TRENDS IN SOLAR PRICING AND STATE POLICIES: A BASELINE FOR CONSUMER ADVOCATES

Sean Gallagher, VP State Affairs
Solar Energy Industries Association

June 1, 2016
About SEIA

• U.S. National Trade Association for Solar Energy
  • Founded in 1974
  • 1,000 member companies from all 50 states
• Our Mission: Build a strong solar industry to power America
• Our Goal: 100 gigawatts of solar capacity by 2020
Agenda

• Solar market statistics
• Distributed generation policies and trends
• Utility scale solar policies and trends
Yearly U.S. Solar Installations

Source: SEIA/GTM Research U.S. Solar Market Insight Q4 2015
greentechmedia.com/research/ussmi
Solar Growth by Market Segment

Yearly U.S. Solar Photovoltaic (PV) Installations

Source: SEIA/GTM Research
Investment in Solar has increased 10x since 2006

Yearly U.S. Solar Investment

Source: SEIA/GTM Research U.S. Solar Market Insight Q4 2014
greentechmedia.com/research/ussmi;
NREL, Concentrating Solar Power Projects
Solar as an Economic Engine

- Nearly 209,000 American workers in solar – more than double the number in 2010 – at more than 8,000 companies


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Growth in Solar led by Falling Prices

Source: SEIA/GTM Research
U.S. Solar Market Insight Q4 2014
greentechmedia.com/research/ussmi
Lawrence Berkeley National Laboratory, Tracking the Sun
PV Prices fall by 50%+ over last 5 years

Installed PV Price by Market Segment

$2.00
$3.00
$4.00
$5.00
$6.00
$7.00
$8.00
$9.00

$/watt

2009 2010 2011 2012 2013 2014 1H 2015

Residential Non-Residential ≤500 kW Non-Residential >500 kW Utility-Scale Fixed Utility-Scale Tracker

Source: Lawrence Berkeley National Laboratory
Residential Third-Party Ownership Broadens Access to Solar

![Graph showing percentage of new residential installations owned by a third party in CA, AZ, CO, NY, NJ and MA, Q1 2011-Q2 2015.](source: SEIA/GTM U.S. Solar Market Insight Q2 2015)
Solar PV Price Breakdown

Q4 2015 Quoted PV Prices

$/watt-dc

Residential

Commercial

Utility-Scale

PV Module
Inverter
Electrical BOS
Structural BOS
Direct Labor
Engineering and PII
Supply Chain, Overhead, Margin
U.S is a 50 state market

Projected 2015 Year-End Cumulative Solar PV Capacity (MWdc)

- California, 11,710
- Arizona, 2,036
- North Carolina, 1,996
- New Jersey, 1,717
- Nevada, 1,165
- New York, 672
- Hawaii, 623
- Texas, 560
- Massachusetts, 1,026
- Others, 3,817

Source: 2015 projections from SEIA/GTM Research U.S. Solar Market Insight
### Top 10 DG States by Absolute Growth

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>California</td>
<td>3,880</td>
<td>13,234</td>
<td>9,353</td>
</tr>
<tr>
<td>New York</td>
<td>510</td>
<td>2,711</td>
<td>2,201</td>
</tr>
<tr>
<td>Massachusetts</td>
<td>937</td>
<td>2,256</td>
<td>1,319</td>
</tr>
<tr>
<td>Maryland</td>
<td>306</td>
<td>1,111</td>
<td>805</td>
</tr>
<tr>
<td>Connecticut</td>
<td>185</td>
<td>912</td>
<td>727</td>
</tr>
<tr>
<td>New Jersey</td>
<td>1,132</td>
<td>1,683</td>
<td>551</td>
</tr>
<tr>
<td>Texas</td>
<td>113</td>
<td>598</td>
<td>486</td>
</tr>
<tr>
<td>Florida</td>
<td>106</td>
<td>574</td>
<td>468</td>
</tr>
<tr>
<td>Minnesota</td>
<td>28</td>
<td>472</td>
<td>444</td>
</tr>
</tbody>
</table>

