Task 2:
Analysis of Solar Development in States without Incentive Policies

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1 Introduction

The U.S. solar market has grown substantially over the past several years, from an estimated 1.2 GW of total capacity in 2009 to nearly 20 GW by the end of 2014 (SEIA, 2015). This market growth has not been uniform across the country, with some states having substantial solar PV generating capacity installed and others having virtually none. The economic viability of PV systems depends on a range of inputs including system installed costs, ongoing operational costs, federal incentives, power production values, and state or utility incentives. The Task Force has expressed an interest in understanding the relationship between state solar programs and actual deployment of solar, and whether it might be reasonable to expect solar development even in the absence of significant state programs. The purpose of this task is to provide a representative analysis of the level of solar development in states that do not have a state-level incentive program (Massachusetts Net Metering Task Force, 2014).

2 Methodology and Analysis

In order to provide a nuanced discussion of the effects of state-level solar incentives on solar market development, this analysis was divided into three components. Since net metering may be a critical component of solar market development, and the Task Force has been asked to provide recommendations to the legislature on the future of net metering in the Commonwealth, this analysis includes a review of solar market development in states that do not have net metering. Additionally, this task reviewed solar market development in states that have similar characteristics to Massachusetts in terms of the economic value of solar production per kilowatt-hour and expected solar system output given state-level solar insolation. Finally, the project team reviewed recently announced large-scale solar installations in states and utility territories that do not have substantial solar incentives. A more detailed review of the analytical approaches and results of each of these tasks is provided below.

2.1 Review of market development in states without solar incentives or net metering

Net metering allows utility customers with on-site distributed generation to offset their electricity usage by exporting excess power to the grid and to receive credit for exported power on their utility bill (Mass DPU, 2015). Net metering rules vary significantly across U.S. jurisdictions with some states and utilities providing full retail value for power exported to the grid while others provide compensation at some fraction of full retail value. To date, 44 states have adopted state-wide net metering in some form. Table 1 below show the U.S. states that have not had state-wide net metering during the period of interest in this analysis.[1]

Table 1. States without state-wide net metering (IREC & Vote Solar, 2014)

State
Idaho
South Dakota
Texas
Tennessee
Alabama
Mississippi
South Carolina

[1] In December 2014, South Carolina's Public Utilities Commission received a settlement agreement for a statewide net metering program, but this has not yet been approved and the policy has not been implemented.

Solar market development has been limited in states without net metering. Table 2 below shows the cumulative solar installations in each of these states as of 2013. As the table shows, Idaho, South Dakota, Alabama, Mississippi and South Carolina all have less than 10 MW of cumulative solar installed as of the end of 2013. Tennessee, which does have solar incentive programs provided through the Tennessee Valley Authority (TVA) and Texas, which has a solar market driven, in part, by municipal utility solar procurements, have more substantial installed capacity than the other states. Massachusetts has been included in Table 2 for reference purposes.

Table 2. Total Solar Market Capacity in 2013 in Massachusetts (Sherwood, 2014)

State	2013 Cumulative MW	2013 W/GWh Electricity Sales
Idaho	0.7	29
South Dakota	0.0	0.0
Texas	215.9	587
Tennessee	64.8	675
Alabama	1.9	22
Mississippi	0.3	6
South Carolina	8.0	101
Massachusetts	**445.0**	**8,167**

Given the significant diversity of states in this analysis, cumulative state solar capacity has been normalized in Table 2 to account for the size of the state's total power consumption. Total state solar capacity in 2013 in watts was divided by the total state electricity sales in GWh. This provides a better comparison between states without net metering and Massachusetts. As this comparison shows, the normalized cumulative PV watts per GWh of electricity sales shows that the Massachusetts solar market is an order of magnitude larger than any solar market without net metering, suggesting that net metering is a critical component to solar market development.

2.2 Review of market development in states with net metering, but modest solar incentives

Numerous states have implemented diverse programs in addition to net metering in an effort to encourage the development of solar markets. These efforts range from modest benefits such as reductions in sales and property taxes to more lucrative incentives such as rebates and performance based incentives. Analyzing the effect of state-level incentive policies on solar market development is key to understanding if and how Massachusetts' solar market could evolve in the absence of state-level solar incentives. While future market dynamics would be highly dependent on a number of state-specific factors and future solar installed costs, evaluating the solar market development in states that are similar to Massachusetts but lack major solar incentives does provide an indicator of potential market dynamics in the absence of state-level incentive support.

