

Solar Industry Update



David Feldman National Renewable Energy Laboratory

Presented at: National Summit on RPS

Session: Outlook for Renewable Energy Technologies: Technology and Cost Projections

November 6, 2013

Global PV Demand



- BNEF predicts that in 2013 for the first time more PV will come on-line globally than wind – both around 35 GW
- Continued increase in global installations expected through 2014
 - As European demand declines, U.S. & developing world markets expected to grow

Note: P = projection.

Sources: data displayed represents the median figures from the following sources, New: BNEF (08/21/13, 09/26/13), Deutsche Bank (09/26/13), Goldman Sachs (09/30/13), Stifel Nicolaus (09/04/13) Old: BNEF (02/08/13, 03/29/13), Deutsche Bank (03/01/13), Goldman Sachs (01/03/13), Stifel Nicolaus (01/22/13).

Global PV Manufacturing Capacity vs. Demand



- In 2012 global PV manufacturing had 109% more module capacity than necessary for demand
 - Overcapacity is projected to remain through 2015
- Thin-film still projected to remain small portion of overall mfg. capacity

Note: P = projection

Sources: data displayed represents the median figures from the following sources: Module mfg. capacity: GTM "WCM Database, September 2013." Demand: BNEF (08/21/13, 09/26/13), Deutsche Bank (09/26/13), Goldman Sachs (09/30/13), Stifel Nicolaus (09/04/13)

Module Efficiency



- Average efficiency of modules installed in CSI territory have gone up by ~1.5% in past 5 years
 - Will need an acceleration of efficiency improvement to get to SunShot targets
- Third-party installers have historically been less likely to install high efficiency modules
- Controlling for capacity, time and incentive type, systems electing PBI employ 0.30% higher efficiency modules, on average, than ones that elect rebates
 - Incentive structures could have impact on type of panel installed
 - Many other factors also influence decision-making as well

Graph and analysis courtesy of Carolyn Davidson, NREL, using data from California Solar Initiative database March 2013 (unpublished).

First Solar 2017 Roadmap



Sources: Corporate public filings

SunEdison 2016 Roadmap







SunEdison targets similar cost to First Solar

"440 Goal"

- 400Wp Module
- at \$0.40/Wp

51

• by 2016



Note : Cost includes opex, silicon, son-silicon, depreciation, warranty and inbound freight and excludes corporate general & admin. expenses)

Capital Markets Day | March 13, 2013



Sources: Corporate public filings

Best-In-Class Module Cost Reduction Q4'12 – Q4'17 (GTM Estimate)



Overall conclusion from roadmaps: industry is shooting for module costs to be \$0.40/W or less in the near future – 25% margins would give a price of \$0.50/W

- Not clear what efficiency goals are at this price
- With continued mfg. overcapacity expected by analysts, uncertain whether mfg.'s will spend money on new equipment
- Major cost reductions may have to come from "soft-costs"

Sources: GTM Research: PV Technology and Cost Outlook, 2013 – 2017 (June 2013)

PV System Price by Country - 2012



- Reported U.S. residential prices in 2012 were significantly higher than other mature PV markets
 - In particular, the higher priced U.S. markets were 2-3x the price of other countries
- China achieved low installation prices without the installation experience of places like Germany, Italy or even U.S.

Sources: IEA PVPS (01/18/13); Bundesverband Solarwirtschaft e.V. (BSW-Solar), August 2013. Currency conversion: http://www.oanda.com/currency/average; CSI Database, accessed 9/30/13.

PV System Price by Country - 2012



- U.S. commercial scale system prices also lagging other countries, with higher end prices up to 4x more expensive though there is a large range
 - Australia's commercial & utility-scale business, which is reportedly in their nascent stages, have prices higher than their residential market segment
- In utility space, U.S. is much more comparable in price to other countries, though still on higher end
 - U.S. utility-scale systems installed more efficiently than res./com. sectors, and potentially able to spread costs over more MW's

Source: IEA PVPS (01/18/13)

U.S. Installation Breakdown



- U.S. Installed 832 MW of PV in Q2 '13, 1.5 GW in H1 '13
- Challenges maintaining growth rate in all sectors/states
 - Net metering and rate design in CA, CO, AZ, TX
 - GTM reports that developers in HI had difficulties with changing permit fees, state tax credits, and market saturation in some key geographies





- H1 2013 U.S. non-residential market was 11% less than H1 2012
- Other markets opening up could spur demand such as MN, GA, NY (50kW-200 kW systems)
- Cumulative U.S. PV is expected to exceed 10 GW in Q3/Q4 '13
 - A PV project will be installed, on average, every 4 minutes

Note: "Next Four States": NC, MA, HI, CO. Sources: GTM/SEIA : U.S. Solar Market Insight Q2 2013.

2013 YTD System Price Distribution by Region (2.5 kW – 10 kW)



Sources: CSI Database, accessed 09/30/13; MA SREC Program, accessed 09/30/13; Arizona Public Services, & Salt River Project, accessed 10/02/13; NJ SRP & REIP, accessed 07/31/13; NYSERDA (09/30/13) Note: NYSERDA actually represents all "residential" sector data, and is the simple average price per quarter. All other data is weighted by capacity.

