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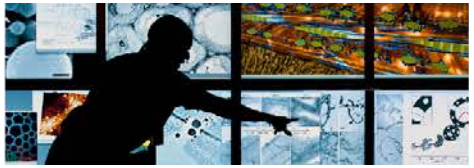
NATIONAL RENEWABLE ENERGY LABORATORY

Solar Soft-Cost Update: Evolving Markets and Challenges

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Presented at:
SunShot Prize: Race to the Rooftops
College of Nanoscale Science & Engineering
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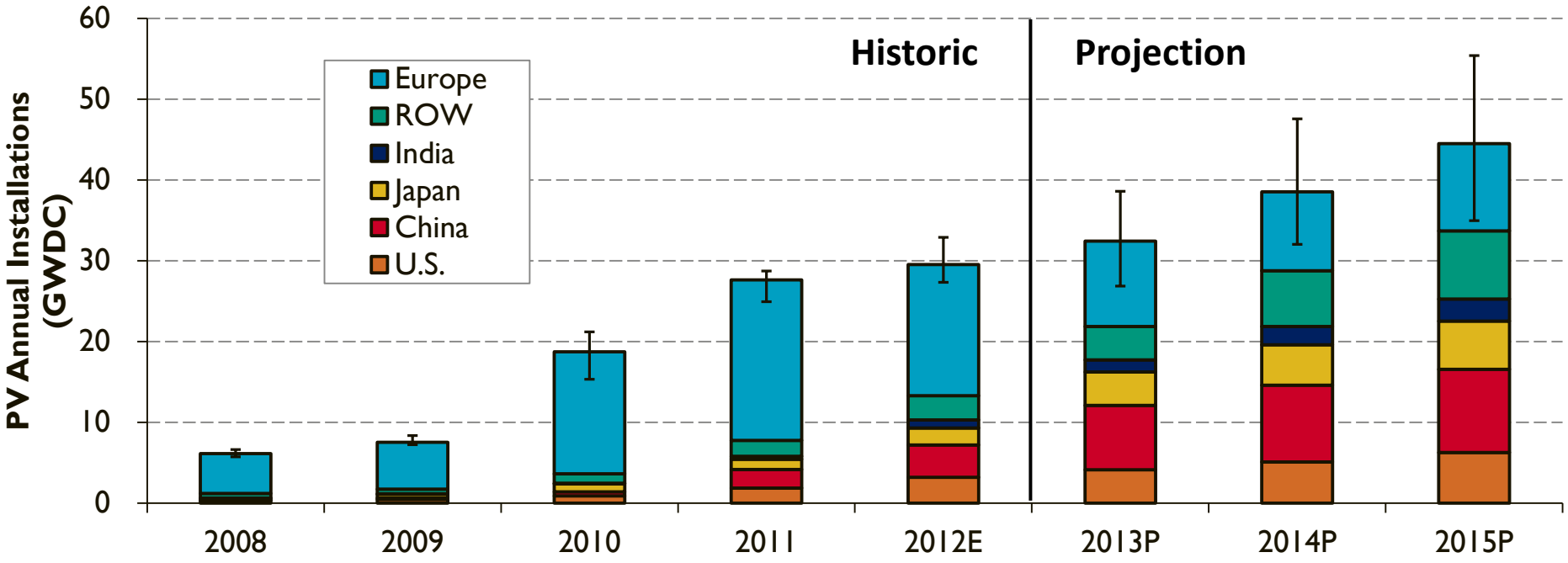
Outline

- **Market and pricing trends by sector, historical and near term projections in context of SunShot targets**
- **Recent changes in business models and their potential impact on the market and pricing**
- **Market dynamics in a low-cost, post-ITC world**

Global PV Demand



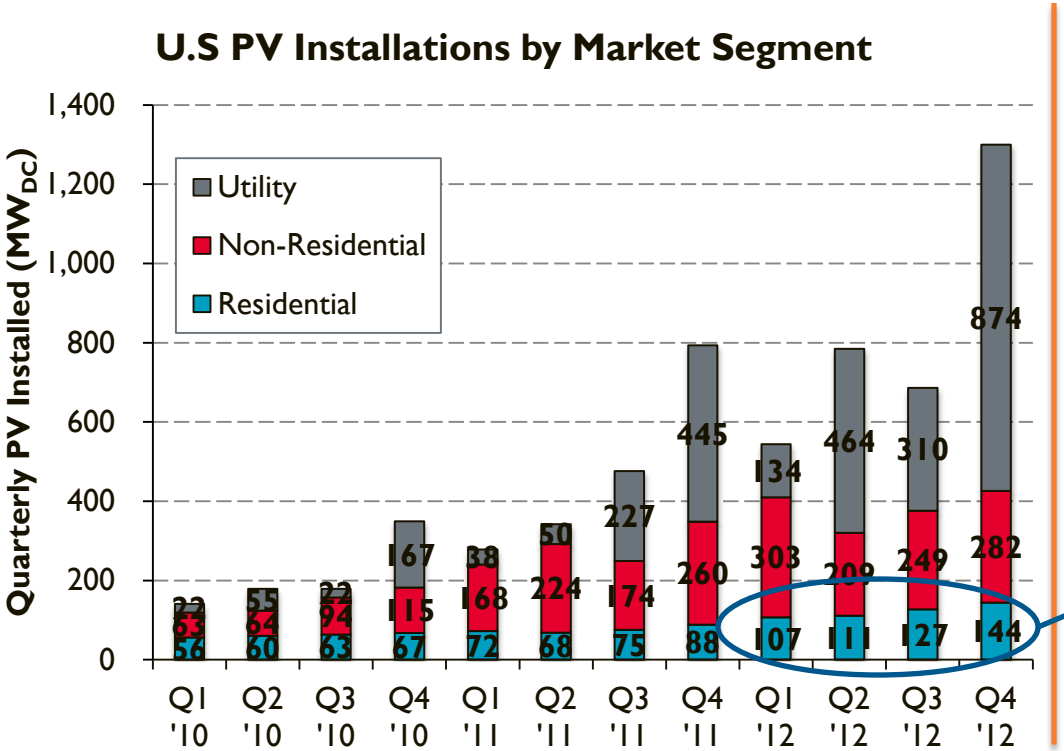
Global installations expected to grow through 2015

