State of Maine
Office of the Public Advocate

STRATEGEN
STRATEGIES FOR CLEAN ENERGY

A Ratepayer Focused Strategy for Distributed Solar in Maine

1. Introduction

This white paper offers a framework for sustainable growth in Maine's distributed solar energy sector that maximizes and fairly allocates benefits for all ratepayers. This approach builds on the Public Utilities Commission's recent "value of solar" study as well as lessons learned from other states. The policy proposed is specifically tailored to the state of Maine and offers innovative program design features intended to capitalize on the latest technological advances in the solar industry. The goals guiding this policy are the following:

- **Maximization of ratepayer benefits**: Establish competitive market structures that take advantage of advances in technology and declining costs to the benefit of all ratepayers.
- **Transparent allocation of costs and benefits:** Clearly link actual system benefits to transparent compensation mechanisms.
- **Opportunity for participation across all solar market segments:** Allow every market segment the opportunity to participate in the program on fair terms, from retail customer-paired residential solar, commercial and industrial resources, to standalone distribution-connected wholesale resources.
- **Market-based encouragement of technological innovation:** Allow data-based value adders to encourage technologies, combinations of technologies, and resource dispatch behaviors that are beneficial to the grid.
- **A fair balancing of stakeholder interests:** Each key stakeholder group receives equal consideration with a focus on win-win approaches (*e.g.* no one group left as a clear loser or winner).

While designed to present a coherent and holistic policy framework for state-wide adoption, this whitepaper is also intended to solicit stakeholder feedback.

1.1 High-level Policy Overview

This framework uses market forces to maximize value to all ratepayers, while fairly compensating solar adopters. The core attributes of the policy are as follows:

1. A cost-conscious and fair alternative to the current net metering based system.
2. Long-term compensation structures with a levelized cost of energy cap set initially at a level based on a value of solar analysis and <u>above</u> the current level of compensation offered by net metering.
3. Competitive bidding and capacity based step downs to drive actual program costs well below this initial level.

4. The potential (if the market can reach aggressive pricing targets) for 300 MWs of total new solar capacity by 2025, divided between three market segments – wholesale (150 MW), residential/commercial (100 MW), and industrial/community (50 MW).
5. Aggregation and procurement of solar resources to capture and monetize the value of solar generation in the relevant markets.

This whitepaper is divided into four sections, including this introduction (Section1). Section 2 provides an overview of Maine's existing net metering policy, its advantages and its shortcomings. Section 3 describes the results of the Maine Public Utilities Commission's value of solar study. Section 4 describes an alternative solar policy, rooted in the Commission's value of solar analysis and the goals described above. The Appendix include lessons learned in three states, California, Arizona, and Minnesota that informed the policy approach set forth here.

2. Overview of Net Energy Policy in Maine

Net metering, or net energy billing (NEB), is a billing mechanism that allows customers to receive credit for energy produced on-site that is sent back to the grid at the variable retail electricity rate. In Maine, this is currently the primary incentive available for distributed solar generation. Maine's two investor-owned utilities (IOUs) must offer net energy billing to their customers.

Net metering is popular with both customers and the solar industry. The primary benefit of net metering is its simplicity: to rate payers, developers, investors, and regulators.

However, the falling costs of solar, paired with rising retail electricity costs have driven increased adoption that has revealed fundamental issues with the net metering platform. While it is not an issue yet in Maine, the scalability of NEM is under review in a number of states. At high penetrations of solar, the retail rates underpinning NEM do not send timely or appropriate price signals to solar adopters—in short, these customers are compensated at rates that do not reflect the value of the resource or the continuing decline in the installed cost of solar. While this may result in higher levels of solar installation, at increased penetration rates these issues may undermine the consensus supporting the continuation of the policy.

Other issues inherent in the net metering incentive structure include:

- There is no certainty for net metering customers, whose rates may change in response to variations in wholesale prices and rate design. This lack of certainty can raise consumer protection concerns and also impacts the costs of financing.
- The economics of the underlying rate design do not make sense for larger commercial and industrial customers because their costs are largely recovered through demand charges.
- High rates of rapid adoption can lead to significant cost shifts to non-net metered customers. In other words, as net metered customers invest in self generation and reduce their electricity bills, non-net metered customers must pick up a greater share of the overall costs to deliver energy.
- There is little transparency regarding the relative costs/benefits and cost shifts.

- Discussion of rate design changes affecting all customers may be disproportionately impacted by a small, vocal subset of solar customers and supporters.

For many of the reasons stated above, states across the country are revisiting traditional net metering or, at least, the underlying rate designs upon which it rests. Still, absent a viable policy alternative, the popularity and simplicity of net metering make it unlikely that Maine's existing net metering policy will be changed, until Maine experiences higher levels of solar penetration.

3. The Maine Distributed Solar Valuation Study

Pursuant to the "Act to Support Solar Energy Development in Maine" (P.L Chapter 562; codified at 35-A M.R.S. §§ 3471-3473) ("Act"), the Maine Public Utilities Commission ("Commission") was required to develop a methodology for determining the value of distributed solar energy generation in the State. In March of 2015, after robust stakeholder input on all aspects of the methodology, the Commission published the "Maine Distributed Solar Valuation Study." The Study contained three major findings: (1) a methodology for estimating the cost and benefits of solar, (2) values for each cost and benefit (expressed as dollars per kilowatt hour) for the three utility territories, and (3) implementation options for encouraging solar adoption within the State's existing utility framework.

2.2 Methodology for Quantifying Costs and Benefits of Solar PV

The Public Utilities Commission and their consultants, with direction from the Legislature, identified ten categories of benefits and costs that provide a reasonable estimate of what distributed solar energy can provide to the state of Maine. Given the broad variation in output and location of solar facilities and the complexities of Maine's competitive market structure, the study made a number of sensible simplifying assumptions. One of the benefits of the policy proposal outlined below is the opportunity to refine these values based on changes in the relevant markets and data based on actual output of solar facilities in Maine. Figure 1 below highlights the elements considered in the cost/benefit calculation performed in the Commission's study.

Figure 1. Identified Cost and Benefits from Maine Distributed Solar Valuation Study

Component	Benefit/Cost Basis
Avoided Energy Cost	Hourly avoided wholesale market procurements, based on ISO New England day ahead locational marginal prices for the Maine Load Zone.
Avoided Generation Capacity and Reserve Capacity Costs	ISO New England Forward Capacity Market (FCM) auction clearing prices, followed by forecasted capacity prices by the ISO's consultant. For reserves, the ISO's reserve planning margin is applied.
Avoided Natural Gas Pipeline Costs	Not included, but left as a future placeholder if the cost of building future pipeline capacity is built into electricity prices.

