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· August 15-18, 2010 · Dallas, Texas ·
· Dallas Convention Center ·

Solar PV Market:
Understanding the Fundamentals

Agenda

- **Overview of the DOE Solar Energy Technologies Program**
- **Market Transformation, Technical Assistance to the GSA**
- **Fundamental Definitions**
- **The Factors of Grid Parity**

The Mission of DOE's Solar Program

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

To accelerate the wide-spread adoption of solar electric technologies across the United States

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Solar Energy Technologies Program, Market Transformation: Technical Assistance to the GSA

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To work in tandem with the Federal Energy Management Program (FEMP) to provide technical assistance to government entities with the goal of *overcoming market barriers* inhibiting the installation of solar systems at their facilities.

GSA's ARRA Photovoltaic Projects

Providing Technical Assistance on over 40 ongoing projects:

- Technology Selection
- RFP Development
- Proposal Review
- User Training
- System Monitoring
- Project Financing
- Preparation of bid-specifications
- Building Codes Review
- Structural Analysis

Assistance also provided to:

Architects of the Capitol

Kennedy Center

Alcatraz

San Juan, Puerto Rico

Smithsonian Zoo

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GSA ARRA: PV Projects

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PV projects that the DOE Solar Energy Technologies Program and National Renewable Energy Laboratory provided technical assistance on:

- Boston, MA, O'Neill Jr Federal Building
- Charlotte Amalies, St. Thomas, VI, Ron de Lugo Federal Building
- Philadelphia, PA, Veterans Administration Center
- Raleigh, NC, Terry Sanford Federal Building
- Carbondale, IL, Sen. Paul Simon Federal Building
- Houma, LA, Ellender Federal Bldg Post Office
- Gallup, NM, Gallup Federal Building
- Victoria, TX, MLK Jr Federal Building
- Austin, TX, V.A. Automation Center
- Laguna Niguel, CA, Chet Holifield Federal Building
- Washington, DC, Veterans Admin Building
- Washington, DC, GSA Regional Office Building
- Washington, DC, Theodore Roosevelt Building
- Washington, DC, US Tax Court
- Reston, VA, Advanced Systems Center
- Seattle, WA, 1201 Federal Center South
- Kansas City, KS, Dole Courthouse
- Madison, WI, Kastenmeier Federal Courthouse
- Washington, DC, Howard T. Markey National Courts Building
- Washington, DC, E. Barret Prettyman U.S. Courthouse
- Richmond, VA, Robinson/Merhige U.S. Courthouse
- Washington, DC, Robert Weaver (HUD) Building
- Omaha, NE, Edward Zorinsky Federal Building
- Denver CO, Denver Federal Center

Moving Forward….

- To provide more assistance on the finance side of solar development
- To strengthen the in house staff capacity of the agencies
- To continue to work closely with the GSA to ensure the quality deployment of PV systems
- To work with other agencies and regions to deploy solar

Credit: Nellis Air Force Base

Nellis Air Force Base PV array

The system has over 72,000 solar panels which save the base approximately $1 million a year in energy costs. Nellis procures the energy through a Power Purchase Agreement.

Understanding the Fundamentals

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Cost Measurements

- Dollars per Watt ($/Watt)
- Levelized Cost of Energy (LCOE)

Grid Parity

- Incentives
- Cost of Electricity
- Production
- Financing

Credit: Dave Mowers; U.S. General Services Administration (GSA).