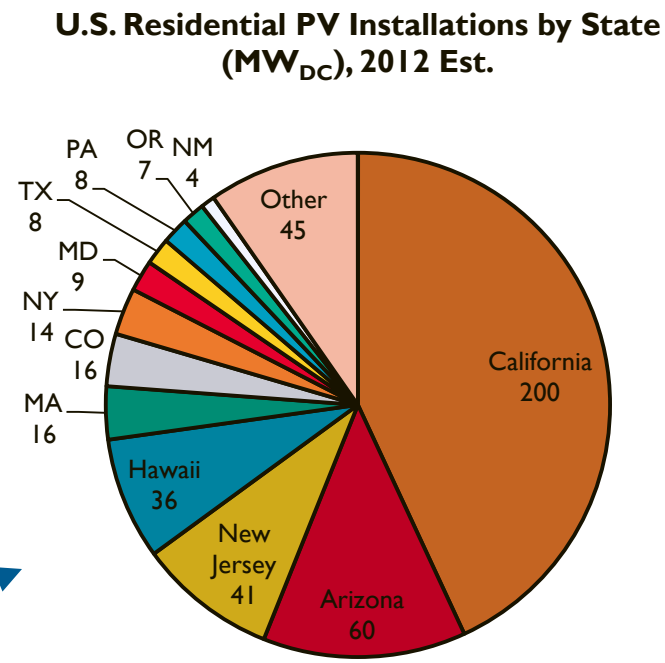
- As European demand declines, U.S. & developing world markets expected to grow
  - China expected to replace Germany as world's largest market in '13
  - Japan could be #2 market, with 6-9 GW, in '13 (according to BNEF)
  - U.S. expected to install ~ 4 GW in '13
  - India set to tender ~4 GW in '13

Note: E = estimate, P = projection

Sources: data displayed represents the median figures from the following sources, BNEF (02/08/13, 03/29/13), Deutsche Bank (03/01/13), Goldmann Sachs (01/03/13), GTM Research (January 2013), Photon Consulting (February 2013), Stifel Nicolaus (01/22/13), UBS (03/10/13)