Component	Benefit/Cost Basis
Solar Integration Costs	Operating reserves required to handle fluctuations in solar output, based on the New England Wind Integration Study (NEWIS) results.
Avoided Transmission Capacity Cost	ISO New England Regional Network Service (RNS) cost reductions caused by coincident solar peak load reduction.
Avoided Distribution Capacity Cost	Not included, but left as a future placeholder if the peak distribution loads begin to grow (requiring new capacity).
Voltage Regulation	Not included, but left as a future placeholder if new interconnections standards come into existence allowing inverters to control voltage and provide voltage ride-through to support the grid.
Net Social Cost of Carbon, SO2, and NOx	EPA estimates of social costs, reduced by compliance costs embedded in wholesale electricity prices.
Market Price Response	The temporary reduction in electricity and capacity prices resulting from reduced demand, based on the Avoided Energy Supply Costs in New England (AESC) study.
Avoided Fuel Price Uncertainty	The cost to eliminate long term price uncertainty in natural gas fuel displaced by solar.

Source: Adapted from Table ES-1. Benefit/Cost Bases from Maine Distributed Solar Valuation Study. Pg. 3. http://www.nrcm.org/wp-content/uploads/2015/03/MPUCValueofSolarReport.pdf

Specific monetary values for providing the benefits listed above were aggregated to each of the three utility service territories (*i.e*., Central Maine Power – CMP; Bangor Hydro District - BHD, and Maine Public District - MPD). As shown in Figure 2 below, the 25-year levelized cost[1] of distributed solar in CMP's service territory was approximately $0.337/kWh. This estimate is broadly broken out by "Avoided Market Costs" and "Societal Benefits," valued at $0.138/kWh and $0.199/kWh respectively.

[1] Levelized cost represents the average total cost to build and operate the power-generating asset over its lifetime divided by the total power output of the asset over that lifetime. It is a metric often used to compare the price competitiveness of different generating technologies.

Figure 2. CMP Distributed Value – 25 Year Levelized ($ per kWh)

25 Year Levelized

		Gross Value A ($/kWh)	× Load Match Factor B (%)	× Loss Savings Factor (1+C) (%)	= Distr. PV Value D ($/kWh)
Energy Supply	Avoided Energy Cost	$0.076		6.2%	$0.081
	Avoided Gen. Capacity Cost	$0.068	54.4%	9.3%	$0.040
	Avoided Res. Gen. Capacity Cost	$0.009	54.4%	9.3%	$0.005
	Avoided NG Pipeline Cost				
	Solar Integration Cost	($0.005)		6.2%	($0.005)
Transmission Delivery Service	Avoided Trans. Capacity Cost	$0.063	23.9%	9.3%	$0.016
Distribution Delivery Service	Avoided Dist. Capacity Cost				
	Voltage Regulation				
Environmental	Net Social Cost of Carbon	$0.020		6.2%	$0.021
	Net Social Cost of SO_2	$0.058		6.2%	$0.062
	Net Social Cost of NO_x	$0.012		6.2%	$0.013
Other	Market Price Response	$0.062		6.2%	$0.066
	Avoided Fuel Price Uncertainty	$0.035		6.2%	$0.037
					$0.337

Avoided Market Costs
$0.138

Societal Benefits
$0.199

Source: Norris, Benjamin; Grace, Robert; Perez, Dr. Richard; Rabago, Karl. Maine Distributed Solar Valuation Study. Prepared for the Maine Public Utilities Commission. Revised April 14, 2015. Pg. 50.
http://www.nrcm.org/wp-content/uploads/2015/03/MPUCValueofSolarReport.pdf

2.3 Avoided Market Costs and Societal Costs

The costs and benefits identified by the Commission fall into two primary categories: avoided market costs, and societal costs.

Avoided Market Costs
Avoided Market Costs are values that most directly affect electricity customer bills. These include the costs and benefits related to capital expenditures and operating expenses normally recouped by the utility in a customer's electricity bill. Distributed solar can offer ratepayer benefits by allowing for avoided costs including avoided energy purchases, avoided capacity purchases and avoided transmission upgrades. The system-wide reduction in electricity and capacity prices due to an overall reduction in energy demand (stemming from distributed solar generation) is a direct benefit as well. From a cost perspective, having more intermittent generation can lead to additional outlays associated with integration and voltage regulation.

Societal Costs
Societal benefits include environmental benefits in the form of avoided air pollution (CO_2, NO_x, SO_2) and avoidance of long-term fuel price uncertainty. These values are typically not included in the utility's ratemaking process or the supply portion of a customer's bill.

Relevant and Direct Values to Ratepayers
Projecting market-based costs and benefits out many years is not without some uncertainty but quantifying societal considerations presents a more challenging undertaking. To be clear, these benefits do exist and can be meaningful; however, the ultimate value may be harder to quantify, much less allocate. Establishing a compensation rate that is initially above direct market cost is one way of recognizing the environmental benefits of solar while not using ratepayer dollars to pay directly for non-market values that may be difficult to quantify. Alternatively if the cost-benefit analysis is clearly justified based upon the avoided market costs, and sufficiently compensates solar generators, the goal of maximizing ratepayer benefits can be achieved without paying directly for societal benefits.

4. A New Program Design

The policy presented here is based on the premise that there are now better ways than net metering to encourage solar adoption that send the right signals to developers and consumers, drive technological innovation, and allow utilities to more easily manage the increase in intermittent generation. This paper presents policy concepts for two important distributed solar market segments in Maine:

- **Customer-sited** (systems installed for residential and small commercial/industrial customers)
- **Wholesale** (systems installed on the utility side of the meter within the distribution system)

An aggregation entity, or "Solar Standard Buyer" (SSB) would interface with the customer sited market segment. Under the existing net metering construct, this role is currently assumed by the Standard Offer Provider or a customer's competitive electricity provider. Centralizing procurement with the SSB would allow for a more efficient aggregation and sale of the different attributes solar energy can provide. The

SSB would aggregate the energy, RECs, capacity value, and ancillary services potential and monetize these in the applicable markets. As stated previously, the underlying goal of the policy structure is to allow Maine ratepayers to capture the benefits of distributed solar energy while minimizing the costs and inequities experienced in other states.

