



Q2/Q3 '14 Solar Industry Update

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October 31, 2014



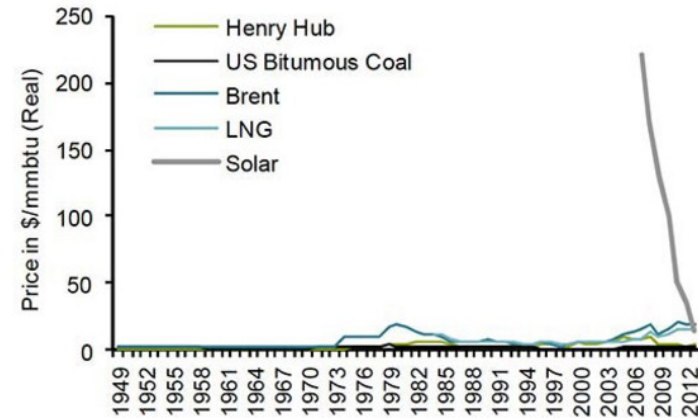
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Agenda

- Recent Solar News
- Key Global Deployment Markets Update
- Global Manufacturing
- Component Costs
- U.S. Installations & Pricing
- Recent Solar Technical Reports & Analysis
- Financial Market Activity
- U.S. Government Updates

Executive Summary

- U.S. installed 2.5 GW in H1 '14
 - 66% of capacity was in California
- U.S. market continues to mature, with companies consolidating, and pushing to lower costs as ITC expiration looms
 - CSP industry already being effected
- U.S. manufacturing industry rebounding with planned capacity expansion and opening of new markets
- Innovative financing products continue to enter the PV market in the form of loans and securities
- Global PV manufacturing continues to improve as top mfgs. ship record levels, maintain positive margins, and decrease module costs
- Several reports have been released recently which detail PV's continued cost-competitiveness and opportunities for further market efficiencies
 - Reported pricing, YTD, is consistent with this trend



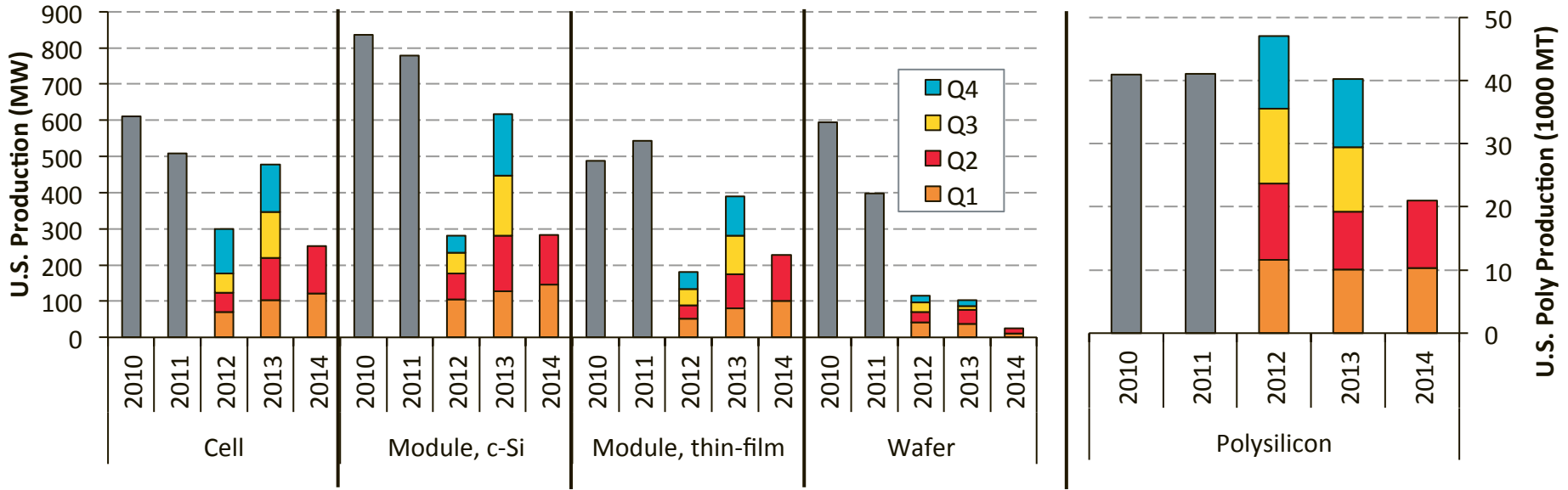
U.S. Developments News

- Experts at SPI in Oct. '14 expect significant consolidation of U.S. solar development industry
 - In Oct. '14 NRG announced it will acquire Pure Energies Inc. to add online sales of residential solar systems to its retail offerings (has purchased two other solar companies this year)
 - SolarCity, SunRun, SunEdison (among others), also consolidating
- In Sept. '14 it was announced IRS to investigate tax implications of VOST for solar after a request from a homeowner in Austin, TX
 - Section 25D tax credit only applicable for solar equipment generating electricity for use for that dwelling
 - VOST could also be treated as revenue, even if it is a credit on a bill
- In Sept. '14 Palen CSP project cancelled – faced environmental and tribal opposition
 - 28 month construction schedule meant that it would not qualify for 30% ITC
 - Developers can propose another project at same site

U.S. Manufacturing News

- First Solar reaches 21% conversion efficiency for CdTe cell
- In Sept. '14 SolarCity broke ground on 1GW Silevo manufacturing plant
 - NY State will contribute \$750MM
 - Solar Frontier also announced in Sept. it has plans to build a manufacturing facility in Buffalo, NY
 - It is currently assessing a manufacturing and research agreement with SUNY
- In Oct. '14 SunEdison announced it was negotiating with a Chinese company to build a \$2 Billion China polysilicon plant
 - Also signed an agreement with Chinese fund management company which will invest in 1 GW of Chinese PV plants
 - SunEdison said in Oct. '14 that its HP FBR technology being ramped at its new joint venture facility in Korea will provide source polysilicon to enable 400 watt peak PV panel performance at a cost of US\$0.40 per watt peak by 2016
- U.S. equipment manufacturer GTAT files for bankruptcy in Oct. '14
 - GTAT had signed a deal with Apple to provide sapphire glass to phones but Apple ending up going with corning's Gorilla Glass
 - Company plans to continue operations
- U.S. Import-Export Bank sign \$1B loan agreement with Indian Renewable Energy Development Agency in Oct. '14 to purchase U.S. equipment for RE development

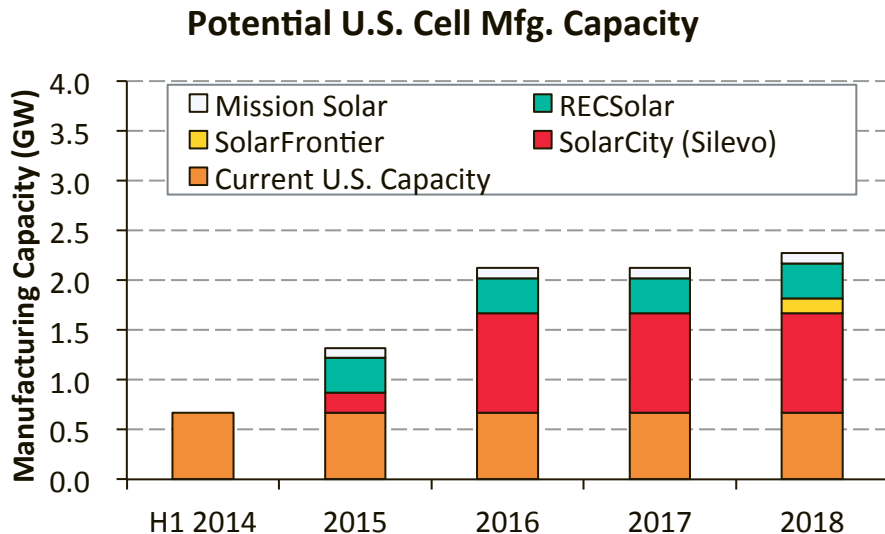
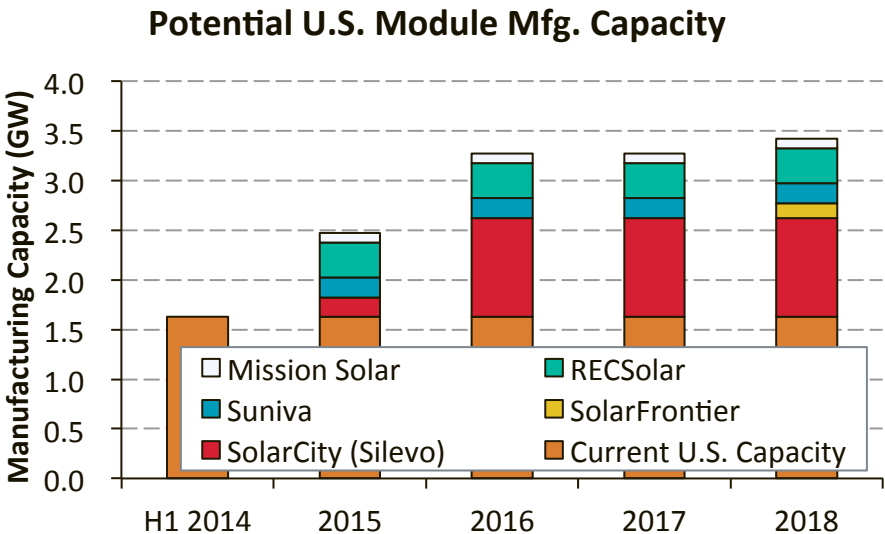
U.S. Manufacturing



- In H1 '14 U.S. was module/cell production approached peak levels achieved in 2010-11
 - U.S. wafer production continues to decline, as only one active manufacturing facility remains
- U.S. poly manufacturing production levels have remained steady at approximately 40-50 thousand MT of solar grade poly

Sources: 2010-11 & Q4 '12-Q1 '13: GTM/SEIA "U.S. Solar Market Insight Q4 2013; Q1 '12-Q3 '12: GTM/SEIA "Q3 2012 US Solar Market Insight;" Q2 '13-Q2 '14: GTM/SEIA "U.S. Solar Market Insight Q2 2014". energy.gov/sunshot

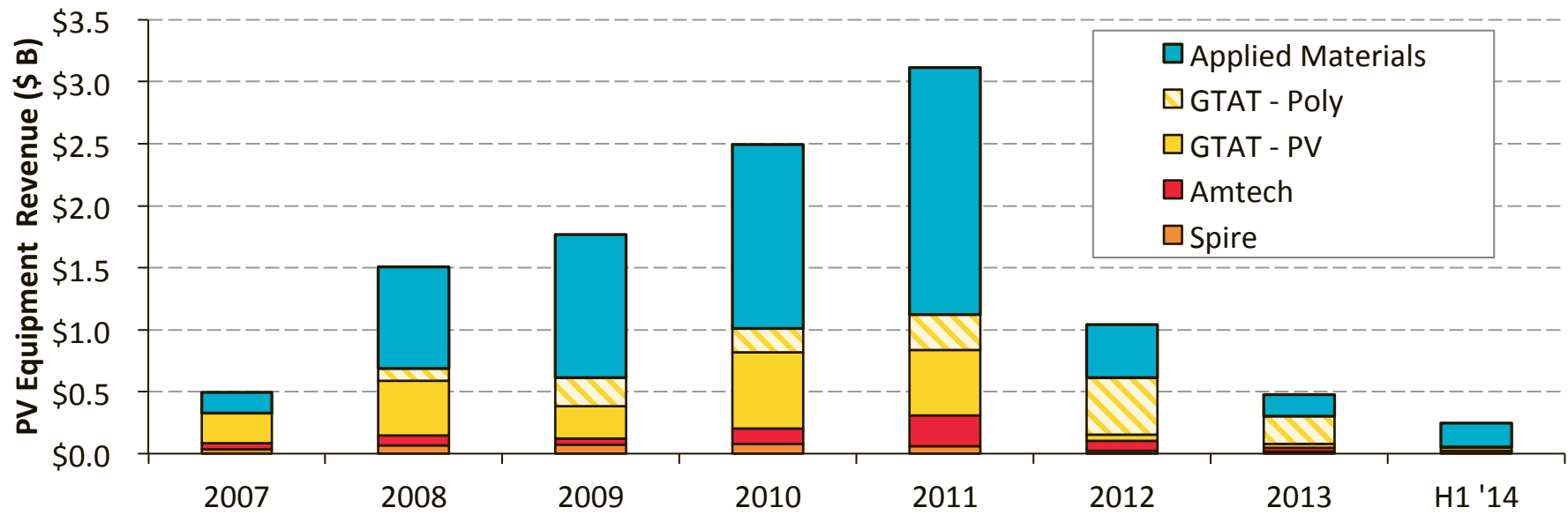
Potential U.S. Manufacturing



- Recent announcements of planned or potential U.S. cell/module manufacturing expansion could significantly increase domestic capacity
 - SolarWorld has also announced expansion plan, however has not given specifics
 - JA Solar is considering U.S. for next manufacturing site
 - Module mfg. capacity could grow above 3.5 GW by 2018 from 1.6 GW
 - Cell mfg. capacity could grow above 2.0 GW by 2018 from 0.7 GW

Sources: current capacity (GTM/SEIA Q2 2014 SMI); PVTech (08/20/14); Renewable Energy World (10/28/14). Note: GTM's cell mfg. estimate does not include thin-film modules using monolithic integration.

U.S. Equipment Manufacturing



- U.S. HQ'd PV equipment mfgs. still at relatively low levels of sales
 - Many do not manufacture in the U.S.
- Amtech purchasing/merging with BTU International in an all-equity transaction
 - Together they had \$95MM in revenues for past 12 months

Sources: Corporate public filings. Only includes "Energy & Environmental Solutions Division" of Applied Materials. Revenues of GTAT for 2007-08 represent FY ending in March of latter year.

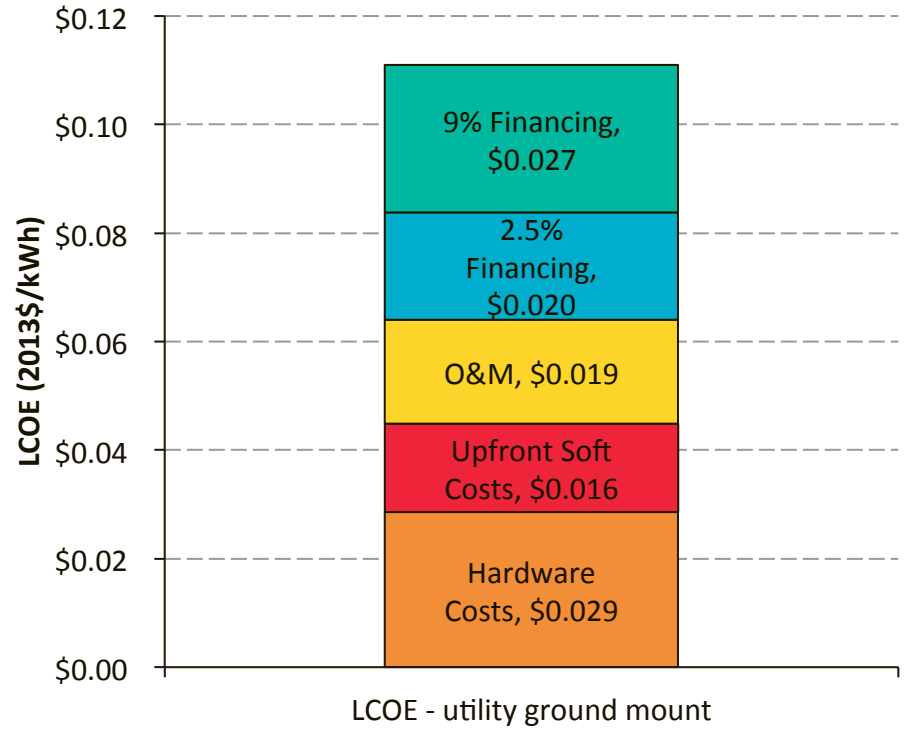
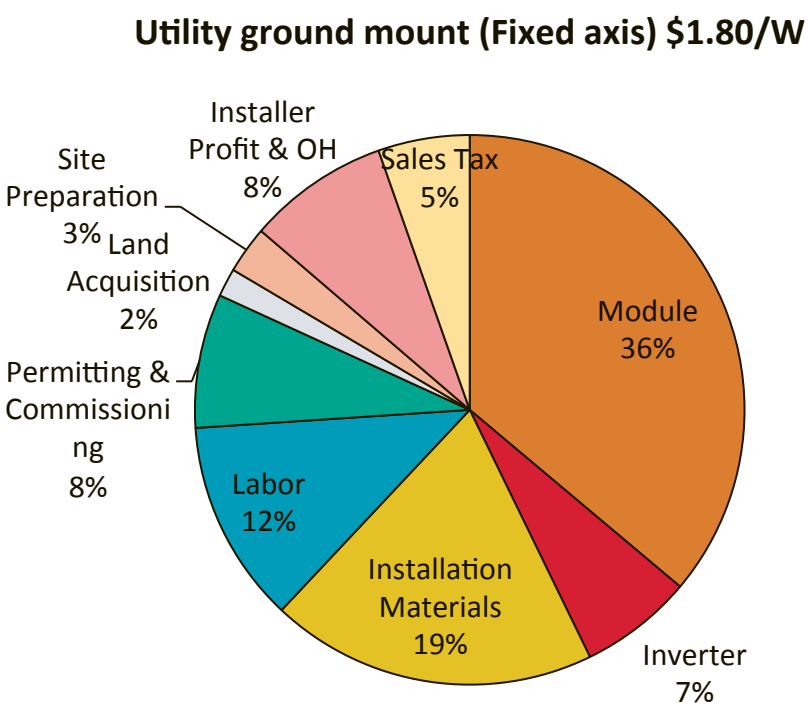
Global Manufacturing News

- Shunfeng (purchaser of Suntech) expects manufacturing capacity of 2.2 GW for cells & 2.4 GW for finished modules
 - Also signed an agreement with Chinese company to fund \$220MM in project development
- U.S. trade case against Chinese modules could expand to include cells made from any origin as the U.S. Commerce Dept. in Oct. '14 invited the industry to help define scope of trade case
 - Pres. Obama has a scheduled trip to China in November and some believe a trade agreement could be worked out then
- In Oct. '14 Deutsche Bank reported that several Chinese solar companies are targeting 20-25% capacity expansion in 2015 timeframe. While some companies suggested they were exploring options in the North American market for module capacity expansion, most indicated that other Asian countries were more likely sites for future plants

