Value of Distributed Generation

Solar PV in Connecticut

March 2015

Acadia Center

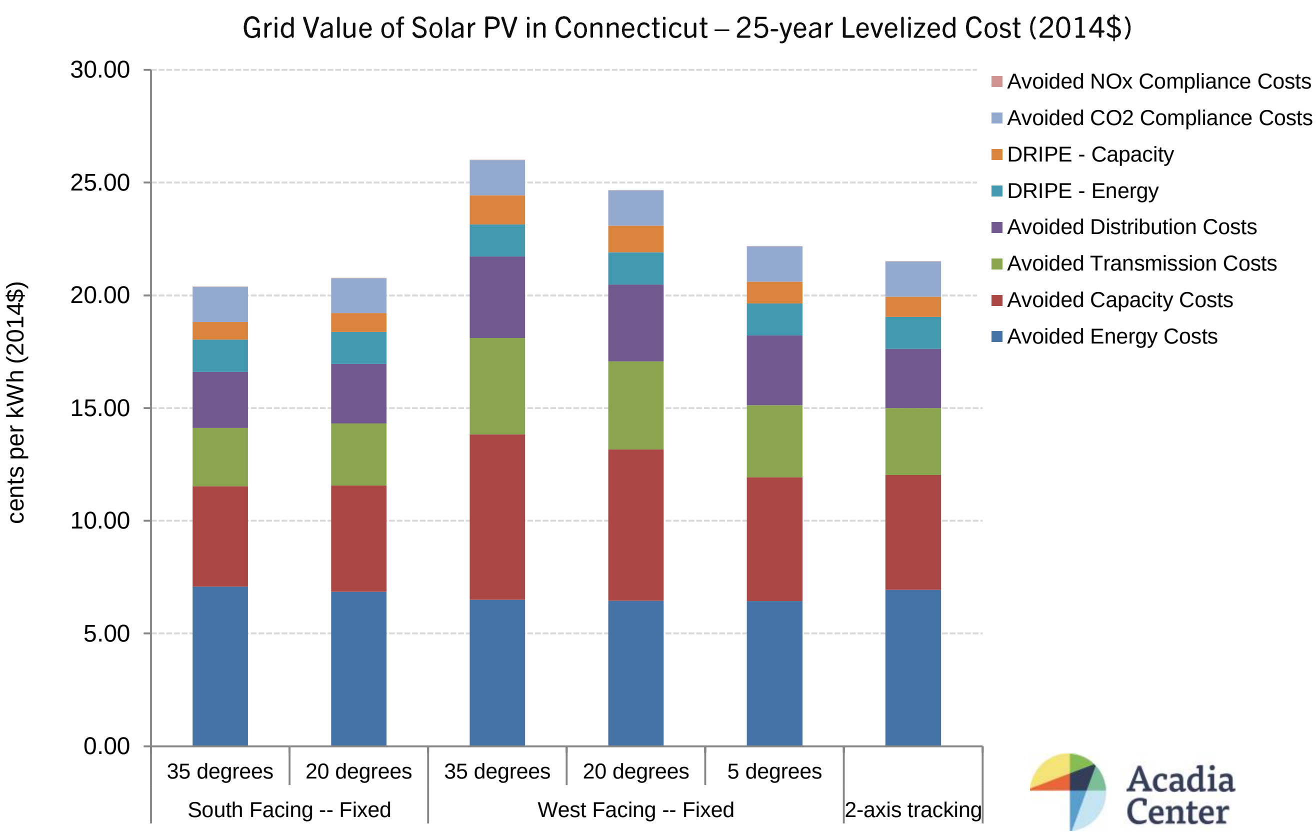
Advancing the Clean Energy Future

Grid Value of Solar PV

Distributed energy resources (DERs) like solar photovoltaic (solar PV) systems provide unique value to the electric grid. The price of electricity varies throughout the day. For example, at 7 a.m. on July 19, 2013, the wholesale market price of electricity in Connecticut was $49.70 per MWh; by 5 p.m. the price had jumped to $222.93 per MWh. A solar PV system feeding electricity into the grid at 5 p.m. on July 19, 2013 would have offset the need to purchase energy from another generator at that high market rate.