For the wholesale market, the Commission would solicit competitive bids with the ultimate purchaser for these contracts being the Standard Solar Buyer. The amounts purchased would "prime the pump" for the Standard Solar Buyer's solar portfolio to ensure that the portfolio is of sufficient scale to efficiently monetize the benefits described above.

These policies combine the values of distributed solar calculated in the Commission's Study with the lessons and experience from other states. The idea is to set Maine on a course that allows the distributed solar market to grow and thrive and for incentives to align with market maturity. If successful, this policy could provide a platform for future innovation and development for all types distributed resources. Below is a more detailed discussion of each program and market specifics.

4.1 Customer-sited Solar Contract

For the customer-sited market segment, the compensation structure must be straight forward for the customer and subject to reasonable financing. [2] The core of the policy is the Customer-sited Solar Contract ("CSC"), a fixed-price, 20-year contract between the customer and the solar aggregator. Twenty years is a common term for solar equipment financing and well within adopter payback. The compensation rate for all market segments would be capped initially at the sum of the direct market derived values found in the Distributed Solar Valuation Study (see below). While societal values will not be compensated directly (for reasons stated above), if the solar industry thrives below the value cap then all Maine residents reap the financial and environmental benefits of solar. The following is the value stack associated with a 20-year levelized assessment:[3]

[2] Experience in other states shows that the ability to obtain reasonable financing for customer-sited solar is essential to ensuring access to customers across a range of income levels.

[3] Several potential market-based values were not included in the value stack presented by the Commission valuation study. These include avoided natural gas pipeline cost, avoided distribution capacity cost, and ancillary service benefits. These values can either be hard to quantity, de minimis, and/or highly locational. The CSC structure should not neglect solar's possible value in these areas and when appropriate, the compensation rate should reflect locational specific benefits. Nevertheless, the quantification of these benefits for compensation will have to be based on further study and market data from actual deployment or established on a project/location specific basis.

Figure 3. Levelized Value Stack (20 years) for Customer-sited Solar Contract - CMP

Value Component	CMP 20 Year LCOE ($/kWh)
Avoided Energy Cost	$0.078
Avoided Generation Capacity Cost	$0.039
Avoided Residential Generation Capacity Cost	$0.005
Solar Integration Cost	-$0.004
Avoided Trans. Capacity Cost	$0.016
Market Price Response	$0.069
Total	**$0.20**

Under the CSC, a solar aggregator would enter in a long-term, fixed contract with residential and small business customers that choose to host solar energy. The "payment" would be based on a per kWh rate that would appear as a monthly bill credit on the customer's bill (similar to Maine's existing NEM structure). The level of compensation would be capped at $0.20/kWh.

As stated above, centralizing procurement with the Solar Standard Buyer would allow for a more efficient aggregation and selling of the different attributes solar energy can provide. The role of the solar aggregator is also central to this policy framework. The solar aggregator, which could be a distribution utility or a Commission-designated third party, will be the counterparty for each CSC, and will be responsible for aggregating and monetizing the value of the different attributes Maine's solar generation fleet provides.

Both the payments to customers under a CSC and the revenues received through this aggregation and sale would be credited to all customers through T&D utilities' existing stranded cost mechanisms. The near-term premium, the difference between the amount recovered by the solar aggregator and the amount paid under a CSC, would be covered in the stranded cost adjustor on each customer's bill. Likewise, this would be the same account that would be credited when wholesale prices increase above the solar contract.

While the near-term compensation level for a CSC is higher than current retail and wholesale rates, non-participating customers will be better off than under net metering, because they will capture, monetize and retain substantially more of the benefits associated with distributed solar generation. Non-participating customers may even realize benefits over time if the revenue received from monetizing the benefits described above overtakes the fixed price of the solar contract. Because the first year level of compensation is capped based on the avoided market costs calculated in the Commission's value of solar, customers will not pay more than the best available estimate of the likely benefits to them, even if all of these benefits are not directly monetized by the Solar Buyer.

4.2 Market Based Step Downs

Common practice for large scale resource procurement is bilateral competitive bidding. For small PV systems on rooftops this is administratively burdensome and impractical for a variety of reasons. Nonetheless, there must be some mechanism to deliver ratepayer benefit as the solar industry scales and the technology matures. The appendix of this whitepaper contains two case studies of states that successfully implemented a capacity-based step down. This policy adopts that approach.

For residential and commercial customers, a declining trigger mechanism based on installed capacity would be established to automatically decrease the level of compensation for new customers entering into CSCs (not existing CSC customers). The capacity-based step down approach would reduce the CSC contract price by $0.01/kWh at each step until the incentive reaches wholesale electricity rates. As shown in Figures 4 and 5, the number of MWs available at each step increases with each consecutive step.

Figure 4. Incentive levels for a Capacity-based step down Approach

Step	MW in Step	Cumulative Installed Capacity	Step-specific Incentive Level (¢/kWh)
1	5	5	20
2	6	12	19
3	7	19	18
4	8	27	17
5	9	36	16
6	10	46	15
7	11	57	14
8	12	69	13
9	14	83	12
10	17	100	11 (or fixed wholesale rate)

The design of the program attempts to glide the industry to scale in a cost effective manner to 2025. The average compensation decline rate through the various steps is approximately 6.5%. This was designed to correlate to the average declines in solar energy system costs over the past 15 years.[4] The declines also more than cover the diminishing returns associated with increase solar penetration.

It is important to note that the rates above are for standard PV systems without locational adders or additional benefits that can be realized when combining PV with other technologies like controllable water heaters, energy storage, or with demand response programs. The Commission could create future