PV Finance Update

- GTM/SEIA report that more than 1.5 GW of PV has been, or will be, used to finance publicly traded investment vehicles
- In Sept/Oct. '14 SolarCity launched several financial initiatives
 - Launched its first residential loan product in eight states
 - 30 year term of loan; rate as low as 4.5%; no penalties or fees for prepayments
 - SolarCity's CEO says loans may required \$0.5B - \$1.0B to finance in 2015
 - Currently negotiating interest rate for \$500MM in its fourth debt offer in less than a year
 - Has filed to sell up to \$200MM worth of solar asset-backed debt directly to the general public through their on-line platform (Common Assets)
 - minimum purchase requirement is \$1,000, maturities range from 1-7 years, and interest rates go up to 4%
- Nextera Solar Fund announced in Sept. '14 it would raise \$426MM by selling shares in order to purchase more projects
- SunEdison filed papers in Sept. '14 to form second yield-co, this one focusing on operating projects in Asia and Africa
- NY Greenbank announced in Oct. '14 its first seven programs, which will provide \$800MM in public and private funding over several years
- NYSERDA/LI PSEG this summer announced the introduction of on-bill recovering loan program that allows customers to repay loans through their electricity bills

Sources of Utility-Scale PV Costs – LCOE vs. Upfront Costs

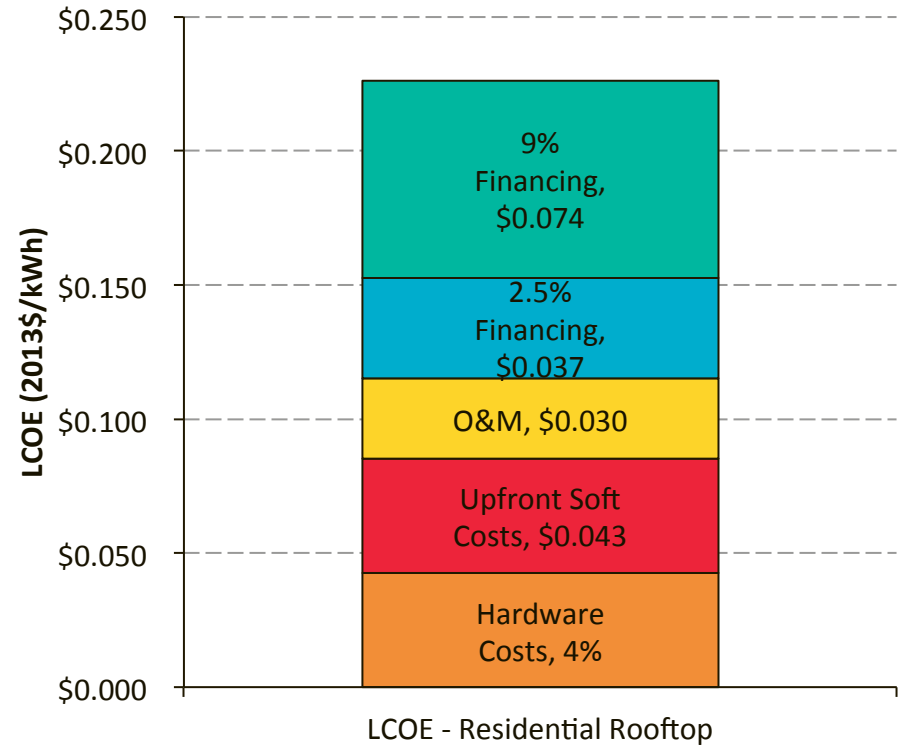
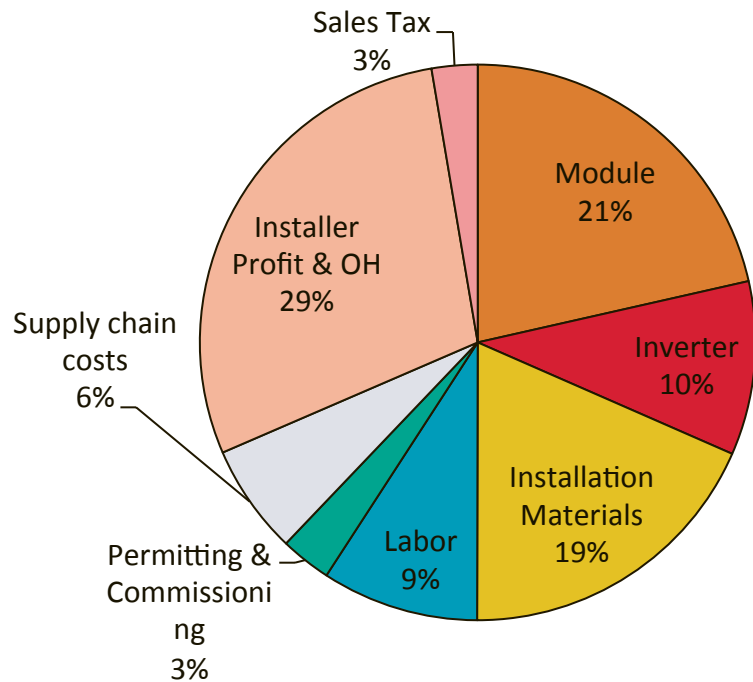


- There are a significant amount of hardware and business operations that contribute to the upfront cost of utility-scale PV
- However, equally important to the competitiveness of PV is the cost of financing these systems
 - A required 9% rate of return represents 42% of a PV system’s LCOE
 - Reducing financing costs to inflation would be the equivalent of cutting all hardware costs

Sources: NREL internal cost modeling.
 Note: numbers quoted in \$2013.

Sources of Residential PV Costs – LCOE vs. Upfront Costs

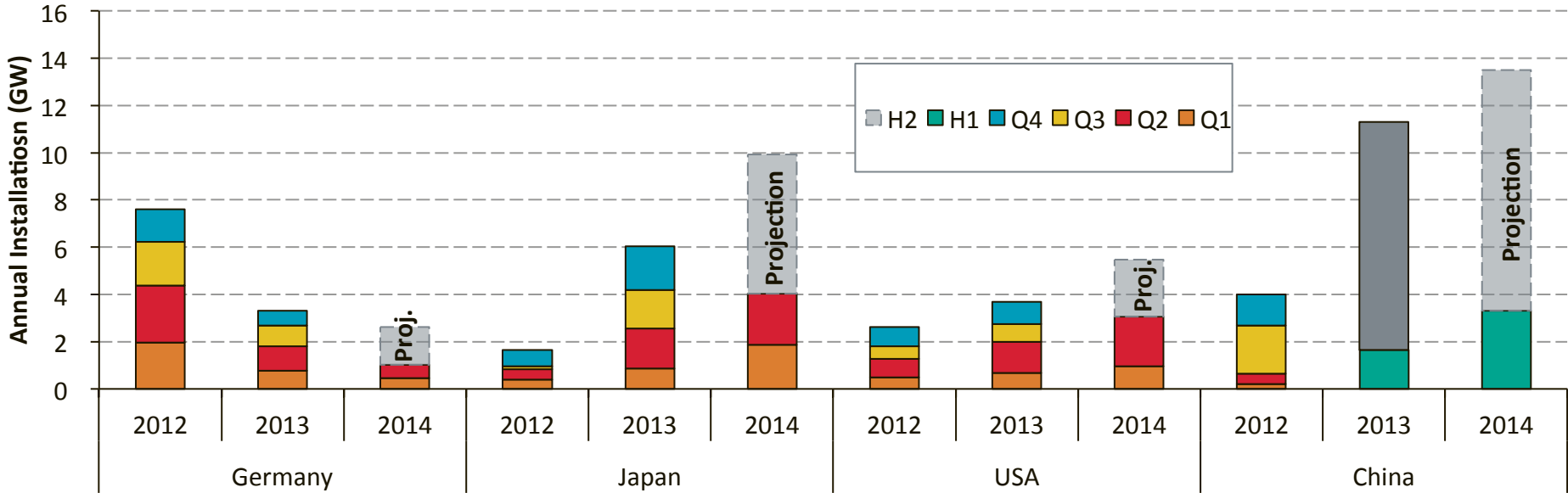
Residential Rooftop \$3.29/W



- The potential impact on the LCOE of residential rooftop PV is greater due to its current higher required rate of return
- Reducing financing costs to 2.5% could reduce 32% of LCOE

Key Markets Update

Country Installations



- Japan & China were two largest markets in H1 '14
 - USA a close third
 - China & Japan expected to have much larger H2 '14
 - China has set a target of 13 GW in 2014
- Germany's market continues to contract
 - UK expected to be largest PV market in Europe in 2014

Sources. Projections: BNEF, 07/24/14. Historic: Germany : BSW Solar (09/30/14). U.S.A. : GTM/SEIA, "U.S. Solar Market Insight, Q2 '14; Japan, pre-FiT, BNEF 01/05/14; FiT, METI published data, accessed 10/20/14. China, 2012, Photon Consulting (06/21/13); 2013-14, PVTech, "China has added 3.3GW solar in 2014, government confirm." 08/07/14.



China Update

- In August, head of China's NEA suggested the country could begin implementing an RPS
 - A week earlier Beijing's administration announced that the city will stop using coal completely by 2020
 - BNEF expects wind, hydro and solar to account for 53% of new builds in 2014
 - China plans to launch a national carbon emissions trading program in 2016
- Discussions of the 2016-2020 five-year plan are currently under way
 - A target of 100 GW of PV by 2020 has been discussed (as well as 15% non-fossil fuel use)
- In May '14 the Chinese government officially announced allowing private investment into energy projects to accelerate deployment
 - Several companies have jumped in: Canadian Solar announced it will create an \$810MM fund to build PV projects; SunEdison also arranging fund
- Approximately 3.3 GW of PV was installed in H1 '14; analysts expect this to dramatically accelerate in H2 as the government has set a target of 13 GW
- In Sept. '14 China released a document outlining initiatives to promote DG PV. Key points:
 - DG projects can choose to receive FiT, like utility-scale projects, which is a more guaranteed payment stream than relying on customer use of power
 - Other measures: make local governments and utilities prioritize/support DG; streamline installation and interconnection processes, improve collection of data, develop innovative financing mechanisms (e.g. loan guarantees, lease models)
- BNEF expects China to produce 45% of '14 global poly (36% in '13), and 70% of '14 modules (70% in '13)
 - However, of the Chinese supply, it is expected that continued consolidation will cause this supply to come from less companies

Japan Update

- As of July '14 11.6 GW of PV projects have been installed under FiT program, out of 69GW of approved PV projects (17%)
 - signals various bottlenecks ranging from the availability of land to the cost of equipment and labor
 - Installed 4 GW in H1 '14 compared to 2.6 GW in H1 '13
- Some Japanese utilities are not considering further applications
 - A METI working group said in Oct. '14 that Japan needs to diversify away from solar because it is strongly effected by weather and seasonality (95% of FiT program is solar)
 - Projects under 50kW do not need permission from utilities
- Most companies/analysts expect no near-term impact from approval delays
 - Some see it as a positive development for the longer term market, as unbuildable projects will be fleshed out of the pipeline and utilities can focus on upgrading the grid and approving realistic projects
 - However, analysts believe current rate of installation is unsustainable and market will eventually contract
- From Apr. '14, the trade ministry began requiring solar projects to secure land and equipment within six months of getting approvals
- Japanese FiT 32 yen/kWh, down from 40 yen/kWh (36 cents) when the incentives started two years ago
- The rules may change so that solar developers will only be able to get the price at the time they begin producing power, which is typically lower, according to Yomiuri newspaper
- In H1 '14 Japanese companies manufactured 3.4 GW of PV modules, 54% of which was produced in Japan
 - 47% mono c-Si, 40% poly c-Si, 14% other (presumably mostly CIGS from Solar Frontier)
 - Country no longer at PV trade parity, particularly with so many Japanese companies mfg. abroad

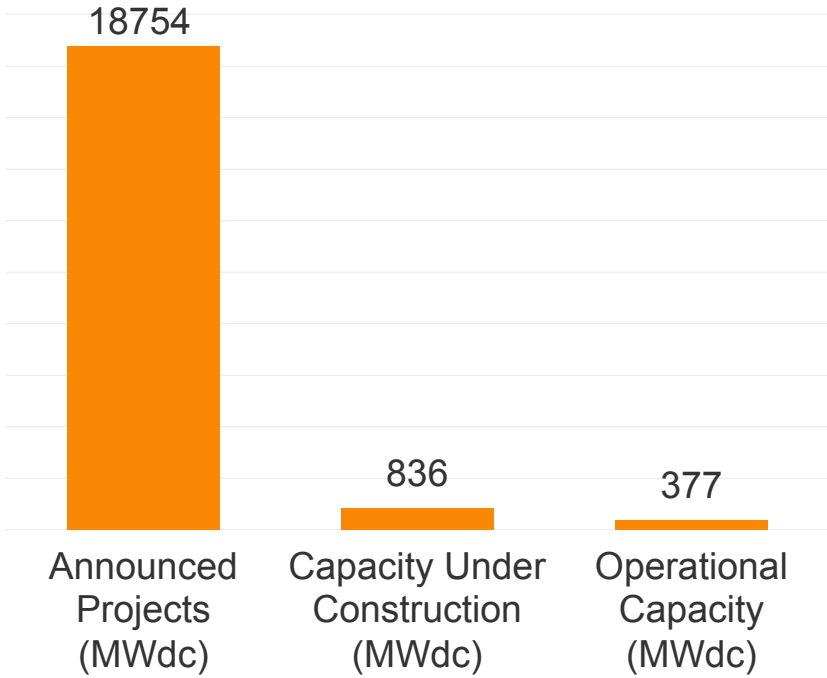
Latin American Markets

- GTM is expecting exponential growth in Latin American markets between 2014 and 2018
 - Mexico, Chile and Brazil have the greatest potential for deployment, but they currently have less than 100 MW deployed
- The Latin American market is dominated by utility scale projects and this trend is expected to increase
 - Currently 70% of solar is >1 MW; GTM predicts 85% utility share by 2018
- Latin America is a diverse and fragmented PV market
 - Differences in electricity markets, risk of financing/inflation, and rate bases are all possible barriers to PV deployment

Latin American Markets Key Facts

- GTM estimates 51% CAGR 2014-2018
- The utility market will form 88% of demand in this time frame
- Policy is neither driving nor preventing growth. The issues facing developers are “nascent growing pains”
- Key PV markets (Mexico, Brazil and Chile) are expected to form 50% of the Latin American Market