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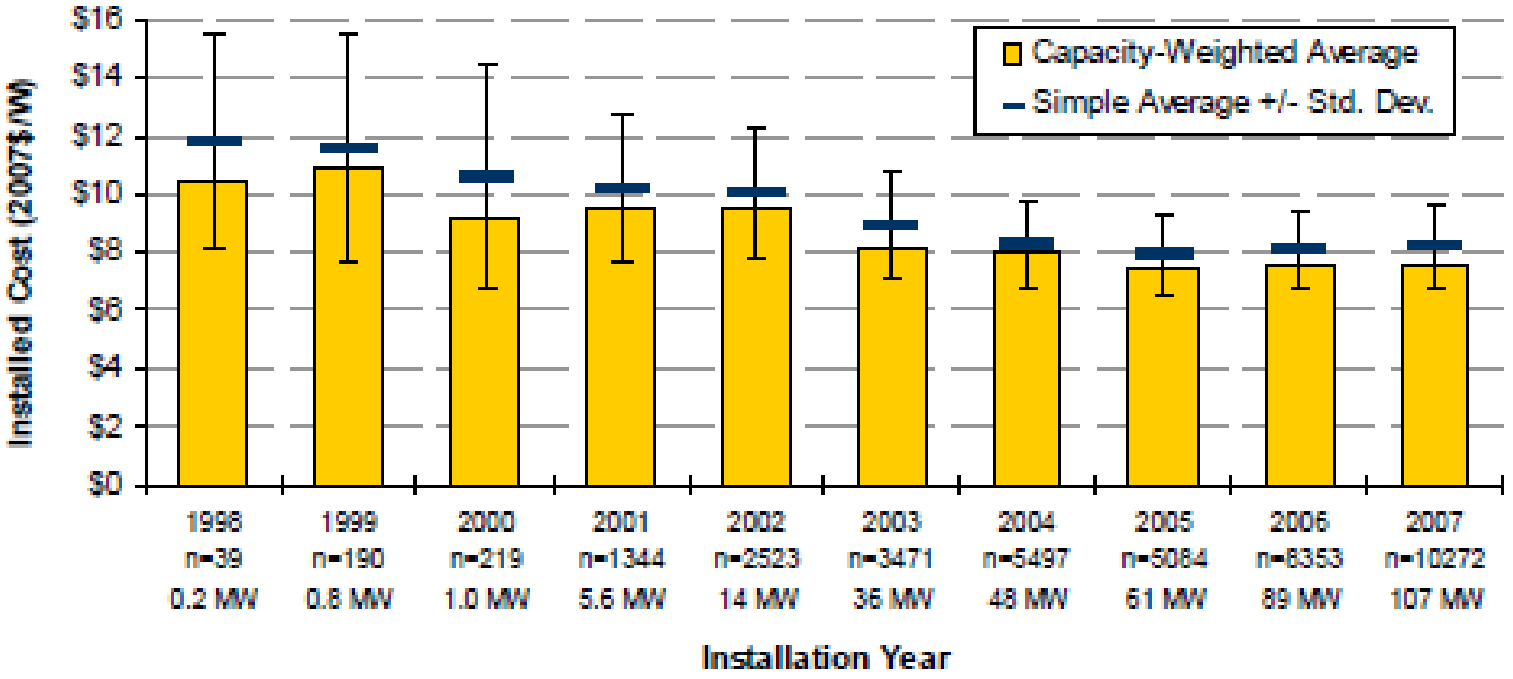
Key Definitions: **Dollars per Watt**

Dollars per Watt ($/Watt)



Source: Tracking the Sun: The Installed cost of Photovoltaics, Wiser

A Closer Look at PV Costs

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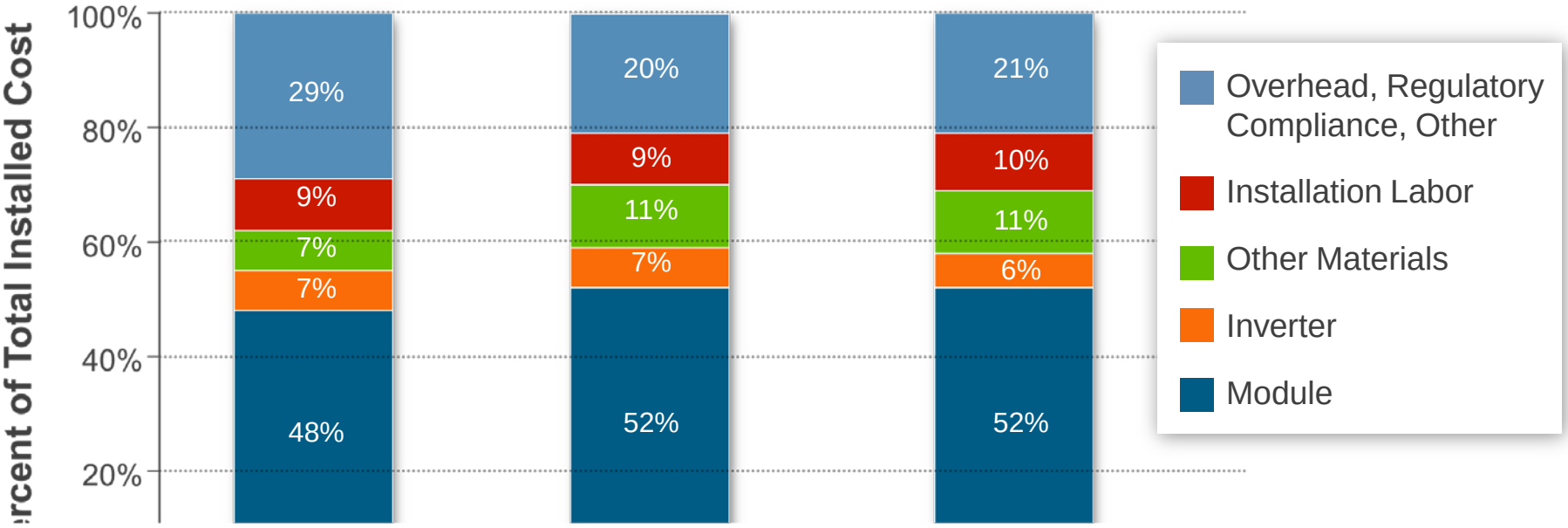
Labor, permitting, interconnection, and other regulatory costs are a significant fraction of the total cost of a PV system