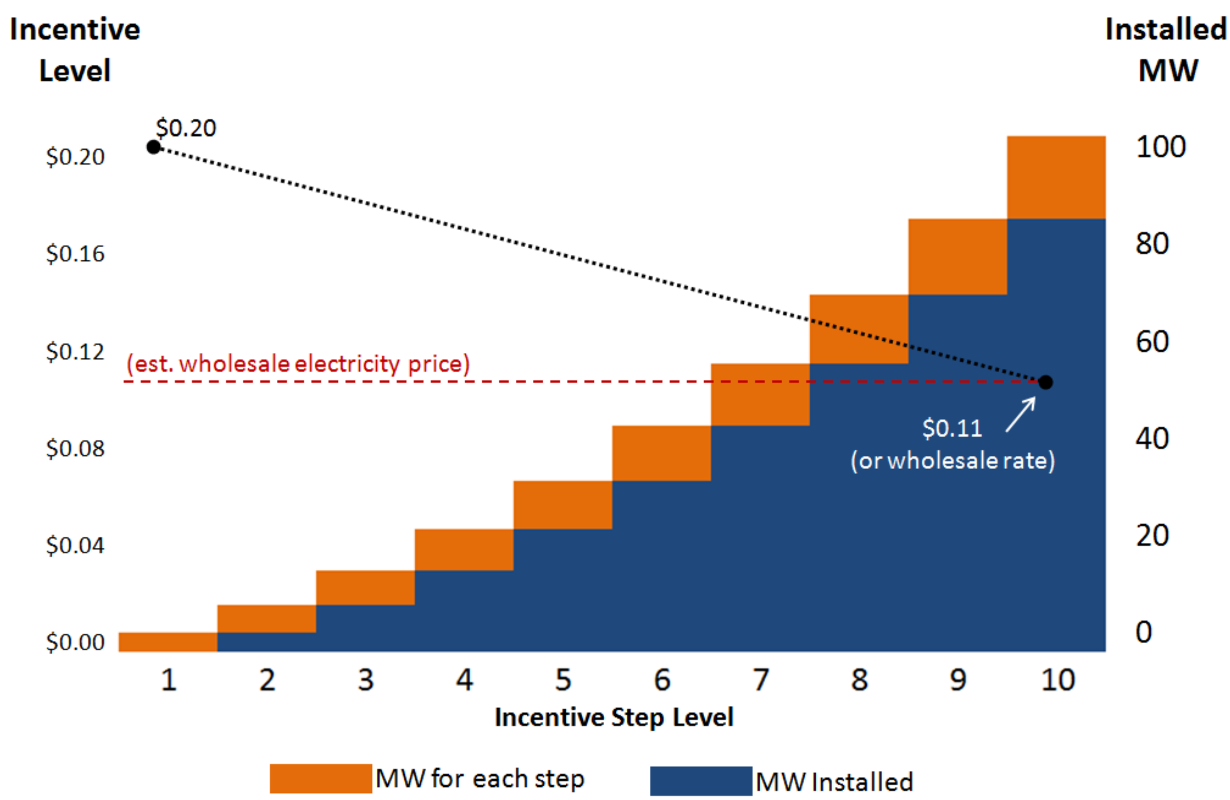
[4] Reported system prices of residential and commercial PV systems declined 6%–7% per year, on average, from 1998– 2013, and by 12%–15% from 2012–2013, depending on system size. Photovoltaic System Pricing Trends, 2014 Edition, US DOE SunShot: http://www.nrel.gov/docs/fy14osti/62558.pdf

set asides with higher compensation depending on market condition, capacity value, and other state objectives.

A 50 MW carve-out would be created for large commercial and industrial customers as well as community-based solar installations. The Commission would conduct a quarterly reverse auction for a specified level of installed capacity, where only the lowest project bids would be accepted. As with residential CSCs, the output of the facilities would be purchased by the solar aggregator. The cap of the compensation would be equivalent to the corresponding cap of the residential program at that time, though we anticipate that these bids would be considerably lower. This would allow large commercial and industrial customers, and residential customers without access to suitable locations on their own property, to participate in the distributed solar market, while using market-based mechanisms that capture the economies of scale associated with larger installations to drive down costs to all ratepayers.

Once the capacity-based step down mechanism is in place, on an annual basis, the Commission can revisit and adjust value of solar (VOS) levels according to changes in the energy market (*e.g.*, spikes in natural gas prices) or include adders to stimulate more adoption. Any potential changes in the VOS would not affect customers with existing long-term contracts. As such, there will be minimal impacts to the ability to finance projects. In the event that the Commission decreases the VOS below an existing step, the revised value will remain unchanged until a subsequent step is triggered with a lower value. If the Commission increases the VOS, it will need to stipulate how it declines by step.

Figure 5. Overview of Step-level Changes



4.3 Wholesale Distributed Generation Program

While the value of solar study informs a maximum cap of $0.20/kWh, the lower the compensation rate paid to solar generation facilities under this "value of solar" cap, the greater the benefits to Maine's non-participating ratepayers. Fortunately, the economies of scale that solar energy possesses can bring the price per kWh down quickly. Therefore, utility side of the meter wholesale solar within the distribution system may bring all the benefits of customer sited solar energy but at much lower cost. The output of these larger facilities would also serve to provide a critical mass of solar output to make aggregation and sale of the output from residential solar by the Solar Buyer more cost-effective.

Similar to the arrangement described above in Figure 5, developers of these 1-5 MW scale installations would be compensated at a fixed rate. Bi-annual competitive procurement by the transmission and distribution utilities would attempt to find the lowest priced but most impactful projects. The mechanism would be similar to that currently used by the Commission under 35-A M.R.S. § 3210-C to purchase energy and capacity from grid scale renewables.

4.4 Program Size

The program size for Maine was determined by studying California's CSI program (see Appendix) and Arizona's distributed generation set asides as a proxy. When California's CSI program started in 2007, the goal was to install approximately 1,940 MW of new solar generation for homes and small businesses. At the time, this represented about 3% of their total installed capacity.[5] Arizona's RPS based program set a DG solar target of 4.5% of load by 2025.[6] Maine's current generation capacity is approximately 4,500 MW.[7] In 2014, Maine's retail electricity load for its investor-owned T&D utilities was approximately 10,500 GWh. A 2025 DG target of 3.3% is between CA and AZ's target (trending more towards California) and would result in approximately 150 MW of new solar capacity. This would be complimented by 150 MWs for wholesale programs over five years. This establishes a total potential program size of 300 MW if the market succeeds on compensation rates closer to wholesale. By comparison, recent legislative proposals in Maine advanced by solar advocates targeted 200 MW of new solar installations by 2021.

A total of nearly 5% of load served by customer sited and wholesale solar resources is reasonable given the maturing state of the solar technology, especially if the program envisioned fully utilizes advanced inverters, optimal locations, and coupling with other technologies. Moreover, if the full 300 MW is deployed, a large portion of those MWs will be compensated at or near the future wholesale rate of energy. If this occurs, it would present a significant amount of benefits to ratepayers for years to come. A sensitivity analysis conducted in the Maine Distributed Solar Valuation Study for exactly 300 MW of distributed solar shows solar retains value even at higher penetrations.