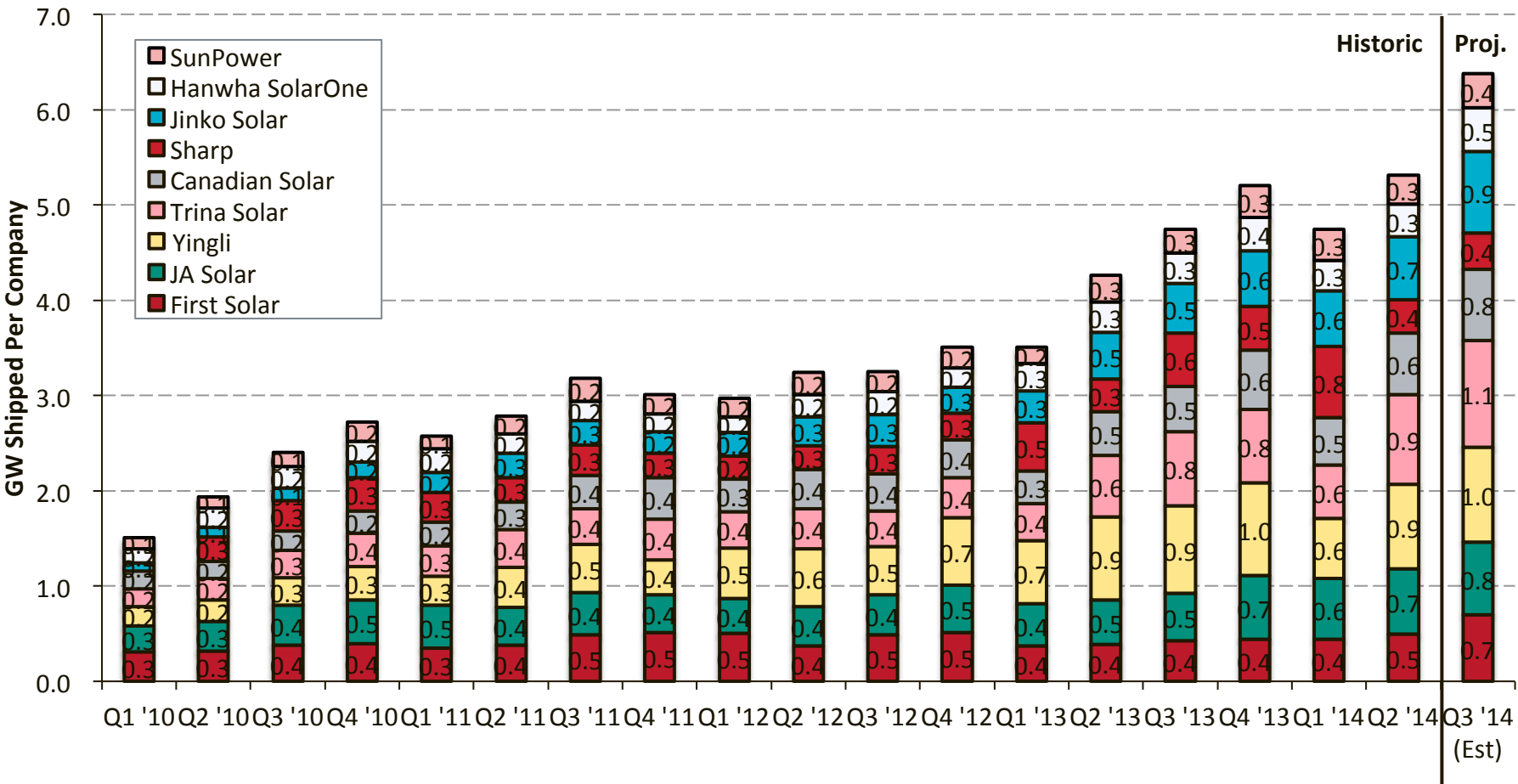
Latin America Project Tracker



Source: GTM Research 3Q14 Latin America PV Playbook

Manufacturers' Shipments

Top 9 cell/module manufacturers

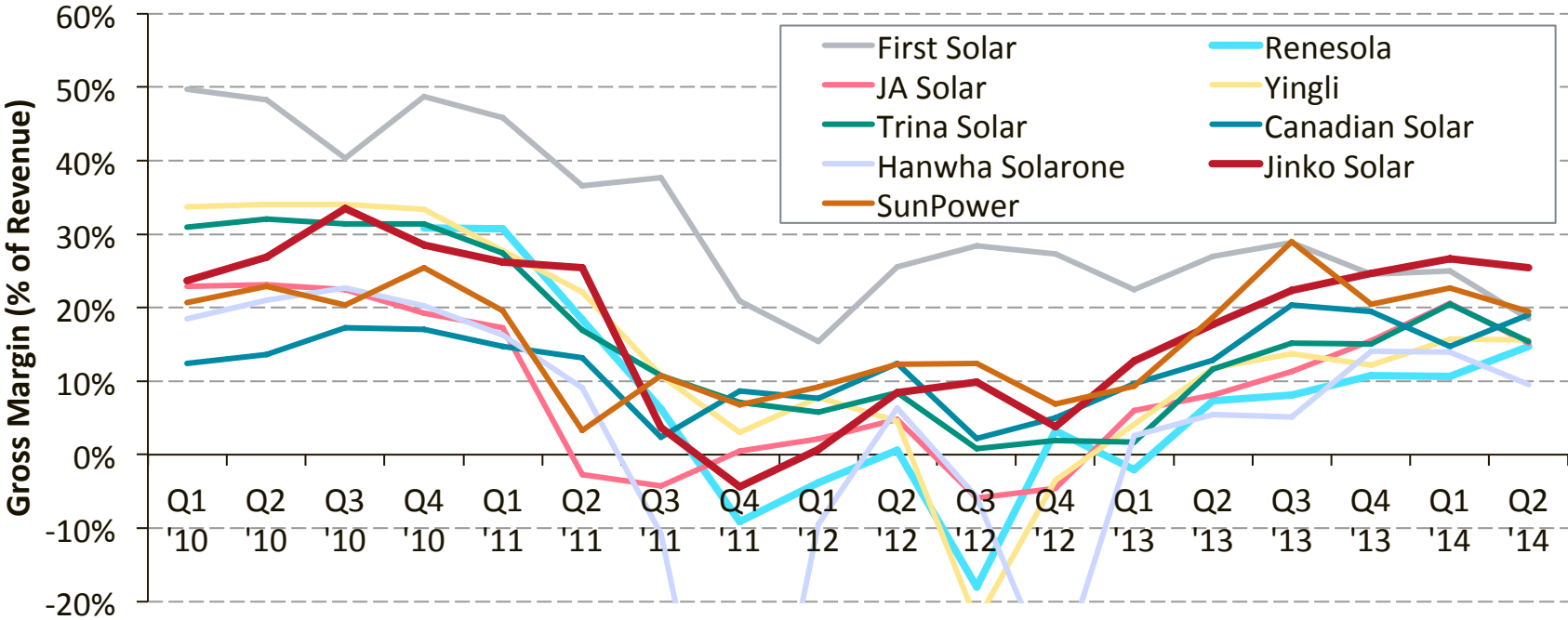


- After a slight dip in Q1 2014, Q2 '14 shipments surpassed previous high (Q4 '13)
- Chinese manufacturers surpass Sharp (leader past 2 quarters); Trina leads Yingli
- Trina & Yingli are predicting shipments of over 1 GW in Q3



Sources: Company figures based on Q2'14 (and previous) SEC filings by the respective companies. Note: First Solar estimates production, not shipments.

PV Manufacturers' Gross Margins

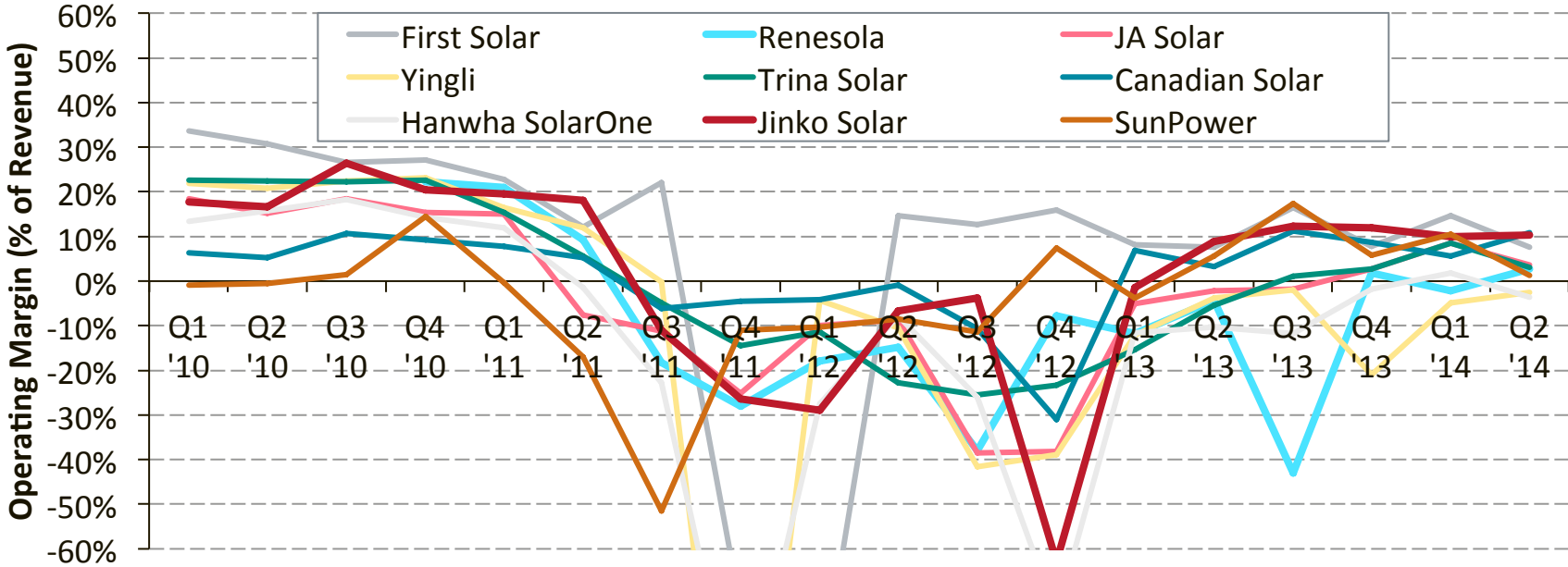


- Gross margins dip slightly but continue to recover due to stabilization of market pricing and continued cost reductions
 - 17% avg. gross margin of above companies in Q2 '14
 - 19% in Q1 '14
 - 18% in Q4 '13
- Many manufacturers focus on decreasing non-silicon costs, and relying on more efficient sourcing to improve margins



Sources: Company figures based on Q2 '14 (and previous) SEC filings by the respective companies.

PV Manufacturers' Operating Margins

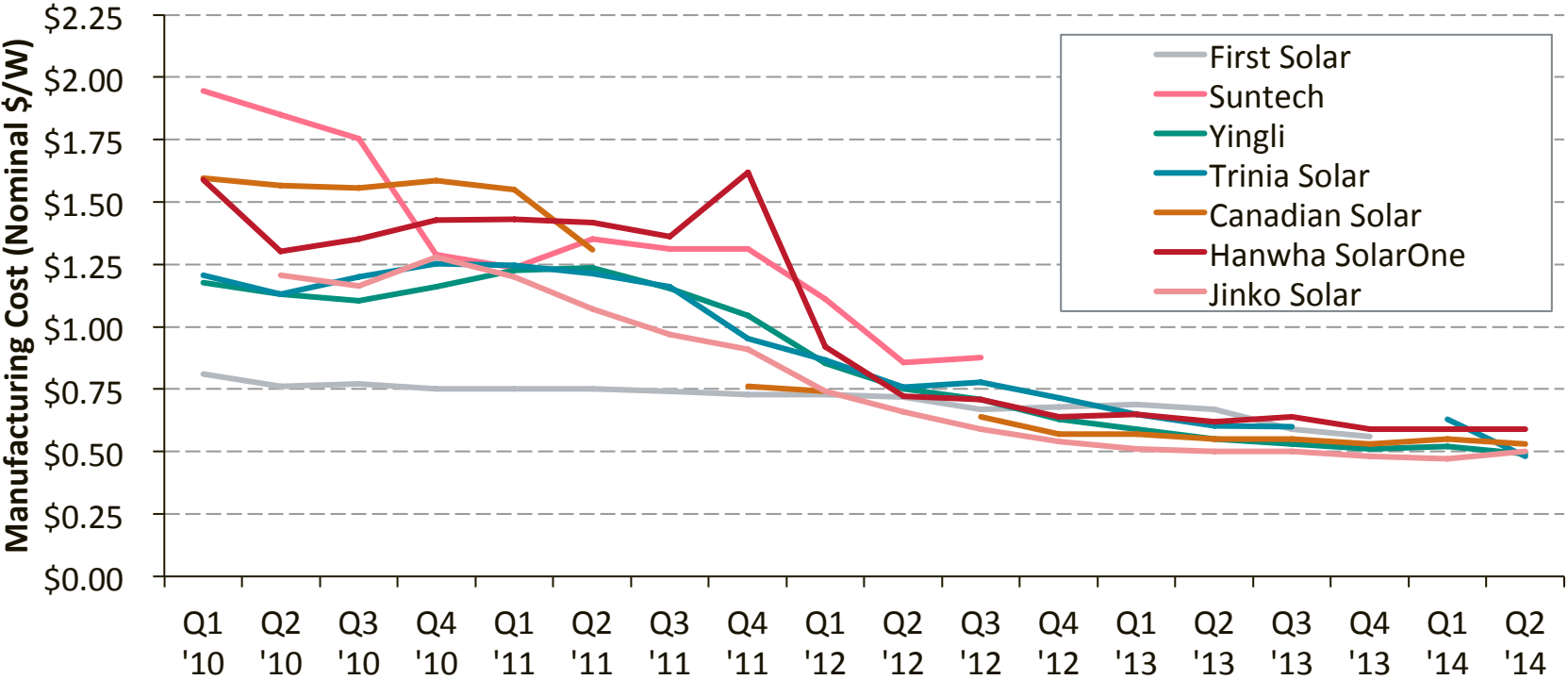


- Operating margins also recovering, with some companies beginning to make operating profits
 - 4% avg. operating margin of above companies
 - Previous 8 quarters average -12%
- Yingli and Hanwha continue to sacrifice profits for growth
- There has been increasing stability among operating margins in 2013 and 2014



Sources: Company figures based on Q2 '14 (and previous) SEC filings by the respective companies.

PV Manufacturers' Cost

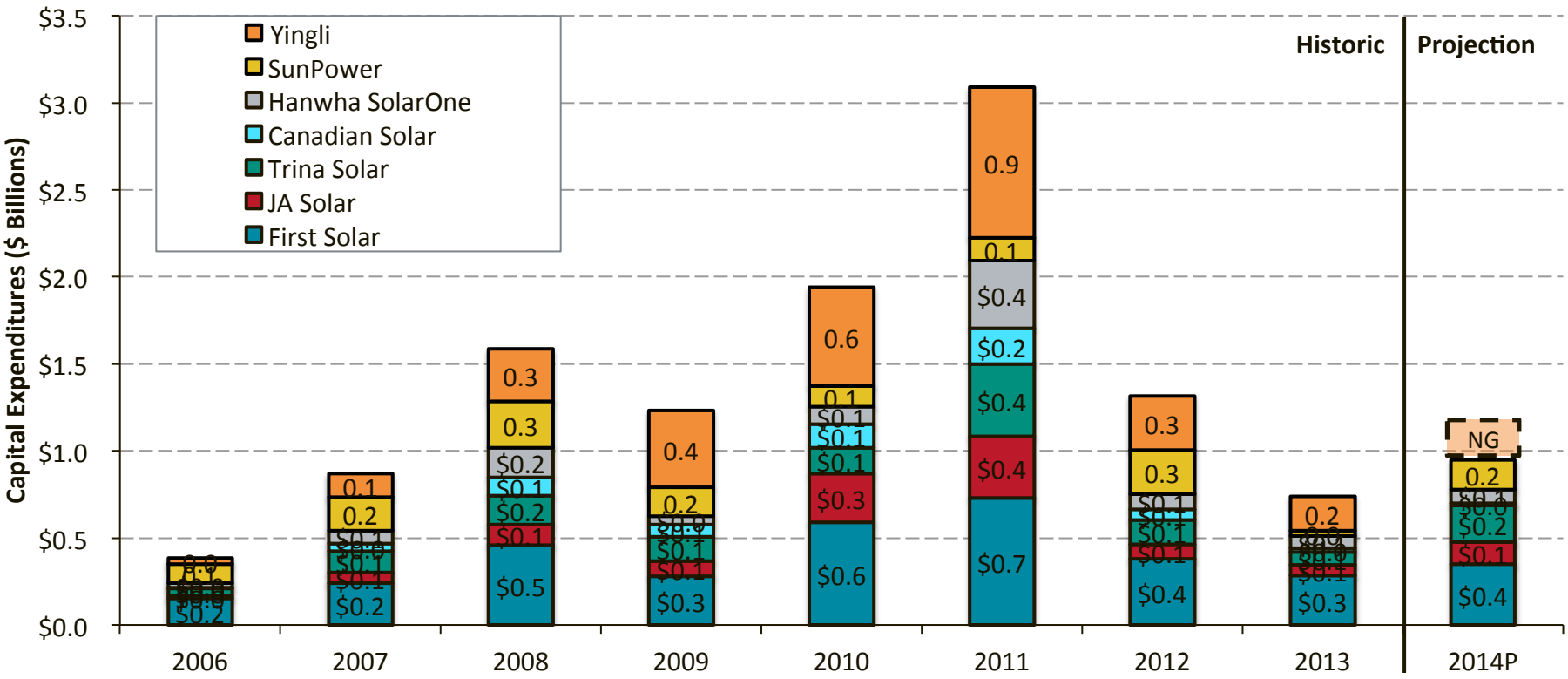


- In Q2 '14 module costs were between \$0.48-\$0.59/W
 - Q2 '14 costs from above companies are, on average, 7% less than Q1 '14
- Manufacturers have roadmaps to further lower costs and increase efficiencies, focused on non-silicon cost reduction and efficient sourcing



Sources: Corporate public filings.

Capital Expenditures



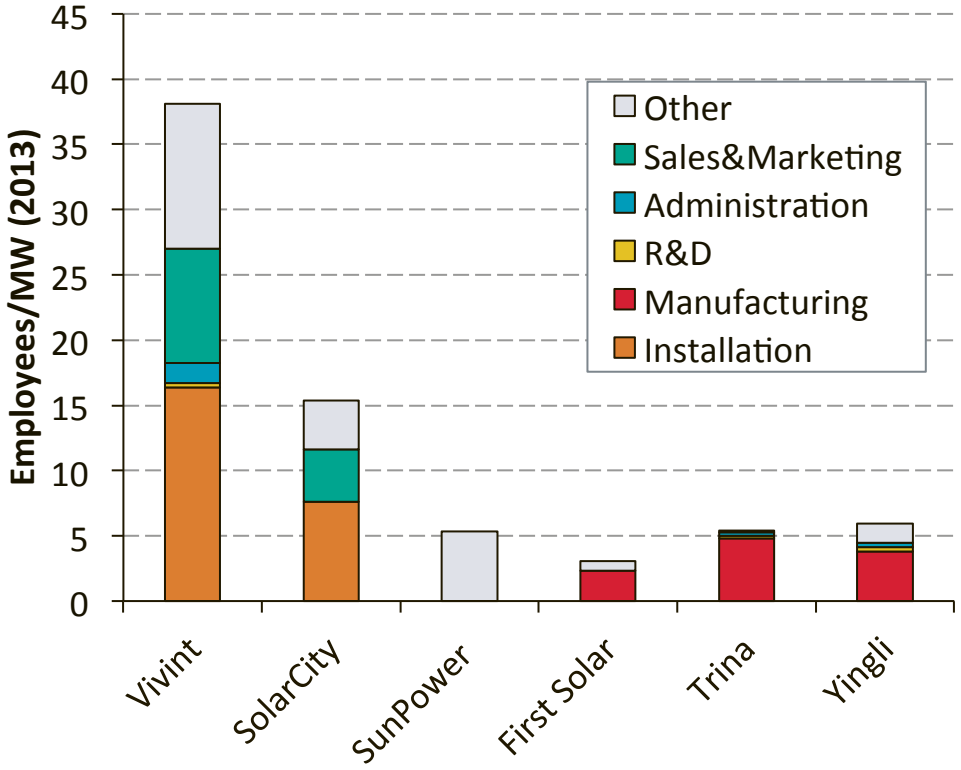
- Companies continue to invest in PPE, but in significantly lower levels than in previous years
- Most companies cite manufacturing capacity expansions, and purchase of equipment to increase cell efficiency as reasons for investment



Sources: Company figures based on SEC filings by the respective companies. Yingli has not reported 2014 Capex. NG=not given.

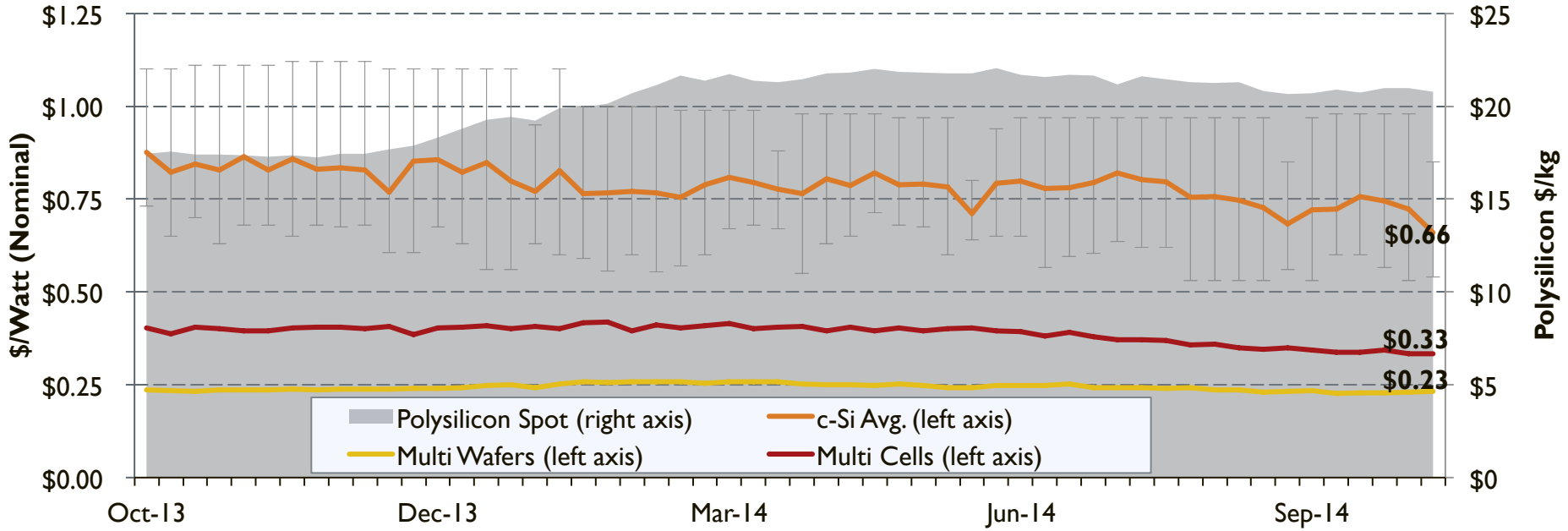
Employment vs. Capacity

- In 2013 SolarCity/Vivint had a much higher workforce per MW installed, than the below manufacturers had workforce per MW manufactured
- This suggests that incentivizing deployment versus manufacturing may result in more jobs
- Vivint’s higher ratio may be a result of the company scaling or its emphasis on a direct sales approach
- While First Solar had a much lower labor ratio than Chinese competitors, SunPower was approximately equivalent
- Employees working in manufacturing made up the bulk of the workforce in production based companies, However Yingli had a disproportionately high number of non-manufacturing employees



Source: Corporate SEC filings. Note: SolarCity did not breakout employee classification in 2013 so 2012 ratios used as proxy.