Solar PV system economics are influenced by several state-specific factors beyond incentives, most notably the potential production of the system (i.e., the solar resource in the state) and the retail value of each kWh produced by that system. The combination of these two factors provides a proxy for the potential value of PV systems excluding state and federal incentives in each state.

In order to conduct a comparative analysis of state-level solar market development that is most relevant to the Massachusetts context, the project team identified 19 states that have a similar combination of retail electricity prices and solar resources to Massachusetts. This was done by calculating the expected value of power produced by a 1 kW system in each state by multiplying the expected production a PV system in that state by the average retail value of power.[2,3]

$$Annual\ \$\ per\ kW = 8760\ Hours\ Per\ Year\ X\ State\ Average\ Capacity\ Factor\ X\ Average\ Retail\ Power\ Price$$

[2] The retail value of power used in this analysis was based on the average state-wide retail power price for all customers in the state between 2008 and 2012 (EIA, 2015). While different customer classes may pay substantially different retail rates within a state and even within separate utility territories, for the purposes of this analysis, state-level average power prices provide an adequate proxy for more granular power price data.

[3] The average state-wide solar PV capacity factor was based on National Renewable Energy Laboratory data. PV systems within a state will have highly variable production profiles based on site-specific factors such as orientation and system shading, however state-level capacity factor estimates provide a reasonable estimation of system production and are adequate for the purposes of this analysis.

This calculation resulted in a hypothetical value for the power generated by a 1 kW PV system in each state in the absence of state-level incentives. States with low solar resource, but high retail power values, may have expected power production values that are similar to that in states with high solar resources, but low retail power prices. To illustrate this phenomenon, example calculations are provided below for Vermont and Nevada--two states with very different solar resources and retail power prices, but similar expected PV system expected production values.

$$Nevada\ \$\ per\ kW\ per\ year = 8760\ X\ 0.186\ X\ \$0.0958\ = \$\ 155$$

$$Vermont\ \$\ per\ kW\ per\ year = 8760\ X\ 0.129\ X\ \$0.1327\ = \$\ 149$$

Table 3 shows the 19 states where the combination of state-level solar resource and state-level retail power value most closely aligns with Massachusetts.

Table 3. Average Annual Retail Electricity Value from a 1 kW PV system[4]

State	$/kW	State	$/kW
CA	$206	MD	$158
CT	$204	NV	$155
NY	$184	VT	$149
NJ	$181	ME	$147
MA	**$172**	NM	$144
NH	$169	FL	$144
RI	$169	CO	$139
DE	$165	TX	$135
DC	$163	GA	$134
AZ	$162	KS	$120

As the table shows, the expected value of PV system production in many northeast states, with their relatively high retail power prices, is higher than that in many states in the south and southwest that have greater solar resources but lower retail power values. The 19 states identified as having the most similarity to Massachusetts with respect to the combination of solar resource and retail power prices were further examined to determine how state solar market development differed between states with major solar incentives and those without.

For the 19 states identified as having the most similar non-incentive solar market condition (i.e., the combination of solar insolation and retail electricity prices), the project team reviewed available state-level solar incentives. Solar incentives in each of the analyzed states were classified as major or minor based on a qualitative review of the incentive type, incentive value and volume of available incentives. For example, some states have renewable energy incentives available, but do not have incentives specifically reserved for solar. These states would be classified as having minor solar incentives. Conversely, some states have created specific solar or distributed generation [DG] targets as part of their renewable portfolio standard. These states would be classified as having major solar incentive programs.

Data on 2013 cumulative solar capacity for each of the 19 states of interest were normalized based on total retail electricity sales in order to compare solar market activity in states of dissimilar sizes. This was accomplished by dividing the cumulative state solar capacity in 2013 by the total retail electric sales in that year (EIA, 2015; Sherwood, 2014). Additionally, 2013 RPS solar (or DG) targets were researched (DSIRE, 2015). For some states with major incentive programs, explicit annual solar goals were not available while in others, solar targets were an explicit part of the RPS policy. Table 4 below shows both the 2013 solar/DG targets along with the 2013 adjusted solar market capacity in solar watts per GWh of sales.

[4] Hawaii, with high retail electricity costs and relatively high solar insolation, had an average annual retail electricity value from a 1kW PV system of $418, making it a significant outlier.