U.S. Installation Breakdown

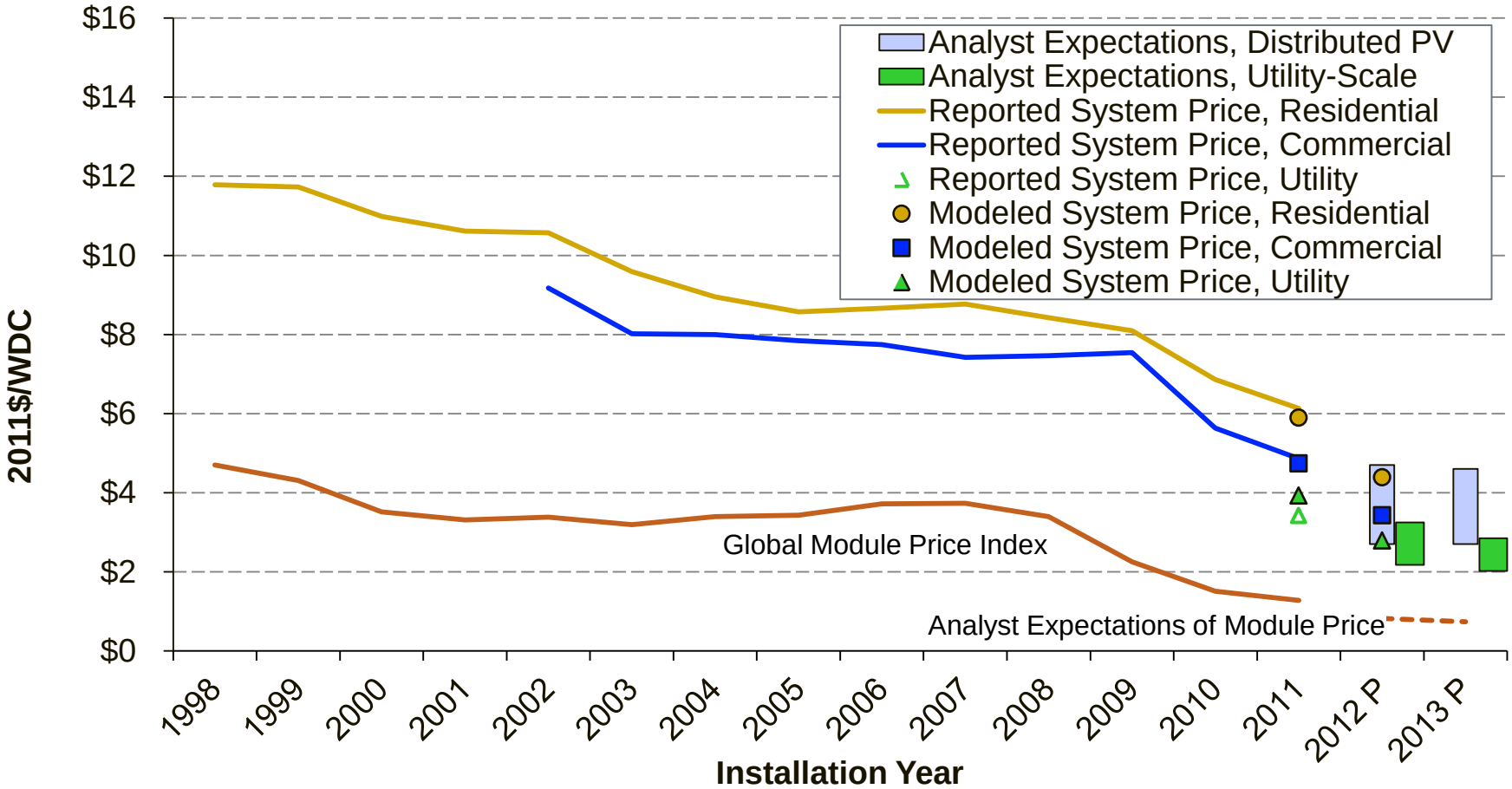




- **2012 total U.S. installations were ~3.3 GW**
  - Residential installs accounted for ~490 MW
  - Residential sector has been most steady, with cumulative installs of 1.4 GW through 2012
- **CA, AZ, NJ and HI dominated residential market in 2012**
  - 8 other states installed 4 MW+
  - Some local markets dominate in some state (Gainesville, FL; Austin, TX)

Sources: GTM/SEIA : U.S. Solar Market Insight Q3 &Q4 2012

U.S. Installed PV System Price Trends



- **Have experienced dramatic decline in installed system prices**
  - Residential: ~$12/W in 1998, ~$8/W in 2009, ~$6/W in 2011, and ~$5/W in 2012

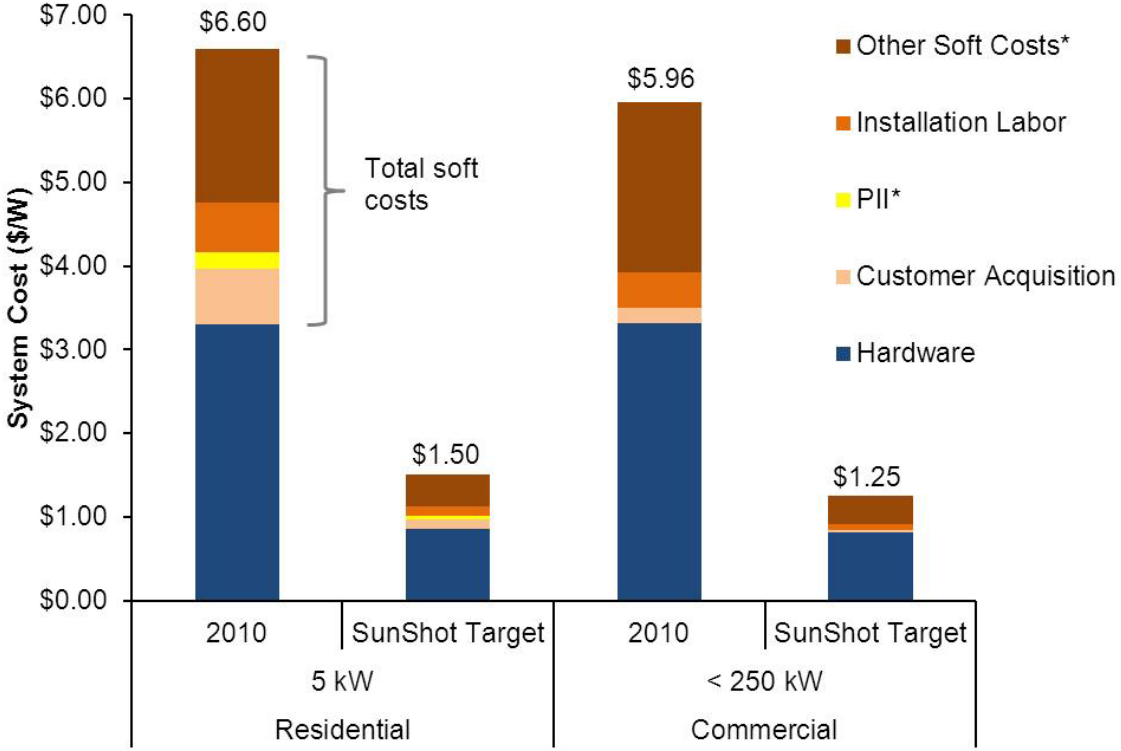
➢ **DOE/SunShot target is $1.5/W in 2020 for residential systems**

Source: Feldman et al. "Photovoltaic Pricing Trends: Historic, Recent, & Near-Term Projections" (Nov. 2012)

SunShot 2010 Benchmark vs. 2020 Targets

NREL/LBNL benchmarked 2010 soft costs in the following DOE priority areas

- Customer Acquisition (CA)
  - *includes marketing and advertising, and* system design
- Permitting, Inspection, Interconnection (PII)
- Installation labor
- Finance
- All Other Soft Costs
  - including profit

