STATE OF MAINE
PUBLIC UTILITIES COMMISSION

MAINE PUBLIC UTILITIES COMMISSION **RE: Notice of Inquiry into the Determination of the Value of Distributed Solar Energy Generation in the State of Maine.** **Docket No. 2014-00171**	**COMMENTS OF THE OFFICE OF THE PUBLIC ADVOCATE** **July 18, 2014**

In response to the Commission's June 10, 2014 Notice of Inquiry into the design and implementation of a methodology to determine the value of distributed solar energy in the state of Maine, the Public Advocate offers the following comments to assist the Commission with its inquiry.[1]

1. For purposes of this study how should the Commission define "distributed solar generation"?

Under the Commission's Rules governing Net Energy Billing (Chapter 313) and Small Generator Interconnection Procedures (Chapter 324), eligible facilities—including distributed solar generators—may have an installed capacity of 660 kW or less if located within the territory of an investor-owned utility, and 100 kW if located within the territory of a consumer-owned utility. These size limits reflect political compromises associated with the establishment of net energy billing, and not specific technical or economic limitations associated with solar generation or utilities' distribution systems. As a practical matter, solar installations in Maine have generally

[1] These comments were prepared with the assistance of Synapse Energy Economics, Inc.

been much smaller than these limits due to limitations on customers' ability to use excess net metering credits.

New England's Independent System Operator's (ISO-NE's) active Distributed Generation Forecast Working Group (DGFWG) defines distributed generation resources more broadly as "typically 5 MW or less in nameplate capacity and interconnected to the distribution system (typically 69 kV or below)."[2]

To the extent that distributed solar is economic under the current net metering regime, the Commission's definition will suffice. However, if the underlying incentives change such that larger, non-net-metered installations become economic, ISO-NE's definition may be more appropriate. For example, a substantial number of installations in excess of 1 MW but less than 5 MW have been installed in North Carolina recently, made financially viable due to a combination of state-specific incentives and North Carolina's standard Public Utility Regulatory Policy Act (PURPA) contract for renewable generators under 5 MW. We recommend that the Commission evaluate distributed solar generation up to 1.5 MW, which would include all existing and proposed solar generation in Maine.[3]

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[2] Independent System Operator New England, *Distributed Generation Forecast Working Group (DGFWG) Proposed Scope of Work*, September 25, 2013. Page 2.

[3] http://community.bowdoin.edu/news/2013/10/maines-largest-solar-power-complex-proposed-for-bowdoin/

2. **The Act requires the Commission to consider published guidance from the Interstate Renewable Energy Council (IREC) and other published materials regarding methods for consistently evaluating the value of distributed solar energy generation. Commission Staff has begun a literature review of the current best practices relating to value of solar in the United States, reviewing material from Minnesota, Austin, Texas, and reports published by IREC. Please recommend other relevant sources of information that the Commission should consider as background for its analysis.**

We suggest that the PUC review the following sources, in addition to the ones listed in its Notice of Inquiry:

AESC 2013: While AESC examines the avoided cost of energy efficiency, and not distributed solar, this report is a detailed resource of up-to-date New England data and detailed electric-sector modeling results.

Rick Hornby et al. (2013) *Avoided Energy Supply Costs in New England: 2013 Report*. Prepared for the Avoided-Energy-Supply-Component (AESC) Study Group. http://www.synapse-energy.com/Downloads/SynapseReport.2013-07.AESC.AESC-2013.13-029-Report.pdf

RMI 2013: This study reviews 15 studies, including national and state-level analysis, and provides a detailed primer on the costs and benefits of distributed solar.

Rocky Mountain Institute (2013) *A Review of Solar PV Benefit & Cost Studies, 2nd Edition*. Electricity Innovation Lab, Rocky Mountain Institute. http://www.rmi.org/elab_empower

Other sources: Several studies have been released since the publication of RMI 2013; we list these separately here.