3rd-Party System Ownership by Region



- 3rd-party ownership continues to dominate residential sector in several markets
- AZ & CA % have leveled off in past year with continued sales of some host-owned systems
 - New availability of residential loans
 - Rebounding of housing market allow systems to be financed through mortgages or home equity loans
 - Some customers may prefer owning system

Sources: CSI Database, accessed 09/30/13; MA SREC Program, accessed 09/30/13; Arizona Public Services, & Salt River Project, accessed 10/02/13.

Utility Involvement in 3rd party ownership/distributed systems

- Utilities making strategic investment in distributed solar to diversify risk
- "On its face you would look at it and say distributed generation is a threat," said Nick Akins, chief executive of American Electric Power, in an interview." But on the other hand we see it as an opportunity because our business is changing. There's no getting around it."
- <u>SolarCity has formed partnerships with Direct Energy and Crius Energy Trust</u> (both energy retailers) to finance projects for utilities' customers
 - Direct Energy and SolarCity sign \$124MM deal to provide solar to Direct Energy's business customers
 - Crius has 230,000 customers in 9 U.S. states. SolarCity will now offer residential products to them
 - Partnerships are designed to reduce SolarCity's customer acquisition costs
 - SolarCity also purchased Paramount Solar, a lead generation firm it had been working with, to improve customer acquisition as well
- <u>Edison International</u>, which owns SCE, announced in Aug. '13 it <u>had bought SoCore Energy</u>, a distributed solar developer focused on commercial rooftop installations
- In H1 '13, <u>Edison International, Duke Energy</u> and two other undisclosed utilities were part of a \$42MM corporate <u>investment in Clean Power Finance</u>
- In May '13, the IPP <u>Nextera</u>, which owns mostly wind, natural gas and nuclear assets, <u>acquired Smart</u> <u>Energy Capital</u>, a commercial solar project developer
 - Smart Energy Capital has been involved in 75 MW of PV deployment; Nextera operates 18 GW of energy assets
- Other utilities are investing in portfolios of projects (PG&E) or installing solar panels themselves (Dominion, PSE&G)

Sources: BNEF (09/11/13); Cleantech Finance (07/03/13), 09/23/13); Forbes (08/13/13); Greentech Media (05/16/13); Wall Street Journal (05/28/13).

US Solar PPA Price (Utility Projects)



- PPA prices have continued to decline due to intense competition among solar developers
 - Macho Spring was signed for \$58/MWh however benefits from a \$27/MWh state tax credit
 - As states near RPS targets and RFP's taper out, PPA's are becoming harder to find

* Represents aggregation of three projects in California. **Source**: BNEF H2 2013 NA PV Outlook.

Large PV, In Operation (> 1 MW)



Note: PV Capacity is quoted in Watts AC. **Sources:** SEIA Major Solar Projects, 02/05/13; GTM/SEIA U.S. Solar Market Insight Q3 2012

Large PV, In Construction (> 1 MW)



Note: PV Capacity is quoted in Watts AC. **Sources:** SEIA Major Solar Projects, 02/05/13; GTM/SEIA U.S. Solar Market Insight Q3 2012

Large PV, In Development (> 1 MW)



Note: PV capacity is quoted in watts AC. **Sources:** SEIA Major Solar Projects, 02/05/13; GTM/SEIA U.S. Solar Market Insight Q3 2012

U.S. Large CSP Pipeline (> 1 MW)



Note: CSP capacity is quoted in watts AC. **Sources:** SEIA Major Solar Projects, 02/05/13; GTM/SEIA U.S. Solar Market Insight Q3 2012

Capacity Additions to Satisfy Solar RPS Carve-outs

• 16 states (and D.C.) have a solar carve-out in their RPS

- By 2028 states are required to produce ~16 TWh's of solar ~11 GW
 - Represents 0.4% of U.S. electricity sales
 - ~4GW in Southwest (~1.6 GW installed as of Q3 '12)



Sources: RPS: DSIRE RPS Spreadsheet120612, Retail Sales: 2011 EIA

Total RPS Targets of all 29 States with Laws



- Solar is incentivized beyond carve-out through total RPS targets
- Solar carve-out is a small portion of the total RPS goals
 - 16 TWh solar carve-out vs. 370 TWh's by 2020 (10% of U.S. electricity sales)
- If California, which has no solar carve-out, satisfied additional RPS requirements from 2012-2020 through solar installations, it would represent ~22 GW
 - CO ~7GW (solar carve-out 1.1 GW)
 - NV, NM, AZ ~2 GW
 - Other regions more likely to use larger % of Wind (and some RPS's have % req. for other technologies)
- Other factors may push solar installations beyond RPS targets

Sources: RPS: DSIRE RPS Spreadsheet120612, Retail Sales: 2011 EIA. Assumed capacity factor 1,400 kWh/kW

Thank You

David Feldman

Senior Financial Analyst National Renewable Energy Laboratory 202-488-223 I <u>david.feldman@nrel.gov</u>