Table 4. State Solar Market Incentives and 2013 Metrics

State	Major/Minor Incentive	Major Incentive	State 2013 DG/Solar Goal	Annual Solar Value w/o Incentives	2013 W/GWh
AZ	Major	State RPS that includes DG carve out	1.20%	$162	20,651
CA	Major	Utility-supported rebate and long-term contracting programs as part of RPS	Major incentive; no %age target	$207	20,171
NJ	Major	SREC obligation as part of state RPS	0.80%	$182	15,921
NV	Major	Energy portfolio standard with solar carve-out	0.90%	$156	12,070
NM	Major	RPS with solar carve out	2.00%	$145	11,068
MA	Major	**SREC obligation as part of state RPS**	0.38%	$172	8,167
VT	Major	Solar-specific long-term contracting program	Major incentive; no %age target	$150	7,460
CO	Major	State DG carve out in RPS	1.25%	$139	6,690
DE	Major	SREC obligation in state RPS	0.40%	$166	5,590
MD	Major	SREC obligation in state RPS	0.25%	$159	2,833
CT	Major	Utility-supported ZREC programs	Major incentive; no %age target	$205	2,596
NY	Major	NYSERDA supported rebates and long-term contracting through RPS	0.34%	$184	1,677
DC	Major	SREC obligation in district RPS	0.50%	$164	1,488
RI	Major	Utility-supported long-term contracting program, recently increased targets	Major incentive; no %age target	$170	976
NH	Minor	State has RPS solar carve out, however credit price caps are not differentiated from other renewable technologies	0.20%	$170	873
GA	Minor	Limited utility-based programs	0.00%	$135	835
FL	Minor	Limited utility-based rebate programs	0.00%	$145	620
TX	Minor	No major state-wide solar incentive; some utility-specific programs and contracts	0.00%	$135	587
ME	Minor	No major solar incentives	0.00%	$148	448
KS	Minor	No major solar incentives	0.00%	$121	28

In order to determine whether state-wide solar policies--and therefore incentives resulting from those policies--or non-incentive factors such as in-state solar resource and retail power prices were major drivers of market development, scatter plots were developed that graphed market penetration against average non-incentive solar system annual value as well as market penetration against state-wide solar goal. These graphs are shown in Figure 1 and Figure 2.

Figure 1. Adjusted 2013 PV Market Capacity vs. Average Annual Solar Non-Incentive Value

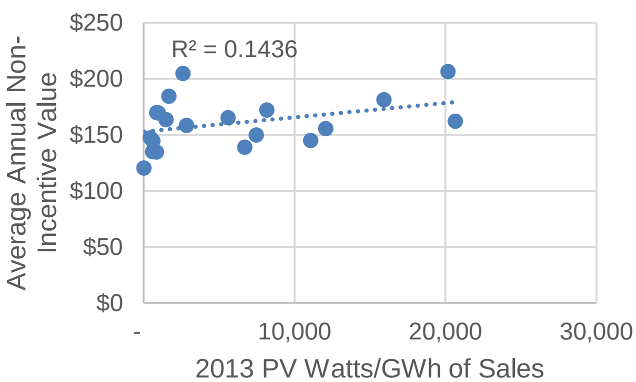
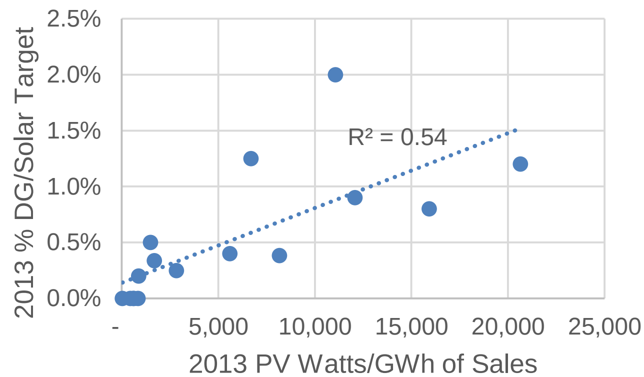


Figure 2. Adjusted 2013 PV Market Capacity vs. 2013 State RPS Solar/DG Target



As the figures show, non-incentive annual solar value had limited relationship to total solar market penetration in the states analyzed, while state-wide solar goals had a more robust linear relationship to solar market penetration. As would be expected, states with more significant solar goals in 2013 had more in-state solar capacity than states with smaller or non-existent solar goals. This result suggests that, during the period reviewed and for the states analyzed, state-level policies in the form of solar RPS targets (and the various forms of incentives that result from those policies) were the primary driver of solar market development and that states that have substantial solar potential, but did not have incentive policies, had not developed significant solar markets.