In addition to avoided energy costs, behind-the-meter solar PV helps offset other costs associated with the electric grid and, ultimately, all ratepayers' electricity bills. These include: avoided capacity costs; avoided transmission and distribution costs; energy and capacity market price suppression effects (also called demand reduction induced price effects or "DRIPE"); and, avoided environmental compliance costs. While not included in this analysis, there is locational value associated with solar PV and other DERs if they are strategically located on the grid to help avoid the need for expensive infrastructure upgrades. DERs also generate significant societal benefits. Including economic benefits and the avoided social costs of greenhouse gas emissions and other pollutants such as SO_2 would further enhance the value proposition of solar PV. Those components are not included in the figure below (note: in a recent analysis in Maine, including the net social cost of carbon, SO_2, and NO_x added 9.6 cents to the overall value of solar).

Below are the results of Acadia Center's assessment of the value of a solar PV system installed near Hartford, CT (assuming a marginal unit). The methodology behind each component is available at: http://acadiacenter.org/?p=1326



Note: Where appropriate, avoided reserve capacity costs, transmission and distribution losses, and a wholesale risk premium or price hedge are included in the calculations.

This assessment considers six different solar PV system orientations: 1) south-facing (azimuth of 180 degrees) with a 35 degree tilt; 2) south-facing with a 20 degree tilt; 3) west-facing (azimuth of 270 degrees) with a 35 degree tilt; 4) west-facing with a 20 degree tilt; 5) west-facing with a 5 degree tilt; and, 6) a 2-axis tracking system. As shown in the figure above, the orientation of a system will deliver different values. For example, the value of the avoided energy component in south-facing systems is larger since overall output is maximized; whereas, capacity-related components are larger in systems that are facing the sun during periods of greater demand (i.e., west-facing systems that produce more energy in the afternoon) because these systems deliver greater output during peak hours.

Policy Ramifications for Connecticut

One of the key findings of this analysis is that a "flat" system of compensation – such as net metering – distorts the market for solar PV by inadequately valuing west-facing systems relative to south-facing ones. As shown in the table below, the total value per year of a 5 kW south-facing system versus a 5 kW west-facing system would be similar – $1,306 and $1,359, respectively – but under net metering the west-facing system would receive almost 20% less compensation than a south-facing system.

Grid Value of Solar, Annual Output and Total Annual Value by System Type

	South-facing @ 35˚	South-facing @ 20˚	West-facing @ 35˚	West-facing @ 20˚	West-facing @ 5˚	2-axis tracking
Unit Value of Solar (cents/kWh)	20.4	20.8	26.0	24.6	22.2	21.5
Total Annual Output (kWh)	6,403	6,227	5,225	5,388	5,491	8,086
Total Annual Value ($)	$1,306	$1,295	$1,359	$1,325	$1,219	$1,739

The differences in value for production from south-facing and west-facing systems also have implications for the appropriate design of the residential solar incentives currently offered by the Connecticut Green Bank. Incentives should be designed to maximize the value that the solar PV resource provides to both system owners and all ratepayers rather than simply kWh throughput. This helps ensure that incentives are fair and optimize grid support.

These solar PV production values also need to be factored into any policymaking and rate design for new solar initiatives – for instance, for any new community solar projects or for any new tariffs designed for solar PV. One way this might work is a bi-directional rate structure where a solar PV owner pays retail rates for all power imported from the grid and receives the "value of solar" for all power exported to the grid (less distribution charges based on volume or demand at system peak). This would help remedy the concern that solar PV owners might be unfairly shifting grid costs onto other grid users. See Acadia Center's UtilityVision for additional rate design recommendations.

Locational values have not been considered in this study, but are important for maximizing the savings in distribution costs that solar PV can bring for all electric ratepayers. Price signals from the electric distribution companies are needed so that customer-sited solar PV and other DER can be targeted to areas of the grid where infrastructure improvements might be needed in the near future. The load reductions that DERs can bring to these high load areas can defer or avoid the need for new infrastructure spending that would be paid for by all ratepayers.

For more information:

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