The Fair Market Value of Rooftop Solar

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Vice President, General Counsel and Corporate Secretary
Edison Electric Institute

NCSL Legislative Summit
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Minneapolis, Minnesota
Rapid Growth of Renewable Energy

Installed Capacity (MW)

Source: Ventyx, Inc., The Velocity Suite
Non-Hydro Renewable Sources More Than Double Between 2012 and 2040

Non-hydro Generation, Billion kWh

Typical Energy Production and Consumption for a Small Customer with Solar PV

Source: Value of the Grid to DG Customers, Institute for Electric Innovation, October 2013
2013 solar surpassed FOUR GIGAWATTS (GW), bringing U.S. solar capacity to over 10.5 GW.

U.S. Solar Capacity in MW
- Residential
- Non-residential
- Utility

Cumulative MW
- Before 2013: 6,298
- Before 2013: 313,420
- 2013: 4,211
- 2013: 137,074

ANNUAL MW
1. Pacific Gas and Electric Company (CA): 1,571 MW
2. San Diego Gas & Electric Company (CA): 643 MW
3. Arizona Public Service (AZ): 471 MW
4. Southern California Edison (CA): 373 MW
5. Duke Energy Progress (NC, SC): 137 MW
7. Public Service Electric & Gas Company (NJ): 100 MW

ANNUAL W/CUSTOMER
- Sterling Municipal Light Dept (MA): 531 W
- San Diego Gas & Electric Company (CA): 481 W
- Silucos Valley Power/City of Santa Clara (CA): 421 W
- Arizona Public Service (AZ): 355 W
- Hawaiian Electric Company, Inc. (HI): 320 W
- Pacific Gas and Electric Company (CA): 281 W
- Hawaiian Electric Light Company (HI): 182 W
- Maui Electric Company Ltd (HI): 178 W
- Kauai Island Utility Cooperative (HI): 161 W
- Imperial Irrigation District (CA): 152 W

ANNUAL INTERCONNECTIONS
- Hawaiian Electric Company, Inc. (HI): 47 projects
- Southern California Edison (CA): 37 projects
- Hawaiian Electric Light Company (HI): 24 projects
- San Diego Gas & Electric Company (CA): 10 projects
- Hawaiian Electric Company, Inc. (HI): 9 projects
- Arizona Public Service (AZ): 5 projects
- California Public Utilities Commission (CA): 3 projects
- San Diego Gas & Electric Company (CA): 2 projects
- Arizona Public Service (AZ): 2 projects
- Southern California Edison (CA): 1 project

Top 10 Solar States (total MW)
1. California (CA): 5,537 MW
2. New York (NY): 241 MW
3. Arizona (AZ): 1,026 MW
5. Massachusetts (MA): 319 MW
6. Texas (TX): 235 MW
7. Colorado (CO): 264 MW
8. Nevada (NV): 241 MW
9. Florida (FL): 188 MW
10. Oregon (OR): 112 MW

Program News from 2013 Utility Survey
- 70% of responding utilities are currently offering customer solar incentives.
- 45% are currently offering programs for key accounts.

SEPA = solar electric power association

MW = megawatt-ac
U.S. Solar Capacity

U.S. Solar Capacity in MW

- Residential
- Non-residential
- Utility

Cumulative MW

- 2010: 679 MW
- 2011: 906 MW
- 2012: 2,627 MW
- 2013: 10,509 MW

Source: Solar Electric Power Association
Lower Costs for Utility-Scale Systems

Figure 2: Average system cost per kW based on system size reported in California Solar Initiative database

Source: National Regulatory Research Institute, Report No. 14-05, June 2014
Rooftop Solar Remains the Most Expensive Form of Electricity Generation