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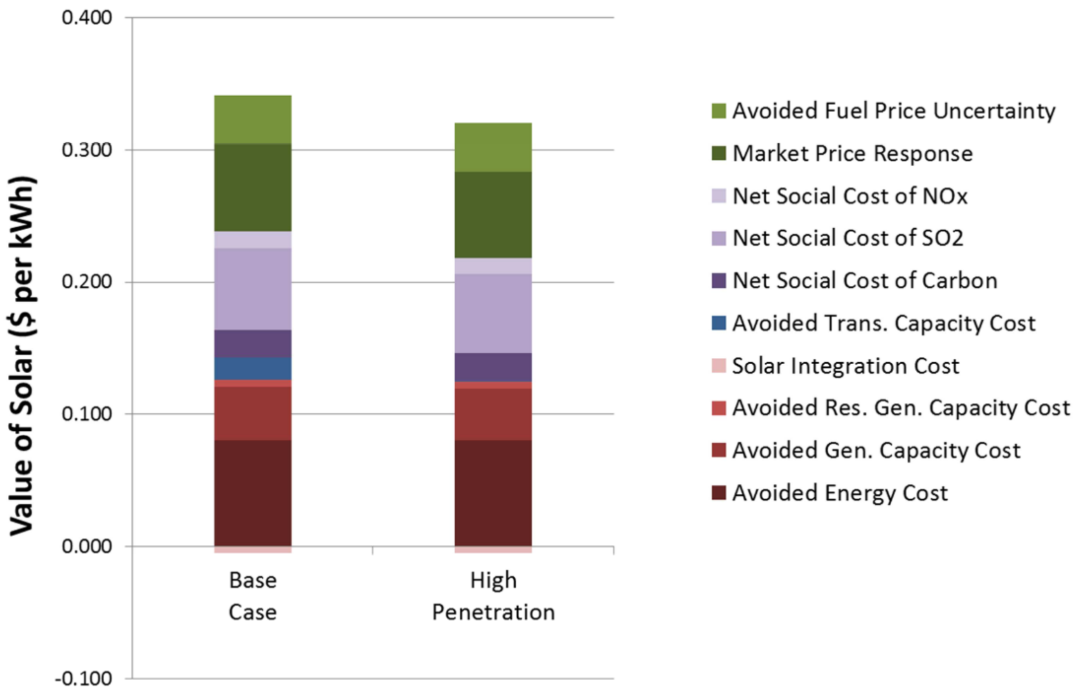
[5] California Energy Commission. Installed in-state Electric Generation Capacity by Fuel Type (MW). Energy Almanac. http://energyalmanac.ca.gov/electricity/electric_generation_capacity.html

[6] 2006, the Commission approved the Renewable Energy Standard and Tariff http://www.azcc.gov/divisions/utilities/electric/res.pdf?d=97

[7] U.S. Energy Information Administration. Maine Electricity Profile, 2012. http://www.eia.gov/electricity/state/maine/

Figure 7. 300 MW Sensitivity (CMP)[8]



4.5 Additional Program Features

Very few resources are able to be deployed in a modular fashion within the distribution system and on customer premises. Clearly, the various attributes of solar energy bring challenges and opportunities. However, correctly structured programs can balance the tradeoffs. Significant flexibility could be in built into both programs to allow for such things as locational adders, advanced inverters, renewable energy credit transfer, and differentiated rates based upon on-peak performance. The following list includes some additional features of the proposed solar programs:

Renewable Energy Credit ("REC") Transfer – With a portion of Maine's renewable resources able to deliver to other states and the unknown impact of the EPA Clean Power Plan, RECs can be valuable to the state. As such, program participants would be required to assign their RECs over to the distribution utility.

Advanced Inverters – New inverters have the capability to provide grid services and remotely update new software parameters to meet future needs. Program participants would be required to obtain advanced inverters. Further, if in the future the distribution utility seeks to control certain inverter functions remotely, they could do so as long as the impact on system production was less than 5%. The potential of having an aggregated fleet of distributed resources could yield many benefits to Maine's ratepayers.

[8] Norris, Benjamin; Grace, Robert; Perez, Dr. Richard; Rabago, Karl. Maine Distributed Solar Valuation Study. Prepared for the Maine Public Utilities Commission

Role for Other Technologies - This VOS program puts in place the infrastructure for other resources like combined heat and power (CHP), energy storage, and small scale hydro to take advantage of once their respective benefits are studied. The general framework of market competition and long-term contracts can easily be swapped to different technologies. More importantly, the greater the diversity of resources, the better it is from a grid balancing perspective. The unique attributes of the different technologies available today bring system wide diversity and resiliency to the system.

Obligation of the Solar Standard Buyer and Distribution Utility – The Solar Standard Buyer plays a key role in these programs. It must actively seek ways to maximize the value of the solar resource and facilitate market adoption within the confines of the program. Likewise, distribution utilities have a responsibility to drive down the soft costs of distributed energy resources through streamlined interconnection and constructive participation in procurement programs. Subject to reasonable limitations, there could be a role for utility participation in the wholesale distributed generation program.

Yearly Program Revision – The Commission must have a yearly update and review process to ensure correct compensation and offer new ones to maximize solar’s value. This can include price signals to encourage different production profiles, dispatchablity by encouraging pairing with onsite storage, or location-specific targeting. Again, new rates would only impact new subscribers. The market based step downs should alleviate any concern of over compensation, but a regular review may be needed, particularly in response to new occurrences in the market (e.g. gas prices volatility and new regulations).

Switching for Existing NEM Customers – Those customers that want to switch to the CSC program can do so as long as they separately meter their installation, assign over their RECs, and commit to installing an advanced inverter when replacement of their current inverter is needed. These customers would have no impact on the total program cap or step downs but a limited window would exist for switching. Those NEM customers who choose not to switch would continue in that program.

Tax Implications – The non-wholesale PV systems under this program would still be on the customer side of the meter and the kWh based compensation would not be a legal sale of energy. It would be a non-taxable bill credit. As under the current program, any excess credits at year end would be forfeited to the distribution utility.

Federal Policy Considerations – If the 30% Federal Investment Tax Credit sunsets, the current rate of CSC compensation for new sign-ups increases proportionally to make up for the loss as long as compensation rate is still below the $20 cent/kWh cap. The same treatment applies to any new tax implications that may arise for the proposed compensation structure.