Source: Lawrence Berkeley National Laboratory, 2009

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Key Definition, Key metric: **LCOE**

Levelized Cost of Energy (LCOE)

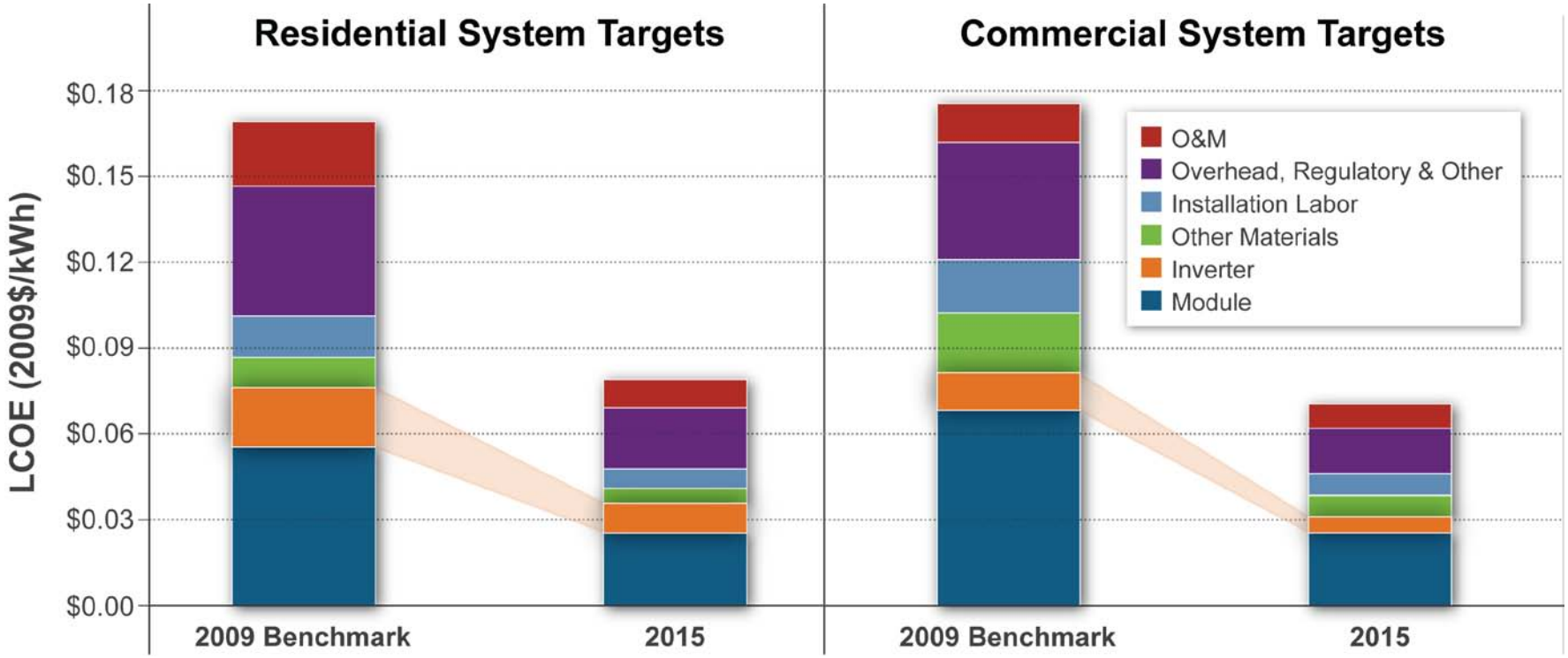
A means of calculating the cost of generating energy (usually electricity) from a particular system that allows one to compare the cost of energy across technologies. This is captured in cents/kWh.