### Top 10 DG States by % Growth

<table>
<thead>
<tr>
<th>State</th>
<th>2011-15 DG MW</th>
<th>2016-2020 DG MW</th>
<th>DG % Growth</th>
</tr>
</thead>
<tbody>
<tr>
<td>South Carolina</td>
<td>8</td>
<td>172</td>
<td>2097%</td>
</tr>
<tr>
<td>Minnesota</td>
<td>28</td>
<td>472</td>
<td>1579%</td>
</tr>
<tr>
<td>Indiana</td>
<td>9</td>
<td>130</td>
<td>1348%</td>
</tr>
<tr>
<td>Virginia</td>
<td>19</td>
<td>208</td>
<td>1003%</td>
</tr>
<tr>
<td>Michigan</td>
<td>15</td>
<td>151</td>
<td>936%</td>
</tr>
<tr>
<td>New Hampshire</td>
<td>23</td>
<td>222</td>
<td>868%</td>
</tr>
<tr>
<td>District of Columbia</td>
<td>15</td>
<td>136</td>
<td>796%</td>
</tr>
<tr>
<td>Delaware</td>
<td>32</td>
<td>271</td>
<td>752%</td>
</tr>
<tr>
<td>Illinois</td>
<td>22</td>
<td>180</td>
<td>731%</td>
</tr>
<tr>
<td>Vermont</td>
<td>55</td>
<td>399</td>
<td>632%</td>
</tr>
</tbody>
</table>

Source: SEIA/GTM Research
### Top 10 Utility-Scale States by Absolute Growth

<table>
<thead>
<tr>
<th>State</th>
<th>2011-15 Utility-Scale MW</th>
<th>2016-2020 Utility-Scale MW</th>
<th>Utility-Scale Growth</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Texas</td>
<td>394</td>
<td>4,233</td>
<td>3,840</td>
</tr>
<tr>
<td>2 California</td>
<td>7,179</td>
<td>10,407</td>
<td>3,229</td>
</tr>
<tr>
<td>3 Utah</td>
<td>194</td>
<td>1,466</td>
<td>1,272</td>
</tr>
<tr>
<td>4 Nevada</td>
<td>777</td>
<td>1,978</td>
<td>1,201</td>
</tr>
<tr>
<td>5 Florida</td>
<td>21</td>
<td>1,173</td>
<td>1,152</td>
</tr>
<tr>
<td>6 Georgia</td>
<td>339</td>
<td>1,392</td>
<td>1,054</td>
</tr>
<tr>
<td>7 New Mexico</td>
<td>250</td>
<td>1,287</td>
<td>1,037</td>
</tr>
<tr>
<td>8 Oregon</td>
<td>26</td>
<td>1,042</td>
<td>1,016</td>
</tr>
<tr>
<td>9 Colorado</td>
<td>162</td>
<td>956</td>
<td>794</td>
</tr>
<tr>
<td>10 Virginia</td>
<td>2</td>
<td>750</td>
<td>748</td>
</tr>
</tbody>
</table>

### Top 10 Utility-Scale States by % Growth

<table>
<thead>
<tr>
<th>State</th>
<th>2011-15 Utility-Scale MW</th>
<th>2016-2020 Utility-Scale MW</th>
<th>Utility-Scale % Growth</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Washington</td>
<td>0.0</td>
<td>142.4</td>
<td>-</td>
</tr>
<tr>
<td>2 Iowa</td>
<td>0.0</td>
<td>68.0</td>
<td>-</td>
</tr>
<tr>
<td>3 Louisiana</td>
<td>0.0</td>
<td>33.7</td>
<td>-</td>
</tr>
<tr>
<td>4 New Hampshire</td>
<td>0.0</td>
<td>12.5</td>
<td>-</td>
</tr>
<tr>
<td>5 Virginia</td>
<td>2.1</td>
<td>750.4</td>
<td>36414%</td>
</tr>
<tr>
<td>6 Minnesota</td>
<td>2.3</td>
<td>682.6</td>
<td>29578%</td>
</tr>
<tr>
<td>7 Michigan</td>
<td>1.3</td>
<td>333.5</td>
<td>26372%</td>
</tr>
<tr>
<td>8 South Carolina</td>
<td>3.7</td>
<td>525.2</td>
<td>14095%</td>
</tr>
<tr>
<td>9 Florida</td>
<td>20.9</td>
<td>1,173.0</td>
<td>55111%</td>
</tr>
<tr>
<td>10 Oregon</td>
<td>26.3</td>
<td>1,041.8</td>
<td>3861%</td>
</tr>
</tbody>
</table>