R. Thomas Beach and Patrick G. McGuire (2013) *The Benefits and Costs of Solar Generation for Electric Ratepayers in North Carolina*. Crossborder Energy. http://energync.org/assets/files/Benefits%20and%20Costs%20of%20Solar%20Generation%20for%20Ratepayers%20in%20North%20Carolina%282%29.pdf

R. Thomas Beach and Patrick G. McGuire (2013) *Benefits and Costs of Solar Distributed Generation for the Public Service Company of Colorado: A Critique of PSCo's Distributed Solar Generation Study*. Crossborder Energy. http://www.oursolarrights.org/files/5513/8662/3174/Crossborder_Study_of_the_Benefits_of_Distributed_Solar_Generation_for_PSCo.pdf

Price Snuller et al. (2014) *Nevada Net Energy Metering Impacts Evaluation.* Prepared on behalf of the Nevada Public Utility Commission. http://puc.nv.gov/uploadedFiles/pucnvgov/Content/About/Media_Outreach/Announcements/Announcements/E3%20PUCN%20NEM%20Report%202014.pdf?pdf=Net-Metering-Study

3. Section 2 of P.L. 2013 Ch. 562 requires the Commission to adopt a methodology for valuing distributed solar generation that, at a minimum, includes the value of energy, market price impacts, value of delivery, generation capacity, transmission capacity, transmission and distribution line losses, and societal value of the reduced environmental impacts of energy.

3a. What other factors should be considered for inclusion in this methodology?

The Commission's methodology for valuing Maine's distributed solar generation should consider the value of avoided energy, market price impacts, avoided generation capacity, avoided transmission capacity, and avoided transmission and distribution line losses:

Avoided Energy: The value of avoided energy includes the variable costs avoided by the generator: fuel costs, other operations and maintenance costs, and variable embedded environmental costs associated with dispatch (i.e. the costs to comply with existing NO_x, SO_x, and CO_2 regulations). To the extent that there are associated non-embedded environmental costs (that is, externalities, or costs that are not part of market prices), those additional costs should also be included. It is anticipated that non-embedded CO_2 costs will continue to dominate this category, and those costs belong in the avoided energy category because they are directly tied to the quantity of generated electricity.[4]

Market Price Impacts: There are two distinct market price impacts associated with distributed solar: an energy-induced price effect (energy price impact), and a capacity-induced price effect (capacity price impact).

Because ISO-NE uses economic dispatch with Locational Marginal Prices (LMPs), and because the marginal cost of solar is $0/MWh, any increase in generation from solar results in either a rightward shift in the supply curve (if the solar is in-front-of the meter) or a leftward shift in the demand curve (if the solar is behind-the-meter). In either case, the net result is that the energy market clears at a lower price for all participants in the ISO-NE market.

In additional, net-metered distributed solar reduces a utility's forecasted peak demand. This results in a capacity leftward shift of the capacity demand curve, resulting in a capacity market that clears at a lower price for all participants in the ISO-NE market.

[4] Rick Hornby et. al., Avoided Energy Supply Costs in New England: 2013 Report, July 12, 2013. Chapter 4.

Avoided Generation Capacity: For reliability purposes, Maine's load serving entities (LSEs) are assigned a capacity load obligation (CLO) based upon their customers' usage during the peak hour. Because distributed solar is correlated with peak summertime consumption, it is expected that distributed solar will reduce the peak load profile for utilities in Maine, and as a result reduce the quantity of capacity that Maine LSEs must procure. To the extent that the reduction in peak demand is expected, the savings resulting from less capacity being procured materializes in reduced cost future-year standard offer bid solicitations. This savings is distinct from the capacity-price effect, which lowers the price at which the utility would pay to procure capacity.

