provider. PPAs and leases are also easier to avail of (relative to loans) as a way to access solar energy.

In the recent years, third-party ownership has driven the growth of the residential solar PV market across the U.S. As noted in Figure 5 below, the third-party ownership for residential solar PV has been the primary mode of ownership and has been rising in the last few years. Although solar experts predict them to lose share to direct-ownership, they will continue to maintain a significant share of the market in the future (Munsell 2015).

Figure 5: Residential Solar PV Third-Party Ownership Penetration and Installations by Ownership Type across U.S. (Munsell 2015)



The argument for direct ownership

Third-party ownership (TPO) provides significant benefits to the homeowner. First, with TPO, homeowners need not have access to upfront capital to purchase the solar PV system. Second, TPO providers undertake a lot of the work that needs to be done with moving to solar, including permitting, interconnection, management of SRECs and net metering. Lastly, any maintenance or service related issues that arise during the operation of the solar PV system are to the account of the TPO provider.

Direct ownership, however, is financially more beneficial to the homeowner. When the system is paid for upfront in full, the net present value of the electricity bills that the homeowner would save (by going solar), over the life of the system is typically greater than the cost of the installation. Even when the system is not paid for upfront, the monthly installments (for a loan) are lower than electricity bills.

At the same time, most installers and other service providers are offering services like permitting coordination with the local jurisdiction, liaising with utility for

interconnection and management of SRECs and net metering. Moreover, while solar PV systems are built to last and maintenance needs are known to be negligible during its operation, local installers and electricians are offering maintenance and upkeep of solar PV systems.

In a study commissioned by the Massachusetts Department of Energy Resources (Cadmus Group et al. 2013), a group of consultants presented some market findings that compared the economic impacts of different ownership and financing alternatives. The study's scope included the economic impacts of direct versus third-party ownership to the homeowner and the local economy. This discussion is restricted to the sections of the report on homeowner impacts. The report showed the cash flows for directly owned (procured with a loan and sourced via a local installer) versus third-party owned Solar PV (offered as a lease project via a nationally based company). Shown here is the example cited in this report, while bearing in mind that some of the costs for Solar PV have changed since then. First, a look at the investment profiles of the two different scenarios of direct and third party ownership in the state of Massachusetts:

Table 2: Investment Profiles of Directly- and Third-Party Owned Residential Rooftop Solar PV (Cadmus Group et al. 2013)

Input	**Value**	**Value**
Installed Cost	$22,712	
Capacity (kW-DC)	5.0	
Scenario	**Direct Ownership**	**Third-party Ownership**
State Tax Credit	$1,000	-
Federal Tax Credit	$6,280	$6,280
Bank Loan	$6,173	$6,814
Equity	$9,259	$9,618
Total	**$22,712**	**$22,712**

The sources of financing in the direct and third party owned scenarios are not very different. Under direct ownership scenarios, it is assumed that the homeowner:

a. has sufficient tax liability to avail the federal and state investment credits
b. takes out a personal loan and a home equity loan to fund the project, as described above. The interest rate applied to this loan is at 4% for a term of 15 years.

Under the third party ownership scenario, the assumptions are that the third party:

a. procures loans to fund the project at 6% interest rate
b. loan term is for 5 years

The homeowner does get an additional $1,000 from the Commonwealth of Massachusetts on account of the State Investment Tax Credit. This amount is set at 15% of the project value or $1,000, whichever is lower. The main difference is that in the third party ownership scenario, the homeowner does not own the system, and the policy and incentive benefits that accrue are availed of by the system operator, typically the leasing company or PPA provider.

Which brings us to the incentives. With direct ownership, the example in the report accounted for the state and federal incentives available to the homeowner, such as Solar Renewable Energy Credits (SRECs), Renewable Energy Credits (RECs). With third party ownership, the illustration assumed that the operator avails bonus depreciation at

50% via the federal incentive of Modified Accelerated Cost-Recovery System (MACRS)[15].

Here are the incentives to the homeowner presented in tabular format:

Table 3: Direct Ownership Scenario - State & Federal Tax Incentives (Cadmus Group et al. 2013)

Level	Incentive	Value	Notes
MA	Personal Income Tax Credit (for direct ownership only)	$1,000	15% or $1,000 maximum
	Solar Renewable Energy Credits	$300	Yrs 1 through 10
	Renewable Energy Credits	$25	Yrs 11 through 25
Federal	Residential Renewable Energy Tax Credit/Investment Tax Credit	$6,280	30% of applicable project costs

On the other hand, solar comes with risks. Some of those risks from the lender's point of view have been enumerated through surveys conducted among lending officers at banks at credit unions. Here, we present the risks from the homeowner's perspective under both directly owned and third party owned scenarios (Cadmus Group et al. 2013):

Table 4: Comparison of Risk Exposure to Homeowners Under Ownership Scenarios. Source: (Cadmus Group et al. 2013)

Risk Category/ Risk	Example	Direct	Third-party
Solar PV Performance[16]			
Equipment Failure	Inverter Failure	Yes	
Lower than Expected Generation	PV generates only 50% of the expected energy in a year	Yes	
Change in Law[17]			
Net Metering (NM)	NM services substantially altered	Yes	Yes

[15] For more information, see http://programs.dsireusa.org/system/program/detail/676

[16] In case of direct ownership, exposure to this class of risks is only pertinent and/or significant after the service agreement has expired, typically 5 years after installation.

[17] Under third party ownership, agreements may allow for contracts to be renegotiated if there are any unforeseen changes in the law.

Risk Category/ Risk	Example	Direct	Third-party
SRECs	SREC program substantially altered	Yes	
Energy & SREC Market			
Grid Supplied electricity	Energy prices drop, making PV relatively more expensive	Yes	Yes
SRECs	SREC oversupply lowers prices	Yes	

It is important to highlight that the risks pertaining to the changes in the law or the regulatory environment are quite real. Take Nevada for example, where net metering customers have received a double-blow and regulations have brought the solar industry in the state to a standstill. According to the new net metering rules, customers of Nevada Power that have solar PV will immediately be required to pay a higher fixed charge that will ratchet up to nearly $40 by 2020. Furthermore customers with solar PV will also receive a lower value credit for energy pumped into the grid with solar PV, which will ratchet down to 2.6 cents per kWh by 2020[18] (Whaley 2015).

When the two distinct ownership scenarios are considered and all of the incentives that the homeowner derives are accounted for, there are two ways of comparing these scenarios. One is with Net Benefits over the lifetime of the project or the Net Present Value[19] (NPV). If it is assumed that all of the assumptions made in the study stand true, then the Net Benefits and the NPV for the homeowner is significantly

[18] The Alliance for Solar Choice and the Nevada Consumer Protection Bureau have asked the Public Utilities commission to stay the new rate until they can submit petitions for reconsideration. A hearing on their motions is set for Jan. 7 2016, with a decision expected by the full commission Jan. 13 2016.

[19] Net Present Value (NPV) is an investment concept that computes the present value of future cash flows from an investment and the amount of investment, given a required rate of return. NPV is useful when comparing different investment options, as it applies a required (percentage) rate of return and tells you in present terms what the value one will net with each investment.

higher for the homeowner under the direct ownership scenario as compared to the third party owned one.

Table 5: Comparing Lifetime Benefits and Net Present Values of Solar PV under Direct and TPO scenarios (Cadmus Group et al. 2013)

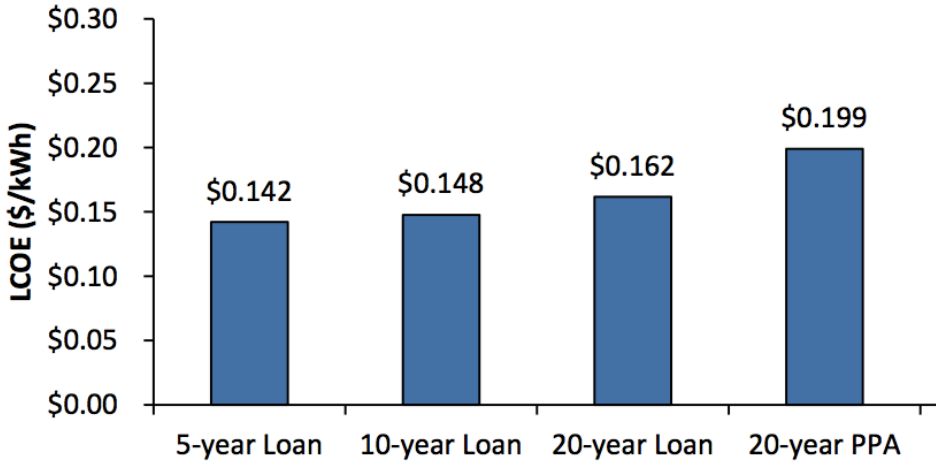
Scenario / Beneficiary	Lifetime Total	Net Present Value
Direct Ownership		
Homeowner (A)	$18,194	$8,927
Third party Ownership		
Homeowner (B)	$1,248	$734
Third party owner (C) (lease/PPA provider)	$11,425	$4,894
Multiplier for homeowner: Direct to TPO (A/B)	*14.5x*	*12.2x*

From Table 5 above, it is clear that homeowner stands to gain the most with direct ownership from both lifetime benefits and net present value perspectives. Indeed, the homeowner gains 12 to 14 times more with direct ownership when comparing these scenarios with third-party ownership[20]. Furthermore, analysis by National Renewable Energy Laboratory (Feldman and Lowder 2014) demonstrated that on a levelized-cost-of-energy[21] basis, solar loans of different tenure are more viable than a PPA on a dollars per kWh basis. Figure 6 below, represented here from an NREL report, illustrates this.

[20] In this study, for this illustration (Table 5), it was assumed that the homeowner was under a PPA contract and was receiving energy at a 5% discount on the utility price over the lifetime of the solar PV system.

[21] "Levelized cost of electricity (LCOE) is a convenient summary measure of the overall competiveness of different generating technologies. It represents the per-kilowatt-hour cost (in real dollars) of building and operating a generating plant over an assumed financial life and duty cycle" (EIA 2015a)

Figure 6: LCOE of residential PV systems, financed under a PPA or loan (Feldman and Lowder 2014)



When it comes to financing solar PV, in spite of the benefits of solar loans, as compared to third-party structures (as noted above), solar loans are not available to the extent third party offerings like PPAs or leases (interviews with lenders and key stakeholders) are.

Research question

Solar PV is unlike most other improvements that a homeowner makes on their property. It is a renewable energy asset that generates savings, and potentially returns for the homeowner. If Solar PV, as shown above, pays for itself in the long term, then theoretically, lending for such an asset ought to be a relatively safe investment from the point of view of a bank or a credit union. It follows that such loans would be widely available. However, this is not the case; less than a dozen lenders offer solar-specific loan products in Massachusetts. One way to understand this more clearly would be to talk to lenders about Solar PV and how (or whether) its features might influence their policies on lending. So the guiding question for this thesis became:

What are the perceptions of banks and credit unions towards solar loans in Massachusetts?

Based on this question and the background, a research plan was developed to study the perceptions of banks and credit unions in MA.

Why is this research important?

The lending policies of banks and credit unions (lenders) play a significant role in determining the loan products they offer. Understanding the perceptions of the lenders towards solar PV may add to and inform the research, and institutional or public policy on solar lending.

This research is also in line with one of key activities of the Banking on Solar project developed and managed by the National Renewable Energy Laboratory, which is to further the lending industry's perception of investor risk (Feldman and Lowder 2014).

As discussed above, loans are important from the consumer point of view. Further, if more homeowners purchase and install solar panels (photovoltaic and thermal), their families and their communities may, in some way, contribute to reduced emissions of hazardous air pollutants and reduced public health impacts as solar energy displaces conventional fossil fuel sources. Another benefit, discussed above, includes increased property values.

However, there is currently a lack of loans available specifically for solar PV. There may be several reasons for this. Primary research, such as this, may fill the gap between how policymakers think about lenders perceptions of solar PV and the actual perception of lenders around solar PV. Eventually, it may influence how policymakers allocate resources and develop programs and policies for the highest impact.

Study design & methodology

At first, a literature review was conducted, which compiled information from academic journal articles, industry reports and papers. This compilation included an overview of the larger climate change problem and delves deeper into placing residential solar PV into that context or framework. This formed the background of the study.

Interviews

Next, the first phase of primary research was conducted. This involved the development of an interview instrument. The instrument (please check Appendix A) was used to conduct interviews and collect primary data. In all, four interviews were conducted. This included lending officers from two credit unions and one bank and an industry representative for credit unions.

The interview instrument was structured around three main areas:

- Loan policies of the lending institutions
- Experience with solar lending, if any
- Risks and opportunities for the institution with the solar loan market

Surveys

After the first few interviews, senior staffers at industry associations suggested circulating a survey. They even provided assistance and guidance in designing the survey instrument (see Appendix) and framing the questions with language that lenders would easily relate to. Furthermore, and most importantly, they wrote to dozens of lending heads at banks and credit unions, personally requesting them to fill out the survey. All

this help proved critical in getting the primary data for this research from a directly relevant sample set of respondents.