### Top 10 Utility-Scale States by Per Capita Growth

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1 New Mexico</td>
<td>119.99</td>
<td>617.30</td>
<td>497.30</td>
</tr>
<tr>
<td>2 Utah</td>
<td>64.80</td>
<td>489.22</td>
<td>424.42</td>
</tr>
<tr>
<td>3 Nevada</td>
<td>268.73</td>
<td>684.25</td>
<td>415.52</td>
</tr>
<tr>
<td>4 Hawaii</td>
<td>38.23</td>
<td>333.57</td>
<td>295.34</td>
</tr>
<tr>
<td>5 Oregon</td>
<td>6.33</td>
<td>258.58</td>
<td>252.06</td>
</tr>
<tr>
<td>6 Vermont</td>
<td>94.04</td>
<td>286.45</td>
<td>192.42</td>
</tr>
<tr>
<td>7 Colorado</td>
<td>29.63</td>
<td>175.15</td>
<td>145.51</td>
</tr>
<tr>
<td>8 Texas</td>
<td>14.33</td>
<td>154.11</td>
<td>139.78</td>
</tr>
<tr>
<td>9 Minnesota</td>
<td>0.42</td>
<td>124.34</td>
<td>123.93</td>
</tr>
<tr>
<td>10 South Carolina</td>
<td>0.76</td>
<td>107.27</td>
<td>106.52</td>
</tr>
</tbody>
</table>

Source: SEIA/GTM Research
Extending the ITC

- Extended at 30% through the end of 2019
  - Drops to 26% in 2020 and 22% in 2021
  - After 2021, Commercial credit drops to 10%, Residential credit expires

- Commence Construction language added
  - Projects must be placed in service before the end of 2023
100 GW by 2020 with Extension

U.S. PV Market Forecast Post-ITC Extension

From 2016-2020
72 GW, 220,000 jobs

ITC Extended
12/18/2015

Source: GTM Research Preliminary U.S. PV Forecast_Omnibus ITC Extension

Residential  Commercial  Utility-Scale

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Broad Public Support for Solar

ROOFTOP SOLAR AND NET METERING ARE CLEAR WINNERS (REPUBLICANS)

<table>
<thead>
<tr>
<th>Policy</th>
<th>Support</th>
<th>Oppose</th>
</tr>
</thead>
<tbody>
<tr>
<td>NET METERING</td>
<td>86</td>
<td>11</td>
</tr>
<tr>
<td>ROOFTOP SOLAR</td>
<td>82</td>
<td>13</td>
</tr>
<tr>
<td>PORTFOLIO</td>
<td>69</td>
<td>26</td>
</tr>
<tr>
<td>GOVT R&amp;D</td>
<td>59</td>
<td>37</td>
</tr>
<tr>
<td>CARBON FEE</td>
<td>56</td>
<td>39</td>
</tr>
<tr>
<td>TAX INCENTIVES</td>
<td>55</td>
<td>40</td>
</tr>
<tr>
<td>NUCLEAR</td>
<td>56</td>
<td>37</td>
</tr>
</tbody>
</table>
Net Metering

41 States + DC, AS, USVI, & PR have mandatory net metering rules

KEY
- State-developed mandatory rules for certain utilities (41 states + DC + 3 territories)
- No statewide mandatory rules, but some utilities allow net metering (2 states)
- Statewide distributed generation compensation rules other than net metering (4 states + 1 territory)

U.S. Territories:
- AS
- PR
- VI
- GU
Net Metering

• Under current NEM rules, distributed generation solar at grid parity in 20 states

Source: Shayle Kann, GTM Research
U.S. Solar Market Insight Conference
Keynote: The Future of Solar
Net Metering

- If export rate is cut in half, 0 states at grid parity
- Nevada outcome looms large, but not emblematic of NEM policy nationally

Source: Shayle Kann, GTM Research


Market Insight Conference Keynote: The Future of Solar
Impact of other rate design changes

Number of States at Grid Parity in 2016: Business-as-Usual NEM vs. NEM Reform Scenarios

Executive Summary: U.S. Residential Solar Economic Outlook 2016-2020
Renewable Portfolio Standard Policies

29 States + Washington DC + 3 territories have a Renewable Portfolio Standard
(8 states and 1 territories have renewable portfolio goals)

Renewable portfolio standard
Renewable portfolio goal

Extra credit for solar or customer-sited renewables
† Includes non-renewable alternative resources
State RPS – threats since 2013

- 13 states have considered repeal or weakening RPS (Source: Center for American Progress report, March 2015)
- Ohio RPS frozen; WV RPS repealed (but included clean coal and old tires)
- Colorado and NC bills to weaken RPS defeated in 2015
- Texas bill to weaken RPS passed state Senate in April, but died in House
- Kansas bill to make RPS voluntary agreed to by AWEA May 2015