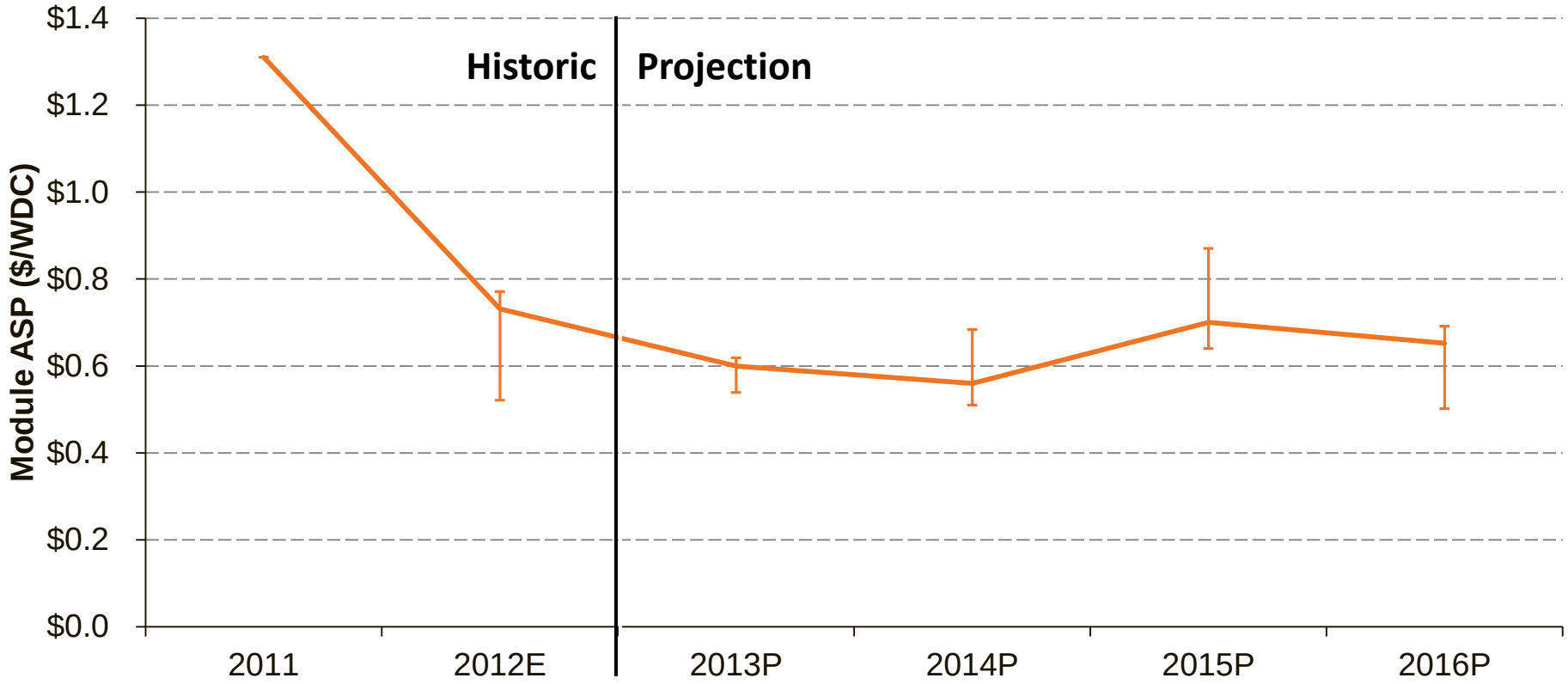


* For commercial PV, the other soft costs category includes PII.

Residential	2010 ($/W)	2020 ($/W)
Total Price	6.60	1.50
Soft Costs	3.32	0.65

Commercial	2010 ($/W)	2020 ($/W)
Total Price	5.96	1.25
Soft Costs	2.64	0.44

Module Average Selling Price (ASP)



- Do not expect dramatic increase or decrease in APSs during next couple of years
- 2016 ASP projected to be between $0.48/W - $0.66/W

➢ Major system price reductions are not expected to come from PV module during next couple of years

Note: E = estimate, P = projection

Sources: data displayed represents the median, max, and min figures from the following sources: BNEF (02/08/13), Goldman Sachs (01/03/13), GTM Research (January 2013), Photon Consulting (February 2013), UBS (03/10/13)

Soft-Costs: Linked to State and Local Policies

State

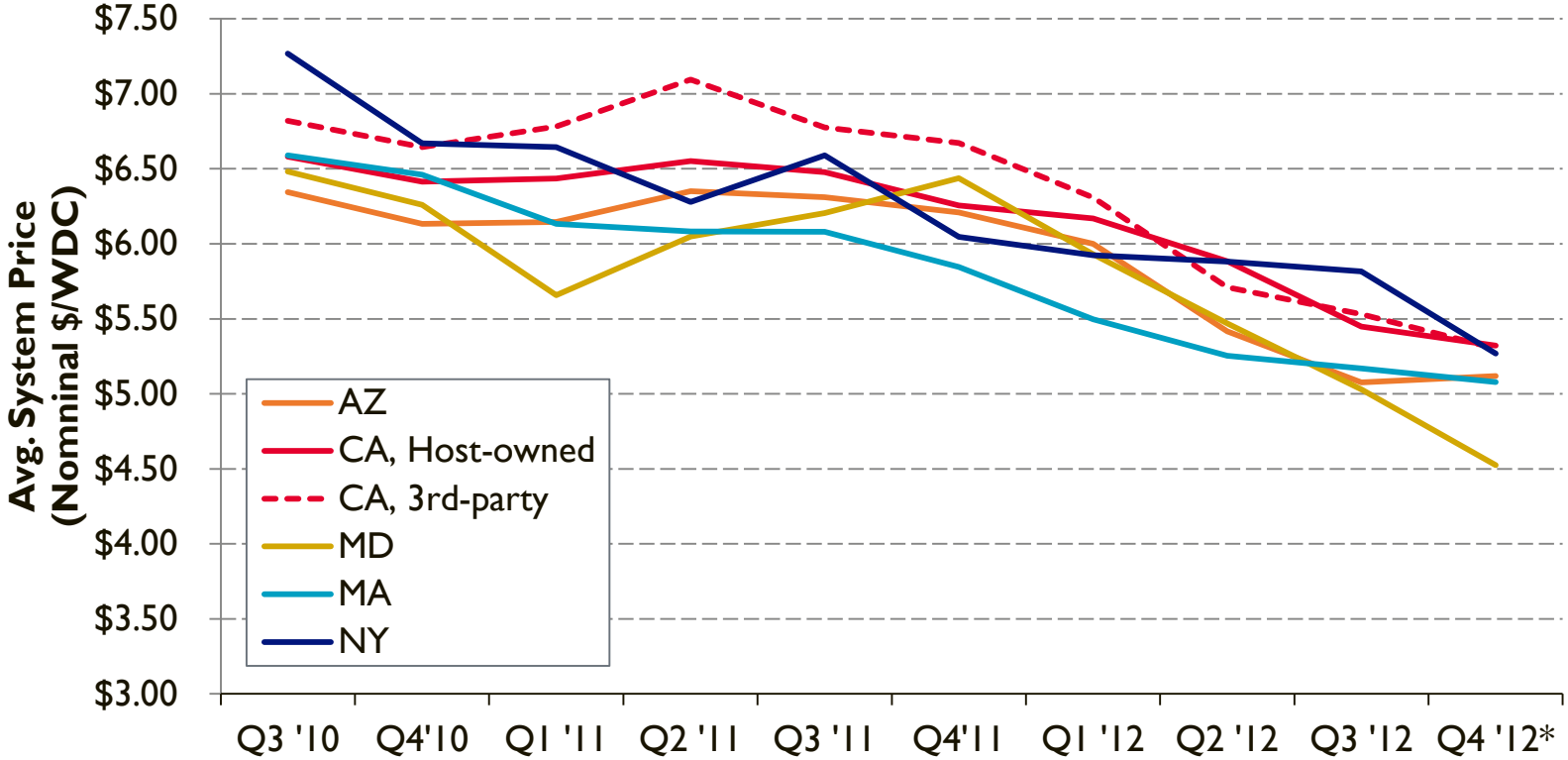
- Utility Regulation
- Interconnection Process
- Third-Party Power Sales