End of Term Conditions – For all market segments, after the term of the contract is completed, the solar host would be paid at a different rate based on either a wholesale derivative or the then current value of solar rate.

4.6 Comparison to NEM

Figure 6 highlights the existing retail rates in Maine. The capacity-based step down approach would compensate the customer at rates that initially exceed retail rates. Not until Step 8 or 9 does the estimated payment match current retail rates. A customer's preference at that point depends on future rates and rate design as well as risk tolerance. The CSC provides a fixed predictable rate with adders to encourage technology coupling. Net metering under a traditional rate design does not offer those features even if it is initially at a higher rate than the CSC.

Figure 6. Standard Offer Rates for Maine IOUs

(All values in expressed as ¢/kWh)

Investor-owned Utility	Delivery Rates	Residential /Small Commercial	Total*
CMP	4.19	6.45	10.73
Emera - Bangor Hydro Division	6.63	6.64	13.13
Emera - Maine Public Division	6.31	8.49	14.80
Average		**7.19**	**12.89**

Source: http://maine.gov/mpuc/electricity/standard_offer_rates/index.html
*The average retail rate for Medium Non-residential customers is approximately the same as residential (12.90 ¢) through the end of 2015.

Figure 7. Highlights the differences between the existing net metering framework and proposed program design

Existing NEM Structure	New CSC Program Design
Non transparent payment that can be either above or below the true market cost	Fully transparent compensation rate with customers being paid for the actual values they provide to the grid
More difficult for utility to manage grid as intermittent generation increases	Smart inverters are required.
Lack of easily updateable price signals	Transparent setting of prices on a regular basis
Non locational and technology coupling adders	Able to reward systems in beneficial locations and/or pairing with other technologies
Uncertain economics due to future rate changes	A 20-year contract at a fixed price makes solar financing easier and does not leave customers with unmet expectations if anticipated cost increases do not materialize.

Figure 8. Representative Utility Bill with Value of Solar Credit

CENTRAL MAINE POWER

Your CMP account number:
211-000-0000-001

Central Maine Power
customer assistance line
1-800-750-4000
To report a power outage: 1-800-696-1000

J.Q. CUSTOMER
12 ANYWHERE RD
ANYTOWN STATE
Service location

Billing date: 09/08/14 **Read cycle:** 09 **Page:** 001 of 003

Customer Meter Summary

Meter Number	Read Date	Prior Read date	Number of Days	Meter Reading	Prior Meter Reading	Total KWH
AB0000000000	09/04/14	08/07/14	30	81907	81169	738

Account Summary

Prior balance				$103.32
Payments received through 09/08/14 **- thank you**		$103.32-		
Balance forward				$0.00
New charges				
Electricity Delivery:	**Central Maine Power (see details below)**		$54.18	
Electricity Supply:	**Standard Offer Service**	$55.79		
Value of Solar Credit:	300 KWH @ $0.20/KWH			($60.00)
Total new charges				$49.97
Current Account Balance:				$49.97
You have agreed to pay before 10/04/14				**$49.97**

Central Maine Power Delivery Service Account Detail

Prior balance for Central Maine Power delivery					$40.85
Payments received - thank you				$40.85-	
Balance forward					$0.00
Current delivery charges					
Delivery Charges: Residential					
Delivery Service:		738 KWH			
	Up to	**50 KWH @**	$10.65	$43.53+	
	Other	**50 KWH @**	$0.063264		
Total current delivery charges		$43.53			
Central Maine Power account balance:					$43.53

Please see back page for important information

Your electricity usage (in kilowatt hours)

	09/14	08/14	07/14	06/14	05/14	04/14	03/14	02/14	01/14	12/13	11/13	10/13	09/13
Daily	25	23	24	25	23	22	23	21	19	28	25	23	21
Monthly	738	700	740	701	680	663	774	583	608	617	808	678	599

Please return this stub with payment to CMP. If applicable, supply payments are forwarded to the appropriate energy provider. Do not send cash or coins, and do not return with staples or paper clips. Refer to back to fill in information for mail address changes or to sign up for the Automatic Payment Option plan.