Module, Cell, Wafer & Polysilicon Price



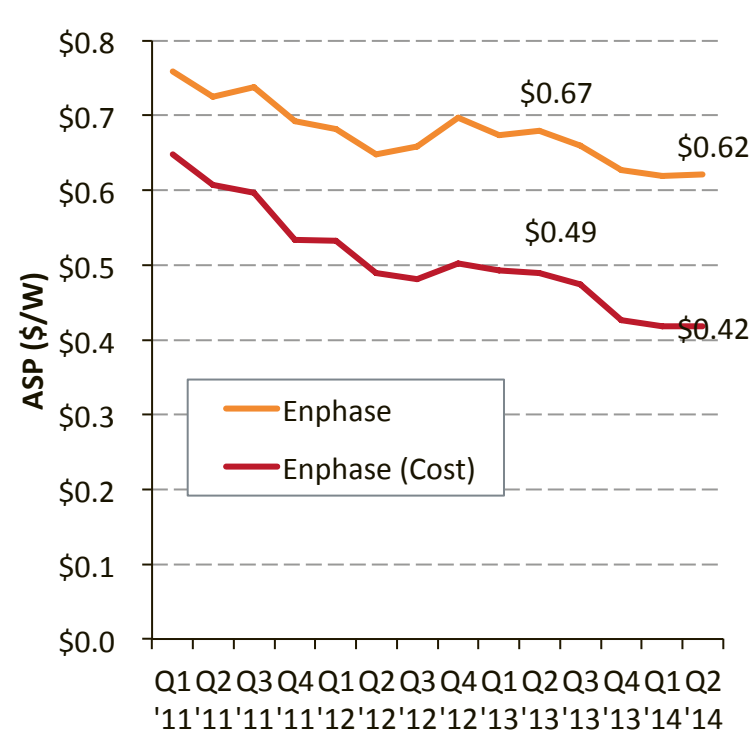
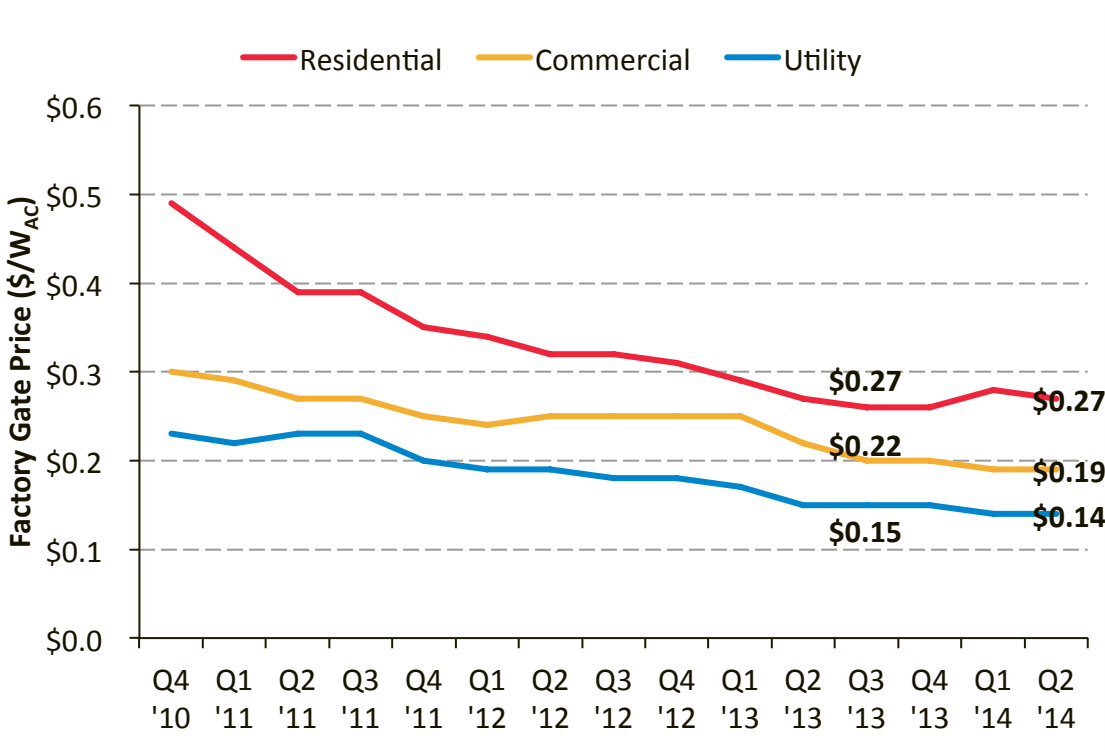
- From Oct. '13 to Oct. '14 average module and cell prices have fallen 25% and 17% respectively
 - Wafer prices have decreased only slightly and poly price has increased 19% - could go to \$23/kg next month due to potential shortages
- Module prices have a large price range, from \$0.55/W - \$1.0/W
 - Differences in geographic pricing due to tariffs
 - Deutsche Bank reports that module pricing in China is \$0.56-\$0.57/W, while in the U.S. it is \$0.72/W
 - Also price differences due to make/model of panel (dependability, efficiency)



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Sources: BNEF Solar Spot Price Index (10/20/14); Cowen (10/23/14); Deutsche Bank (10/23/14). Note: error bars represent high and low quotes.

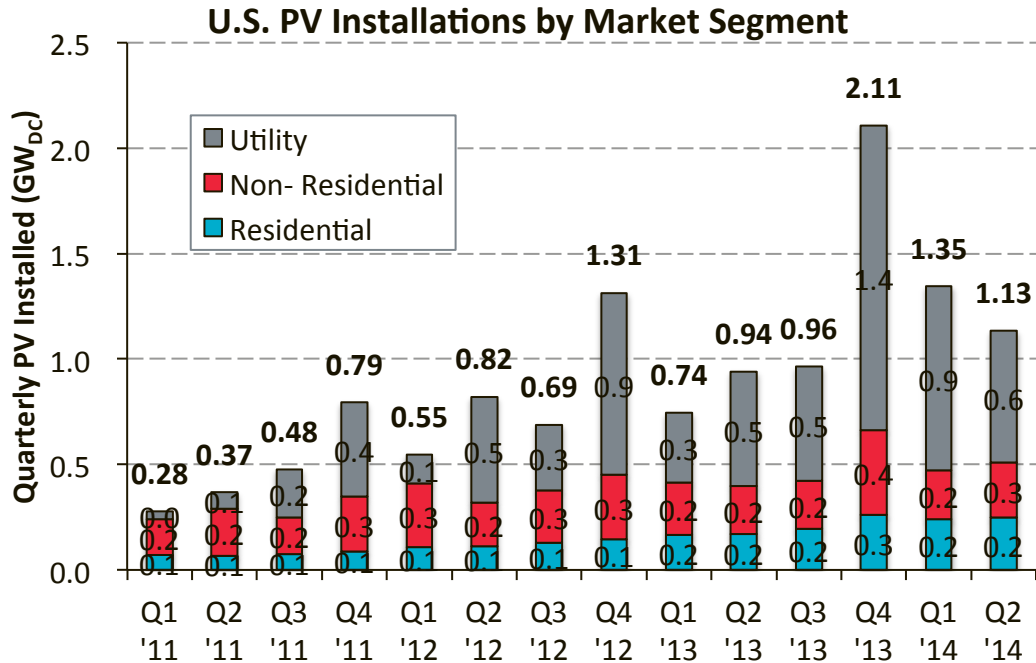
Inverter Pricing



- According to GTM/SEIA inverter pricing has been relatively flat for the past year
- Enphase prices (and cost) also relatively flat in the first 2 quarters of 2014

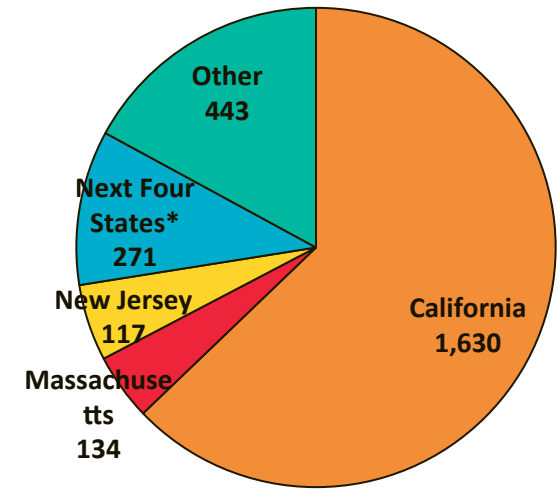
Sources: GTM/SEIA “Solar Market Insight Q2 ‘14”; Enphase public filings.

U.S. Installation Breakdown



- U.S. installed 1GW of PV for the third straight quarter
 - Utility-scale systems decreased Q/Q, however residential and non-residential sectors grew
 - In 2010 30% of non-res. systems were >1MW, in H1 '14 it has grown to 56%
- California continues to dominate U.S. market, representing 66% of H1 '14 installs

U.S. PV Installations by State (MW_{DC}), H1 '14



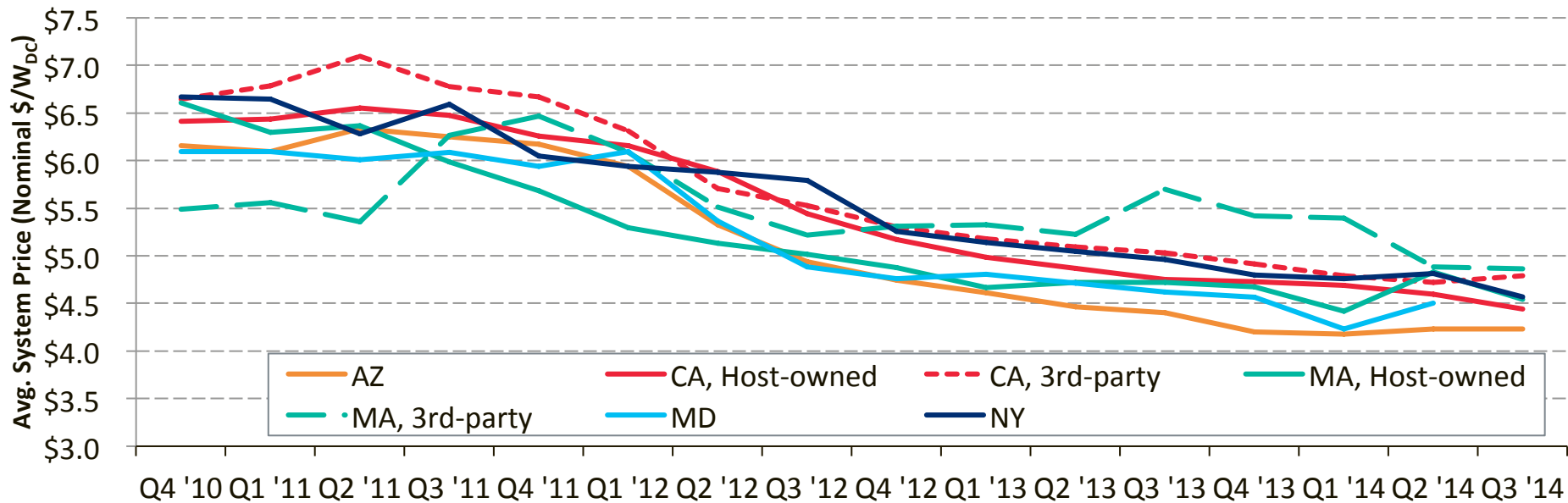
- CA market grew 71% from H1 '13 to H1 '14, ROUS grew 16%
- Due to PV's concentration in a handful of states it is particularly exposed to regulatory risk (e.g. net metering, RPS changes)
 - In CA, four-tiered rate structure will likely be flattened to some extent, a fixed fee up to \$10/month will be implemented and a new net metering program will begin in 2017
 - HI PUC ordered HECO to devise action plan for improving interconnection process in high penetration areas



Sources: GTM/SEIA, "U.S. Solar Market Insight Q2 2014." Note: "Next four States": AZ, NM, NC, HI. CT clerical error prevented rebates and NM

Average System Pricing by Size & Region

2.5 kW – 10 kW



- System prices in the above states, between 2.5 -10 kW, fell on average 5% between Q3 '13 & Q3 '14 (except 3rd-party systems in MA)
 - System prices fell 10% from Q3 '12 to Q3 '13
- Average prices between \$4.25 - \$4.75/W
 - 20% percentile of host owned systems is between \$3.3-\$3.8/W
 - Average 20th percentile fell 8% between Q3 '13 & Q3 '14 (except 3rd-party, MA)

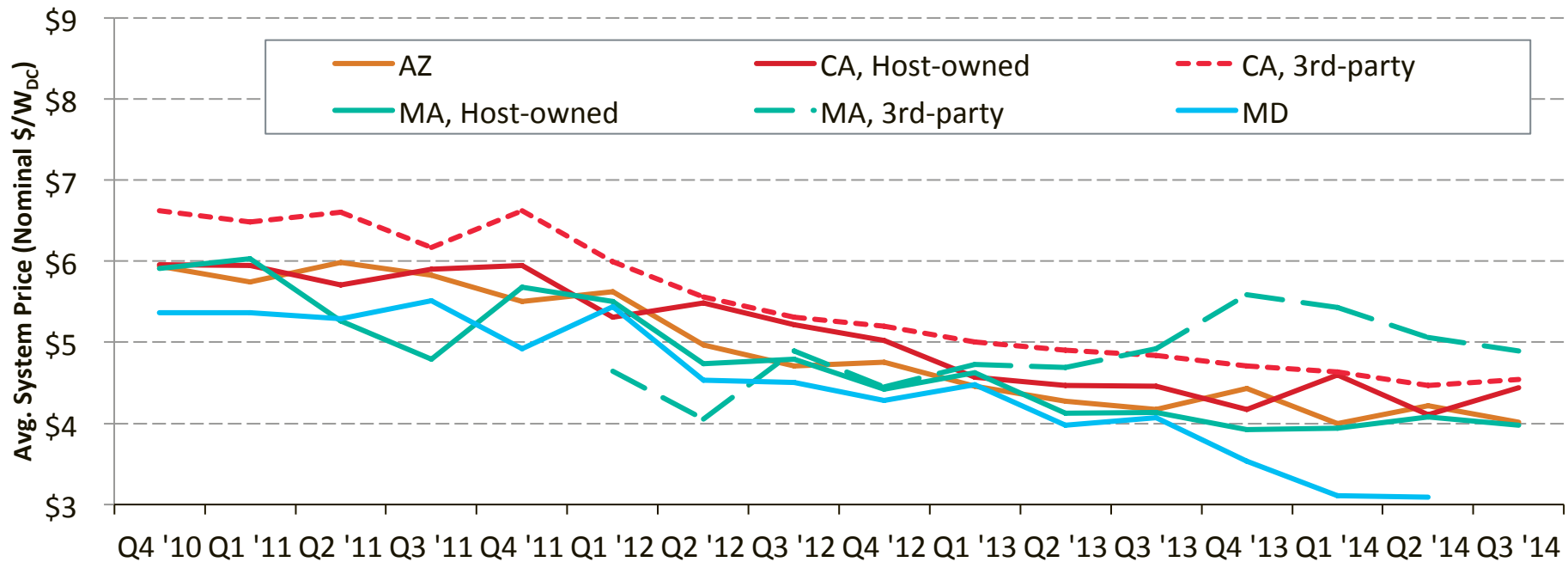
2014 YTD MW: AZ (27); CA H.O. (27); CA 3rd-P (49); MA HO (7); MA 3-P (2); MD (1); NY (20).

Sources: Arizona Public Services, & Salt River Project, accessed 10/06/14; CSI Database, accessed 10/01/14; MA SREC Program I & II, accessed 10/07/14 & 10/08/14; Maryland Energy Administration, accessed 09/23/14; NYSERDA, accessed 10/06/14.