FIGURE 1
Battles over state-level renewable energy standards
Selected efforts to repeal or weaken ramp-up schedules for renewable energy

- States that have repealed or frozen their renewable energy standards
- Other states with bills introduced from 2013 to present that propose to repeal or weaken their ramp-up schedules
Industry Trends: Non-RPS Procurement

Utility Procurement Outside the RPS: 3 GW in 12 Months

- 299 MW PURPA Rules
- 279 MW Utility-Owned Generation
- 221 MW Utility RFP
- 520 MW Bilateral Contract
- 437 MW PURPA Rules
- 10 MW Utility RFP
- 130 MW Utility RFP
- 437 MW Utility RFP
- 165 MW Merchant Solar
- <20 MW Bilateral Contract
- 725 MW Utility RFP

Source: U.S. Utility PV Market Tracker

Industry Trends: Community Solar

13 states & DC have adopted shared or community solar programs

Expands solar access to more customers
- Multi-family
- Shaded roof
- Low & moderate income
- Poor credit

Multiple business models, including utility ownership

Over the past several years, shared renewables has grown quickly into a mainstream movement. Today, 13 states and the District of Columbia have shared renewables policies in place, and many more are considering programs to expand consumer access to clean energy.

CLICK STATE TO VIEW POLICY DETAILS

Source: http://www.sharedrenewables.org/community-energy-projects/
Clean Power Plan - Opportunity

• CPP will drive 20 GW of additional capacity by 2030
• SEIA is focused on Southeast & Midwest
  – State targets > 35%
  – States planning SIPs
  – Open new markets
  – Cross over with other SEIA policy priorities
  – Regional approach allows efficient use of resources
• CPP Mechanisms could include:
  – RPS expansions (CA, IL, MI)
  – IRP (GA, CO)
  – Other utility RFP (TN, VA)
  – Utility ownership (AL)
  – Community Solar (MN, CO)
Changing Policy Landscape – Utility Scale Solar

• Not just RPS any more – though RPS remains big driver
• USP gains acceptance from Utilities as prices fall and utility holding companies gain experience owning & operating large solar plants
  – PPA pricing reported below $40/MWh
  – Utilities owning solar projects include:
    • Southern, Dominion, Mid-American, Duke
• Clean Power Plan and other economic and regulatory challenges to the aging coal fleet presents near term opportunities in the South.
• PURPA & voluntary markets
  – PURPA in NC
  – Voluntary programs by municipal utilities in Texas
    – Alabama (500 MW)
    – Virginia (400 MW)
    – Tennessee (800 – 3,800 MW)
    – Arkansas (~100 MW)
    – South Carolina (~100 MW)
    – Georgia Power IRP
• In slightly longer term Texas comes into play in a big way
  – ERCOT projects 13,000 MW solar
Changing Policy Landscape – Utility Scale Solar

- Corporate buyers present new market in some states
  - Kaiser virtual PPA in CA
  - Apple and Google projects in NC, VA
  - Switch in NV
  - Utilities in mature markets increasingly look to offload procurement obligations to other entities (e.g. PG&E, “even with 50% RPS, expect minimal procurement”)

- Grid Integration and Transmission present challenges that will increase with penetration
  - Reduced capacity values with increasing solar penetration
  - California “duck curve”
  - Long distance transmission projects remain subject to multiple layers of state, federal and local regulation, with no end in sight
  - Grid-scale storage development remains nascent
Utility Scale

U.S Utility-Scale PV Pipeline

- Operating: 13,745 MW-DC
- Contracted (PPA signed): 14,629 MW-DC
- Announced (Pre-Contract): 27,014 MW-DC

Legend:
- In Construction
Industry Trends: Solar Plus Storage

- SEIA views storage as an enabling technology, for both the utility-scale and distributed generation markets
  - Storage and related advanced electronics enable solar projects to provide grid services to utilities, mitigates integration of variable resources, increases value to grid
- California is expected to be the biggest solar-plus-storage market, with 422 MWdc installed in 2020 alone.
- In dollar terms, GTM expects the market to grow to $246 million in 2015 and $643 million in 2016. By 2020, the annual U.S. solar-plus-storage market will be $3.1 billion.
- State storage incentive programs/proceedings
  - California 1,300 MW by 2024
  - NJ FY 2016 incentive program
  - MA considering incentives for storage
Thank You