Local

- Building and Zoning Codes
- Solar Access
- Permitting Process

➢ **As a result, we see significant variation in pricing across jurisdictions**

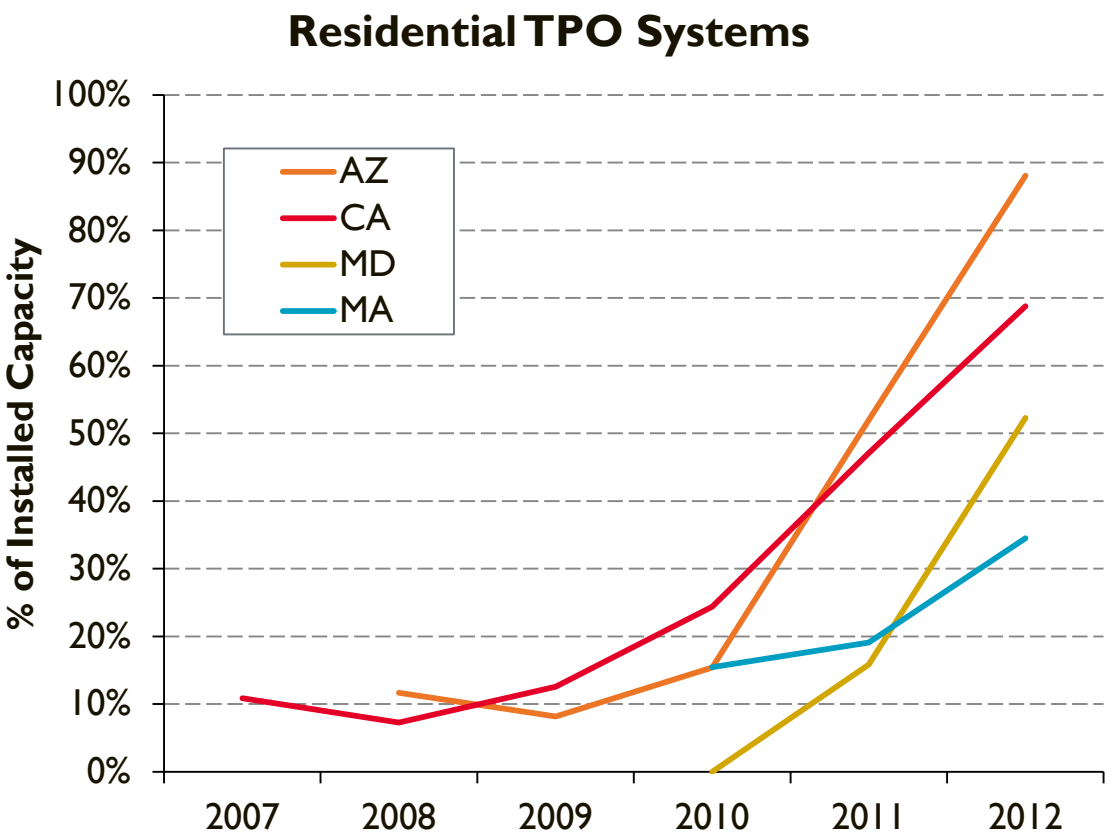
Average Residential System Price by State



- **Prices trending downwards in all states**
- **Q4'11-Q4'12: Median ASP across states fell over $1/W**
- **Reported 3rd-party pricing becoming more consistent with host-owned pricing**

Note: all average prices, except NY, are representative of all systems in each market between 2.5 kW – 10 kW.
Sources: CSI Database, accessed 12/05/12; MA SREC Program, accessed 12/12/12. Arizona Public Services, accessed 12/12/12, NYSERDA (12/12/12); Maryland Energy Administration (12/11/12). Note: NYSERDA actually represents all "residential" sector data, and is the simple average price per quarter. All other data is weighted by capacity.