Your CMP account number:
211-000-0000-001

Please pay this amount:
$49.97
before 10/04/14 so you can avoid late charges

00018D

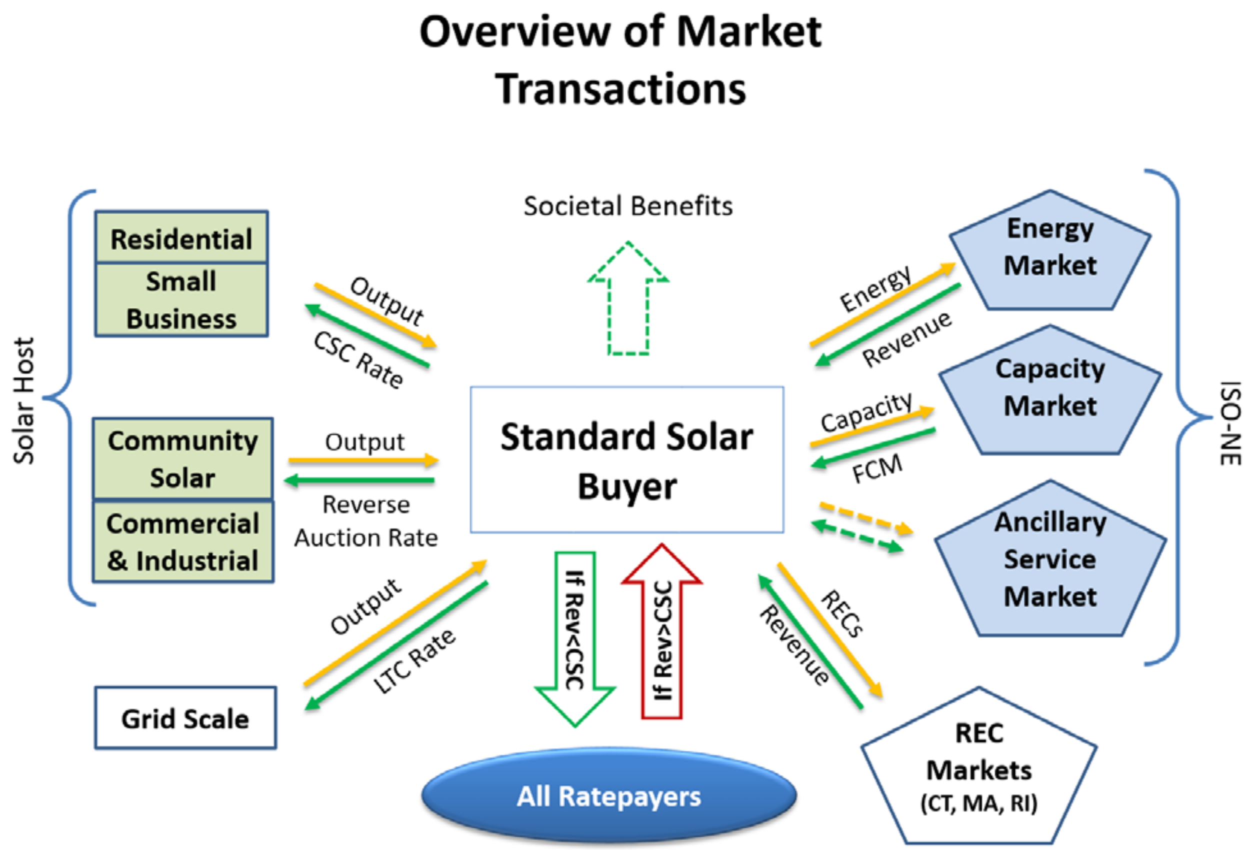
J.Q. CUSTOMER
12 ANYWHERE RD
ANYTOWN STATE

Central Maine Power Co.
P.O. Box 847810
Boston, MA 02284-7810

Please write amount paid:
$ ______
Thank you!

Please do not write below this line

Figure 9. Market Overview



5. Conclusion

This whitepaper proposes an alternative to the existing net-metering program that supports the installation of additional solar while prioritizing ratepayer benefits and encouraging fairness, transparency, and market principles. Moreover, it proposes the opening of a new market segment, wholesale DG, which can deliver nearly the same benefits of rooftop solar but a significant discount in cost. The policy vision presented here strikes a balance between stakeholder interests with a unique focus on producing benefits for all of Maine's ratepayers. With the correct structure in place, economic development benefits follow, large political fights can be diffused, customer options multiply, and innovation occurs.

While many details would need to be defined, it is our hope that all parties can agree on the general goal of maximizing benefits while mitigating costs, and that this common guiding principle can foster further dialogue on strategic and sustainable solar deployment in Maine. Rather than simply adopt the policy conventions of other states, Maine can establish a policy tailored to its specific needs, goals, and market structure. Maine can build on the innovative, collaborative work in its Value of Solar Study to be the first restructured market to adopt a value of solar based compensation structure. It can also be one of the first states to aggregate DG resources to the benefit of all ratepayers. Maine can anticipate and avoid the conflict seen in other states that have built solar incentive on net metering, by developing an alternative approach that builds a sustainable solar industry while benefiting all ratepayers. Finally, Maine can both recognize the value and benefits that distributed solar provides, while not necessarily paying for each and every value. Instead, ratepayers can and should obtain these values at the lowest price possible, while still maintaining resource diversity and customer sited options. For this concept specifically, Maine can show a path forward that balances the cost-based resource acquisition with value based compensation in a way that is efficient, transparent, and fair.

Appendix

Lessons learned: California

In 2007, California launched the California Solar Initiative ("CSI") with the goal of installing 1,940 megawatts (MW) of solar in the three IOU service territories by the end of 2016 and transition the industry to a point where it can thrive without state subsidies. As of the April, 2015 the program has incentivized 1,893 MW of solar, nearly reaching its statutory goal 1.5 years ahead of schedule. The program is ratepayer funded and incentivizes residential and non-residential system between 1 kW and 1,000 kW and is widely regarded as one of the most successful solar incentive programs in the world. It has a unique structure that has allowed it to avoid the boom-bust cycles of other incentive programs that have cooled off or disappeared after feed-in tariffs were retroactively rolled back, incentive programs changed, or renewable energy credit markets collapsed. As the CSI program draws to a close, the market is not cooling off – developers are installing projects in record numbers.

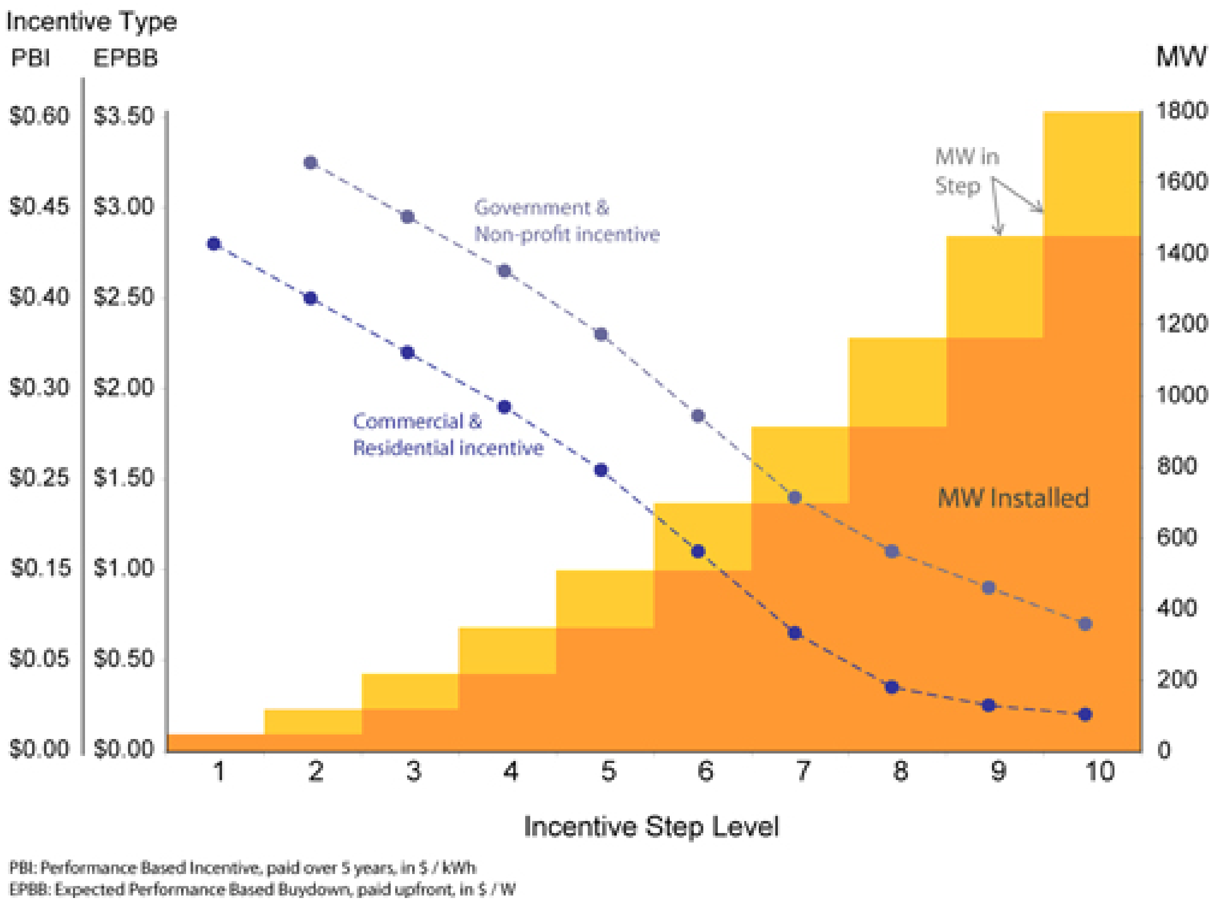
Much of the success of the CSI program can be attributed to its capacity-based declinations in incentive levels. As installed capacity targets are reached, incentive levels drop down accordingly. Under this approach, instead of relying on legislators or having funding allocated based on calendar year or some other arbitrary time frame, the market dictates incentive levels. In addition, competition prevents developers from artificially increasing their rates in order to capture a portion of the incentive –virtually all of it gets passed through to the customer.[9]