LCOE takes into consideration the installed solar energy system price and associated costs such as the cost of financing, land, insurance, operation and maintenance, and other expenses.

The price of the energy is discounted at an assumed discount rate in order to incorporate the time value of money

LCOE = Total Life Cycle Cost / Total Lifetime Energy Production

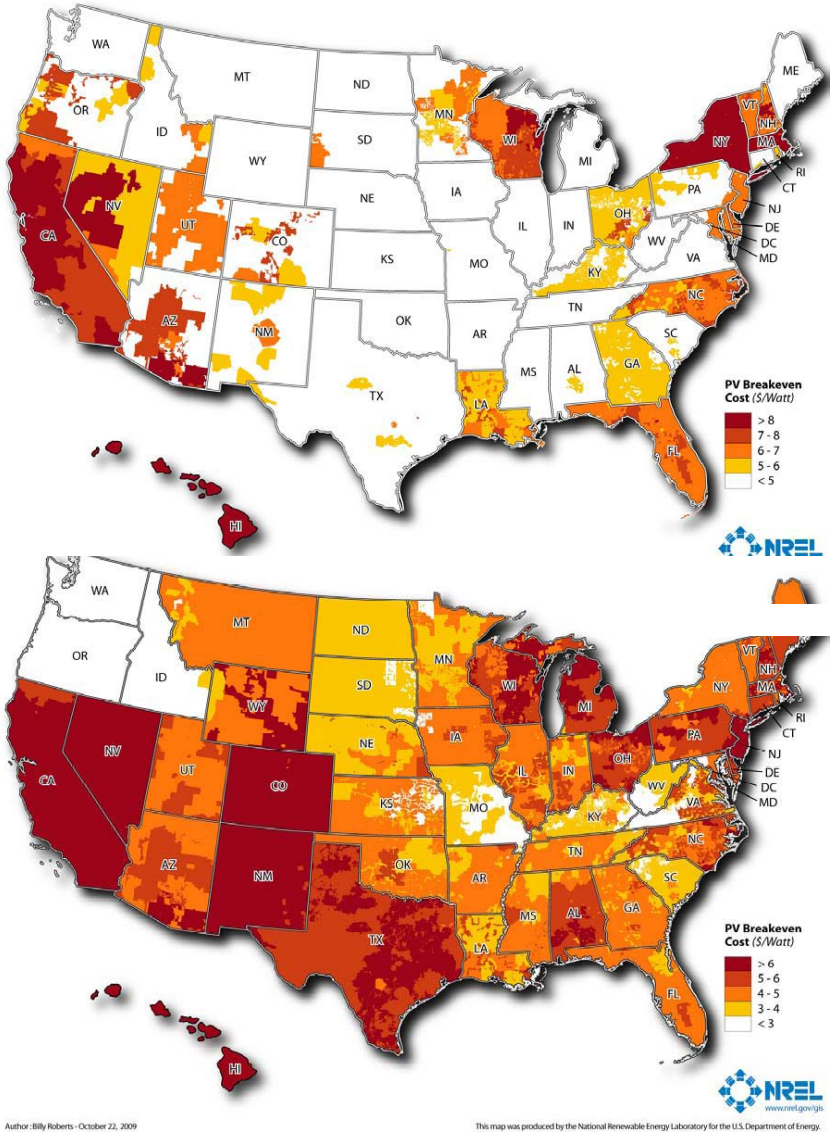
Reducing LCOE



Key Definitions: **Grid Parity**

Grid Parity for Solar

- "The break-even cost for photovoltaic (PV) technology is defined as the point where the cost of PV-generated electricity equals the cost of electricity purchased from the grid over a 20-year period."
- "This target has also been referred to as 'grid parity' and may be expressed in $/W of an installed system."
- "Achieving PV breakeven is a function of many variables, including the solar resource, local electricity prices, and various incentives."



Break-Even Cost for Residential Photovoltaics in the United States: Key Drivers and Sensitivities
Paul Denholm, Robert M. Margolis, Sean Ong, and Billy Roberts