Third Party Ownership (TPO) by State



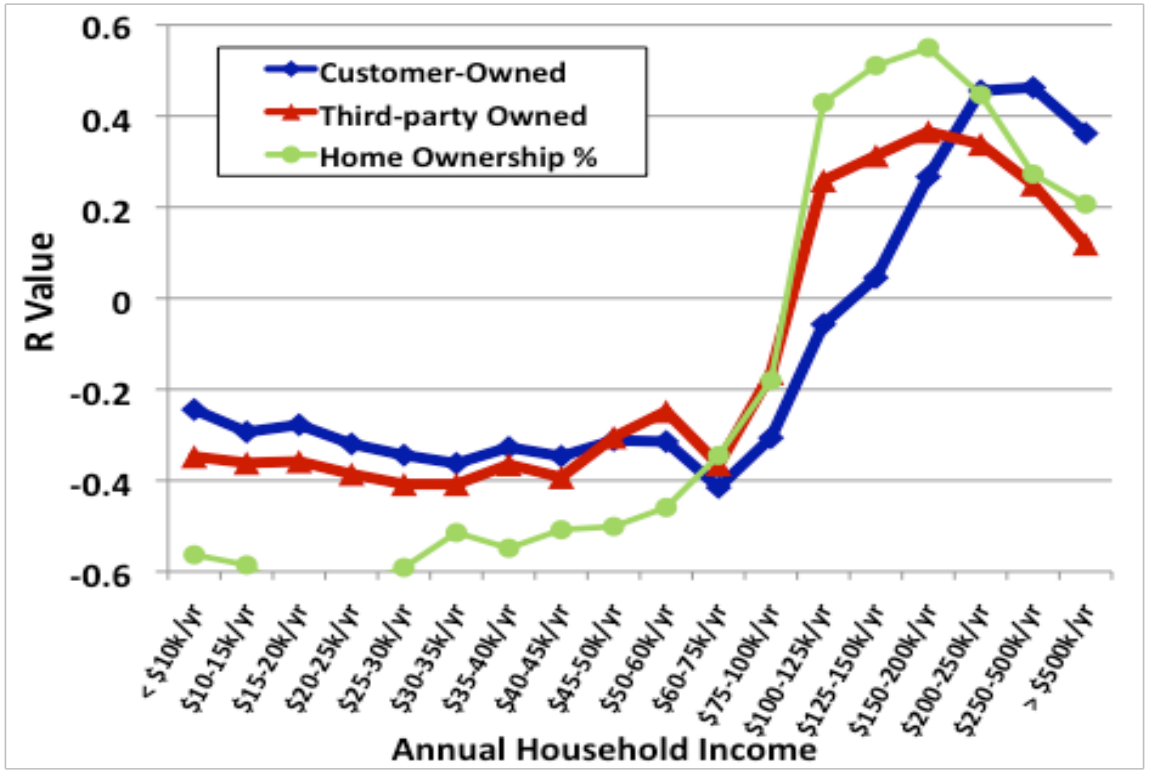
- **Share of systems acquired via TPO in the residential sector has increased significantly during past couple of years**
  - In 2012 accounted for 90% AZ, 70% CA
  - Growing rapidly in MD & MA
  - TPO now available in 13 states and growing
- **But also see new debt products entering (bank loans, PACE, etc.)**

Sources: CSI Database, accessed 03/13/13; MA SREC Program, accessed 03/13/13; Arizona Public Services, & Salt River Project accessed 12/12/12 (APS), 03/25/13 (SRP); Maryland Energy Administration (03/12/13)

Changing Market Dynamics

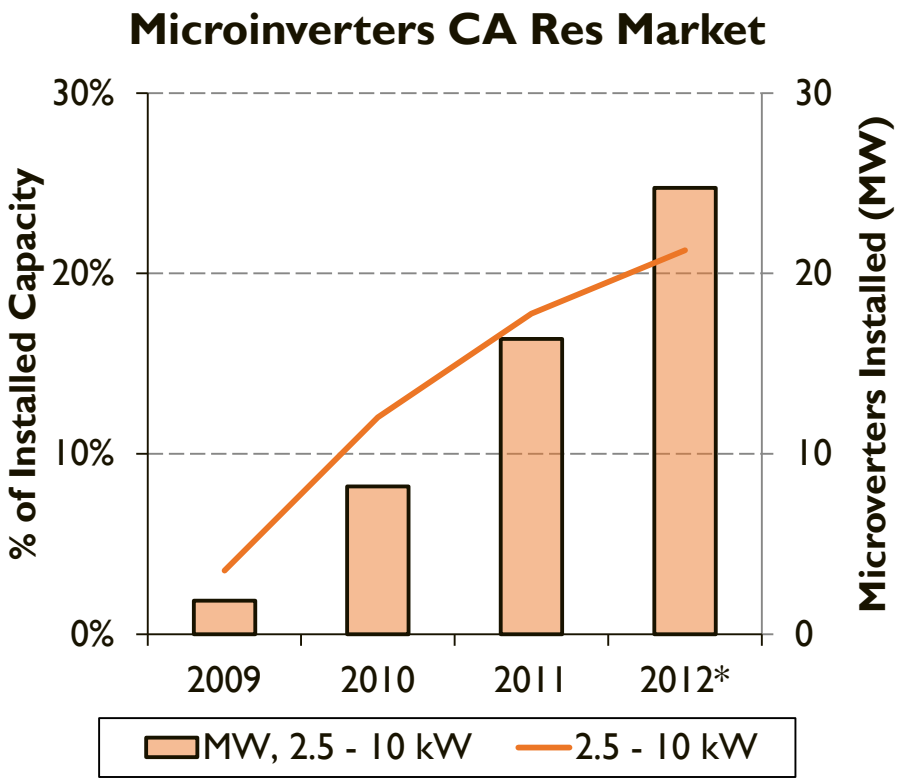
- **Emergence of third party ownership (TPO) is changing market dynamics**
  - Recent analysis in LA indicates TPO opened market to broader range of households
- **Growing data suggests that customers weigh several factors in buy/lease decision**
  - Economics
  - Complexity of process
  - Performance guarantees
  - Maintenance contracts
  - Hedging value