Note: NYSERDA actually represents all “residential” sector data, and is the simple average price per quarter. All other data is weighted by capacity. MA does not report whether a system is 3rd-party owned therefore it was estimated using the “applicant entity” or “installer” for the following organizations: SolarCity, CPF Capital, SunRun, Vivint,

Average System Pricing by Size & Region

10 kW – 100 kW



- System prices in the above states, between 10 -100 kW, fell on average 7% between Q3 '13 & Q3 '14 (except 3rd-party systems in MA)
 - System prices fell 12% from Q3 '12 to Q3 '13
- Average prices between \$3.0 - \$4.5/W
 - 20% percentile of host owned systems is between \$3.0-\$3.3/W

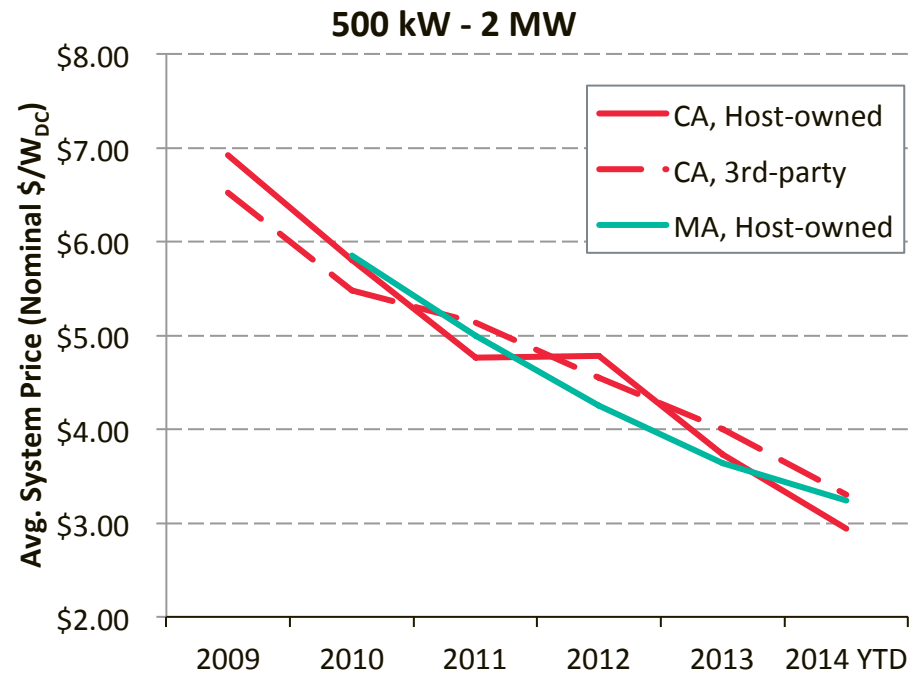
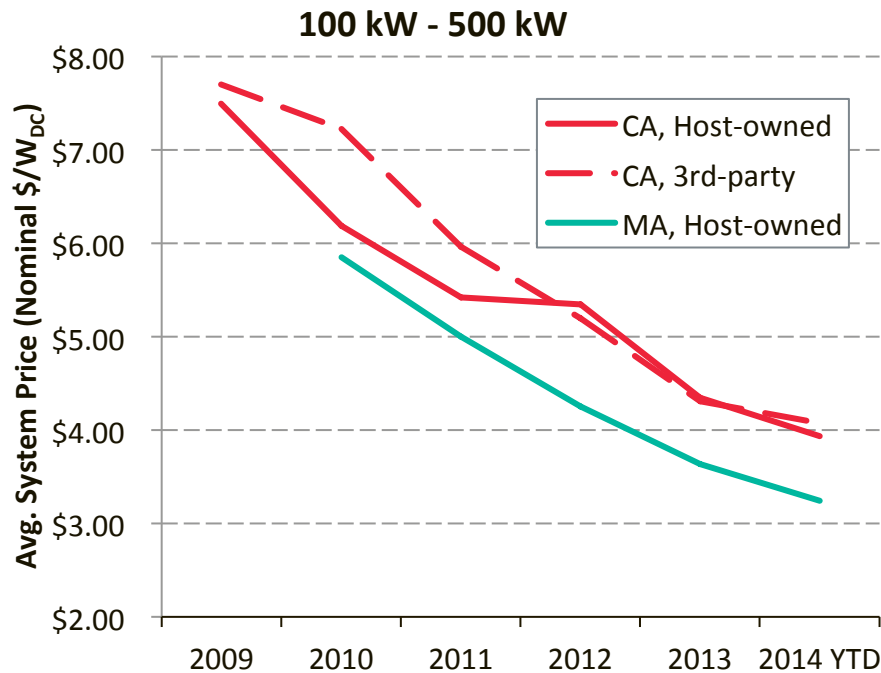
2014 YTD MW: AZ (14); CA H.O. (15); CA 3rd-P (14); MD (1); MA H.O.(5); MA 3rd-P (1); MD (1).

Sources: Arizona Public Services, & Salt River Project, accessed 07/09/14; CSI Database, accessed 07/02/14; MA SREC Program, accessed 07/09/14; Maryland Energy Administration, accessed 06/24/14.

Note: MA does not report whether a system is 3rd-party owned therefore it was estimated using the “applicant entity” or “installer” for the following organizations: SolarCity, CPF Capital, SunRun, Vivint, Sungevity.

Average System Pricing by Size & Region

100 kW – 500 kW & 500kW – 2 MW



- System prices in the above states, of the above sizing, fell on average 5 – 25% between 2013 & '14 YTD
 - Many large-scale systems going in below \$3/W
 - Consistent to declines experienced in previous 5 years
- 20% percentile of host owned systems in CA & MA (500 kW – 2 MW) is \$2.18/W & \$2.52/W for 2014 YTD

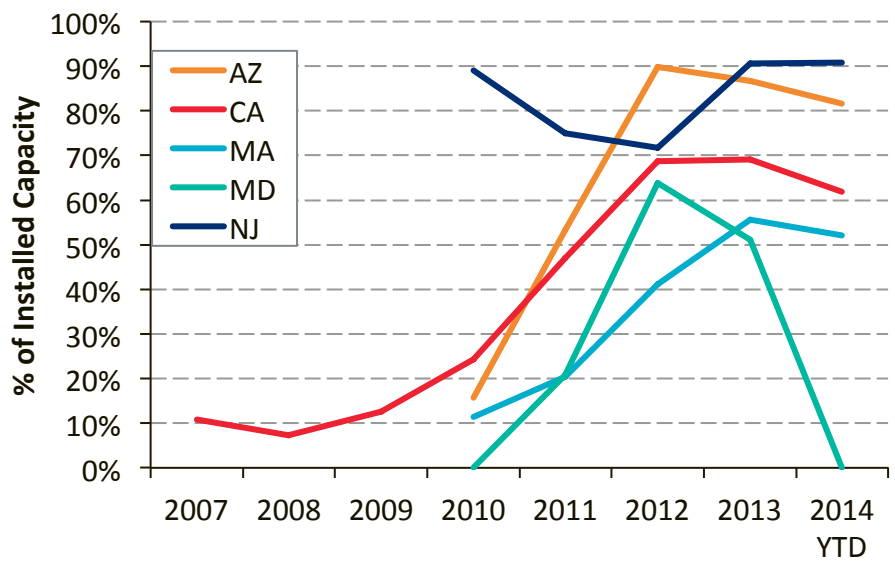
H1 '14 MW: (100-500kW) CA H.O. (29); CA 3rd-P (14); MA H.O.(3); (500kW-2MW) . CA H.O. (18); CA 3rd-P (17); MA H.O.(8).

Sources: CSI Database, accessed 07/02/14; MA SREC Program, accessed 07/09/14.

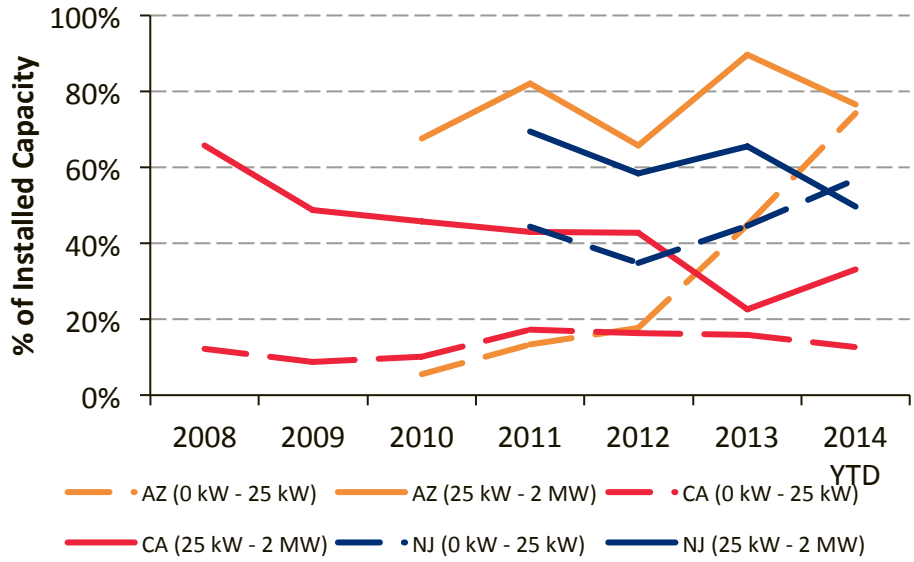
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3rd-Party System Ownership by Region

Residential Systems



Commercial Systems



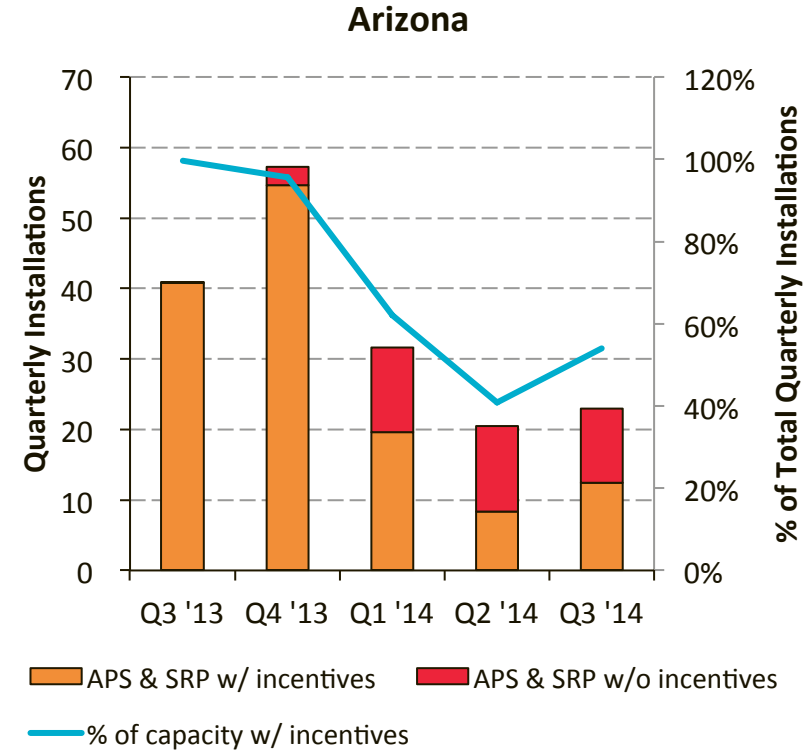
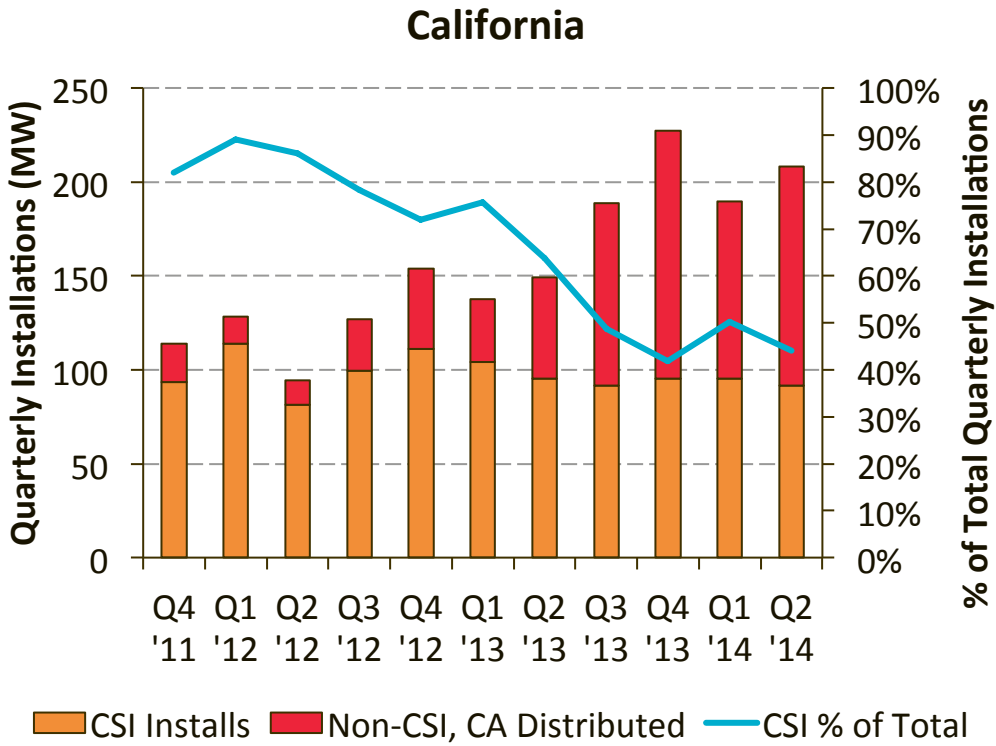
- 3rd-party ownership continues to dominate residential sector in several markets
 - However, TPO market share appears to be declining in some markets
- 3rd-party ownership in the commercial market varies by system size
 - Self-financed large systems represented a larger percentage of Q2 '14 commercial market in CA & NJ, however TPO still represented a significant part of many markets

Sources: Arizona Public Services, & Salt River Project, accessed 10/06/14; CSI Database, accessed 10/01/14; MA SREC Program I & II, accessed 10/07/14 & 10/08/14; Maryland Energy Administration, accessed 09/23/14; NYSERDA, accessed 10/06/14.

Note: MA does not report whether a system is 3rd-party owned therefore it was estimated using the “applicant entity” or “installer” for the following organizations: SolarCity, CPF Capital, SunRun, Vivint, Sungevity.



Systems Installed Without Incentives

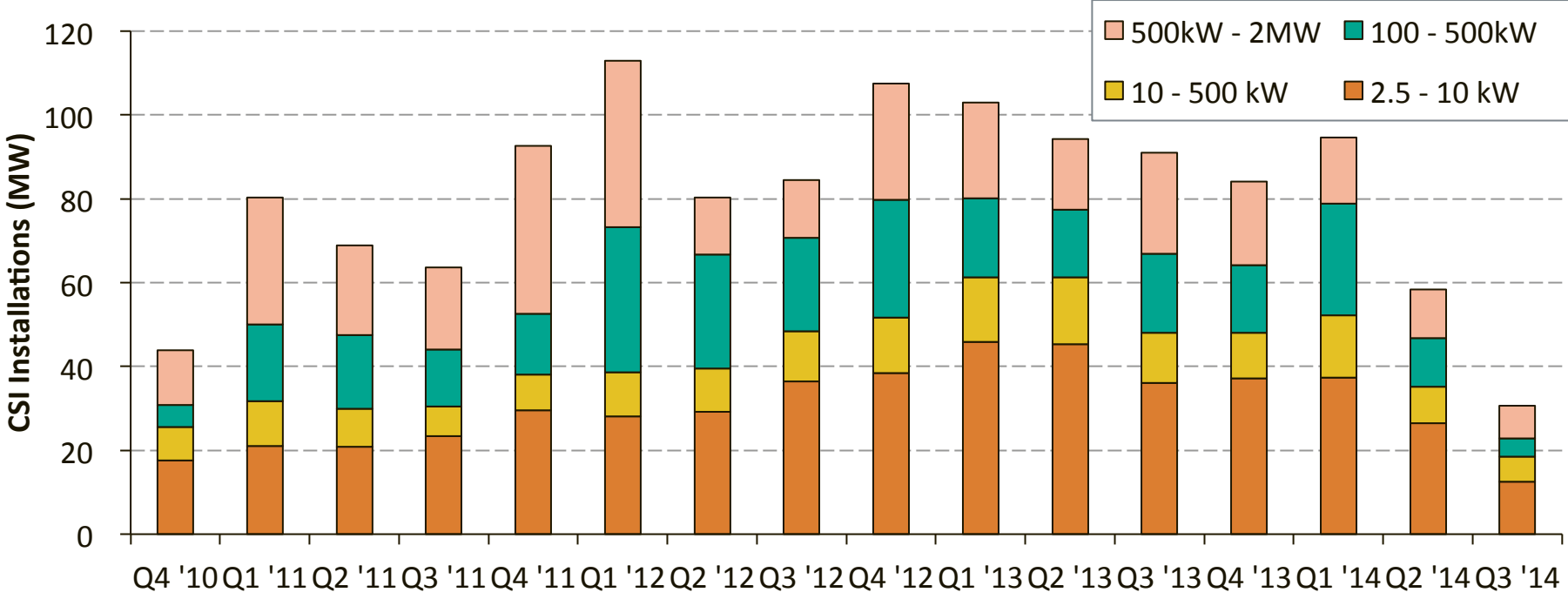


- CA distributed PV installations continue to grow, however majority of them are now doing so without CSI incentives (more than 100 MW in Q2 '14)
- AZ distributed PV installations in SRP & APS territories have dropped in past year (potential concern over new APS NEM fee), however many systems that are installed are doing so without incentives

Sources: CA: CSI Database, accessed 10/01/14; GTM/SEIA Q4 2013 U.S. Solar Market Insight. AZ: APS & Salt River Project (SRP), accessed 10/06/14. Dataset segmented by "incentive type"; all projects listed as "non-incentive", "non-incentive residential", or "non-incentive commercial" assumed to have received non incentives.



CSI Installations by System Size



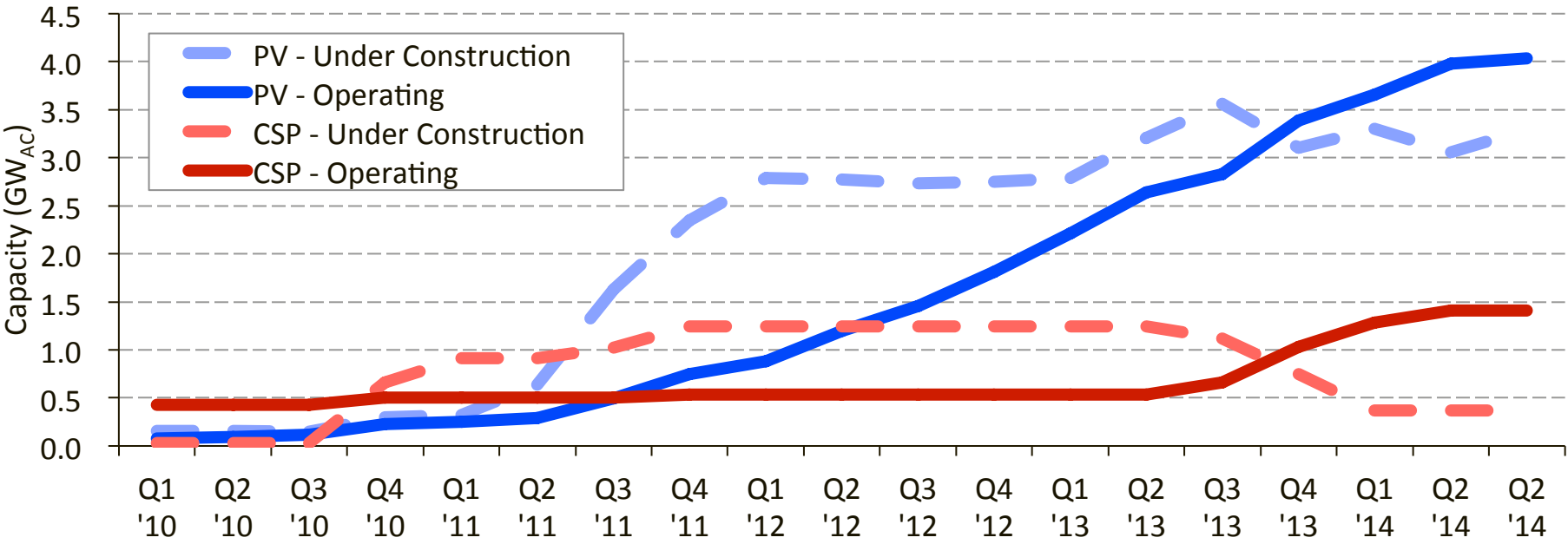
- Significantly drop-off in CSI installs in Q2 and Q3 '14
 - All system sizes installed less
- The general CSI program started in January 2007, and has a 10 year budget of \$1.95B to install 1,750 MW of PV by 2016
 - As of Oct. '14 CSI completed 1,796 MW of PV projects using \$1.80B in incentives
 - A limited number of programs are still open, and in the final stages
 - CSI projects program will achieve 1,929 MW of deployment



energy.gov/sunshot

Sources: CSI Database, accessed 10/01/14; http://www.californiasolarstatistics.ca.gov/reports/budget_forecast/#Par6Paid.