Avoided Transmission and Distribution Capacity: The value of avoided transmission and distribution capacity should include an estimate of the costs of regional and local transmission projects that may be avoided as a result of solar distributed generation. Maine's share of the cost of ISO-NE transmission projects deemed necessary for regional reliability is approximately 8 percent, varying over time. The cost of distribution projects and of transmission projects (or portions thereof) undertaken for local reasons are borne entirely by ratepayers in Maine. As discussed below, a detailed estimate of these impacts would take into account specific projects in identified locations that might be avoided through construction of distributed solar generation, but this is difficult if not impossible to model at a high level. In the alternative, it may be possible to estimate the contribution of additional solar generation on the load levels used for transmission and distribution planning purposes.

Avoided Transmission and Distribution Line Losses: Because electricity generated by distributed solar in excess of local use does not use the transmission grid at all and generally uses less of the distribution grid than electricity from large power plants, and because line losses are greater during times of peak use (when solar tends to be generating electricity), distributed solar provides savings with respect to line losses.

Additional categories that should be considered in the Commission's methodology for valuing distributed solar generation include:

Fuel Hedge: Natural gas resources represent a substantial fraction of Maine's electric generation[5] and natural gas units are typically on the margin in New England.[6] The price of natural gas has been volatile[7] over the past decade, and distributed solar that displaces natural gas generation provides a hedge for fuel price risks.

Avoided RPS Compliance Costs: Distributed solar generation located behind-the-meter reduces electricity sales. Because Maine's Renewable Portfolio

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[5] Rick Hornby et. al., Avoided Energy Supply Costs in New England: 2013 Report, July 12, 2013. Exhibit 6-8.
[6] Rick Hornby et. al., Avoided Energy Supply Costs in New England: 2013 Report, July 12, 2013. Page 6-18.
[7] Rick Hornby et. al., Avoided Energy Supply Costs in New England: 2013 Report, July 12, 2013. Exhibit 2-4.

Standard (RPS) requirements are expressed as a percent of sales, reduced sales as a result of net metering decrease the number of renewable energy certificates necessary for compliance with Maine's RPS.

Finally, as discussed in greater detail below, the Commission should carefully consider the mechanism and timing through which these benefits are realized and to whom they accrue. In a restructured environment, there is no guarantee that these benefits will necessarily be experienced by consumers. For example, if the contribution of distributed solar is not properly incorporated into the calculation of the installed capacity requirement used for determining regional capacity needs, the potential reduction in capacity costs may not be realized, though the benefit theoretically exists.

3b. To what degree should location-specific differences in value be captured by the methodology and how should such differences be quantified?

While there may be location-specific differences in the value of distributed solar generation, quantifying these differences is often quite difficult. It is plausible that a particular distributed solar installation may defer or eliminate the need for a specific transmission or distribution infrastructure project, but forecasting these opportunities *en masse* is likely to be complicated and costly.

Any additional generation (or demand reduction) inside the state, including distributed solar, could reduce other costs associated with reliability. These costs include out-of-market payments in the capacity market for units that seek to retire but are needed for reliability, or daily uplift payments to units that are dispatched by the ISO to meet local reliability needs. Additional distributed generation will tend to reduce these additional costs. Dispatch modeling can reflect reduced uplift costs, and system planning modeling can estimate reliability payments.

Finally, there may be location-specific societal benefits from distributed solar generation. For example, non-transmission alternatives exist when local generation is used to avoid the cost of a transmission project, as is the case with the Boothbay pilot project. Because determining an incremental financial value to location-specific societal values may be particularly challenging, an alternative is to omit the location-specific benefits in the avoided cost calculations and instead encourage or prioritize projects to be built in specific geographic areas using targeted marketing or accelerated permitting.

4. Maine is one of the first states with a deregulated electricity market to engage in a comprehensive value of solar analysis. What are the key differentiating factors that the Commission should consider in reviewing the work done in other states and what changes to the methodology implemented by efforts in regulated states can be made to adapt current best practices to Maine's energy market?