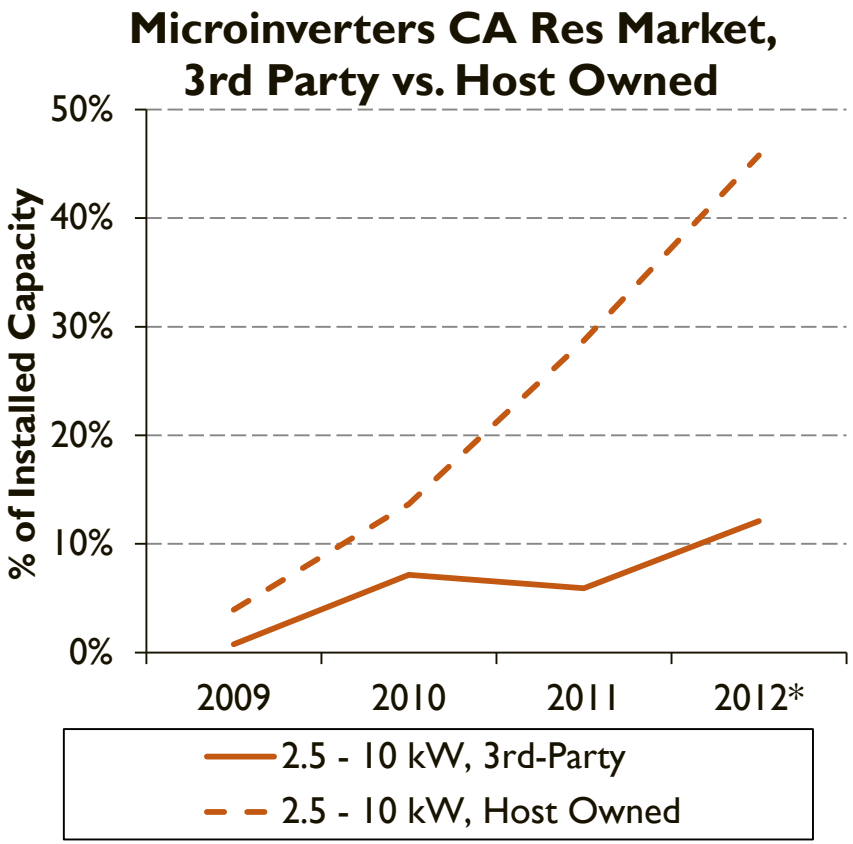
Correlation between PV adoption and household income in Los Angeles, CA



Source: Drury, et al. 2012. Energy Policy, 42, 681-690.