U.S. Utility-Scale Solar Projects (> 5MW)

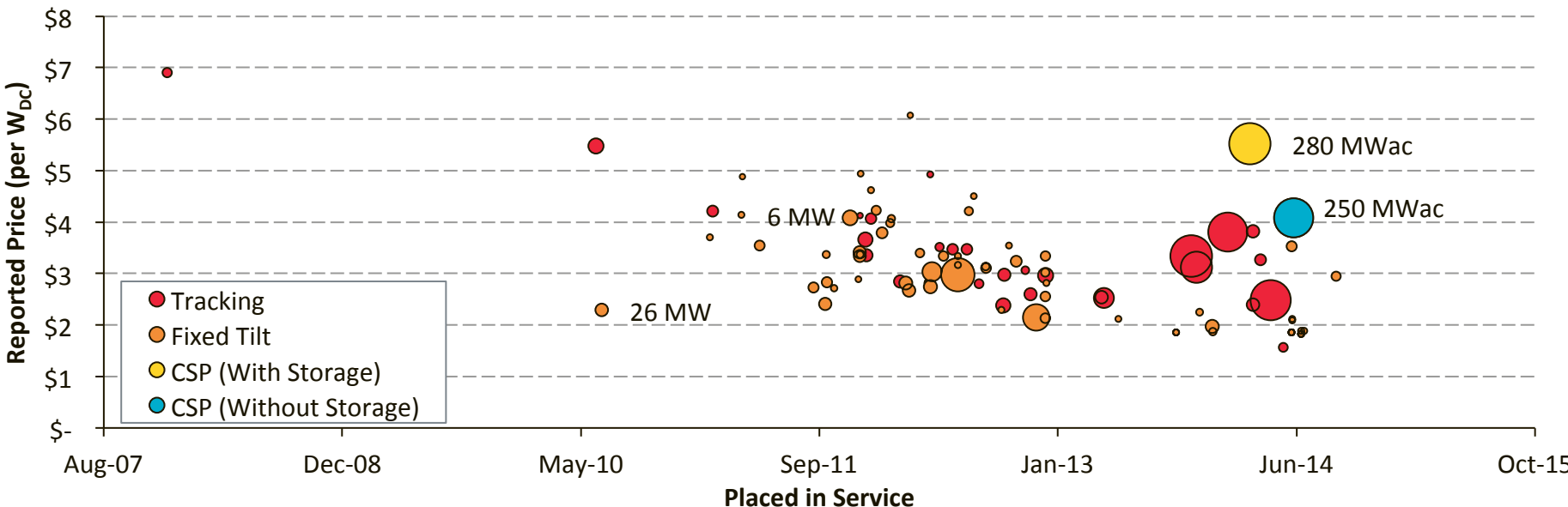


- Last two US CSP plant with loan guarantee still in construction: Crescent Dunes & Mojave Solar
- Current developers of CSP projects are facing increasing pressure with the projects' long lead-times and the upcoming expiration of the 30% ITC
 - In Sept. '14 500 MW Palen CSP project cancelled – faced environmental and tribal opposition and a 28 month construction schedule
 - In Oct. '14 it was reported that 150 MW Rice Solar Project “all but dead”
 - PPA with PG&E cancelled
 - Other CSP projects are on hold until financing climate changes



Note: As of 10/23/14.

Utility-Scale Pricing (>5 MW)



- Projects reported pricing as low as \$1.56/W
- Utility scale PPA's in the US are being signed at no higher than 6.9 cents per kwh, with some as low as 4 or 5 cents, according to Deutsche Bank
- Developers are looking in other states like Idaho and Utah, according to Cowen, to exploit the PURPA rules now that kWh pricing is so low
- GTM reports that utility-scale solar project developers have amassed more than 3 gigawatts of new contracts over the past twelve months for industry that had been focused on existing pipeline build-out

Increasing cost competitiveness, new procurement mechanisms

Source: Individual system pricing from corporate press releases & public filings. Additional information gathered from publicly available grant data from Treasury Department. Cowen (10/23/14); Duetsche Bank (10/23/14); GTM/SEIA Q2 '14 SMI <http://www.treasury.gov/initiatives/recovery/Pages/1603.aspx>,. Specific project location and system size based on various press releases and corporate filings. Grant basis is assumed to be 1.00/0.30 of grant award.



Storage for PV

- As distributed PV penetration levels rise there has been a push for more “self-consumption”
- Recent IEA reported that average self-consumption ratio for a 5kW system ranges from 20-40% depending on the region, usage patterns, and installation type
 - A 1 kW system still feeds 19% of its electricity to the grid
- Current commercially available battery systems could improve the self-consumption ratio to 60-80%
 - Additional integration strategies: EVs, energy efficiency trends, load management, smart-grid infrastructure
- CA utilities are required to file energy storage procurement plans – only 50% of which they can own
 - 200 MW is proposed to come from customer-side applications (15%)
- In Oct. ‘14 Enphase announced it will incorporate a 1.2kWh lithium-ion battery pack into its energy management system for residential and commercial customers in mid to late 2015

- Solar developers and battery companies are attempting to change utility rate structures so that storage gets paid for additional services such as voltage and demand management to make batteries more economical
- However, according to Bloomberg report, batteries still two years away from being economical with PV

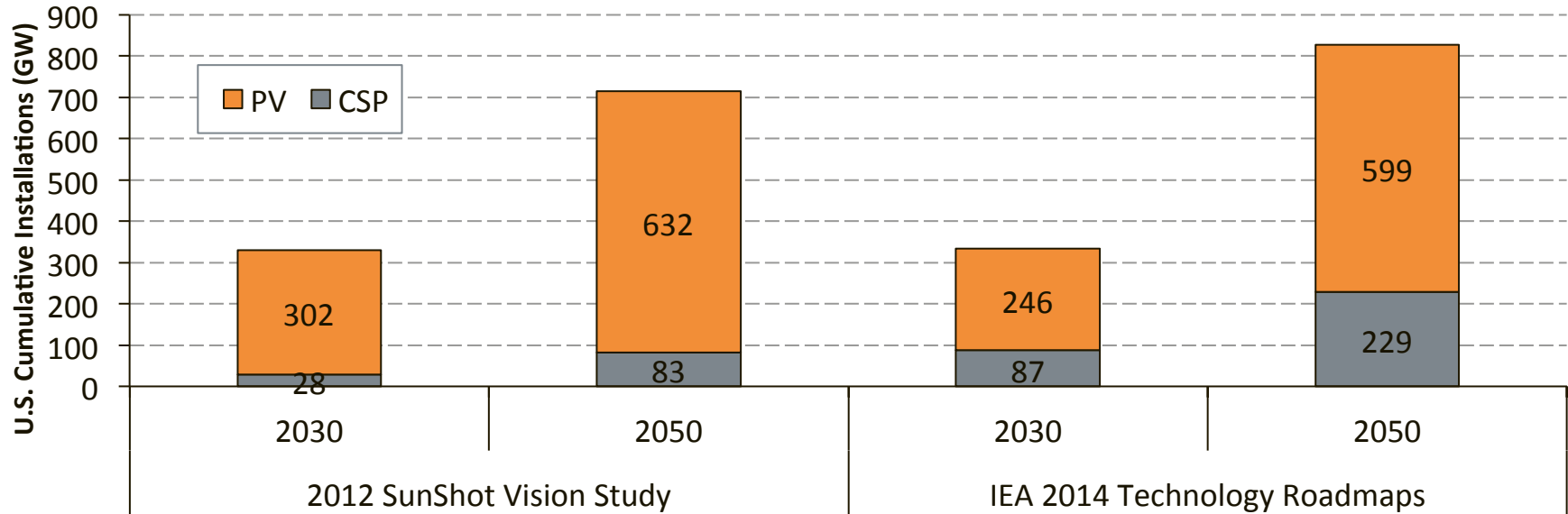
Proposed Procurement Targets for 3 CA IOUs (MW)

Point of Interconnection	2014	2016	2018	2020	Total
Transmission	110	145	192	253	700
Distribution	67	90	115	153	425
Customer	23	35	58	84	200



Sources: BNEF (10/24/14); CA PUC “Decision 13-10-040 October 17, 2013”; Cowen (10/23/14). IEA “Residential prosumers - drivers and policy options (re-prosumers)”, June 2014. IEA “Self-Consumption of PV Electricity,” forthcoming.

IEA CSP & PV Technology Roadmaps

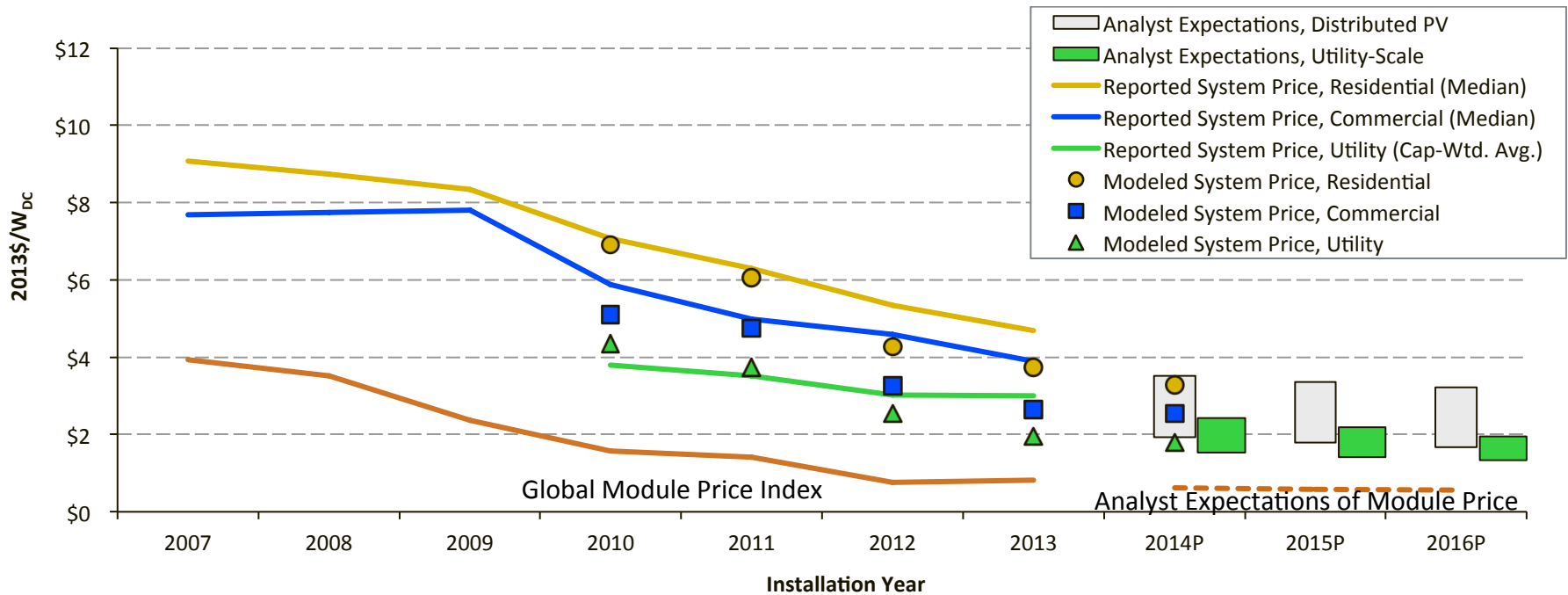


- IEA recently released technology roadmaps, through 2050, for PV & CSP
 - PV projections are within 5% of each other by 2050, however IEA predicts 176% more CSP
 - IEA also projects global PV and CSP installs to reach 4,674 GW and 982 GW respectively by 2050, or 16% and 11% respectively of global electricity generation (TWh) – together, over a ¼ of worldwide electric generation
 - Assumes an average cost reduction for PV of 45% by 2030 and 65% by 2050



Sources: SunShot Vision Study, NREL (2012). Technology Roadmap Solar Photovoltaic Energy 2014 edition, IEA (2014). energy.gov/sunshot
 Technology Roadmap Solar Thermal Electricity 2014 edition, IEA (2014).

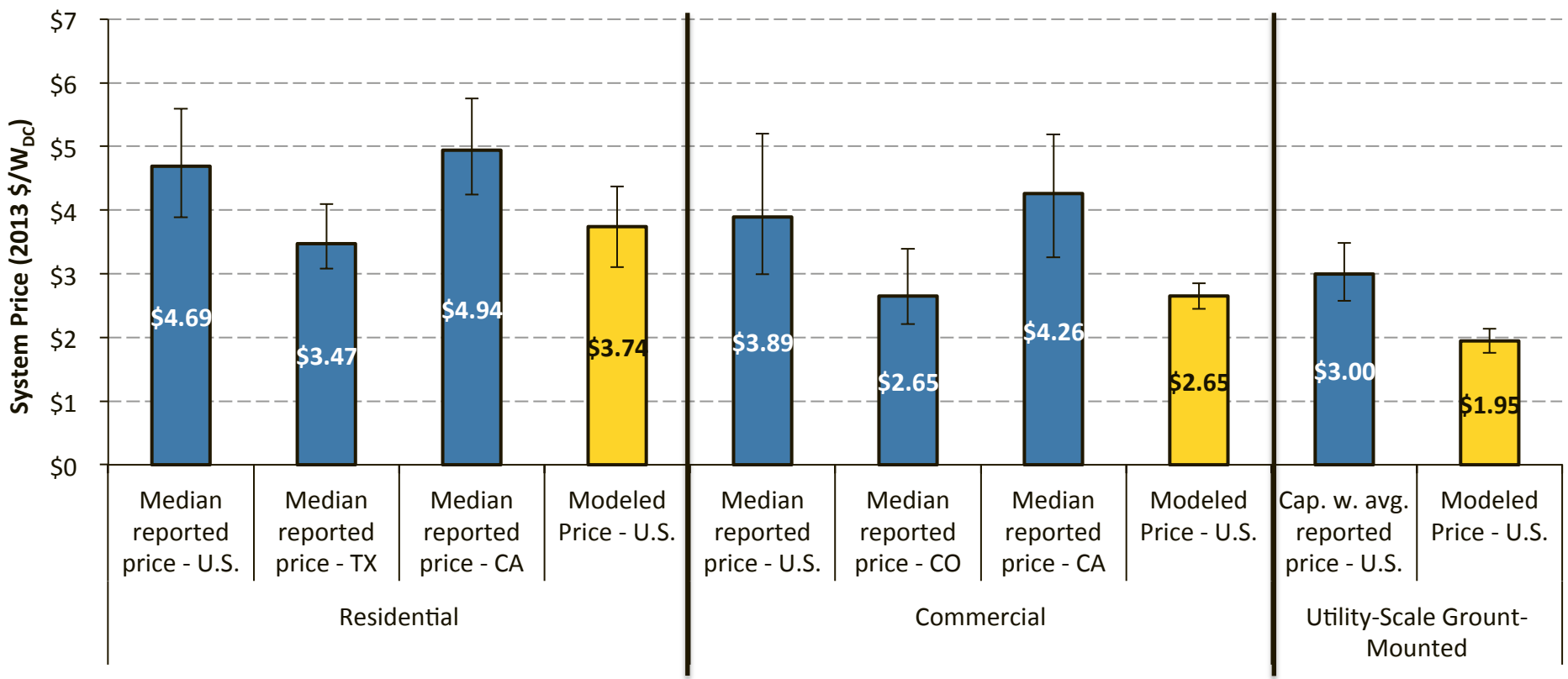
Reported, Bottom-up, and Analyst-projected Average U.S. PV System Prices over Time



- All methodologies show a downward trend in PV system pricing
- Reported pricing and modeled benchmarks historically had similar results, however have recently diverged in estimated pricing

Note: The reported system price for the residential market is the median price reported for systems less than or equal to 10 kW. The modeled residential system price represents a ~5 kW system. The reported system price for the commercial market is the median price reported for commercial systems greater than 100 kW. The modeled commercial system price represents a ~200 kW rooftop system. The reported system price for the utility-scale market is the capacity-weighted average reported price for ground-mounted systems greater than or equal to 5 MW in size, with a capacity-weighted average project size of 150 MW in 2013. The modeled system price of utility-scale systems represents a ~175 MW fixed-tilt ground-mounted system. Modeled system prices for all sectors are representative of bids issued in the fourth quarter of the previous year. The Global Module Price Index is the average module selling price for the first buyer (P Mints SPV Market Research).