Key factors differentiating vertically integrated (sometimes called regulated) and restructured (sometimes called deregulated) states include rate design, potential lost revenue and cross-subsidization. Rate design in regulated states is broken down into components that may vary from state to state but generally consist of:

- a fixed charge (with many different elements),
- an energy charge (based on volume of usage),

- a distribution charge (based on volume of usage),
- a transmission charge (based on volume of usage), and, perhaps,
- a capacity charge (based on peak day usage).

Payments for all charges are made to the local distribution company.

Rate design in restructured states includes the same basic components, but the way in which these components are billed differs from practices in vertically integrated states. Restructured states' standard offer rate design is usually very similar to vertically integrated states' rate design, with all payments initially going to the local distribution company, but then dispersed to the energy supplier and the transmission and distribution utilities. This dispersion of payments to multiple parties requires more careful accounting of which parties received specific benefits and or increased burdens resulting from distributed solar generation. For example, while the value of the energy produced by solar generation varies depending on when it is produced, net metering customers receive the same level of credit. It will be important to understand how any surplus or deficit is allocated, and to whom, particularly if the "value of solar" will provide a basis for additional subsidies or changes to net metering.

Another critical issue for designing a methodology to estimate the value of distributed solar generation is the extent to which costs are recovered through fixed charges versus volumetric (variable) charges. If some transmission and distribution costs are based on the volume of energy consumed, then distributed solar generation will reduce the revenues to transmission and distribution utilities and/or create a cross-subsidy from customers without solar installations to those with solar installations. The revenue erosion is most severe for small utilities that pass energy, capacity, and transmission costs to the suppliers of those services and rely entirely on revenues from its distribution services.

Potential cross-subsidies to energy suppliers may be of some concern. Suppliers agree to supply all energy requirements of a large group of customers. The actual quantity supplied varies annually based on numerous factors: weather, economy, energy-efficiency implementation, combined-heat-and-power implementation, and so on. In theory, distributed solar generation is another factor for which suppliers will have to plan when making their annual offers to individual customers or when bidding on standard offer contracts. Ideally, the relatively slow implementation of distributed solar will allow suppliers time to learn how to adjust. However, if net metering customers are confined to the standard offer (for example, if competitive suppliers do not accept net metering customers), these additional risks and/or cross-subsidies could drive up the price of default service relative to competitive supply options. For both regulated and restructured states, the revenue erosion from distributed solar customers is an issue for the collection of transmission and distribution costs. To the extent that distributed solar customers' annual net payments are equal to zero, all other customers have to pick up the costs of maintaining and building new transmission and distribution infrastructure.

5. How would the proposed value of distributed solar generation methodology differ from a traditional avoided cost of energy for efficiency demand side analysis such as the Avoided Energy Supply Costs in New England: 2013 Report prepared by Synapse for the Avoided-Energy-Supply-Component Study Group?

It will be necessary for the Commission's value of distributed solar methodology to differ from that of *Avoided Energy Supply Costs in New England: 2013 Report* (AESC 2013) in several ways. AESC 2013 focuses exclusively on the benefits (avoided costs) of energy efficiency. As such, the report provides a detailed approach that is a good starting place for creating a methodology for estimating the avoided costs of any demand- or supply-side resource. AESC 2013 does not, however, provide analysis of the costs (or costs net of benefits) of energy efficiency, which would be included in this proceeding.

In contrast to distributed solar, energy efficiency does not: (1) put energy onto the grid, (2) reduce any customer's instantaneous or net energy consumption to zero; or (3) offset fixed charges. Some distributed solar systems supply the grid with energy, introducing potential new costs to the utility. However, if solar penetration levels are low or the size of distributed solar installations is capped at levels gauged to avoided net excess generation, then the costs of these systems are more similar to energy efficiency.

6. How should the Commission define the phrase "societal value of reduced environmental impacts of energy" used in the Act? Should the study consider any increase societal environmental costs or benefits such as from solar manufacturing, land use impacts or overall life cycle costs or benefits?