The survey was designed using Qualtrics, an online tool available free of cost to all students at Tufts University. Qualtrics was not only used to design the survey but also manage the outreach to recipients of the survey. After the first email sent out by the industry representatives, Qualtrics was used, quite effectively, in sending out and tracking follow-up emails to the respondents.

In total, about 350 unique survey requests were sent out. After multiple follow-up requests, the total number of responses received was 41, amounting to a response rate of 11.7%.

Limitations of this research and areas for future work

Any research project is limited in its ability to fully answer the questions it poses. This research is no different. Here below are some of the limitations of this research and analysis along with recommendations for future researchers looking to study the area of lending for residential solar PV in Massachusetts.

Limitations of survey method

When conducting surveys, it is possible that respondents are not encouraged to provide honest answers or represent themselves in manner that reflects them in poor light. The survey method may also lack validity. There is also the problem of researcher imposition in designing the survey; in that it is possible that some important answer options may have been left out while constructing the survey. Also, some of the

questions in the survey were not answered by all of the respondents. This non-response has the potential to create bias.

Lack of statistical analysis

The analysis of the results from the survey did not include statistical methods to derive the correlation across responses to different questions. The results, therefore, may be limited due to the lack of such analysis.

Sampling and Response biases

30 of the 41 respondents in this survey are participants in the MassSAVE Heat Loan program. This may create a sampling bias because there are not enough respondents in the survey that are not involved in any kind of program and so the responses provided may not be representative of the general population of lenders in the state of Massachusetts.

Another limitation of this study may be a response bias that may arise due to the nature of the data collection method: a survey. Further, this type of bias may be exacerbated by 30 of the 42 respondents being participants in the MassSAVE Heat Loan Program, although the survey was distributed to nearly every lender in Massachusetts.

Reliability and validity

Some of the reliability and validity issues pertaining to this research project have already been discussed above in the limitations of the survey method.

Re reliability, some of the concerns are around the number of respondents that are already involved in the MassSAVE Heat Loan program. It may be difficult to claim

that these results are representative of the broader population of lenders in Massachusetts. On the other hand, as mentioned above, high participation from Heat Loan lenders may represent that group's perceptions about Solar PV and solar lending. Also, the respondents are skewed towards credit unions (24 credit unions and 16 banks). This makes it hard to generalize the results across all lenders in Massachusetts.

Re validity, every effort has been made to develop a survey and study design that captured the perceptions of lenders on the question of solar loans for residential use. However, it is possible that questions that needed to be asked were omitted. For example, one question that may have been asked more directly is related to the intent to offer solar PV loans in the future. Or on the size of market concern, one question might be to provide an estimate on the size of the solar loan market and what the respondents believe to be a valuable enough size in dollar terms. Responses to such questions would have been useful in gauging perception.

Further research

A study such as this one provides clues, but also gives rise to new questions. Further, given the limitations mentioned above, there are some queries or methods that may be applied to either dig deeper into the research questions or improve upon the reliability and validity of the results.

Nuanced breakdown of the size of the market in Massachusetts

As stated above, a concern (one that was not anticipated prior to conducting the survey) among a significant number of lenders surveyed is the size of the market for

solar PV in Massachusetts. Some reports have discussed the technical potential for solar PV in the U.S. and in Massachusetts (Feldman and Lowder 2014; Lopez et al. 2012; Munsell 2015) but a nuanced understanding of the market potential is lacking and likely worth studying further. Beneficiaries of such a study include lending institutions in Massachusetts, who may be in a better position to assess the place of solar PV in their lending portfolios.

Understanding repayment patterns in solar PV loans

Although solar PV lending is a relatively new industry, it may be useful to gather repayment data on solar PV loans. Correlating this data to repayment and default patterns of other lending products such as car loans, home loans etc. may provide insights re pricing of lending products for solar PV.

Importance of incentives vs. savings

The results also indicated that lenders are more concerned with the policies and incentives for solar PV, than they are with the savings of homeowners due to the instillation of solar PV. Further research may attempt to study this in-depth and also aim to understand the implications of such findings for policy makers.

Results

The survey was divided into five main parts:

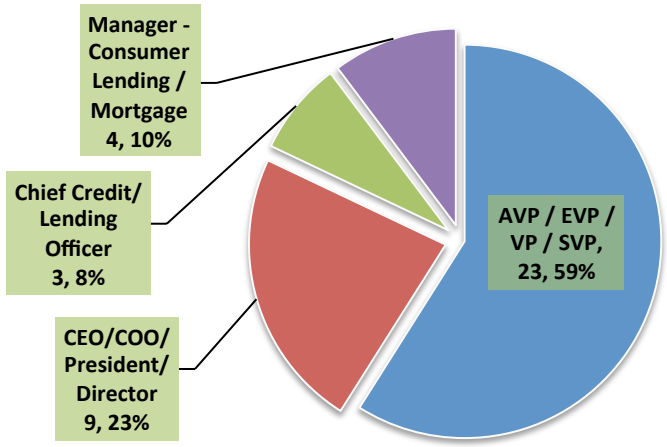
1. Target respondent
2. Current engagement with the MassSAVE Heat Loan program
3. Current engagement with solar loans
4. Perceptions of solar as an investment for the homeowner and opportunities within solar lending for the lender
5. Engagement with installers; outreach to customers for solar loans
6. Perceived concerns and risks around loans offered for solar PV

Target Respondent

This research aims to understand the perceptions of banks and credit unions around lending for solar PV. Interviewing the industry representative for credit unions revealed that senior lending officers at banks and credit unions would be the ideal key informant. The rationale provided for this was that senior lending officers are in positions to best represent the lending policies of their employer. Interviews with other lending officers confirmed this view.

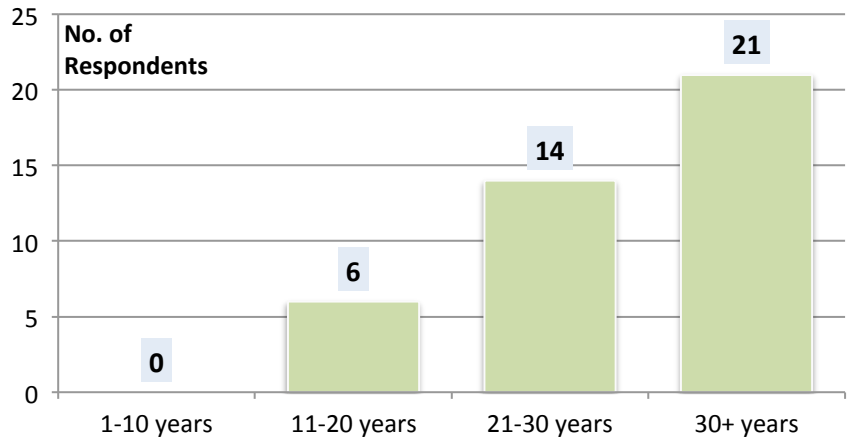
Figure 7 below shows the breakdown of the respondents group by their title at the organization they were at, at the time of the survey. More than half of the respondents have the term 'Vice President' in their title, with prefixes such 'Assistant', 'Executive' or 'Senior'. Several respondents were also in the more senior position of CEO, COO, Director or President, while a few were either Chief Lending / Credit Officers or at the Manager level.

Figure 7: Titles of respondents for Solar PV perception survey (n=39)



The respondents were also highly experienced individuals with most having experience well beyond 10 years. Figure 8 below also shows the experience of these informants with lending, in number of years. All the respondents have over 10 years of experience with lending while more than half of them have over 30 years experience.

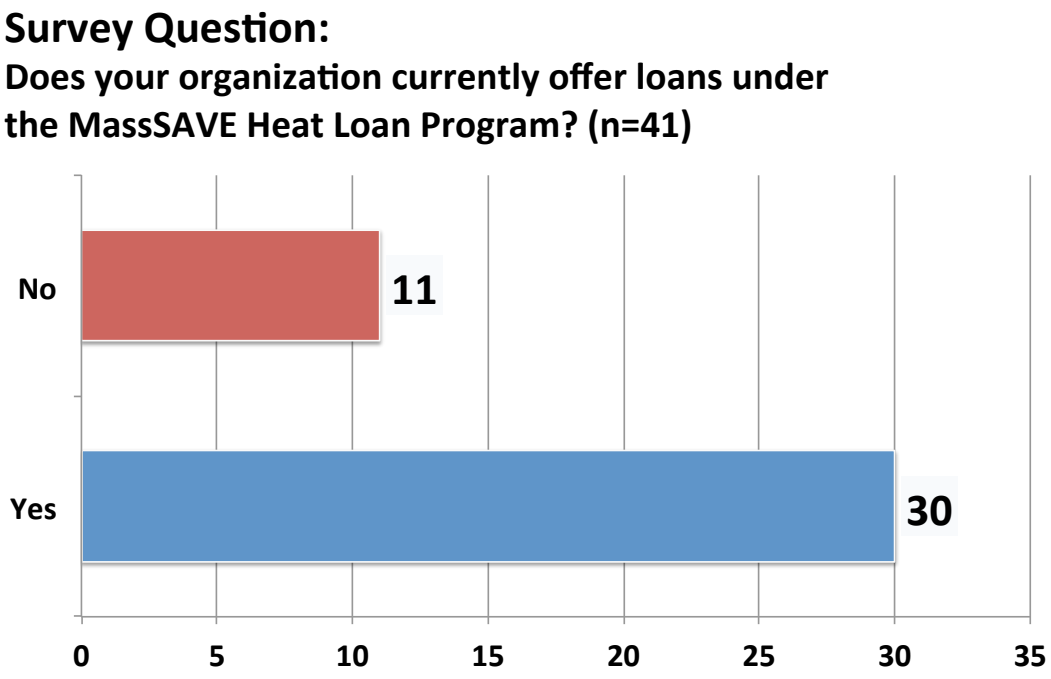
Figure 8: Number of respondents, grouped by years of experience in Lending Industry, in years (n=41)



Most of the respondents that took the survey were with organizations that were already participating in the MassSAVE Heat Loan program. As noted in Figure 9 below, 30 of the 41 respondents were with organizations that were offering loans which were

eligible for an interest rate buy down under the MassSAVE Heat Loan Program. The results section below explains the program and its relevance to this study.

Figure 9: Lender Participation in MassSAVE Heat Loan Program (n=41)



The MassSAVE Heat Loan program has 64 participating lenders (MassSAVE 2015). It is interesting to note that 30 of the 64 lenders participating in MassSAVE's Heat Loan program responded to the survey. This constitutes 47% of the participating lenders list. With this level of responses from the Heat Loan lenders, the findings, it can be argued, are representative of the larger set of heat loan lenders. This is not the case for the other lenders, because from the 286 (350 total number of lenders, less 64) lenders not participating in the MassSAVE Heat Loan program, only 11 lenders, or about 4% responded to this survey.

This is an unintended outcome of the survey exercise and one question that arises with this sampling is: Why did so many heat loan program lenders respond to this survey? There may be several reasons for this. One reason may be 'familiarity'. Like the heat loan, a solar loan may be considered as another type of an energy loan. This may have piqued the interest of the heat loan lenders. Another reason may be that heat loan lenders may be considering participation in the Mass Solar Loan program and this survey, although not connected in any way to the work of the Department of Energy Resources, would be of interest.