Microinverters in CA Residential Market

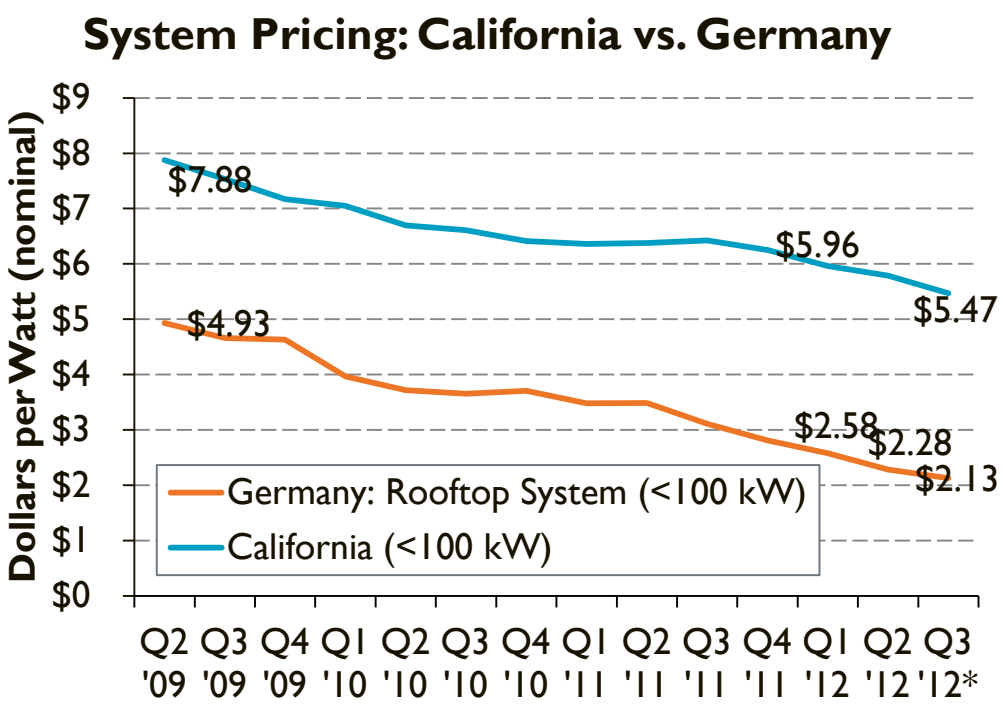


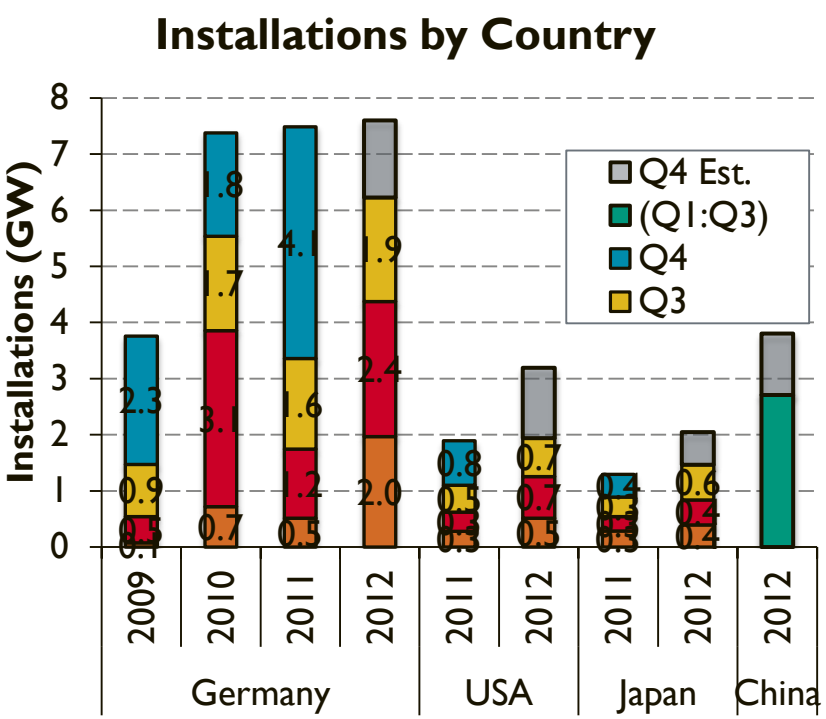


- Microinverters used in more than 20% of 2012 small systems in CA (% MW)
- Microinverters made up almost half of all host-owned 2012 small systems in CA
  - 3rd-party installers much less likely to use micro-inverters
  - Enhanced system performance and features vs. price?

Source: CSI Database, accessed 12/05/12.

Significant Gap Exist Between U.S. and German System Pricing





- **Gap between German and U.S. system pricing ~$3/W**
  - Scale of market (Germany installed ~7.5 GW in 2012) => supply chains efficiencies
  - Paperwork and processes are streamlined
  - Financing available through German federal bank (KfW)

Source: German system price: BSW-Solar PV Price Index 5/2012 & 8/2012. Exchange Rate: http://www.oanda.com/currency/average. CA system price: CSI Database, accessed 09/12/12; host owned systems. Installs to-date: Germany (Bundesnetzagentur); US (GTM/SEIA "Q3 '12 Solar Market Insight"); Japan (RTS, "PV Activities in Japan"); China (SolarServer, 11/05/12); 2012 estimates: Germany (BSW-Solar as reported by Solarserver.com (01/10/13)); US (GTM/SEIA, Ibid); Japan (BNEF H2 2012 Japan Insight Call); China (BNEF H2 2012 China Market Outlook)

Moving Towards a Low Cost PV Future

Current PV environment

- 30% federal ITC
- Accelerated depreciation
- Mix of state/local level incentives
- High 1st cost
  - Typical residential rooftop system cost $20-30k (in 2012)

- TPO/Lease model provides many benefits
- Technology, market, and policies are changing rapidly

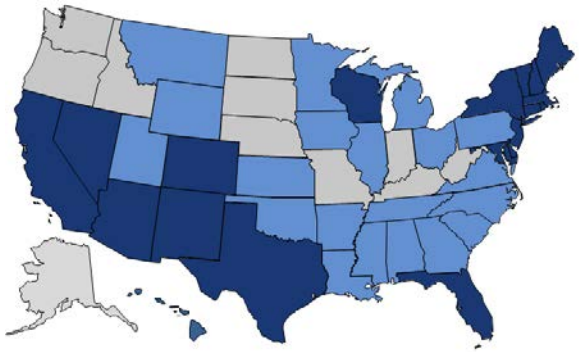
Potential future environment?

- What will happen to ITC and MACRS post-2016?
- Mater Limited Partnerships/Real Estate Investment Trusts (REITs)?
  - $6b tax equity vs. $900b MPL/REITs
  - Increased pool of capital would lower costs of financing
- What alternative financing mechanisms will emerge?
  - Standardized solar loans?
- Implications of much lower 1st cost?
  - Typical residential rooftop PV system could cost $5-6k
- Technology changes?
  - Plug and Play, BIPV, etc.?
- Streamlined permitting, inspection interconnection?
- Combining solar with other services?

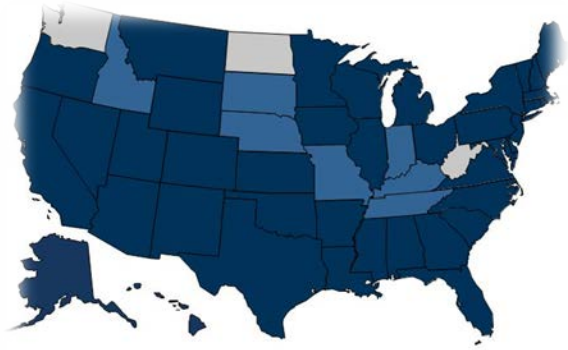
Residential grid parity in low-cost, post-ITC case

- **Observe residential market threshold below $3/W:**
  - At $2.50/W, many states in SW and NE at or below grid parity. Others close.
  - At $2/W, most states are within 25% of reaching grid parity or below grid parity.
  - At $1.50/W, all but 2 states are at or below grid parity.
- **Grid Parity Definition: The point at which the levelized cost of electricity (LCOE) generated by a PV system equals the retail electricity price from the grid.**

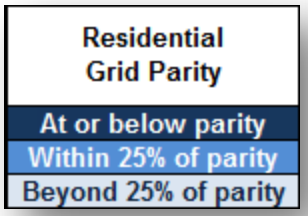
$2.5/Watt



$2/Watt



$1.5/Watt



Assumptions:

- South facing, 25 degree tilt
- *15 year home equity loan*
- 8% nominal interest rate
- No Federal, State, or Local Incentives
- 1% annual electricity price escalation
- 1% annual PV degradation
- State average electricity rates
- Analysis begins in year 2020, electricity prices scaled accordingly
- Used the System Advisor Model