The CSI pays solar customers through two types of incentives, (1) Expected Performance-Based Buydown ("EPBB") and (2) a Performance-Based Incentive ("PBI"). The EPBB is an upfront incentive available only for systems <50 kW and is paid on a $/W basis. The PBI is applied to systems >50 kW and pays customers based on actual measured performance of over 5 years. The incentive is paid on a fixed dollar per kilowatt-hour ($/kWh) of generation.

Figure **A-1** highlights how CSI incentives step down as capacity increases. Once the capacity for a given step (shown in yellow) is reached, the program simply transitions to the next step and incentives shift accordingly. With every sequential step, the capacity has a larger. Systems for government or non-profit customers are on a separate track.

[9] Dong, C.G.; Wiser, R.; Rai, V. 2014. Incentive Pass-through for Residential Solar Systems in California. Berkeley, CA: Lawrence Berkeley National Laboratory. http://emp.lbl.gov/sites/all/files/lbnl-6927e.pdf

Figure A-1. The CSI Capacity-based Incentive Step Down



Lessons learned: Minnesota

In March, 2014, Minnesota became the first state in the nation to approve a Value of Solar tariff. The legislation allowed the utilities to voluntarily implement the policy - in lieu of the existing net metering program. Below are key characteristics of MN VOS policy[10,11]:

- **Size limitations**: <1MW (and limited to 120% of the customer's load)
- **Compensation decoupled from retail electricity price:** The customer is billed for total electricity usage at the retail rate. Their bill is credited at the VOS rate based on their solar system's production.
- **Value:**

[10] Minnesota Value of Solar: Methodology. Minnesota Department of Commerce, Division of Energy Resources. April, 2014. http://mn.gov/commerce/energy/images/DRAFT-MN-VOS-Methodology-111913.pdf
[11] Cory, Karlynn. Minnesota Values Solar Generation with New "Value of Solar" Tariff. October 3, 2014. NREL (blog). https://www.nrel.gov/tech_deployment/state_local_governments/blog/vos-series_minnesota

- The VOS is expressed as the levelized value over 25 year, expressed in $/kWh.
- Reflects values to the utility, its customers, and to society.
- VOS rate is updated annually, using transparent inputs and calculations.

- **Tariff**: Intended to reflect the displacement of existing values - it is not an incentive.

The VOS rate, established by the MN Department of Commerce, is currently higher than retail electricity costs. Therefore, no MN utility has adopted the policy. However, as retail prices increase – or as the VOS decreases - and ultimately eclipses the VOS rate, it is likely that the utilities will opt to apply to the MN Public Utilities Commission to enact the VOS in the place of net metering. By establishing a transparent market price, the VOS addresses concerns about having non-solar customers subsidizing solar customers. It remains to be seen, however, whether the VOS is compatible with 3rd party business models.

Lessons Learned: Arizona

In 2012 the Arizona Corporation Commission instated a quarterly trigger decline mechanism for residential PV incentives. This was in response to boom and bust cycles of incentives that hurt the industry and led to ratepayers over paying for incentives. Perhaps the most intricate of any state step down, the exact amount of the incentive decline related to how soon a capacity target was reached. This produced a gradual step down sensitive to panel prices and financial innovation.

Figure A-2. Rules for Arizona's Quarterly Declination Mechanism

Date of Trigger	Reservations to Activate Trigger	Rules for Incentive Reductions
On or before March 31, 2012	25%	If the trigger is activated there will be a $0.15/Watt incentive decline.
On or before June 30, 2012	50%	If the trigger is activated within 30 days of the last trigger activation there will be a $0.20/Watt incentive decline, 31-60 days a $0.10/Watt incentive decline, over 60 days a $0.05/Watt incentive decline.
On or before September 30, 2012	75%	If the trigger is activated within 30 days of the last trigger activation there will be a $0.20/Watt incentive decline, 31-60 days a $0.10/Watt incentive decline, over 60 days a $0.05/Watt incentive decline.
On or before November 1, 2012	90%	If the existing incentive is greater than $0.35 per Watt, the incentive will reduce to $0.20 per Watt. If the existing incentive is less than or equal to $0.35 the incentive will decline to $0.10 per Watt.

Due to this structure, 2012 saw a record year for residential installs in Arizona compared to years past. The rooftop solar industry was able to scale and ratepayers saved money. This set the stage for the industry to move off of direct incentives the following year. NREL in a report on “value of solar tariffs stated the following:

> “It is only within the last two years that solar in portions of certain states (e.g., Hawaii, California, and Arizona) has moved from pre-economic to grid-competitive, allowing for the reduction or elimination of state and utility incentives while still maintaining high solar growth rates. Utilities in those three states account for 65% of the national distributed solar market capacity in MW (Makhyoun et al. 2014).”[12]

[12] “Value of Solar: Program Design and Implementation Considerations” National Renewable Energy Laboratory (NREL) http://www.nrel.gov/docs/fy15osti/62361.pdf