MassSAVE Heat Loan

Mass Save® is an initiative supported and managed by Massachusetts' gas and electric utilities and energy efficiency service providers[22]. Customers of electric utilities, pay an additional 2.5 mills (1/4 of 1 cent) per kWh of energy as a 'System Benefit Charge' on their bill. This charge is accumulated into a fund co-managed by the utilities and is used to fund a range of energy efficiency programs in the state. One of Mass SAVE's energy efficiency programs is the Heat Loan and Expanded Heat Loan financing program[23]. Via the Heat (and Expanded Heat) Loan Program, utility customers (residential and businesses) can avail of heat-related energy efficiency improvements. The way it works is that banks and credit unions become participants in the program and the electric utility customers can avail of 0% loans from these lenders for heating

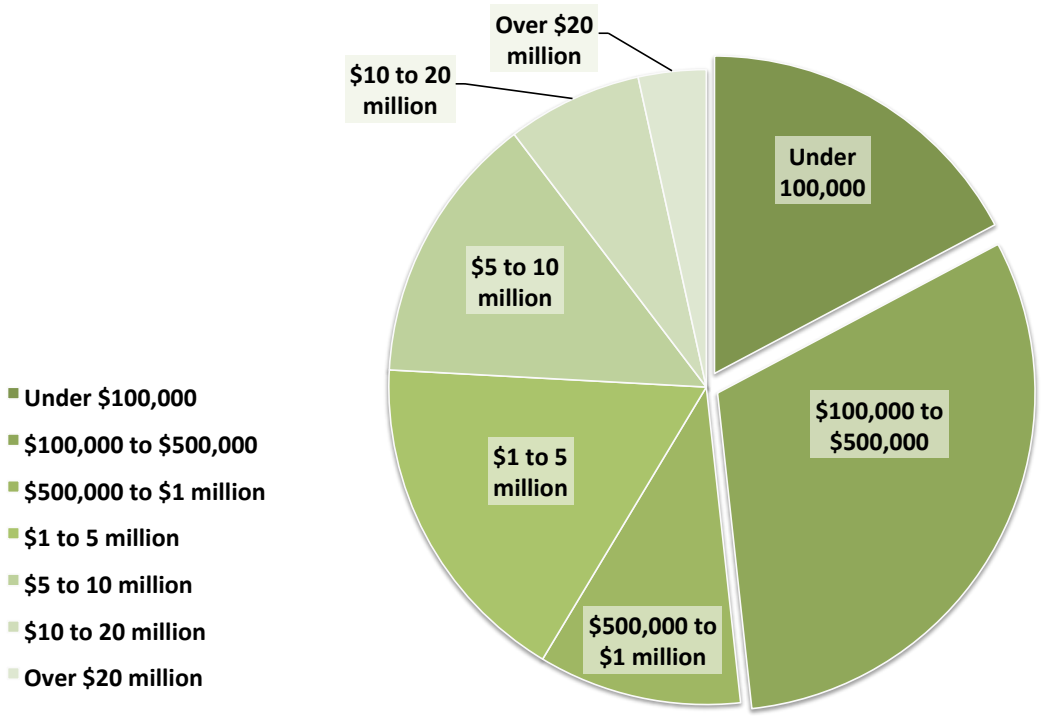
[22] Including Berkshire Gas, Cape Light Compact, Columbia Gas of Massachusetts, National Grid, New England Gas Company, NSTAR, Unitil, and Western Massachusetts Electric Company

[23] For more, please visit http://www.masssave.com/residential/offers/heat-loan-program

and insulation-related home improvements. The lenders are compensated for the interest via MassSAVE (fund entirely via the 'Systems Benefit Charge').

The Heat Loan program has relevance to this research because participating lenders in this program are familiar with lending for energy-related home improvements. Further, 75% of the lenders (n=21) had been offering loans under the program since 2013. Eight of them had started as early as 2011. The dollars volumes of the loans were also not insignificant; over 82% of the respondents (n=29) had a portfolio of over $100,000 or more, while 7 lenders had a portfolio of $5 million or more.

Figure 10: MassSAVE Heat Loan lenders portfolio sizes (n=29)

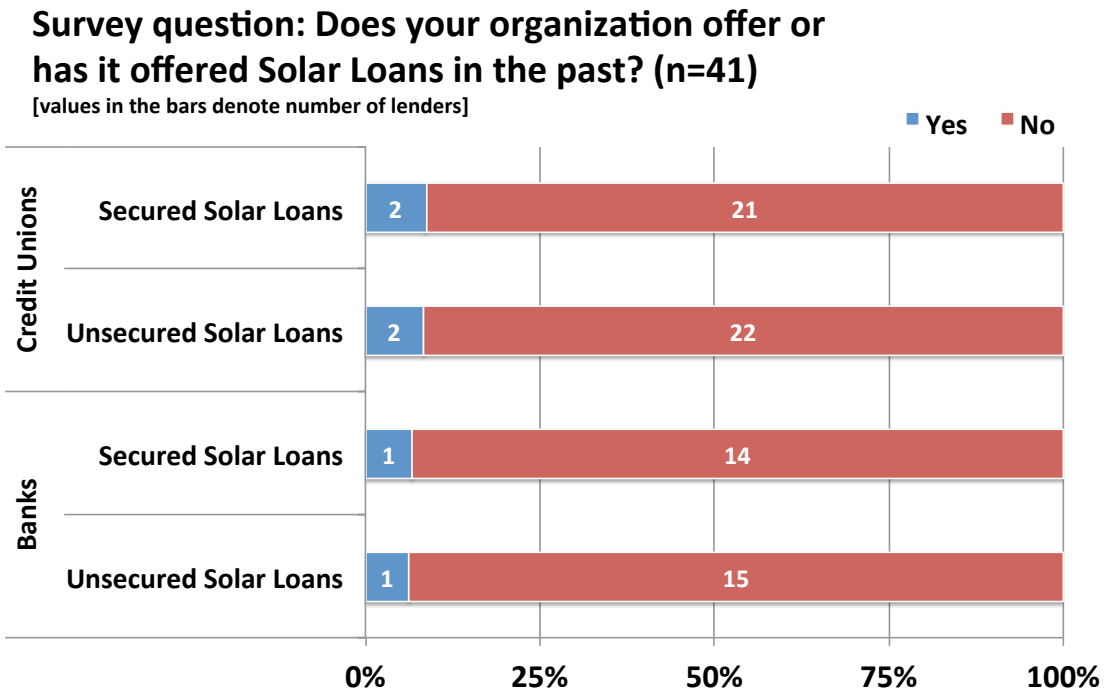


Current engagement with solar loans

Of the 41 participants in the survey, only 3 (7.3%) were offering solar PV loans. For this survey, the types of solar loans were divided into secured and unsecured. An

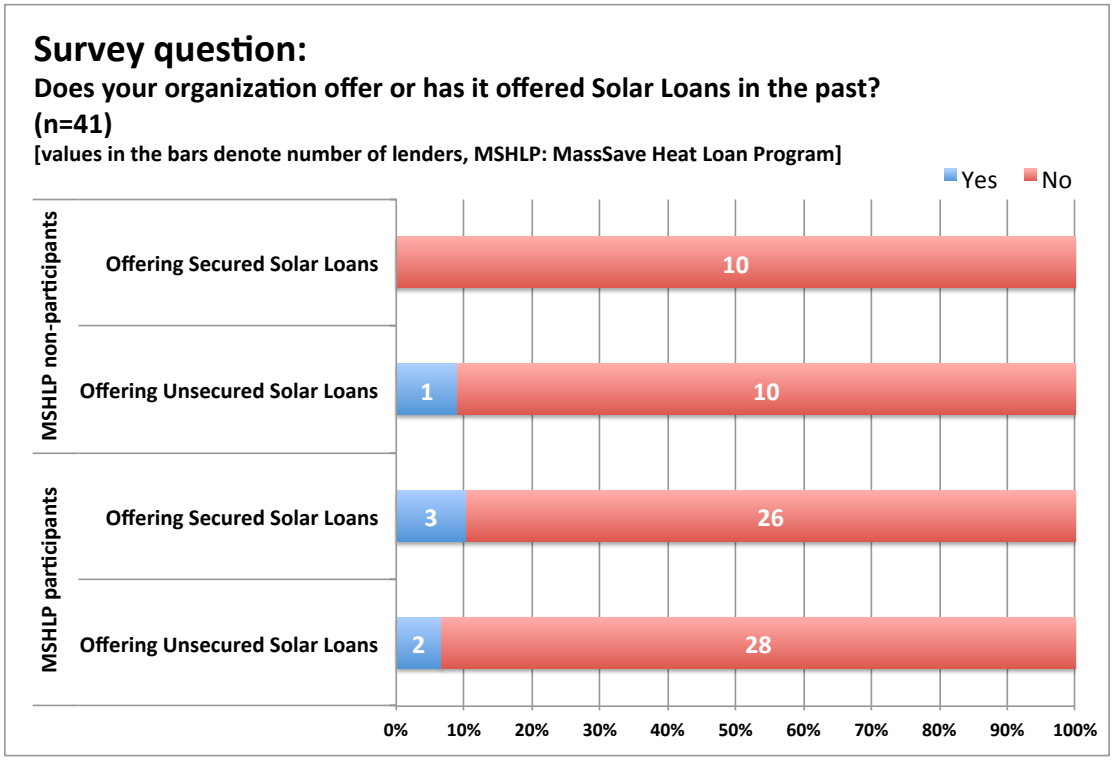
analysis of the respondents also revealed that there was no difference between credit unions and banks offering solar loans, however, the sample size is too small to make this finding representative of the universe of lenders. Figure 11 below provides a breakdown of secured and unsecured solar loans being offered among banks and credit unions in MA.

Figure 11: Breakdown of secured and unsecured solar loans among banks and credit unions in MA



The data was also cross-referenced for solar loan participation among heat loan program participants. Although, most of the lenders offering solar loans are also heat loan program participants, it was found that even within this lender group, there is a low level of participation. Figure 12 below illustrates this data, showing that even among heat loan program participants, less than 15% are offering solar loans.

Figure 12: Solar loans being offered among participants in the MassSAVE Heat Loan program

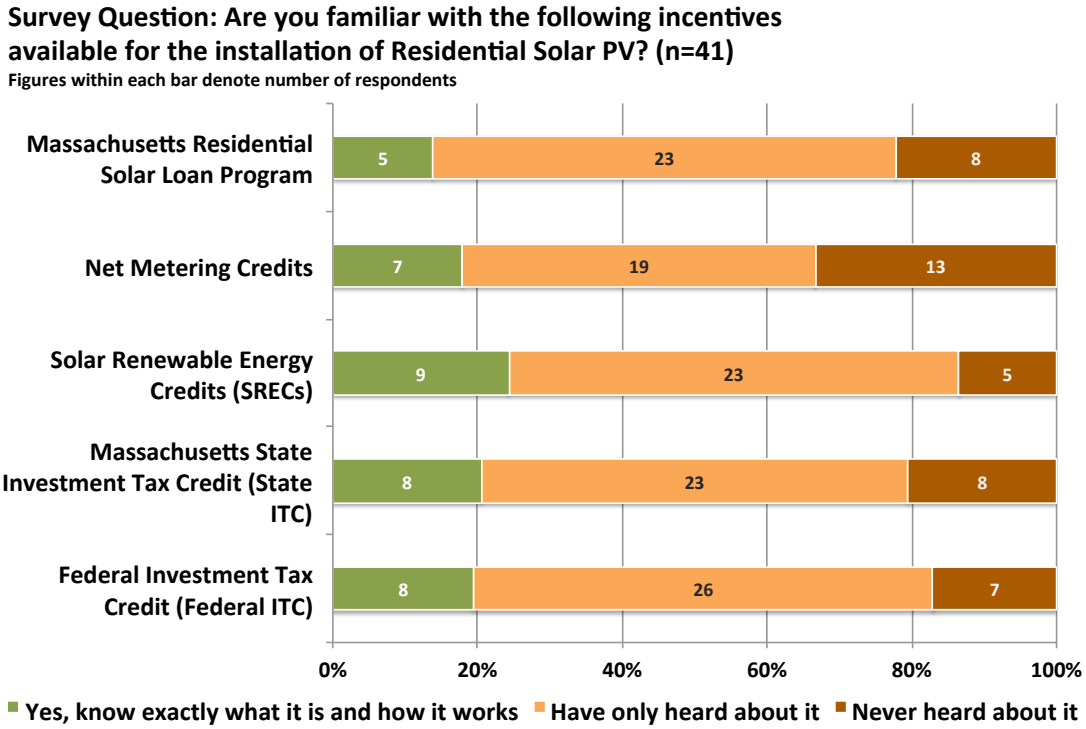


Perceptions of solar incentives and savings

The third section of the survey included questions around lenders' familiarity with the various incentives (to homeowners) for solar and the respondents' views on the extent to which solar the financial benefits of solar PV (to the homeowner) and the incentives available would impact the assessment of loans offered by the respondent's organization. The responses to these questions might help us understand whether lenders think of solar as a financially viable investment.