**Unsubsidized Levelized Cost of Energy Comparison**

<table>
<thead>
<tr>
<th>Technology</th>
<th>Solar PV—Crystalline Rooftop</th>
<th>Solar PV—Crystalline Utility Scale</th>
<th>Solar PV—Thin-film Utility Scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost (2017 USD/MWh)</td>
<td>$149</td>
<td>$91</td>
<td>$99</td>
</tr>
</tbody>
</table>

**Notes:**
- **50% debt at 8% interest rate and 40% equity at 12% cost for conventional and Alternative Energy generation technologies.**
- **Assumes Powder River Basin coal price of $1.99 per MMBtu and natural gas price of $4.50 per MMBtu.**
- **As many have argued, current solar pricing trends may be masking material differences between the inherent economics of certain types of thin-film technologies and crystalline silicon.**
- **Denotes distributed generation technology.**
- **(a)** Analysis excludes integration costs for intermittent technologies. A variety of studies suggest integration costs ranging from $2.00 to $10.00 per MWh.
- **(b)** Low end represents single-axis tracking. High end represents fixed-tilt installation. Assumes 10 MW system in high insolation jurisdiction (e.g., Southwest U.S.). Not directly comparable for baseload.
- **(c)** Diamonds represent estimated implied levelized cost of energy in 2013, assuming $1.50 per watt for a crystalline single-axis tracking system and $1.50 per watt for a thin-film single-axis tracking system.
- **(d)** Low end represents single-axis tracking. High end represents fixed-tilt installation. Assumes 10 MW fixed-tilt installation in high insolation jurisdiction (e.g., Southwest U.S.).
Rooftop Solar Remains the Most Expensive Form of Electricity Generation

Figure 2.7 Bottom-Up Average System Prices, Q1 2014

“German customers already pay the highest electricity prices in Europe... This year, German customers will be forced to pay €20 billion ($26 billion) for electricity from solar, wind and biogas plants—electricity with a market price of just over €3 billion. Even the figure of €20 billion is disputable if you include all the unintended costs and collateral damage associated with the project... Depending on the weather and the time of the day, the country can face absurd states of energy surplus or deficit.”

“Germany’s Energy Poverty: How Electricity Became a Luxury Good,” Der Spiegel, 09/04/2013
Germany: Overgenerous Subsidies

Costa del solar

Germany’s:

- solar PV installation cost € per KW peak
- subsidy to renewables €bn

Source: CF Partners

The Economist, 12 October 2012

EEG surcharge: Share of subsidy FIT paid for by customers in their electricity bills, the difference between the total FIT tariff and the wholesale price of electricity.

EEG cost per year: Total annual cost of the EEG surcharge. Total disbursements to renewable energy providers in addition to their proceeds from wholesale markets.

Source: German Federal Ministry of the Environment, Nature Conservation, Building and Nuclear Safety
Germany: €40B to Expand the Transmission Grid

The Grid Development Plan, 2013

Existing Grid 2013

Target Grid 2023

Source: Bundesnetzagentur – Grid Development Plan 2013
Non-Energy Charges Paid by a Typical Residential Customer on a Retail Tariff

<table>
<thead>
<tr>
<th>Average Residential Customer:</th>
<th>Non-Energy Charges as Percent of Typical Monthly Bill</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average Monthly Usage (kWh)*</td>
<td>1000</td>
</tr>
<tr>
<td>Average Monthly Bill ($)*</td>
<td>$110</td>
</tr>
</tbody>
</table>

Typical Monthly Fixed Charges

<table>
<thead>
<tr>
<th>Description</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ancillary/Balancing Services</td>
<td>$1</td>
</tr>
<tr>
<td>Transmission Systems</td>
<td>$10</td>
</tr>
<tr>
<td>Distribution Services</td>
<td>$30</td>
</tr>
<tr>
<td>Generation Capacity ^</td>
<td>$19</td>
</tr>
<tr>
<td>Total Fixed Charges for Customer</td>
<td>$60</td>
</tr>
<tr>
<td>Fixed Charges as Percent of Monthly Bill</td>
<td>55%</td>
</tr>
</tbody>
</table>

*Based on Energy Information Administration (EIA) data, 2011

^The charge for capacity varies depending upon location. This is just an estimate.
Real-time energy prices peak when demand is high, but rarely equal the amount paid to distributed solar customers through the current net metering tariff.