The Commission's approach to estimating a societal value of reduced environmental impacts of energy should be as comprehensive as possible while keeping in mind practical considerations. If life-cycle analysis is employed care must be taken to assure that the same scope of analysis is applied to all resources. For example, if the environmental impacts of solar manufacturing are to be included, so too must the impacts of manufacturing or constructing fossil and other resources. A comprehensive life-cycle analysis includes "cradle-to-grave" impacts of both the generation resources themselves and fuels, extending from resource extraction through construction and generation to eventual fuel disposal and plant decommissioning. A robust estimation of all life-cycle stages for all types of generation resources could prove both challenging and costly.

An alternative approach would be to focus the estimation of the value of reduced environmental impacts of energy on the difference between two resources: (1) distributed solar; and (2) the marginal resource—in New England at present, this is natural gas in most hours of the year. This technique would streamline the methodology for estimating externality costs by concentrating on expected displaced energy, but would not allow for comparison of environmental benefits among other resources (including imports), or exploration of the benefits of displacing coal or oil generation.

7. Should the scope of the study as specified in the Act include assessment of the aggregate total solar generation resource potential in Maine? If so, how would this part of the analysis be similar and not similar to a maximum-achievable cost effective (MACE) analysis done for energy efficiency? Or is it the intent of the Act to assess the value of solar on a $/unit basis only?

Section 2 of the Act appears to indicate the intent of the Act is to assess the value of solar on a dollars-per-unit basis only. Subsection 1 is titled "Value of distributed solar energy generation," and explicitly states that "the Public Utilities Commission shall determine the value of distributed solar energy generation in the State" and that it should account for a variety of factors, most of which are typically expressed in dollars and all of which can be expressed in a per-unit basis. Subsection 4 requests "a report on the determination of the value of distributed solar energy generation in the State."

The Act includes two specific references to the value of distributed solar energy and language calling for the inclusion of factors which, in aggregate, are expressed in dollars per unit, but no references to "potential" or "maximum-achievable." The concept of cost-effectiveness is addressed in 35-A M.R.S.A. §3474(2), but only in the context of developments, policies, and programs that Maine shall pursue to encourage development, an action distinct and wholly separate from the call to study the value of solar.

Our assessment is that an assessment of the value of solar on a dollars-per-unit basis will satisfy the Act. An assessment of the aggregate total solar generation resource potential in Maine, while not prohibited by the Act, is not explicitly required.

Should such an assessment be desired, it is important to consider some key differences between an energy efficiency supply curve and a distributed solar supply curve. Firstly, an energy efficiency supply curve has extremely high granularity due to the wide variety of technologies, opportunities, and costs associated with energy efficiency. The high granularity results in a curve that behaves according to traditional microeconomic models. The distributed solar supply curve, on the other hand, has extremely low granularity, akin to a step function. Furthermore, while the total supply of energy efficiency is bound by the total sales of electricity, distributed solar has no upper limit. These two factors can make applying an analysis designed for energy efficiency on distributed solar difficult.

8. What criteria should the commission use to evaluate the reliability of distributed solar generation when developing the valuation methodology?

The Commission should continue to require that all distributed generation installations (including solar) comply with state jurisdictional interconnection standards (generally consistent with the Institute of Electrical and Electronics Engineers' IEEE Standard 1547). To the extent that ISO-NE or FERC have published standards or methods regarding reliability, the commission should give considerable weight to that guidance.

The Commission should also look at ISO-New England's recent solar photovoltaic forecast coming out of the Distributed Generation Forecast Working Group (DGFWG), which analyzes state solar policies, capacity values, and future growth trends. While we are not endorsing the ISO's outcome, the forecast should be considered as one set of data points to help understand the value of distributed solar.[8]

Respectfully submitted,

Timothy R. Schneider
Public Advocate

Agnes Gormley
Senior Counsel

[8] Materials on the ISO's Solar Photovoltaic Forecast are available here: http://www.iso-ne.com/committees/comm_wkgrps/othr/distributed_generation_frcst/index.html