Familiarity with Incentives

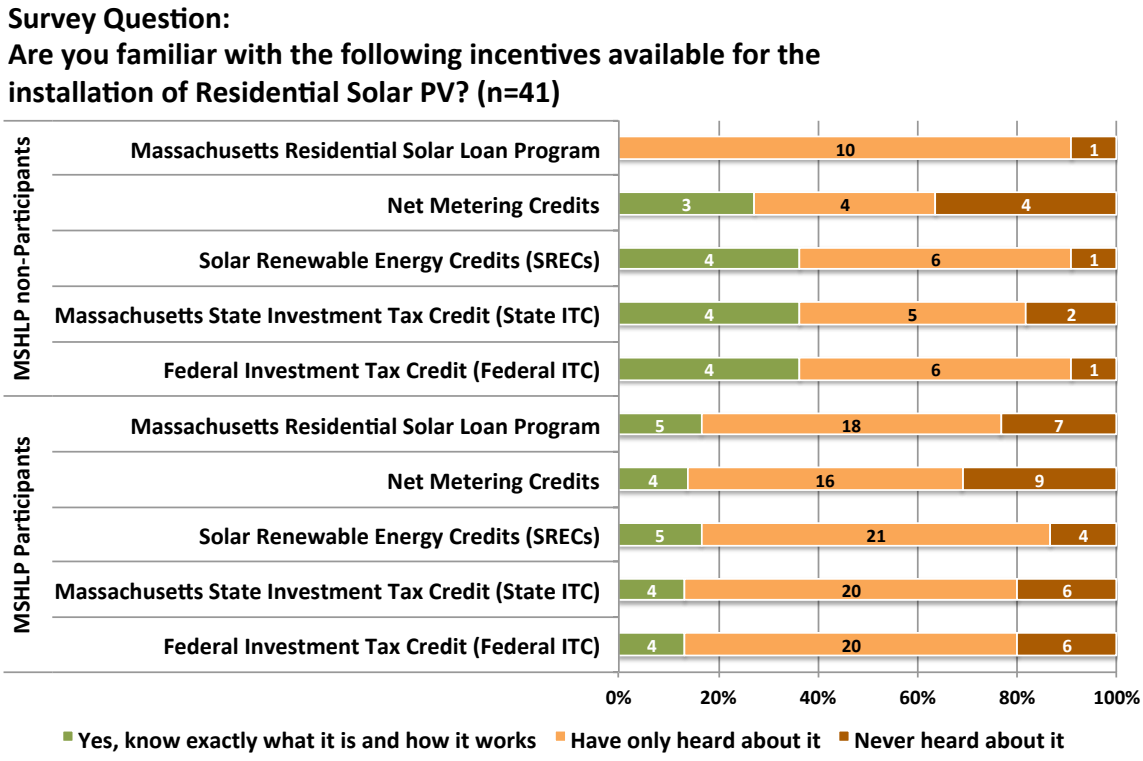
Figure 13: Lenders' familiarity with the various incentives (to homeowners) for solar PV



As stated in the previous section on support for solar PV in Massachusetts, there are a number of state- and federal-level incentives available for residential solar PV. As noted in Figure 13, the survey results revealed that only around 20% of lenders know what the incentives for solar PV are and how they work. The rest have either only heard of them, or have never heard of them. Of note are the federal and Massachusetts state tax credit which provide some reductions on the homeowner's income taxes for investing in solar PV. The federal tax credit has been around since 2006, while the state tax credit, since 1979. However, 20% of the respondents have never heard of either of these incentives.

Familiarity with incentives varied in percentage terms across lenders participating and not participating in the MassSAVE Heat Loan program. Figure 14 below illustrates these differences.

Figure 14: Lenders' familiarity with the various incentives (to homeowners) for solar PV cross-referenced with MassSAVE Heat Loan program (MSHLP) participation

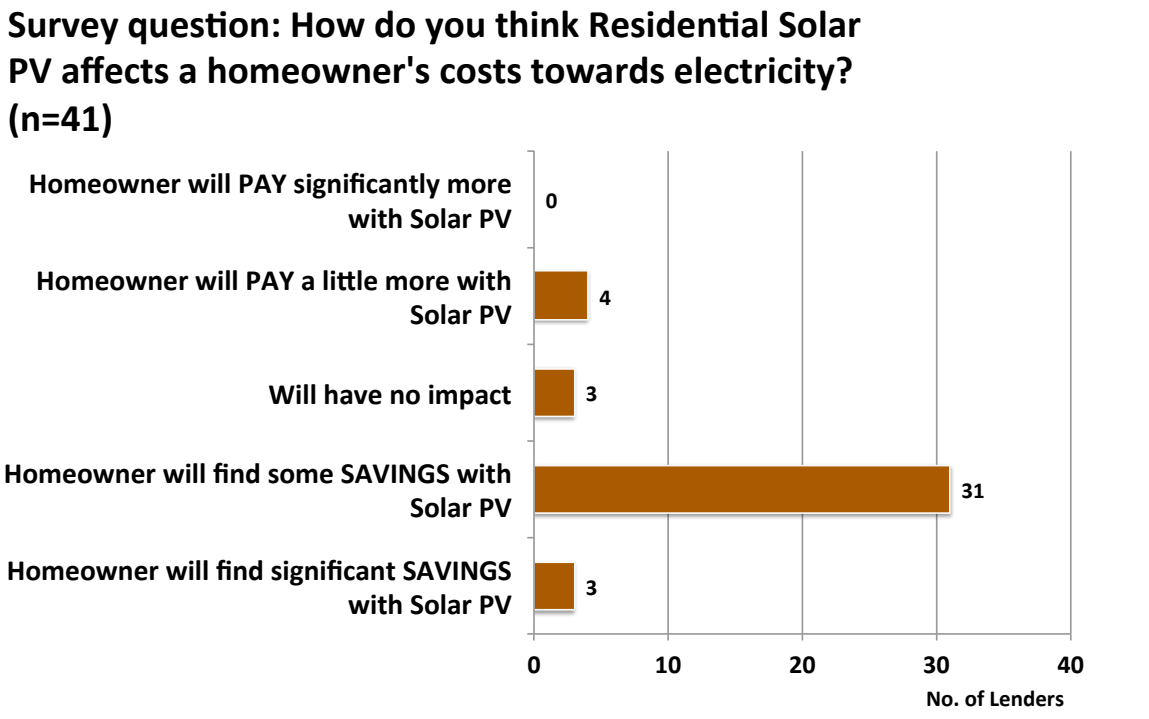


When looking only at the participants in the Heat Loan program, it is clear that they are far less familiar about the incentives available for solar PV, when compared to the overall group of respondents. Given that the sample when subdivided this way makes for 47% of the Heat Loan lenders, it is safe to say that this is representative of the overall set of Heat Loan lenders.

Perception of Savings and its impact

One of the questions in the initial interviews was about the impact of the savings that the homeowner generates (from solar PV) on the way in which lenders would assess a loan for solar PV. While designing the survey, however, the savings and impact on loan assessments were decoupled. One of the survey questions asked about lenders' perceptions about homeowner savings due to solar PV. This generated some interesting results. Most lenders (34 of 41) who took the survey have the view that solar PV will generate 'some' or 'significant' savings for homeowners. Figure 15 below provides a breakdown of these responses.

Figure 15: Lenders' perception of electricity savings for homeowners installing solar PV



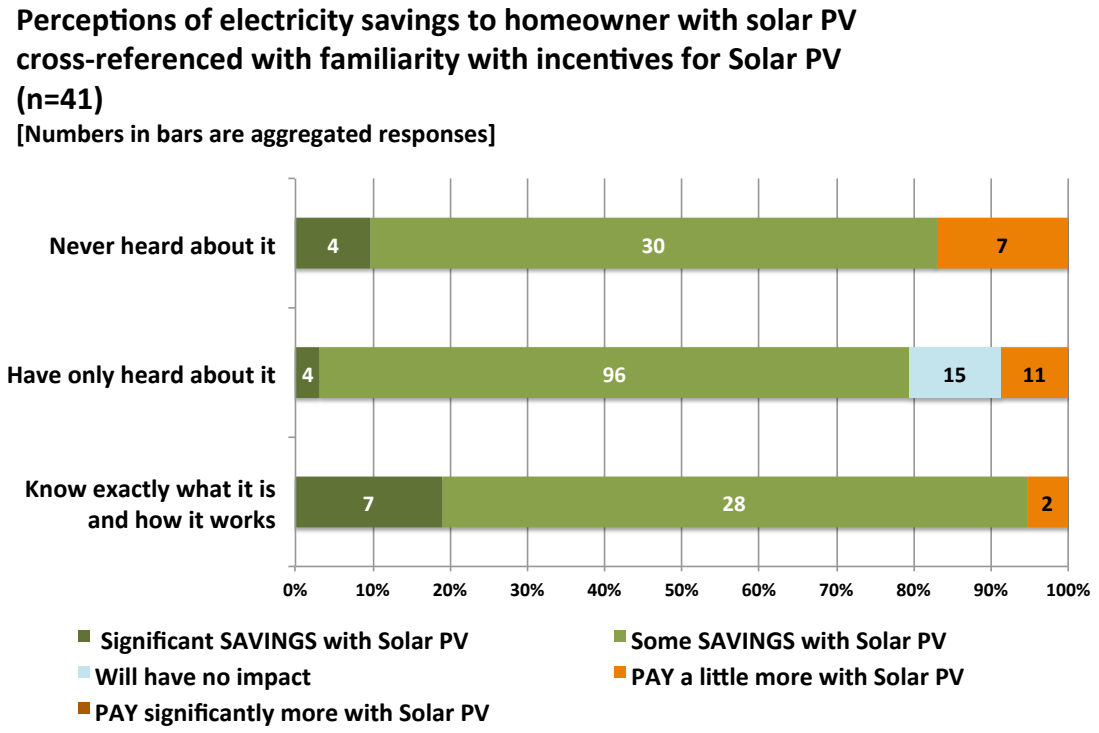
When the data on familiarity with incentives was aggregated and subsequently cross-referenced with the perceptions about savings with solar, the following dataset

(see Table 6) emerged. Viewing this data as a percentage stacked bar chart (see Figure 16) illustrates a relationship between perception of savings and the familiarity with incentives. Among lenders that are more familiar with the incentives for solar, a higher incidence (in percentage terms) of the perception that there will be 'some level of savings to the homeowner', was noted. Alternately, among lenders that have never heard about an incentive, they are more than *three times* as likely to perceive that homeowners will 'pay a little more [for electricity] with solar PV' when compared to lenders who are very familiar with an incentive. This is a significant finding that illustrates the relationship between knowledge of the industry and perception of benefits while speaking to the need for information dissemination by policymakers.

Table 6: Cross-referencing familiarity with incentives and perceptions of lenders towards savings with Solar PV [aggregated values across all incentives surveyed]

		Familiarity with all incentives		
Survey question: In general, how do you think Residential Solar PV affects a home-owner's costs towards electricity?		**Yes, know exactly what it is and how it works**	**Have only heard about it**	**Never heard about it**
	Significant SAVINGS with Solar PV	7	4	4
	Some SAVINGS with Solar PV	28	96	30
	Will have no impact	0	15	0
	Will PAY a little more with Solar PV	2 (5.4%)	11	7 (17.1%)
	Will PAY significantly more with Solar PV	0	0	0
	Total	**37**	**126**	**41**

Figure 16: Perception of savings and familiarity with incentives



At the same time, most survey takers reported that savings from solar PV does not affect their assessment of a loan to the homeowner. This was in line with some of the interviewees who stated that their primary concern is with the return of principal and interest; savings generated by the homeowner typically do not play a role in assessing loans for solar PV. This view (savings do not affect assessment), however, was not unilateral. There were a few lenders (~20% of respondents) that selected 'somewhat favorable assessment' as the response to the same question. Note Figure 17 below for a breakdown. It was also noted that for two of three lenders offering solar loans, savings with solar PV 'does not affect assessment' of such loans. Although further research is needed to clarify this, this may be because the solar lenders are clearly more familiar with lending for solar and are concerned with various other factors (note Table 7).