2.3 Discussion of select recent publicly announced utility scale solar projects

The results in the previous two sections relied on data from 2013, the most recently available state solar installation dataset. During the past year, several utilities have announced large-scale solar projects in states without significant solar incentives. These announcements have frequently promoted that the long-term contract prices associated with these installations are competitive with traditional fossil power sources. Beyond these announcements, little public data is available about the overall costs of these systems, the incentives they may be monetizing, and other contract details. Recently announced systems include a 150 MW 25-year power purchase agreement between Austin Energy and Recurrent Energy for below $0.05 per kWh (Wesoff, 2014), more than 320 MW of solar in Utah qualified under an avoided cost program through Rocky Mountain Power (First Wind, 2014), and a 10 MW PV system in Kentucky that was approved by regulators as a hedge against future national carbon regulations (Tincher, 2014). These and other recently announced projects in states that do not have robust solar incentive programs are indicative of the improving economics of solar. That said, the context for these installations is significantly different from the current Massachusetts market, particularly with respect to installation size. Solar PV systems benefit from significant economies of scale and the recently announced low-cost solar power contracts have been in locations where very large, utility-scale solar arrays are viable.

3 Conclusion

As the analysis in this section shows, solar market development has been largely dependent on state-level policies in the United States. States that do not offer net metering have had highly limited solar market development compared to Massachusetts. Additionally, state-level targets and incentives have been a major driver of solar market development to date. As the analysis in this section shows, states that have not had robust solar incentives and targets, but have adequate solar potential, have seen very limited market growth compared to similar states with solar incentives and binding targets. This suggests that, for the time being, state-level solar policies are critical to future solar market growth in the U.S. Finally, a number of utility-scale PV systems have been recently announced in states without major incentives. These systems have purportedly signed contracts at prices competitive with fossil fuel generators. While these systems are very large and are able to capture significant economies of scale, unlike systems currently installed in the Massachusetts market, they do point to a potential future under which solar PV is less dependent of state-level incentives.

4 Works Cited

DSIRE. (2015, January 18). *RPS Quantitative Spreadsheet (2013 Update)*. Retrieved from http://www.dsireusa.org/rpsdata/RPSspread042213.xlsx

EIA. (2015, January 31). *Elecricity Data Browser*. Retrieved from http://www.eia.gov/electricity/data/browser/#/topic/5?agg=0,1&geo=vvvvvvvvvvvvo&endsec=vg&linechart=ELEC.SALES.US-ALL.A&columnchart=ELEC.SALES.US-ALL.A&map=ELEC.SALES.US-ALL.A&freq=A&start=2007&end=2013&ctype=linechart&ltype=pin&rtype=s&pin=&rse=0&maptype

EIA. (2015, January 31). *Electricity Data Browser: Average Retail Price of Electricity*. Retrieved from http://www.eia.gov/electricity/data/browser/#/topic/7?agg=1,0&geo=fvvvvvvvvvvvo&endsec=g&freq=A&start=2005&end=2013&ctype=linechart&ltype=pin&rtype=s&pin=&rse=0&maptype=0

First Wind. (2014, June 19). *First Wind Announces Agreement with Rocky Mountain Power for Clean Energy from Largest Solar Developments in Utah*. Retrieved from http://www.businesswire.com/news/home/20140619005907/en/Wind-Announces-Agreement-Rocky-Mountain-Power-Clean#.VNe3ufnF-Sg

IREC & Vote Solar. (2014, November 13). *Freeing the Grid 2015*. Retrieved from http://freeingthegrid.org/

Mass DPU. (2015, January 18). *Net Metering Frequenty Asked Questions and Answers*. Retrieved from http://www.mass.gov/eea/grants-and-tech-assistance/guidance-technical-assistance/agencies-and-divisions/dpu/net-metering-faqs.html#1

Massachusetts Net Metering Task Force. (2014, November 14). *Net Metering and Solar Task Force Analytical Support Consultant Scope of Work.* Retrieved from http://www.mass.gov/eea/docs/dep/about/final-outline-nms-task-force-scope.pdf

SEIA. (2015, February 15). *Sustainable Energy Factbook Shows Huge Growth in Solar*. Retrieved from http://www.seia.org/news/sustainable-energy-factbook-shows-huge-growth-solar

Sherwood, L. (2014). *U.S. Solar Market Trends 2013.* Latham, N.Y.: IREC.

Tincher, S. (2014, December 23). *Kentucky Public Service Commission approves 10MW solar power facility*. Retrieved from http://www.statejournal.com/story/27694702/kentucky-public-service-commission-approves-10mw-solar-power-facility

Wesoff, E. (2014, May 16). *Austin Energy Switches From SunEdison to Recurrent for 5-Cent Solar*. Retrieved from Greentech Media: http://www.greentechmedia.com/articles/read/Austin-Energy-Switches-From-SunEdison-to-Recurrent-For-5-Cent-Solar