2013 Reported Median (Residential/Commercial) and Capacity-weighted Average (Utility-scale) Prices vs. Q4 2012 Bottom-up Benchmark (Quoted) Modeled Prices

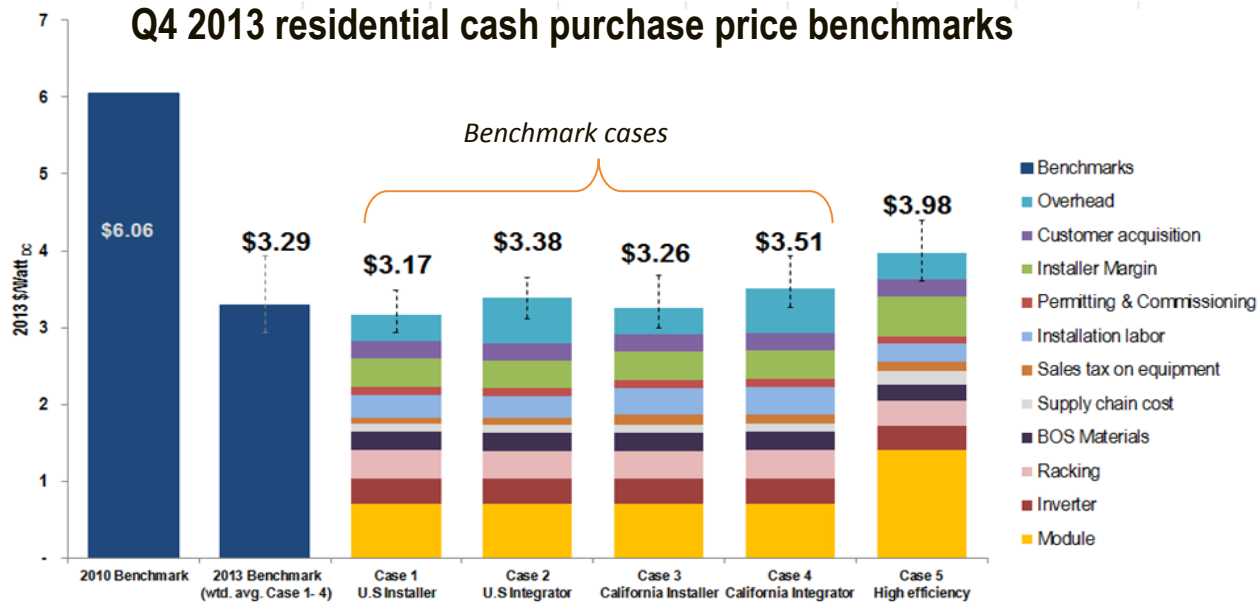


Note: Many factors contribute to the reported price and overnight capital cost differing values including the additional costs above and beyond the overnight capital cost of a project, such as third-party financing; different system sizing; installation time lag; and various methods for calculating system sales price. Error bars for reported price data represent 20/80 percentile of datasets. The costs included in the bottom-up benchmarks represent national averages; there is significant cost variation for each component, depending on the installer, market, or time frame. The above data is representative of the following system sizing: median residential reported size= 5.6 kW; residential bottom-up benchmark overnight capital cost = 5 kW; median commercial reported size (> 100 kW) = 266 kW; commercial bottom-up benchmark overnight capital cost = 223 kW; cap.-weighted average ground-mounted system (≥5 MW) reported size= 149 MW; utility-scale bottom-up benchmark overnight cap. cost = 185 MW.



Detailed U.S. Residential Benchmarks

Technical Report



- Detailed bottom up analysis was performed to assess total installed PV system cost factors, including hardware, labor, sales, general, and administrative expenses and gross profit margins, and sensitivities to these factors based on market data
- Differences in development strategy, technology and location impact the cost of U.S. residential PV systems
- Additional modeling and analysis estimated the typical Fair Market Value and minimum sustainable lease price as well as summarized historical prepaid lease transaction prices to compare with installed PV costs

Scenario	Core Business Functions	Module Efficiency	Labor Costs	Est. U.S. Market Share
1. Large installer – U.S.	Installation	Standard	National average	17%
2. Large installer – CA	Installation	Standard	California rates	15%
3. Large integrator – U.S.	Installation, third-party financing, system monitoring	Standard	National average	8%
4. Large integrator – CA	Installation, third-party financing, system monitoring	Standard	California rates	7%
5. Large installer – high-efficiency modules	Installation	High	National average	17%

The Q4 2013 benchmark incorporates the weighted average (based on estimated market share) of the four standard efficiency cases

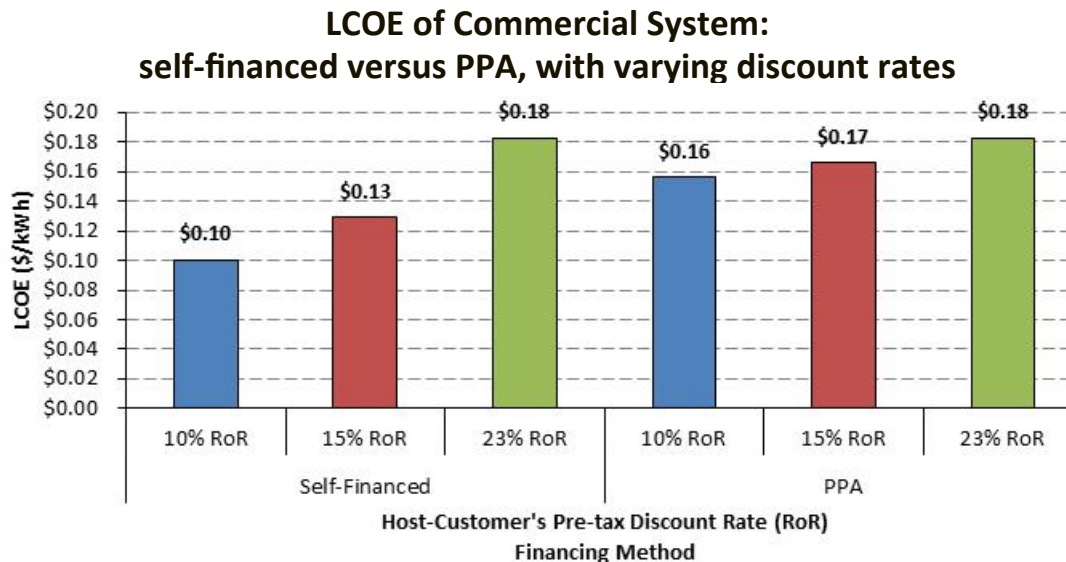


Source: Davidson et. al. "U.S. Residential Photovoltaic (PV) System Prices, Q4 2013 Benchmarks: Cash Purchase, Fair Market Value, and Prepaid Lease Transaction Prices," NREL, forthcoming.

IKEA & Staples – Two Ways to Deploy PV

Technical Report

- IKEA has self-financed over 35 MW of PV, while Staples leases 14 MW of PV through PPA's
- A range of factors determine how a company finances a PV system, including perceived risk and internal cost of capital
 - Both financial arrangements were modeled. While the self-financed "base-case" results in a 30% lower LCOE than the LCOE for the PPA-financed system this assumes an equal perception of risk
 - If a company assumes a 10% discount rate for a PPA and a 23% discount rate for self-purchase, then the LCOE would be 14% lower using the PPA

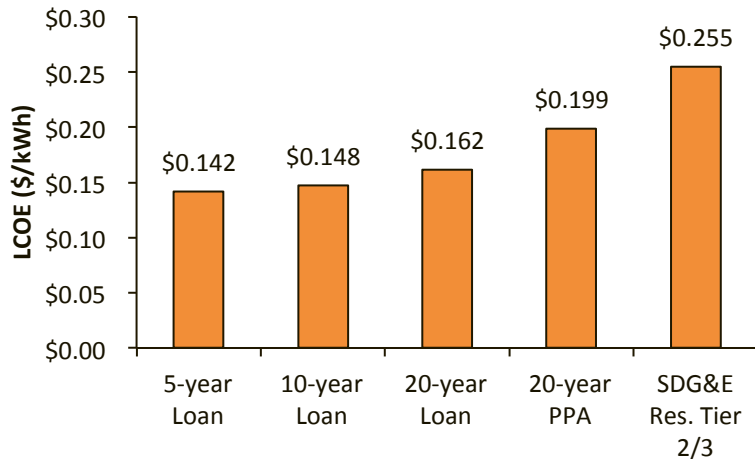


Opportunities for Solar Loans

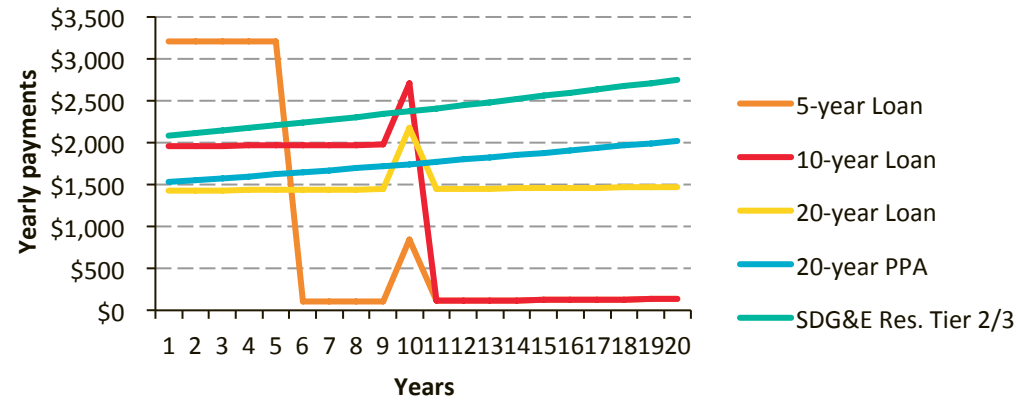
Technical Report

- Solar-specific loan financing is growing in the United States
- A solar loan financing arrangement differs from TPO in several key aspects, including:
 - the retention of ownership rights by the system host (e.g., ITC, residual value)
 - the exposure to risk (e.g., inverter replacement, REC value)
 - and the variability in the size of payments based on the interest rate and tenor of the loan
- LCOE of loans was found to be 19%-29% lower than LCOE of PPA's due largely to the higher cost of capital for TPO

LCOE of residential PV systems, financed under a PPA or loan, compared to retail rates



Comparison of annual payment between residential PV systems, financed under a PPA or loan, and retail rates

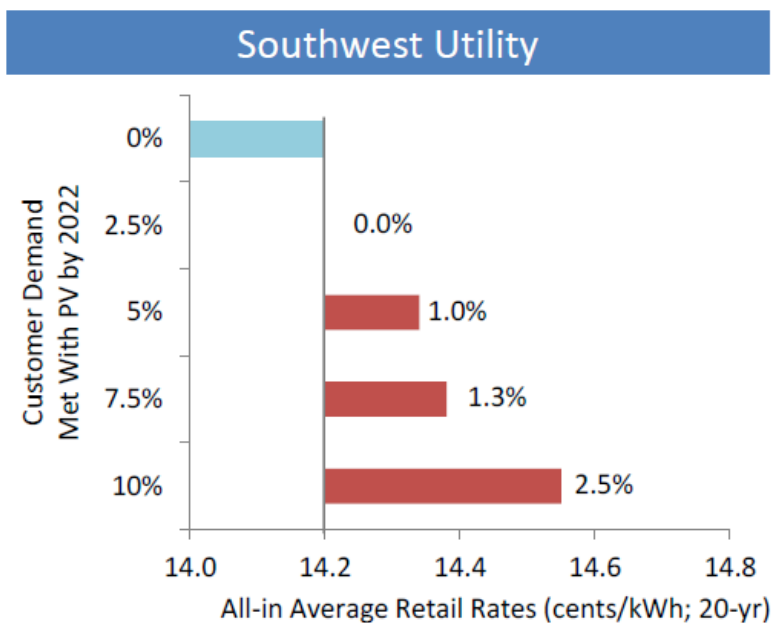


Impact of Increased Net-Metering

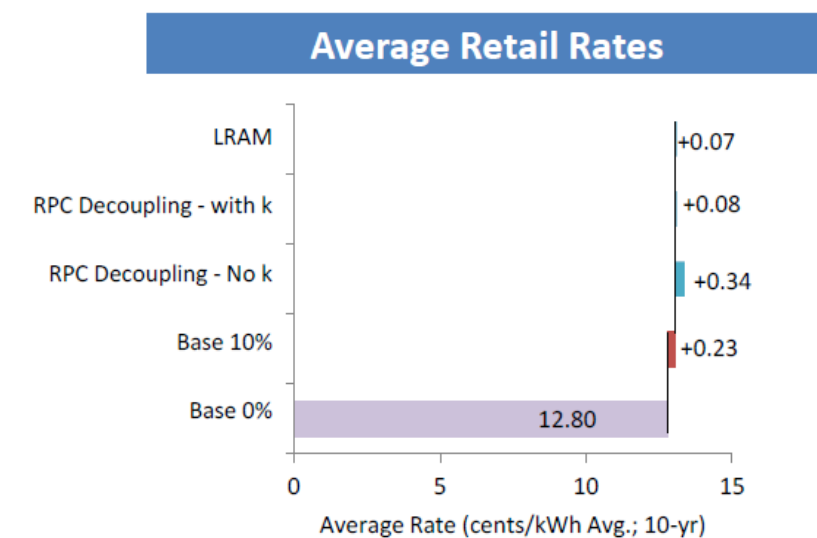
Technical Report

- If net-metering reaches 10% of customer demand it will likely cause an increase in rates (2.5%-2.7%) and a decrease in ROE (3%-18%) and lost future investment opportunity for utilities (8%-15%)
- It will impact individual utilities differently, due to specific fix-costs, size of rate-base and degree at which they own T&D
- However, the impact on average retail rates is relatively modest, and there are various “incremental” changes to business or regulatory models which can mitigate the impacts of customer-sited PV on utility ratepayers and shareholders

Impact of Retail Rates on Increased Net-Metering

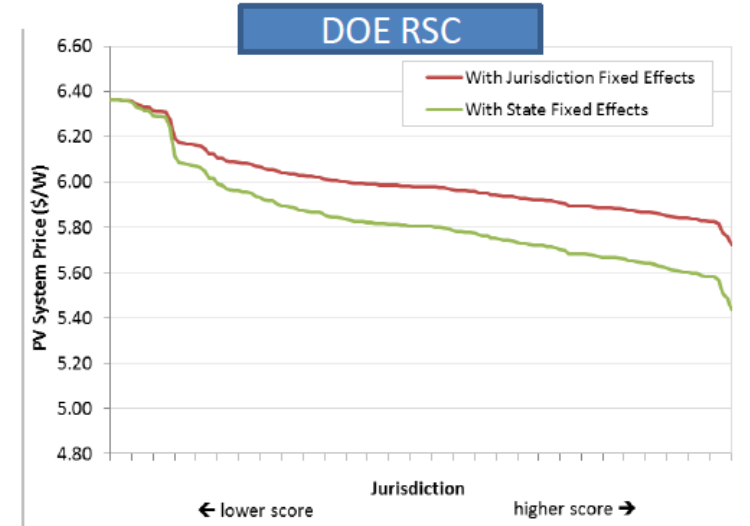
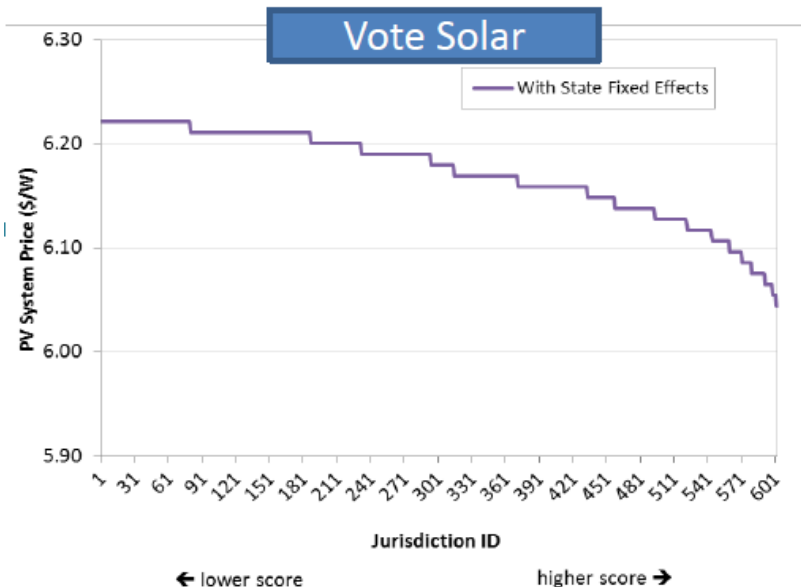


Utility Mitigation Strategies Impact on Retail Rates



Impact of Permitting and Local Regulatory Processes on PV Prices - Technical Report

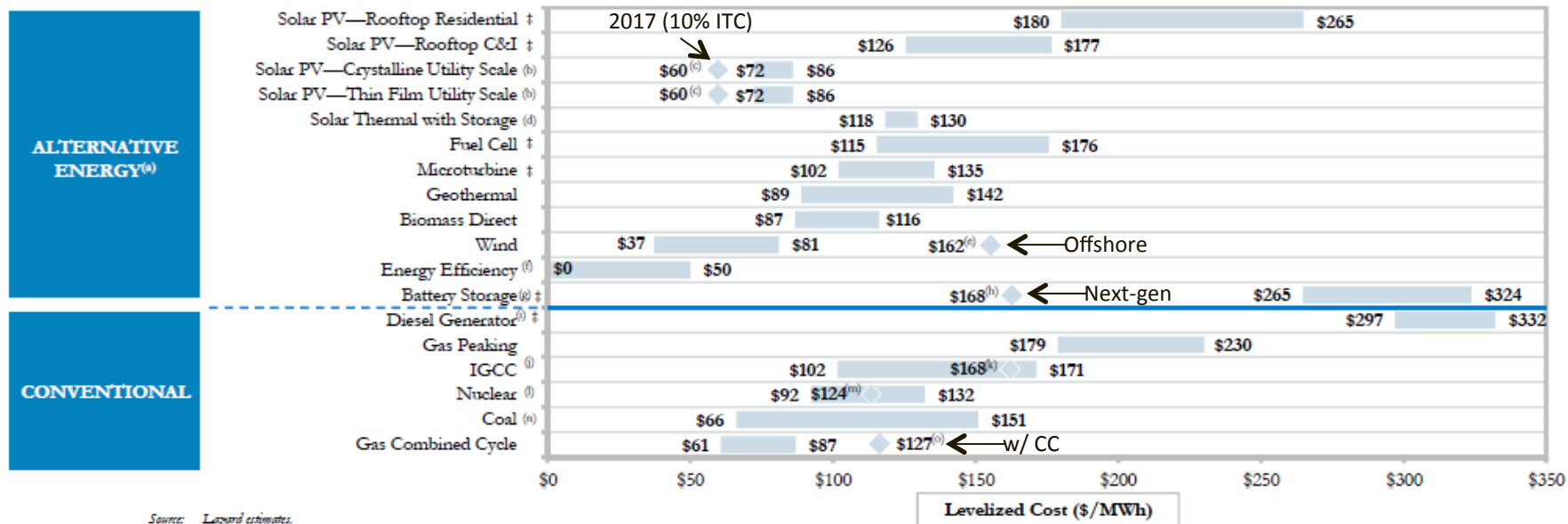
- Looked at best-practices rating systems from Vote Solar and DOE's Rooftop Solar Challenge on hundreds of different jurisdictions across several states
- Average price of PV in highest-scoring jurisdiction in Vote Solar dataset predicted to be \$0.18/W (3%) less than in lowest-scoring jurisdiction
- Average price of PV in highest-scoring jurisdiction in RSC predicted to be \$0.64-0.93/W (10-15%) less than in lowest-scoring jurisdiction
- Results suggest that 13-19% of the total PV price change from 2011 to 2012 might be attributed to improvements in permitting and other local regulatory processes