Figure 17: Impact of savings on assessment of a solar PV loan

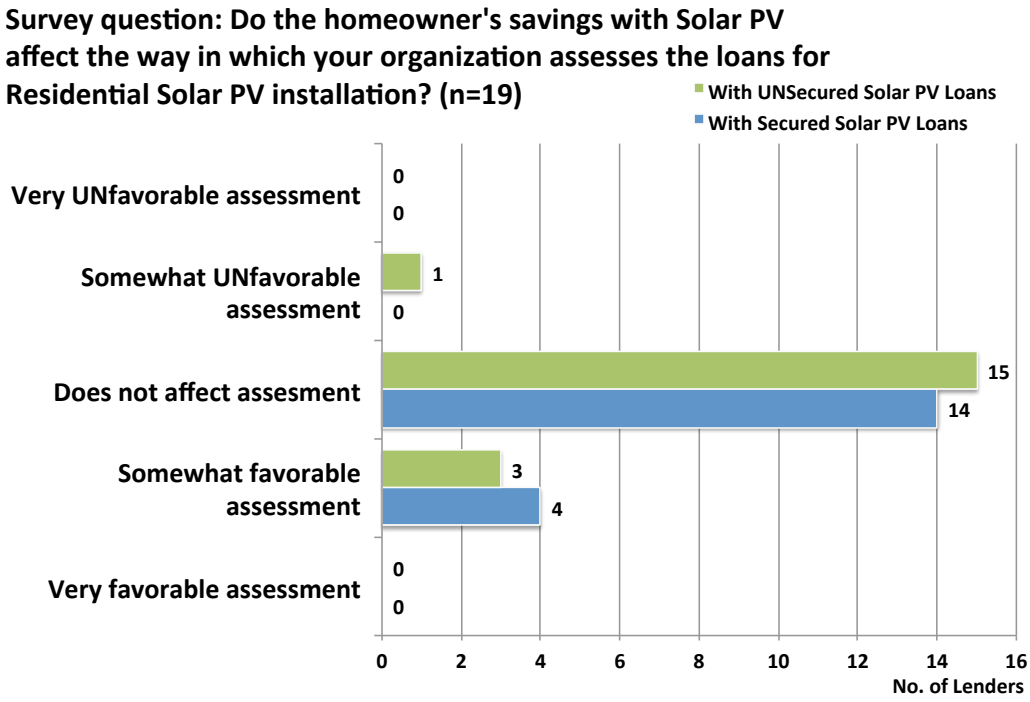
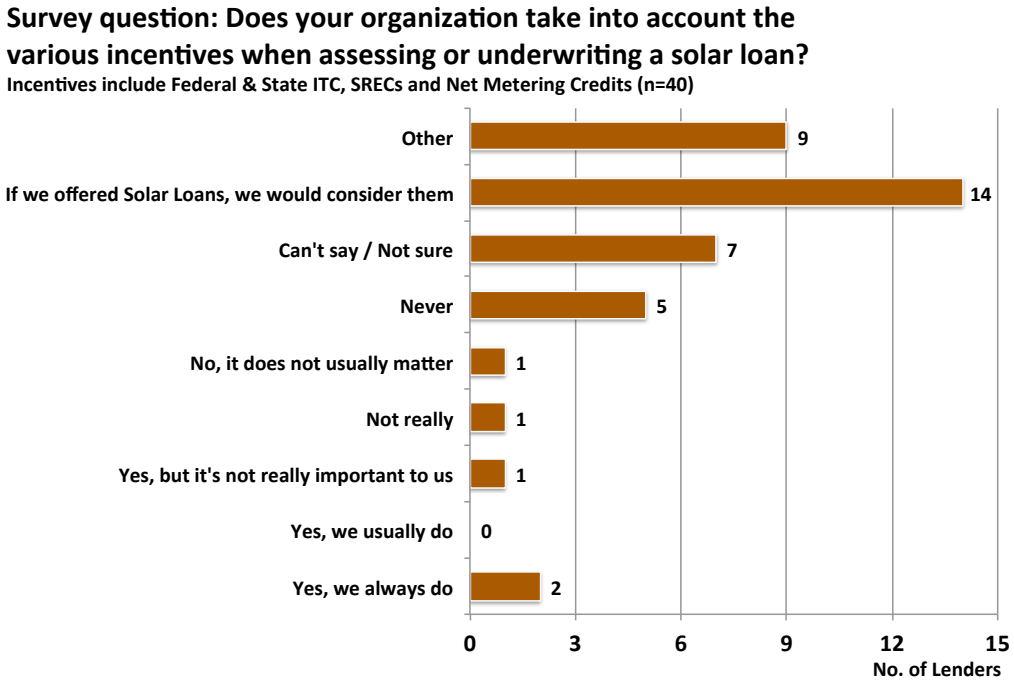


Figure 18: Impact of incentives on assessment of solar loans



With regards to the impact of incentives on assessment of the loan, a number of survey takers (14 of 40) shared that if they did offer solar loans, the incentives would play a role in the assessment (see Figure 17).

Among the three lenders that offer unsecured solar loans, three different options were selected, one by each of them:

- Yes, but it's not really important to us
- Not really
- Yes, we always do

These selections by solar loan providers seem to indicate that incentives are not really an important factor in assessing loans for solar PV. However, due to the size of the sample, it is not generalizable to the wider population. Furthermore, there are not many solar loan providers to draw any reasonable inferences about the lenders that are currently engaged in or plan to engage in solar lending.

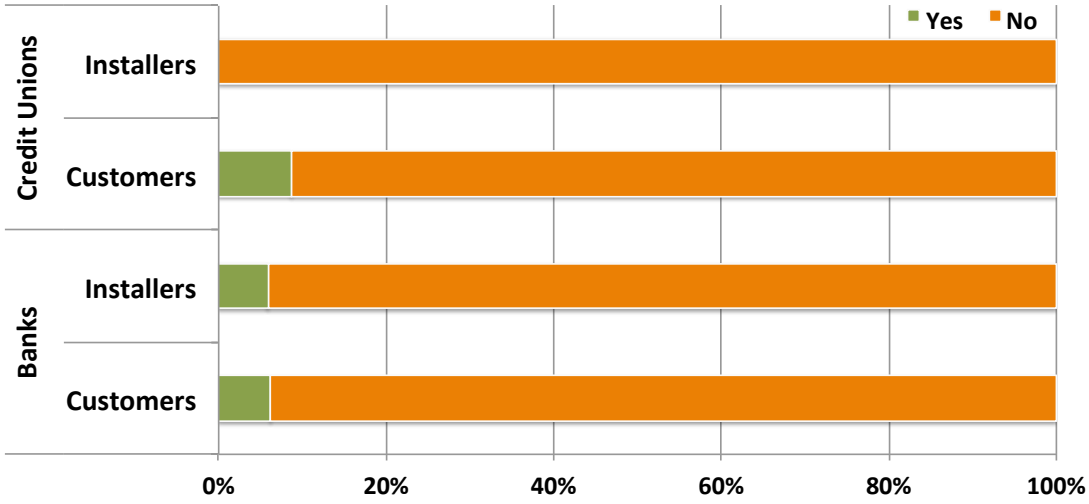
Outreach

Most of the lenders surveyed are currently not engaging in outreach on solar. Only 3 lenders (2 credit unions and 1 bank) have engaged with customers to increase the adoption of solar PV or build partnerships with local installers for solar loan products. Figure 19 provides a breakdown of these results. This is not unexpected given that only a small fraction of lenders actually offer solar loan products.

Figure 19: Lender engagement with customers and installers

Survey questions:

Does your organization currently engage with INSTALLERS to improve the adoption of Residential Solar PV among its customers/members?
Does your organization currently engage with CUSTOMERS to offer them loans for Residential Solar PV installations? (n=40)



Perceived concerns and risks

One of the key findings of this survey was around the perceived concerns and risks that lenders have with solar loans, specifically with unsecured loans. The related question in the survey was: "When you think about a Solar Loan as a distinct unsecured loan product, what specific concerns would you have?" The question was designed in a

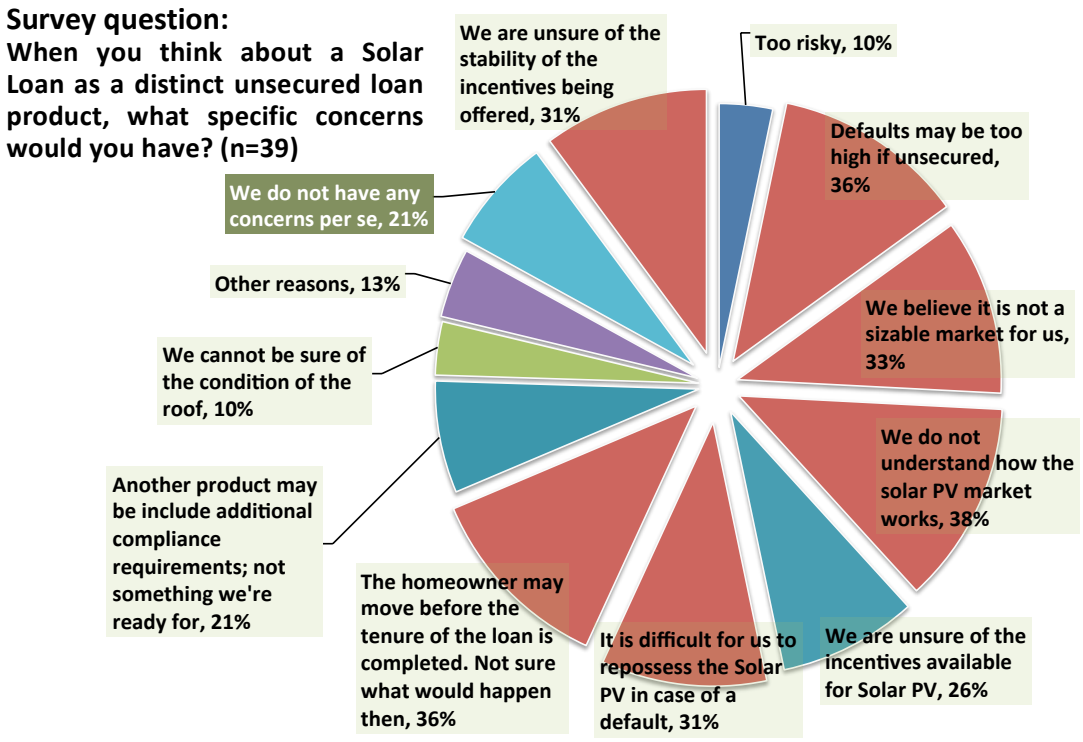
way such that respondents could select (more than one response) from a range of options. The table below shows the distribution of choices for each response.

Table 7: Breakdown of responses from lenders re perceived risks and concerns

Response	Number of respondents selecting this option	Percentage of respondents (n=39) selecting this option
We do not understand how the solar PV market works	15	38%
Defaults may be too high if unsecured	14	36%
The homeowner may move before the tenure of the loan is completed. Not sure what would happen then	14	36%
We believe it is not a sizable market for us	13	33%
We are unsure of the stability of the incentives being offered	12	31%
It is difficult for us to repossess the Solar PV in case of a default	12	31%
We are unsure of the incentives available for Solar PV	10	26%
Another product may include additional compliance requirements; not something we're ready for	8	21%
We cannot be sure of the condition of the roof	4	10%
Too risky	4	10%
We do not have any concerns per se	8	21%
Other reasons	5	13%

The table is graphically represented in Figure 20 below.

Figure 20: Perceived concerns and risks with an unsecured solar product



Note that the percentage values in the Figure 20 above is a fraction denoted by the number of respondents selecting that option from the total number of respondents (n=39). From the table and graph above, we find that almost 80% of the respondents had some concern or another with solar loans. In the Figure 20, the responses selected by 12 (~30%) or more respondents have been marked in red. These vary from concerns around financial risk, to market risk and the stability of the incentives being offered. 38% of the respondents were unsure of how the solar PV market works. 36% chose the homeowner's moving from the home as a cause for concern and the same number of respondents selected high default rates as a concern. This is noteworthy, in that it is the perception of lenders that borrowers may have high default rates on unsecured loans

for solar PV. There are no known data or research that is tracking solar loans as a category. It is possible, although further research will be required to confirm it, that lenders may have assumed that unsecured solar loans will have the same default rates as unsecured loans, in general. This is covered in the future research section below.

Only 21% (8 of 39) of the respondents chose the option "We do not have any concerns per se." However, on parsing the data for this survey question, it was observed that 2 of these 8 respondents also selected the option "It is difficult for us to repossess the Solar PV in case of a default." Therefore, only six respondents (~15%) were of the view that they do not have any concerns with unsecured solar loans. Further analysis also revealed that 18 lenders selected three or more concerns (from the options available) around unsecured solar loans. Some lenders selected as many as 8 concerns. As stated above, the lack of knowledge about how the solar PV market works was the most common concern among lenders.

When viewing responses to this question among MassSAVE Heat Loan Program (MSHLP) participants, it was noted these lenders have marginally more concerns (in aggregate[24]) with Solar PV as compared to those that do not offer the Heat Loan. Finally, when viewing responses to this question among solar lenders and non-lenders, it was

[24] The aggregate for each group (MSHLP and non-MSHLP participants) is calculated by summing up the number of respondents for each concern and dividing that value by the total number of concerns possible (number of respondents X numbers of concerns). $\frac{\sum Number\ of\ respondents\ for\ each\ concern}{number\ of\ respondents \times number\ of\ total\ concerns}$

found that lenders (albeit a small group of three in this sample) had fewer concerns (in aggregate[25]) with solar PV when compared to non-lenders.

[25] The aggregate for each group (solar lender and non-lenders) is calculated by summing up the number of respondents for each concern and dividing that value by the total number of concerns possible (number of respondents X numbers of concerns). $\frac{\sum Number\ of\ respondents\ for\ each\ concern}{number\ of\ respondents \times number\ of\ total\ concerns}$

Discussion

Loans for Solar PV are not a popular product among banks and credit unions in Massachusetts that responded to the survey. This survey attempted to understand the perceptions of banks and credit unions towards solar loans so as to inform the lending industry and policy makers on issues that may be addressed in order to make solar loans more easily available. Some of the key takeaways from this survey are discussed in short below.

Differences in incentives and savings in assessing loans

When comparing the impact of savings and incentives on lenders' assessments of solar loans, the results of the survey seem to indicate that incentives may have a greater impact on assessments of solar loans. This is evidenced by the findings that even though lenders perceive that there is some level of savings with solar loans, these savings do not (for the most part) affect their assessment of such loans. Further, the survey also indicates that if lenders were to offer solar loans, incentives would be a consideration in assessing such loans.