In Michigan, current net metering tariffs reimburse solar customers at the full retail rate providing subsidization at the expense of non-solar customers.

DTE Energy estimates that non-solar customers could pay ~ $120 million over a 20 year period\(^1\) to subsidize solar customers.

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\(^1\) Assumed a 3.4 kW average fixed cost for the Residential Service Rate with 57 MW fully subscribed under the net metering program (category 1).
Which Is the Better Deal for Austin?

Austin, TX

<table>
<thead>
<tr>
<th>Plan</th>
<th>Price (cents/kWh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Austin Energy 2014 VOS</td>
<td>10.7</td>
</tr>
<tr>
<td>Austin Energy 2014 Solar PPA</td>
<td>5</td>
</tr>
<tr>
<td>ERCOT Average Summer 2013</td>
<td>3.77</td>
</tr>
<tr>
<td>ERCOT Peak Summer 2013</td>
<td>4.66</td>
</tr>
</tbody>
</table>

Sources: Ventyx, The Velocity Suite; Austin Energy
## Which Is the Better Deal for Clean Energy?

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>MN 2014 VOS</td>
<td>18</td>
</tr>
<tr>
<td>MN Average Residential Retail 2013</td>
<td>11.94</td>
</tr>
<tr>
<td>MISO Average Summer 2013</td>
<td>2.97</td>
</tr>
<tr>
<td>MISO Peak Summer 2013</td>
<td>3.9</td>
</tr>
<tr>
<td>Average wind PPA</td>
<td>2.4</td>
</tr>
</tbody>
</table>

Sources: Ventyx, The Velocity Suite; U.S. Energy Information Administration; Minnesota Department of Commerce
DG Integration Challenges

The Duck Curve - California

The Nessie Curve - Hawaii


State Tax Incentives

- State Tax Credit for Residential and/or Commercial Projects
- State Sales Tax Incentives
- State Property Tax Incentives and/or Local Option for Property Tax Incentive

State Rebates and Loans

- State PV Rebates
- Loan Programs
- Utility Incentive(s)
- State PV Rebates and Loan Programs

Direct Cash Incentives

- State Direct Cash Incentives for PV
- Utility Direct Cash Incentive(s) for PV and/or Solar Water Heating

Source: www.dsireusa.org (Various maps combined)
U.S. Solar Resource Potential

Photovoltaic Solar Resource of the United States

- kWh/m²/Day
  - > 6.5
  - 6.0 to 6.5
  - 5.5 to 6.0
  - 5.0 to 5.5
  - 4.5 to 5.0
  - 4.0 to 4.5
  - 3.5 to 4.0
  - 3.0 to 3.5
  - < 3.0

Annual average solar resource data are shown for a tilt = latitude collector. The data for Hawaii and the 48-contiguous states are a 10km satellite modeled dataset (UNY/NREL, 2007) representing data from 1998-2009.

The data for Alaska are a 40 km dataset produced by the Climatological Solar Radiation Model (NREL, 2003).

This map was produced by the National Renewable Energy Laboratory for the U.S. Department of Energy.

Billy J. Roberts
19 September 2012
U.S. Wind Resource Potential
Key Takeaways

- Promote clean energy as part of our diverse fuel mix in a way that achieves low costs, maintains the reliability of the system, and is fair and equitable to all stakeholders.

- Focus on those clean energy resources that are most available in your state and most cost effective for your constituents.

- Keep rates low.

- Larger clean energy sources are cheaper.

- Provide utility commissions with goals, but let them use their expertise to integrate renewable energy at the lowest cost for your constituents.

- Be cautious of subsidies that are hidden and hard to undo.