Two Analyst Reports Show PV Competitiveness to Traditional Generation

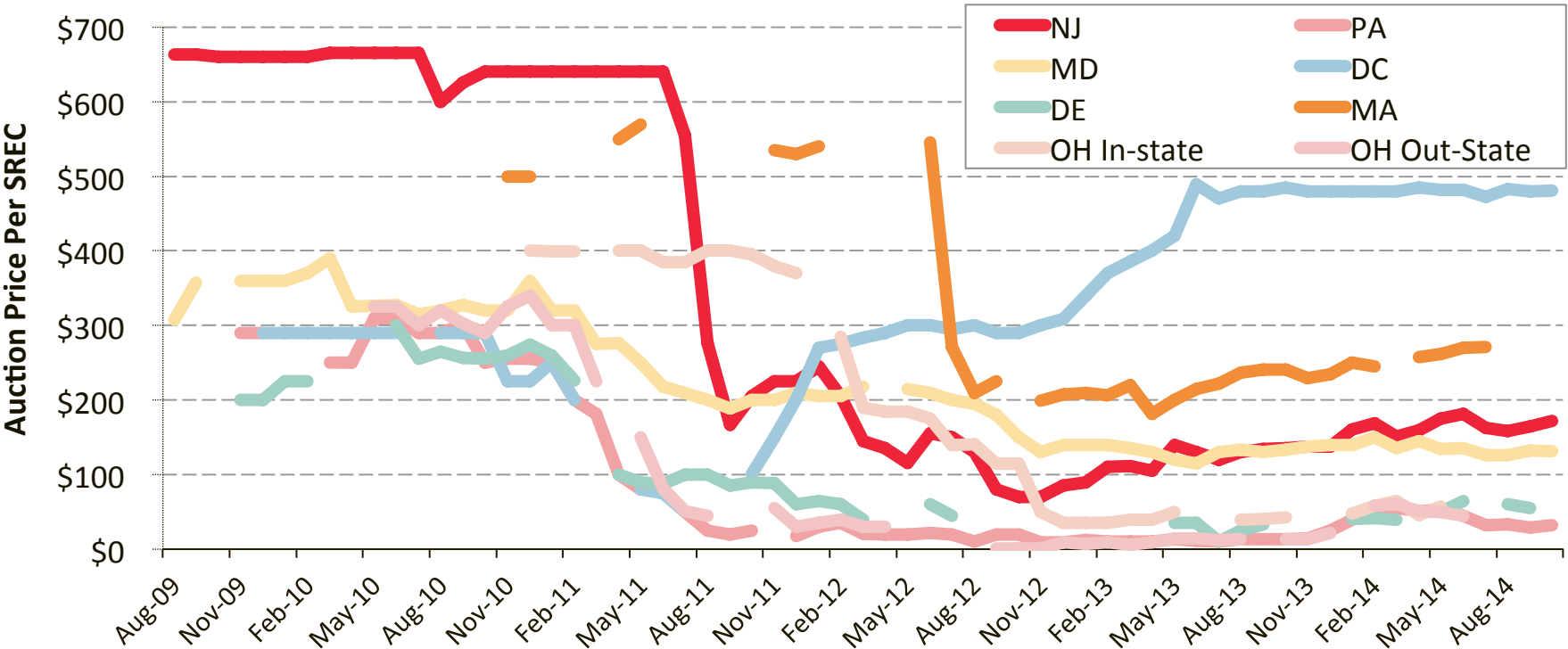
- According to Deutsche Bank report released in Oct. '14, PV is at grid-parity in 10 states and by 2016 the number of states will increase to 47 (w/ 30% ITC)
 - At 10% ITC, PV still competitive in 36 states
- Lazard's Sept. '14 LCOE reports similar numbers, w/ utility-scale PV at \$0.06/kWh by 2017 (w/ 10% ITC)

Unsubsidized Levelized Cost of Energy Comparison



Source: Lazard estimates.

SREC Markets



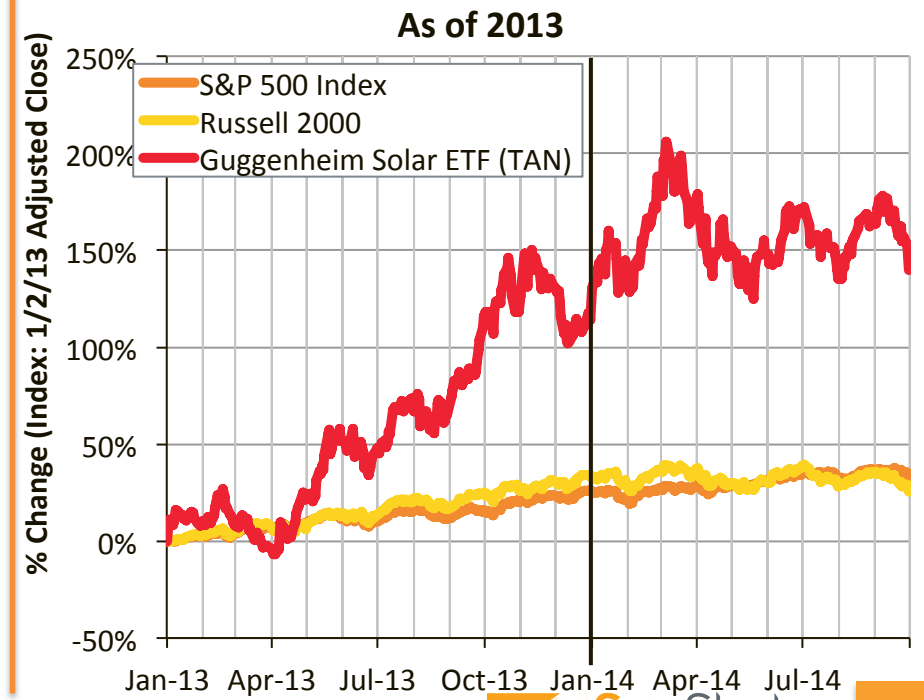
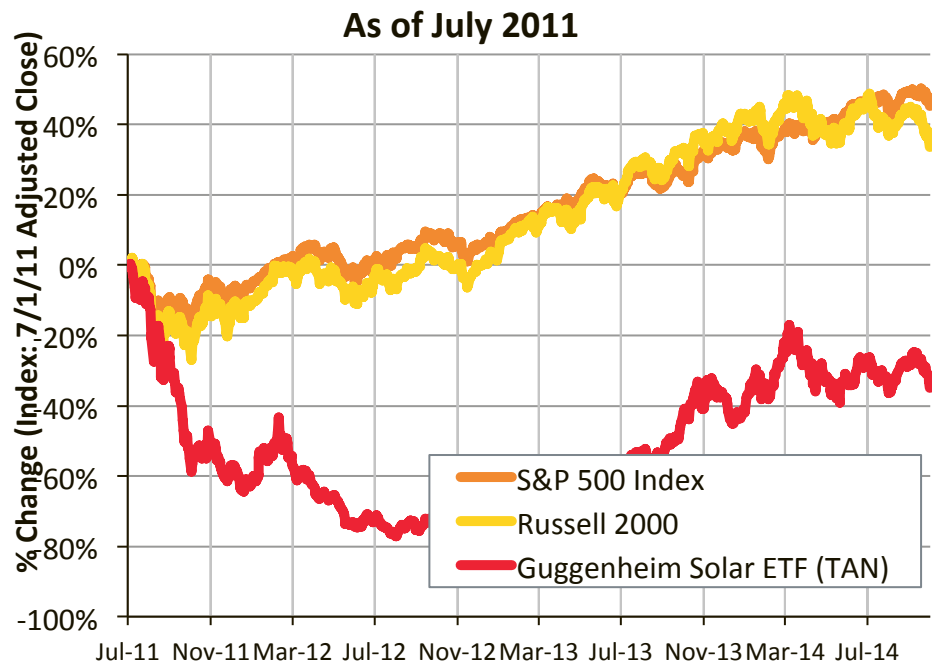
- With exception of Ohio and PA, SREC prices remain relatively flat in 2014
 - Prices are not returning to previous highs but are well above historic lows
- Ohio Gov. John Kasich signed RPS freeze into law on 6/13
 - Ohio SREC prices drop from \$50 (June) to \$26 (Oct)
 - PA sees similar drop while other states see a slight increase



Source: Blog, SRECTrade, www.srectrade.com (accessed October 20, 2014).

Market Activity

- Solar stocks are still underwater from long-term highs, however individual investors may have drastically different results
- Though solar growth was substantial in 2013, fluctuations have caused solar stocks to have slower YTD growth than the general market
- Many attribute solar companies' shares price plunge in Oct. '14 due to "psychological" link with oil price



Notes:

- Of the 34 solar companies in the TAN index, only one is focused on CSP, Solar Millennium.
- Average market cap. of securities in TAN was \$2.1 Billion (3/31/11), Russell 2000, \$1.4b (5/31/11).
- Source: Stock Market: YahooFinance (10/20/14).



Vivint Solar's Initial Public Offering

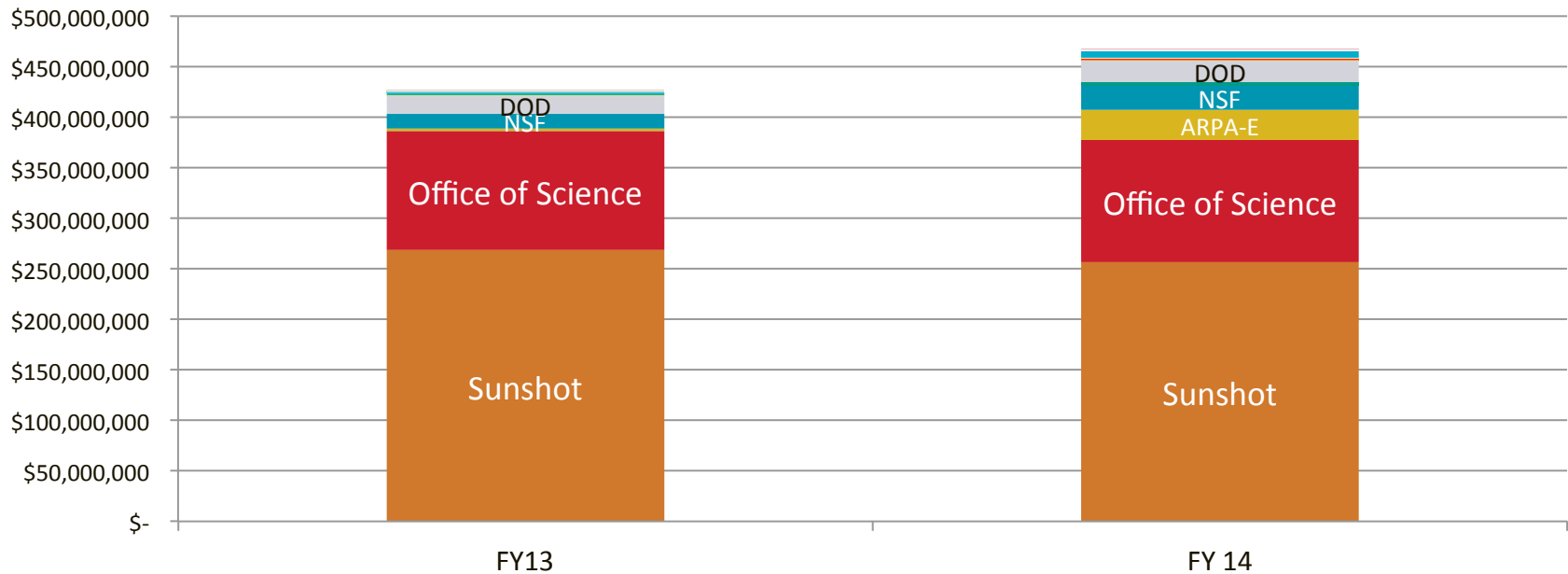
- Vivint made its IPO on Sept 30, 2014 at \$16/share
 - Stock prices dropped shortly after IPO to \$13-14 range
- Vivint is not profitable, but is growing rapidly
 - Posted a \$76 million loss at end of Q2 '14, but has expanded its market rapidly
 - Installations doubled from 2013-2014
- Vivint is currently active in 6 states, holds 7% of the national market share
- The company cites 1) access to third party capital to back solar leases, 2) decline of retail electricity rates, 3) changes in policy landscape, 4) and issues maintaining workforces as biggest risk factors for success
- They are planning on opening at least 20 new offices in current areas of operation and potentially expanding into new markets
 - They are also considering expanding into commercial market
- Maintains that its direct sales model is key to its success

Vivint IPO V. SolarCity IPO

	Vivint	SolarCity
Shares Offered to the Public	20,600,000	11,500,000
Price per Share at IPO	\$16	\$8
Maximum Offer Proceeds	\$329,600,000	\$92,000,000
Market Cap at IPO	\$1,500,000,000	\$600,000,000
Total Shares Outstanding Post-IPO	105,303,122	73,079,499
Current Share Price	\$13.15	\$55.98
Δ Share Price Since IPO	↓17%	↑ 600%
System cost/watt	\$2.31/w	\$2.29/w

Solar R&D

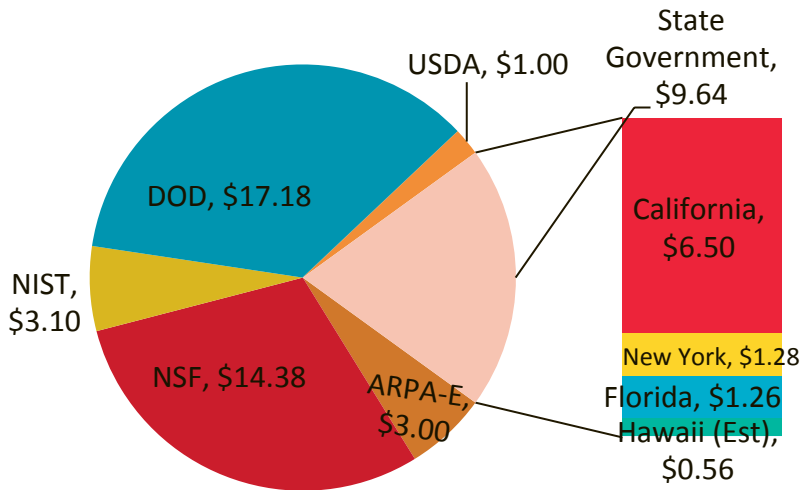
Public Solar R&D



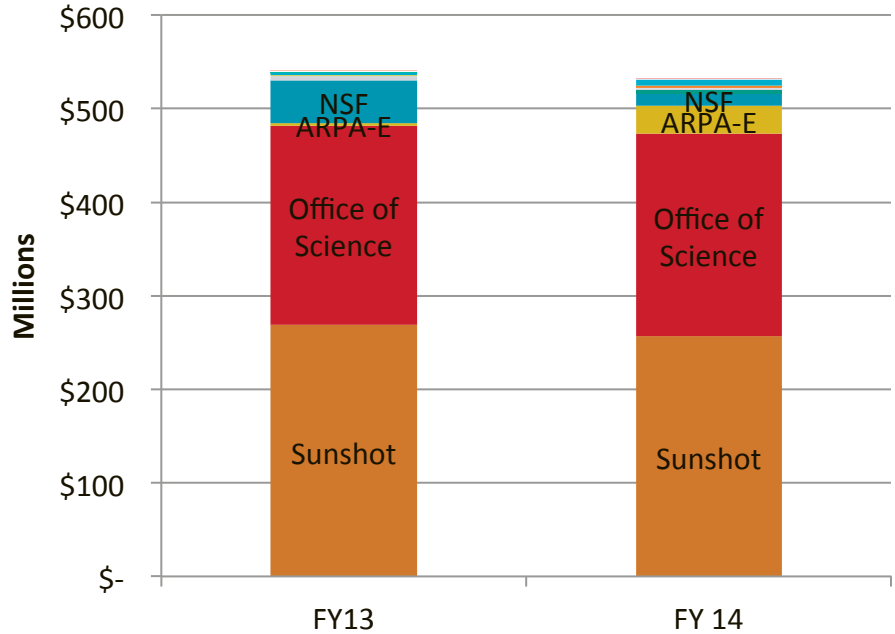
- It is estimated that the U.S. state and federal government spends approximately \$540M on solar R&D a year
 - SunShot and Office of Science provide the majority of funds
- Grew slightly FY13 – FY14, and a more diverse group have begun funding solar R&D
- Two federal agencies began funding solar R&D in 2014 through the National Nanotechnology Initiative
- Grants from some agencies (NSF, ARPA-E, NASA) function on semi-regular cycles

Public Research and Development

Non DOE Solar R&D (MM) FY 13



Public Solar R&D



- It is estimated that the United States state and federal government spends approximately \$450MM on solar R&D a year
 - SunShot represents approximately 50% of the funding followed by DOE office of science (39%) and NSF (9%)
- Funding has remained relatively flat over past few years, but a more diverse group have begun funding solar R&D
- Three federal agencies began funding solar R&D in 2014 through the National Nanotechnology Initiative
- Grants from some Agencies (NSF, ARPA-E, NASA) function on semi-regular cycles



energy.gov/sunshot

Note: 2014 Grants from NASA not yet available. State R&D is based on state energy office programs, Hawaii estimate based proportionally on solar related NEHLA research programs divided across biannual budget

111(D) Primer

- In June '14 the EPA proposed CO2 standards for existing power plants under section 111 (d) of the Clean Air Act
 - Section 11 (b) addresses new power plants
 - Would require existing U.S. power plants to reduce CO2 emissions 30% by 2030 from a 2005 baseline
- Requires each state, with assistance from the EPA, to develop a “standards of performance” for plants located in their state, and a implementation plan to achieving goal (which EPA must approve)
- Designed to offer flexibility to states for implementation, as well as taking into account each state’s specific opportunities (asymmetric opportunities and costs across states)
- 1,000 plants with 3,000 units across the country are covered under the proposed rule
 - Power plants account for about a third of all domestic greenhouse gas emissions in the United States
- Timeline:
 - Accepting comments on plan for 120 days (Oct. 3, 2014)
 - Initial compliance plans by states due June '16 (some extensions allowed)
 - Some states allowed 1-yr extension, and states that join multi-state plans can get 2-yr extension
 - Implementation to begin in 2020 with reductions achieved by 2030
- In October EU endorses a binding target of cutting GHG by 40% from 1990 levels by 2030
 - The EU is on track to meet its previous goal of a 20% reduction by 2020
 - The renewable energy target stays at 27%

Thank You

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