Knowledge about incentives lacking

Less than 10% of the respondents knew about solar PV incentives and how they worked. Among the MassSAVE Heat Loan providers in particular, knowledge about solar PV incentives is even more lacking (see Figure 14). It is likely that this lack of knowledge may be a factor in the lack of certainty around policies and incentives for solar PV.

Savings are of little significance

As noted in Figure 15 and Figure 17, even though lenders are of the view that solar PV can provide some savings to homeowners, the savings per se matter only to a small fraction of lenders when it comes to assessing loans for solar. This is based on the responses for the question on impact of savings on the assessment of loans (see Figure 15) where 15 of the 19 respondents stated that savings from Solar PV 'does not affect assessment' of solar loans. This was also a recurring theme in the few interviews that were conducted wherein lenders shared their primary concern with the return of loan capital.

Box 1: Quote from lender who chose to remain anonymous

" To say they will save $200 a month on their electrical bill does not mean they will pay your $200 solar loan. People's finances don't work that way. They may decide to buy a more expensive car or improve their standard of living with the extra $200. "

– Senior VP at a Credit Union

Lenders have several concerns

Most lenders in Massachusetts are not actively offering solar loans for many reasons. Most reasons are around a lack of knowledge and risks associated in offering solar loans. Lenders are either not familiar with the market, and its policies; or believe they may be taking on too much risk with unsecured solar PV loans.

Further, there is a prevailing concern that lending for solar PV is not a sizable market for lenders. Here is a quick analysis of the size of the market based on its technical potential. An NREL study (Lopez et al. 2012) showed the technical potential for rooftop solar PV in Massachusetts to be 10 GW. It is assumed that only 35% of this

potential (3.5 GW or 3500 MW) is for residential rooftop solar PV and the rest is for commercial rooftop solar PV.

A 3,500 MW installed base at an average 5 kW per installation translates to about 700,000 installations. Further, let us assume that half of these installations will be based on third-party (lease or PPA) ownership. This results in 350,000 remaining potential installations to be made for solar PV. If this were to be simply divided equally among all of the different banks and credit unions operating in the state (about 350 of them), every lender has a potential 1000 residential rooftop solar PV to offer loans for. At an average price of $4.50 per watt, this is a potential $22.5 million portfolio for each lender.

This is of course, an oversimplified, at best rough, analysis, with several assumptions that need testing. Also, $22.5 million may be significant for many lenders, but may not be of interest to some. In any case, it is worthwhile in understanding the basis on which lenders gauge the residential solar PV market.

MassSAVE Heat Loan program participants

The data provides some interesting insights when the responses to questions are divided between those who offer and do not offer MassSAVE Heat Loans. First off, the data seems to indicate that heat loan lenders are more likely to engage in offering solar loans (see Figure 12). However, the level of familiarity about incentives for solar PV among heat lenders is lower when compared to non-participants. At the same time, Heat Loan Program participants surveyed were also seen to have more concerns around solar PV. The top concerns in this sub-group of respondents were the lack of an

understanding of how the (solar) market worked; defaults rates for such loans; size of the market and the homeowner moving away from their home before the end of the loan tenure. These findings present an opportunity for policymakers to engage with group of lenders that are already familiar with energy loans (discussed in greater detail in the section on recommendations).

Solar Loan providers

Three of the respondents to the survey offer some variant of a solar loan product. The sample size is small and cannot be generalized to the larger population, but cross-referencing responses from this group, to select questions may provide further insights. First off, two of the three lenders providing solar loans do not consider the savings from solar PV to the homeowner when assessing such loans. This calls for further research to understand the key considerations for lenders when assessing solar loans in particular. It may be that savings are, indeed, not of value to lenders'. If this found to be accurate, this has implications for policy makers and advocacy groups that craft their message to the financial community around the savings from solar PV. As one Senior VP at a Credit Union pointed out "*People's finances don't work that way. They may decide to buy a more expensive car or improve their standard of living with the extra $200 (saved).*"

Compared to solar non-lenders, this small group also has fewer concerns when thinking about unsecured loans for solar. They are concerned about risk of default, however, and how might repossession of the installation take place in case of a default.

Solar loans not a priority

While a review of how many lenders in Massachusetts offer solar-specific loan products is beyond the scope of this paper, an Internet search revealed fewer than a dozen lenders mentioning solar loans on their websites. This is in line with a resource guide developed by the U.S. Department of Energy stating that only 5% of the 6500 lenders in the U.S offer solar-specific loan products (Laurent 2015).

In summary, from the survey results and limited interviews, it can be inferred that the overall perception of banks and credit unions toward solar PV and solar lending is not entirely positive. There is a lack of knowledge about the market along with perceived risks that may keep them from participating. Lenders in Massachusetts also believe that lending for solar PV may not be a sizable business for them. Based on this research, here below are some recommendations to consider for lenders and policy makers.

Recommendations

For lenders and industry associations

Massachusetts has been a major market for solar PV. Solar PV installations are present in 350 of the 351 cities or towns (personal communication with Director at MassDOER) in the state. At the same time, less than 5% of banks or credit unions are actively offering solar PV loans. Much of the growth in solar PV installations has been fueled by third party ownership. Solar PV can present an interesting opportunity for lenders in the state. Some lenders are already seeing value in direct ownership through loans. For example Digital Credit Union and Sungage Financial, both Massachusetts-based organizations have come together to offer US$ 100 million in loans for solar PV (Doom 2014). Recommendations for lenders and their industry associations considering solar PV as an asset class include:

Outreach to local installers

The data from this survey indicates that community engagement on solar is low among lenders. To that end, whether a lender operates at the community, state, regional or national level, reaching out to local installers and developing relationships can be valuable in understanding the potential of solar PV. Branch managers of both credit unions and banks may consider connecting with some of the installers operating in their service area. This may be a company-wide fact-finding exercise, wherein information may be reported into headquarters, so as to get an aggregated assessment of the value of solar loans as a product line.

Connect with City Hall and the MassDOER's solar database

The survey indicates that knowledge about solar PV's potential is lacking, with many lender holding the perception that the market for solar PV is not sizable for them, as a business opportunity. Simple steps by the installer community and state's energy agency can alleviate this problem.

Every solar PV installation has to go through the permitting process with the city or town in which the installation is being done. The building inspection department databases of cities and towns are valuable public sources of information. Aggregating information across a lender's different service areas (branches) is another way of assessing the market potential. This information can provide trends in solar PV activity in each city.

Further, the MassDOER has well-managed databases[26] of all solar installations that have been qualified for solar renewable energy credits (SRECs) and installed in every city and town in MA since 2010. These databases may provide useful insights for lenders on the solar PV trends that take place in the cities they operate in.

Interact with members and customers

Another way to understand the market potential is interacting with it. Indeed, customer or member feedback can be the most valuable sources of information for banks and credit unions in assessing market potential for solar PV. Simple email surveys indicating willingness or interest in procuring solar may be effective in gauging potential.

[26] Databases for the SREC I and II programs can be found at these links: http://www.mass.gov/eea/docs/doer/rps-aps/solar-carve-out-units.xlsx and http://www.mass.gov/eea/docs/doer/rps-aps/solar-carve-out-ii-qualified-units.xlsx

Lenders may even develop a standard (brief) set of questions for customers/members that have placed inquiries for home improvement loans or have just bought a new home, for instance. Heat Loan lenders, in particular may have a potentially captive audience and may engage customers who have participated in the Heat Loan program previously.

Turning Solar Lenders into Solar Champions

Lenders participating in the survey cited a range of concerns when thinking about unsecured solar PV loans. At the same time, the findings do indicate that the lenders already having a solar loan product tend to have fewer concerns than those who do not offer a solar loan product.

To that end, the state may consider enlisting the current solar lenders as champions for the entire lending industry. This word of mouth approach from one's peers may prove to be an effective approach in creating a platform for discussion around concerns for solar lending. Learning from other banks or credit unions that have been offering loans specifically for solar PV may be more fruitful. Industry associations such as the Mass Bankers Association and the Cooperative Credit Union Association, and also the MassDOER, have an opportunity to create forums for such interactions and knowledge sharing.

A missing piece in risk assessment has to do with defaults on solar loans. In Massachusetts, given the fact that solar loans are relatively new, data are not aged enough for reliable analysis. Industry associations can be particularly useful here in

reaching out to other states (like California) that have longer experience with solar PV in general and lending, in particular.

Pooling of risks

Lending Industry associations can be a platform for bringing its members together. A more general recommendation to help alleviate concerns around defaults with solar loans could be for members to create an insurance pool. Insurance pools are risk mitigation vehicles[27] that spread losses in case of a default, such that the bank experiencing the default does not have to suffer 100% of the losses (McClintock n.d.).

Transferring risk

Another general recommendation is for lenders to consider partnering with financial investors that may be familiar with the solar market more closely, but are not resourced enough to go directly to customers with third-party solutions. In doing so, the lender would transfer all of the risks of default (and much of the corresponding returns via interest charges) to investors. In the process, lenders will be able to offer a new (solar loan) product, augment their balance sheet and also have opportunities to offer different non-solar financial products to such customers.

[27] *"In insurance, the term "risk pooling" refers to the spreading of financial risks evenly among a large number of contributors to the program. Insurance is the transference of risks from individuals or corporations who cannot bear a possible unplanned financial catastrophe to the capital markets, which can bear them easily"* (McClintock n.d.)

Recommendations for policy makers

Invest in education

This research seems to indicate that there is a knowledge gap among lenders in Massachusetts about residential solar PV and lending for the same. Policy makers within state and regional agencies or public and non-profit, that are working on improving the adoption of residential solar PV may consider developing material or programs aimed at banks and credit unions. Initially, these initiatives may be focused specifically towards officers within these organizations that are ultimately responsible for the lending function and have authority to recommend new products to their management. Further, in light of the above findings, working with the extant heat loan lenders may represent an efficient starting point. Developing learning modules for the 64 heat loan lenders and supporting their efforts in developing loan products may be easier prove to be than working with lenders that are not familiar with similar financial products.

In the recommendations to industry, it was pointed out that the industry might use readily available information to learn more about the market potential. In addition, the state could also use this information to create useful maps of the installation trends in cities and towns alongside other useful info graphics for decision-making (for example solar capacity density [kW / person installed or kW / square mile installed]). Once the attention of the lenders has been captured with the market potential, more detailed technical resources may be deployed to assist the lenders in developing solar loan products.

Incent solar PV lending

Besides raising awareness, the state may consider directly incenting lenders to offer loans for solar PV. This is another way to encourage the loan market and generate a track record of transactions that the industry, in general, can use to assess the risks and modalities with lending for solar PV.

One such example is the Massachusetts Solar Loan Program, a program launched in December 2015. The program has a $30 million budget that offers an interest-rate buy down and a loan loss reserve to banks and credit unions that offer solar PV loans for residential and community solar projects. The program also offers an income-based loan support for borrowers. These different incentives within the program seek to address different aspects of the concerns lenders tend to have with solar PV loans. The interest rate buy down make solar loans more lucrative as a business while the loan loss reserve aims to mitigate some of the concerns around default risk.

Community Shared Solar

Over a third of the respondents in this survey were not sure of the outcome of a loan when the homeowner moved away from the home before the tenure of the loan were completed. A simple way to alleviate this problem is community shared solar (CSS). CSS is a solar PV project that is not installed on the rooftop of a home but on a site that usually accommodates a much larger project. As compared to a typical 5 kW system for a home, a CSS project may be up to 100 kW or more. The homeowner participates in a CSS project along with various other parties (homeowners or local businesses) and with the help of virtual net metering (MA DPU 2015), is able to offset their energy costs. The

financial cost of participating in such a project can be met with a solar loan and state support to lenders for a CSS project can encourage lending activity. It is important to point out that CSS projects are eligible (with some conditions) within Mass Solar Loan program. It is recommended that the state provide additional support to CSS projects to encourage loan activity and address lenders' concerns around loan outcomes.

Funding research around specific questions

The lending community's major concerns with solar PV appear to be around the size (viability) of the solar PV loan market, default risks and availability & stability of the incentives for solar PV. Viability of the market and the default risks associated with solar PV are areas of research that may be funded by the state. While it is difficult to state what the outcome of such research will be, it will provide information that might inform decision making within the lending divisions at banks and credit unions. Lenders might be better placed to make decisions around new loan product development, market potential, pricing etc.

Implications for the MassSOLAR Loan Program

The MassDOER and MassCEC announced the launch of the Mass Solar Loan program on 17th December 2015. The details of the incentives offered by the program have been discussed in other sections of this document. In light of the findings from the survey discussed in this paper and its analysis, this section offers a critique of the program and an argument for deploying some of the funds from this program towards the recommendations laid out here.

Incenting is easy, but not easy

Managing a program across agencies within government calls for time and resources and while one does not undermine these efforts, it is important to point out that incentivizing lenders with financial rewards is a relatively easier endeavor than say, developing a statewide educational program. Furthermore, there is the attribution problem, in that with incentives, a direct attribution can be made between incentives provided and loans disbursed. With educational programs, this attribution is challenging, even with the most refined evaluation techniques.

A focused education program

This survey, especially among the heat loan lenders sub-group provides some insight into the perceptions of a group of lenders already familiar with energy-based loans. Working with these lenders can be critical to the Mass Solar Loan program's success. Deploying educational resources aimed at this group, even if on a limited, small number of lenders to begin with, can give the program administrators an opportunity to learn about their willingness to engage with solar loans.

The survey findings and analysis have shown that the level of knowledge among the heat loan lenders is lacking. These lenders are not entirely familiar with incentive programs for solar. Further, within this group, there is a small section (20%) of lenders that hold the perception that with solar PV, homeowners will either have either no impact on electricity savings or will pay a little more.

One opportunity for education is for the program administrators. This researcher learned while working with MassDOER on the Solar Loan program that the common

view is that lenders ought to take into consideration that homeowners save money with solar PV. This leads to the belief that lenders ought to make solar loans more freely available. However, these survey findings indicate that lenders (in this survey) not only pay little heed to savings, but also have other concerns around solar PV, the market and the policies. Understanding, addressing and alleviating these concerns through a focused education and engagement program with banks and credit unions may be of higher value and more efficient use of public funds.

In summary, the underlying question of the Mass Solar Loan program (as it has been developed now), according to this researcher, is this: "How can the state most efficiently deploy US$ 30 million towards toward a program that would incent lenders to increase their willingness to offer solar loan products?" This question assumes that what lenders need is an incentive to participate. And this question is also quite different from asking: "What is keeping lenders from offering solar loans and what are the way in which we might change that with a $30 million budget?" By not assuming that lenders necessarily need incentives, this second question opens up the conversation for a different kind of participatory dialogue with lenders. Based on the findings of this paper, it is a dialogue that this researcher contends might be more effective.

Summary and conclusion

In the fight against the effects of climate change, transitioning to a clean energy economy has become a major imperative for almost every developed country globally. The United States is no exception to this. In fact, within the U.S., many states have developed a range of mitigation strategies. And the state of Massachusetts has become a leader in clean energy and energy efficiency deployment.

Going forward, solar PV plays a major role in the clean energy mix in Massachusetts, with several policies, incentives and programs to support its growth and adoption. Solar PV has grown at a rapid pace in the past few years. In 2014 alone, the state added 368 MW of solar capacity, bringing its total to 751 MW (SEIA 2015b). Within solar PV, residential solar PV is a distributed energy resource that has significant benefits. At significant volumes, distributed energy resources may place a downward push on new centralized power plants and corresponding transmission infrastructure. It also has positive social equity implications, circumvents siting issues and 'NIMBYism' and may even increase the value of the home on which it is installed.

Costs for solar have been dropping consistently over the years. And when the incentives are factored in, residential solar PV is a viable option for homeowners. However, to improve adoption, it is important not only to reduce the cost of solar PV relative to other sources of energy, but also make it easily accessible through finance. Solar PV does have a high upfront cost to homeowners.

While third-party solutions such as power-purchase agreements (PPAs) and leases are available and are effective, direct ownership is financially more beneficial to

the homeowner in terms of savings. Although an outright cash purchase is the first best choice, for many homeowners, the second best choice direct ownership method is a loan, making banks and credit unions a critical player in the clean energy economy.

Loans for residential solar PV, however, are not widely available. There may be several reasons for this lack of availability, and this research was based on the premise that lenders and their perceptions are an influential factor. How lenders perceive solar PV and solar lending is an area of study that does not appear to have been explored prior to this inquiry. At the same time, these perceptions presumably have direct implications on the availability of loans for solar PV.

Surveying 41 lenders from banks and credit unions in Massachusetts revealed some interesting results about lender perceptions with respect to solar PV and solar loans. When assessing solar loans as a product offering, lenders seem to think that the incentives for solar PV are more important than savings to homeowners from installing solar PV. Indeed, savings are of little significance to lenders, who are understandably more concerned with the credibility of the borrower and the return of their capital.

Most lenders are also not entirely familiar with the workings of the incentives available (at the state and federal levels) for solar PV. At the same time, there was a high level of agreement that if they did offer solar loans, incentives would play an important role in assessing solar loans as a product. What implication does this finding have on policymakers is a question open to future researchers.

A majority (~75%) of the respondents to the survey had at least one concern when thinking about unsecured solar PV loans. As many as 18 respondents had three or

more concerns when considering such loans. These concerns were generally categorized around risk (defaults), market size and market or policy uncertainty.

In summary, however, the results seem to indicate that, barring a couple of lenders, solar PV loans are not a priority for banks and credit unions in Massachusetts. There is, hence, some work to be done by both lenders (including industry associations) and policy makers to chart a clear path for the involvement of lenders in the solar PV market and the clean energy economy.

Recommendations for lenders, industry associations and policy makers may be grouped into four mains areas: engage, educate, de-risk and incent.

Engage

It is recommended that lenders and lending industry associations engage with all sections of the solar PV value chain. For example, lenders may engage locally (at the branch level) with installers and city hall to learn how solar is growing in their community and to what extent is there a need for lending products. Policy makers may engage closely with lenders at the headquarters level to learn about their issues with lending for solar PV, gathering feedback and ideas on how to alleviate their concerns.

Educate

Policy makers are encouraged to undertake a statewide solar PV education program, aimed specifically at familiarizing lenders (specifically senior lending officers and their colleagues at banks and credit unions) with solar PV. With the help of webinars, road shows, group discussions and other media, the many facets of the solar PV market may be shared with lenders. Lenders in MA may also reach out to their

counterparts in other states, such as California, to learn about their extensive experience with residential solar PV. Furthermore, policymakers and industry associations may fund research on lending and support programs such as the NREL's[28] Banking on Solar for state-specific initiatives.

De-risk

This study revealed that the risk of defaults is a major concern for lenders. To that end, lending industry associations and lenders too, may consider coming together to create mechanisms that may protect each other from defaults. An insurance pool may be one such solution to spread the risk. Insurance companies too are encouraged to look[29] at the market closely to ascertain what the appropriate level of risk and premiums might be for residential solar PV loans.

Incent

Providing incentives to banks and credit unions is yet another way to improve the availability of solar PV loans. With the Solar Loan program, the state has already developed such a mechanism. Another way to incent lending for solar PV may be to offer statewide recognition to lenders with the largest solar PV loan origination and portfolio.

[28] National Renewable Energy Laboratory

[29] Although, there may not be enough historical data for insurance companies to get involved in this market, at the moment.

Inadequate access to finance is one of the many problems that impede the growth of residential solar PV (Hernandez 2014; Kreamer 2013). By studying the perceptions of lenders toward solar PV loans in Massachusetts, this research has highlighted one aspect of this problem. The results and its discussion aim to fill a gap in the research, providing policymakers and other stakeholders a few high-level snapshots of the state of affairs in solar PV lending. The research also offers some areas of improvement by way of recommendations. Finally, it is hoped that future researchers will build upon this research by overcoming its limitations and developing a more nuanced view of the issues and options in this subject area.

Appendices

Appendix A: Interview instrument

Suveer Bahirwani

Data Collection Instrument & Protocol

Perceptions of banks and credit unions towards solar loans in Massachusetts

Tufts University
Dept. of Urban & Environmental Policy & Planning
February 2015

Table of Contents

Advance Email to Interviewees

Date:
Recipient's Address:

Dear <First Name Last Name>,
I am writing you with a request for an interview. As a student from the Department of Urban and Environmental Policy and Planning (Dept. of UEP) at Tufts University in Medford, MA, I am currently working on a graduate thesis project. **My thesis seeks to understand the Perceptions of the Solar Loan Market to Banks and Credit Unions in Massachusetts.**

This request for an interview is for the purposes of understanding the perceptions of banks and credit unions in Massachusetts towards solar loans. With such an understanding, I hope to gain insight on the process that banks and credit unions in Massachusetts currently use when approaching the solar loan market.

Needless to say, your bank is doing some level of business of loans that have been deployed either directly for Solar PV installations or for home improvements that included Solar PV.

Given your position at your organization, I believe you are highly qualified and suited as a prospective interviewee for this study. ***Please treat this letter as formal request for such an interview.*** The interview should only take thirty to forty-five minutes of your time. Your participation is completely voluntary and you may discontinue participation at any time during the interview process. Direct quotes or direct references to you (or your company) as a contact will only be made with your consent.

I will call you early next week to follow-up and schedule an in-person or phone interview, but please feel free to communicate with me via email or telephone before then. My contact information is listed below. Thank you for your time and consideration.

Suveer Bahirwani
Tufts University
+1.781.588.2350 | suveer.bahirwani@tufts.edu

Introductory Script for Interview

Thank you so much again for agreeing to participate in this interview process.

I might have to repeat some of the things I shared in my email as a matter of protocol so please bear with me.

I am conducting this interview as part of a graduate thesis project I am working on while at the Dept. of Urban & Environmental Policy & Planning at Tufts University. This study has not been commissioned by any agency or organization and should be considered as independent research.

I am here because I am studying the solar loan market for residential rooftop solar in Massachusetts and I am interested in learning how and to what extent your organization currently participates in this loan market, and how you perceive the future of the market.
Solar PV has been growing rapidly in the US and Massachusetts in particular. With support from government policies and incentives, the residential solar market has seen remarkable growth in nearly every city and town in Massachusetts. Currently, the predominant method of ownership for solar is third-party ownership, where companies like Solar City and SunRun offer power-purchase agreements (PPAs) and leases to residential customers. However, from an economic standpoint, direct ownership (either with money-down or a solar loan) is a more efficient approach to installing solar, for the homeowner. One of the long-term visions of the solar community is that solar loans be available more freely. And so, the underlying hypothesis for this study is that access to finance increases adoption. At this time, compared to other popular loan products, viz., car loans or home equity loans, solar loans are yet to become commonplace.

Broadly, the structure of this interview will be as follows:

- in the first section we discuss your own background briefly.
  Although your or your organization's name **will not be published** without consent, it helps establish you as an expert to the thesis review committee.
- then we talk about some of the policies of your institution.
- In the next section, we discuss the experience and of this organization in the Residential Solar PV market.
- Lastly, I have some questions about the potential risks and opportunities that you perceive in the residential solar loan market.

Participation in this interview is voluntary and confidential. You may refuse to answer or skip any question or even stop the interview at any time.

This interview should take approximately 45-60 minutes.
If you are you willing to participate, may I continue?
_____Check if verbal consent was given, then proceed with interview.
To ensure accuracy, this interview will be tape-recorded. Is that ok?
_____Check if verbal consent was given, then proceed with interview.

Time and date interview started: _____
_____Check if verbal consent wasn't given, then conclude conversation.
Thank you for your time.

4 Solar Stimulus

Understanding Perceptions of the Solar Loan Market to Banks and Credit Unions in Massachusetts - a Semi-Structured Interview

This interview consists of about 15-20 questions, divided into four sections: one about your work experience, a second section focusing on the loan policies of your institution for EE and RE loans, a third section about your experience with the Residential Solar Loan market, and finally we discuss risks and opportunities. Needless to say, there are no right or wrong answers to these questions. Further, at any point during the interview, you can ask me to clarify anything that may be unclear to you. And as already mentioned, you are free to skip any question or end this interview at any point.

If you wish to make a comment off the record or one for which you would expressly prefer not to be cited, please let me know, I will make a note of that.

Do you have any questions for me before we begin?

- If yes, take the time to answer said question(s) and then begin interview.
- If no, then begin interview.

Section 1: Interviewee's Experience

1. Would you please share what your current position is and a little about what your responsibilities are, in this position.

Section 2: Loan Policies of your Institution as regards EE and RE

2. Do you offer loans specific to renewable energy or energy efficiency, under the Mass SAVE Loan program?
    a. When did you start with the MassSAVE Program?
    b. How much have you disbursed so far?
3. Would you care to share what the current volume of that business is?
4. Has the business been growing or been the same? What's the trend looking like?
   Probe: What %age of loan portfolio?
5. Is there a loan product offered by <name of organization> specifically for the installation of Rooftop Solar PV? Just to clarify, this is different from the MassSAVE Heat Loan program.
6. To <org name>, how important are the borrower's FICO scores in assessing the risk associated with a SOLAR loan?
    a. Minimum threshold for FICO scores. Are there any absolute minimums?

Section 3: Experience within the Residential Solar Loan market

Let us take a few minutes to talk about your institution's experience within Solar Loan Market.
Would you speak to the experience of <name of organization> within the Residential Solar PV market? In that, have you offered loans that have been used for solar specifically?

7. In your estimate, how many such loans have you serviced to date?
   Prior or follow-up
8. How have you treated these loans? Any differently from home improvement or personal loans?

9. Do you think that solar loans carry a different value as compared to other asset-based loans?
   (Be familiar with current rates of different loan types. Check GMAC, Home, HELOC and Auto)
   a. If yes, why? If no, why not?
   b. What is rate at which you offer these loans as compared to your other standardized loan products
      If someone's going to borrow 20K for swimming pool as compared to solar PV. Is there are difference?
10. Are there other key criteria that you consider while making solar loans?
    What about the terms of the loan? Are they different from other loans?
11. How frequently do you evaluate your loan processes for solar loans?
    - Can you tell me a little more about that?
    - Are you satisfied with the way solar loans are performing at your bank/CU?
12. Can you give an estimate of the default rates on these loans?
    - How does that compare to other loans, esp. mortgage? Do you see correlations in their defaults?
13. Are you familiar with MA's residential solar loan program?
    a. If yes, to what extent, were you engaged in its development?
    Prompt: explain the Residential Solar Loan program
14. Ties in to question 9 above. Consider before asking.
    In effect, what I'm trying to understand here is what role do solar loans play in your over lending business strategy?
    Probe: This can be looked at in another way:
    a. When you compare solar loans and other loans for general home improvements, do you perceive that mix or ratio to change? If so, how? how do you see things changing?

Section 4: Risks and Opportunities

So, just to recap;

- you have shared your background briefly;
- we have discussed in brief your institution's lending policies with regards to Solar Loans
- then, we spoke about your experience within the Residential Solar Loan Market

This section of the interview is much more forward-looking, in that we discuss the risks and opportunities in the Residential Solar Loan Market. As I mentioned earlier, Residential Solar PV installations, in the US and MA in particular, have been growing consistently over the past few years. There are two broad ways of installing rooftop Solar PV, either through third party or direct ownership. Within direct ownership, customers can either pay cash upfront or come to lenders like <name of org> to take out a loan.

15. To what extent is your bank/CU engaging with solar installation companies who are trying to increase penetration of residential solar PV in your area?
16. Is your <name of org> familiar with all of the incentives that are available to homeowners for the installation of solar PV through direct ownership?
    Consider listing the incentives and asking them of awareness.
    a. Tax incentives include the federal ITC (30%) and the State ITC (15% capped at $1000)
    b. Incentives: SRECs

c. Utility: Net meterting

Do you believe your customers have used these incentives? And how that might affect the economics of a solar installation and therefore a solar loan?

Do these incentives affect the underwriting criteria for the loan?

Yes or No

Does your inst factor in or consider all of the fed and state credits prior to making its loan underwriting decisions?

Yes or No

17. How is <name of org>, if it is doing so, addressing the opportunities in the solar loan market?

Do you seeing this market as stagnant, shrinking or growing?

Yes or No

To what extent, in the next 3, 4, 5 years?

18. A rooftop solar PV, when sized appropriately, is an asset that generates significant savings for the homeowners. How do you think this affects or should affect the way your bank/CU evaluates the loan for such a project?

    Probe re DEFAULT RATES: We spoke above about default rates …

    Now, Solar loans or Home improvement loans used for solar have not been around all that long, but in your opinion, what are the default rates that might be associated with them across the board? How does this (opinion) compare to the actual default rates for mortgage / auto loans?

19. Currently, third-party ownership of rooftop solar PV dominates residential solar financing. Why do you think that is the case?

    Probe: talk about the trend of 3rd party ownership.

20. Do you foresee your bank or other lenders encouraging customers to finance solar PV on their property? Much like they do with HELOCs or car loans.
21. What are the specific concerns with a solar loan that keep or might keep you away from the market?

Closing the Interview

Thank you very much for spending time to answer these questions. Your replies will help us learn about the value of solar to the traditional lending community in MA, and I hope to use these interview to develop insights may be of use to the lending as well as the local solar industry.

Once again, Thank you <interviewee's name> for your time today. We appreciate your participation and valuable inputs.

Do you have any questions for me today?

<If yes, respond. If not…>

If you think of anything else that you would like to share with us, please feel free to contact us at Tufts University at 781-588-2350 or emailing me at suveer.bahirwani@tufts.edu. Also, once again, if I plan to publish any of your inputs here as a comment, I will request for your express consent. Alternately, you may offer your consent right now that some or all of your inputs may be published, citing your name and / or the name of your organziation. Would you like to offer this consent?

<If yes, make note> Thank you again.

<If not> I understand. We will not publish your name in this report unless we get your consent for specific quotes.

Time and date interview ended: _____

Interview conducted via:

_____ in person

_____ on the telephone

Appendix B: Survey instrument

Default Question Block

Informed Consent Form
Introduction

This study attempts to collect information about the perceptions of Banks and Credit Unions in Massachusetts towards Solar Loans.

Procedures

You will be asked a few questions about:
1. Yourself and your experience in the lending industry
2. Your institution's engagement with the MassSAVE Heat Loan Program
3. Your institution's current engagement with the Solar Lending Business
4. The Solar PV industry
5. Your institution's approach to Solar Loans and the Solar market

The questionnaire consists of about 20-25 questions and will take approximately 15-30 minutes.

Questions are designed to determine your and your organization's perceptions about the Solar PV and Solar Loan market.
This questionnaire will be conducted with an online Qualtrics-created survey.

Risks/Discomforts

Risks are minimal for involvement in this study. However, you may feel emotionally uneasy when asked to make judgments based on your experience. Although we do not expect any harm to come upon any participants due to electronic malfunction of the computer, it is possible though extremely rare and uncommon.

Benefits

There are no direct benefits for participants. However, it is hoped that through your participation, researchers will learn more about the lending business and be able to fill a research gap in the lending industry, thereby offering some insights to the industry as a whole.

Confidentiality

All data obtained from participants will be kept confidential. At the end of the survey, respondents will be asked if they are willing to provide consent to use their name, organization's name, or both. All questionnaires will be concealed, and no one other than then primary investigator (Suveer Bahirwani) and his advisor, reader listed below will have access to them. The data collected will be stored in the HIPPA-compliant, Qualtrics-secure database until it has been deleted by the primary investigator.

Compensation

There is no direct compensation for participation.

Participation

Participation in this research study is completely voluntary. You have the right to withdraw at anytime or refuse to participate entirely without offering any reason whatsoever. If you desire to withdraw, please close your internet browser and notify the principal investigator at this email: suveer.bahirwani@tufts.edu or phone number: 781.588.2350.

Questions about the Research

If you have questions regarding this study, you may contact
Principal Investigator: Suveer Bahirwani, at suveer.bahirwani@tufts.edu / 781.588.2350,
Thesis Advisor: Ann Rappaport at ann.rappaport@tufts.edu

I have read and understood, the above consent form and desire of my own free will to participate in this study.

- ○ Yes
- ○ No

Some Basic Formalities

Please provide your and your Organization's name

First Name	
Last Name	
Title	
Organization's Name	
Email Address	

Is your organization a Bank or a Credit Union?

- ○ Bank
- ○ Credit Union
- ○ Other

Your Own Experience in Lending

In years, how long have you been working at your organization?

How many years of CUMULATIVE experience do you have in lending?

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Your organization's current engagement with the MassSAVE Heat Loan Program

Does your organization currently offer loans under the MassSAVE Heat Loan Program?

- Yes
- No
- Don't Know / Can't Say

More on MassSAVE Heat Loan Program and your organization

When did your organization start offering MassSAVE Heat Loans?

What is the current annual loan origination under the MassSAVE Heat Loan Program at your organization?

- Under $100,000
- $100,000 to $250,000
- $250,000 to $500,000
- $500,000 to $1 million
- $1 to 2 million
- $2 to 5 million
- $5 to 10 million
- Over $10 million

What is the portfolio size under the MassSAVE Heat Loan Program at your organization?

- Under $100,000
- $100,000 to $500,000
- $500,000 to $1 million
- $1 to 5 million
- $5 to 10 million
- $10 to 20 million
- Over $20 million

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Your Solar Loan Activity

Does your organization currently offer OR has it ever offered a specific Solar Loan Product to homeowners for Residential Solar PV Installation?

Note: For this survey, we distinguish SOLAR LOANS as under:
Unsecured Solar Loans: where there is either no collateral or only the Solar PV installation is collateral.
Secured Solar Loans: Where collateral is another asset, for example the home (Home Equity Loan, Home Equity Line of Credit) or a car or any other asset.

	Yes	No	Don't Know / Can't Say
Unsecured Solar PV Loans	○	○	○
Secured Solar PV Loans	○	○	○

Your Solar Loan Activity (contd...)

When did you start offering these Solar Loans at your organization?

What is the current annual loan origination for Solar PV at your organization?
Select between Secured and Unsecured.

Secured Solar PV Loans

UNSecured Solar PV Loans

What is the portfolio size for Solar PV loans at your organization?
Select between Secured and Unsecured.

Secured Solar PV Loans

UNSecured Solar PV Loans

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Your views on Residential Solar PV as an Investment

Are you familiar with the following incentives available for the installation of Residential Solar PV?

Federal Investment Tax Credit (Federal ITC)

Massachusetts State Investment Tax Credit (State ITC)

Solar Renewable Energy Credits (SRECs)

Net Metering Credits

Massachusetts Residential Solar Loan Program

In general, how do you think Residential Solar PV affects a home-owner's costs towards electricity?

- Homeowner will PAY significantly more with Solar PV
- Homeowner will PAY a little more with Solar PV
- Will have no impact
- Homeowner will find some SAVINGS with Solar PV
- Homeowner will find significant SAVINGS with Solar PV

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Solar & Solar Loans: Risks & Opportunities

Re INCENTIVES

Does your organization take into account the various incentives when assessing or underwriting a solar loan?
Incentives include Federal & State ITC, SRECs and Net Metering Credits

- ○ Yes, we always do
- ○ Yes, we usually do
- ○ Yes, but it's not really important to us
- ○ If we offered Solar Loans, we would consider them
- ○ Not really
- ○ No, it does not usually matter
- ○ Never
- ○ Can't say / Not sure
- ○ Other

Re SAVINGS

Do the home-owner's savings with Solar PV affect the way in which your organization assesses the loans for Residential Solar PV installation?

Note: For this survey, we distinguish SOLAR LOANS as under:
Unsecured Solar Loans: where there is either no collateral or only the Solar PV installation is collateral.
Secured Solar Loans: Where collateral is another asset, for example the home (Home Equity Loan, Home Equity Line of Credit) or a car or any other asset.

With Secured Solar PV Loans

With UNSecured Solar PV Loans

COMMUNITY ENGAGEMENT

Does your organization currently engage with CUSTOMERS to offer them loans for Residential Solar PV installations?

- ○ Yes, we engage with Customers. Here's how...
- ○ No, we do not engage

Does your organization currently engage with INSTALLERS to improve the adoption of Residential Solar PV among your customers / members?

- ○ Yes, we engage with Installers. Here's how...
- ○ No, we do not engage.

When you think about a Solar Loan as a distinct unsecured loan product, what specific concerns would you have?

Select all that apply and please feel free to provide additional response in text box provided below.

- [ ] We do not have any concerns per se
- [ ] Too risky
- [ ] Defaults may be too high if unsecured
- [ ] We believe it is not a sizable market for us
- [ ] We do not understand how the solar PV market works
- [ ] We are unsure of the incentives available for Solar PV
- [ ] We are unsure of the stability of the incentives being offered
- [ ] It is difficult for us to repossess the Solar PV in case of a default
- [ ] The homeowner may move before the tenure of the loan is completed. Not sure what would happen then
- [ ] Another product may be include additional compliance requirements; not something we're ready for
- [ ] We cannot be sure of the condition of the roof
- [ ] Other reasons (please feel free to type as much as you need to):

What sources of information would have informed your perspective of the Solar PV market?

Check all that apply

- [ ] Briefings of MA state and related agencies
- [ ] Conversations with friends, colleagues and family
- [ ] Various media sources
- [ ] MA Department of Energy Resources website
- [ ] Solar Energy Industry Association website
- [ ] Greentech Media website
- [ ] Solar Daily website / newsletter
- [ ] Renewable Energy World website
- [ ] PV-Tech website
- [ ] Other sources (please type in to text box below)

After taking this survey, would you like to learn more about the Solar PV market?

- ○ Yes
- ○ No

Please add here any additional remarks you may have about the Solar PV or Solar Loan

market.
These may include questions that this survey ought to have asked, but did not.

Specific Consent Questions

Please mark the relevant options below so that the Principal Investigator (PI) of this research, Suveer Bahirwani may know how to use your responses.

Note: Using only your organization's name in the PI's Final Thesis may identify you as the respondent.

	Yes	No
The PI may use ONLY my ORGANIZATION's name in his final thesis	○	○
The PI may use ONLY my OWN name in his final thesis	○	○
The PI may use BOTH my organization's and my name in his final thesis	○	○

Based on your responses, the Principal Investigator, Suveer Bahirwani, may want to contact you for further questions.

- ○ Yes, it is ok for Suveer Bahirwani to contact me via email (insert email below, if not provided above)
- ○ No, please do not contact me further

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