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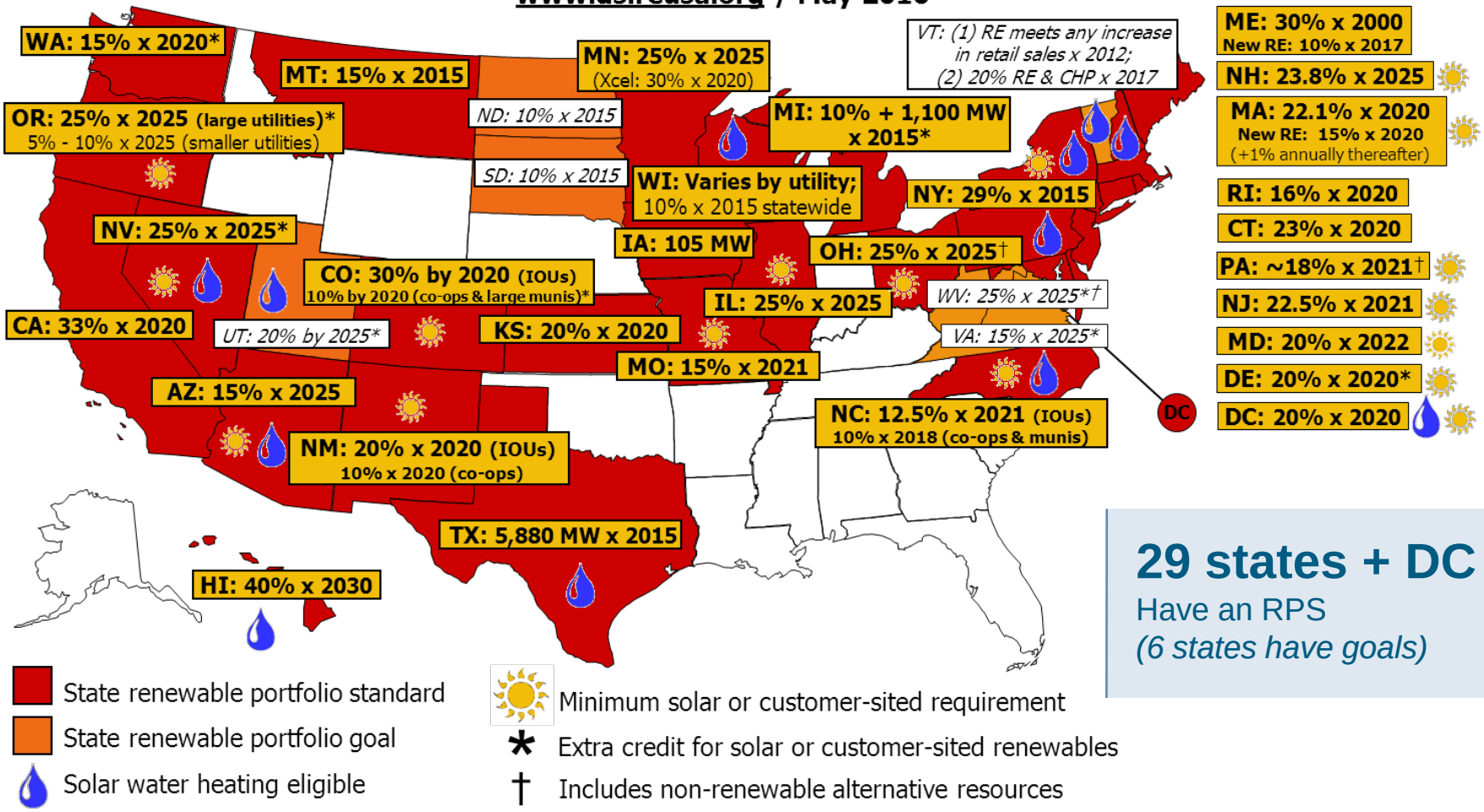
Policy Environment

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

Renewable Portfolio Standards

www.dsireusa.org / May 2010



29 states + DC
Have an RPS
(6 states have goals)

State renewable portfolio standard
State renewable portfolio goal
Solar water heating eligible

Minimum solar or customer-sited requirement
* Extra credit for solar or customer-sited renewables
† Includes non-renewable alternative resources

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Market and Energy Variables

Both utility prices and energy production vary widely from state to state.

STATE	Average Commercial Price of Electricity (cents/kWh)*	Annual Electricity Production for 100kW (DC) System (kWh)**	CITY
New Mexico	8.48	168,139	Albuquerque
Massachusetts	15.3	124,368	Boston
New Jersey	13.35	118,299	Newark
Texas	9.6	137,978	San Antonio

*http://www.eia.doe.gov/electricity/epm/table5_6_b.html
Average Retail Price of Electricity to Ultimate Customers by End-Use Sector, by State, Year-to-Date through April 2010 and 2009

**http://rredc.nrel.gov/solar/calculators/PVWATTS/version1/

Power Purchase Agreement (PPA): Economic Breakdown

The viability of a PPA is dependent on a number of factors:

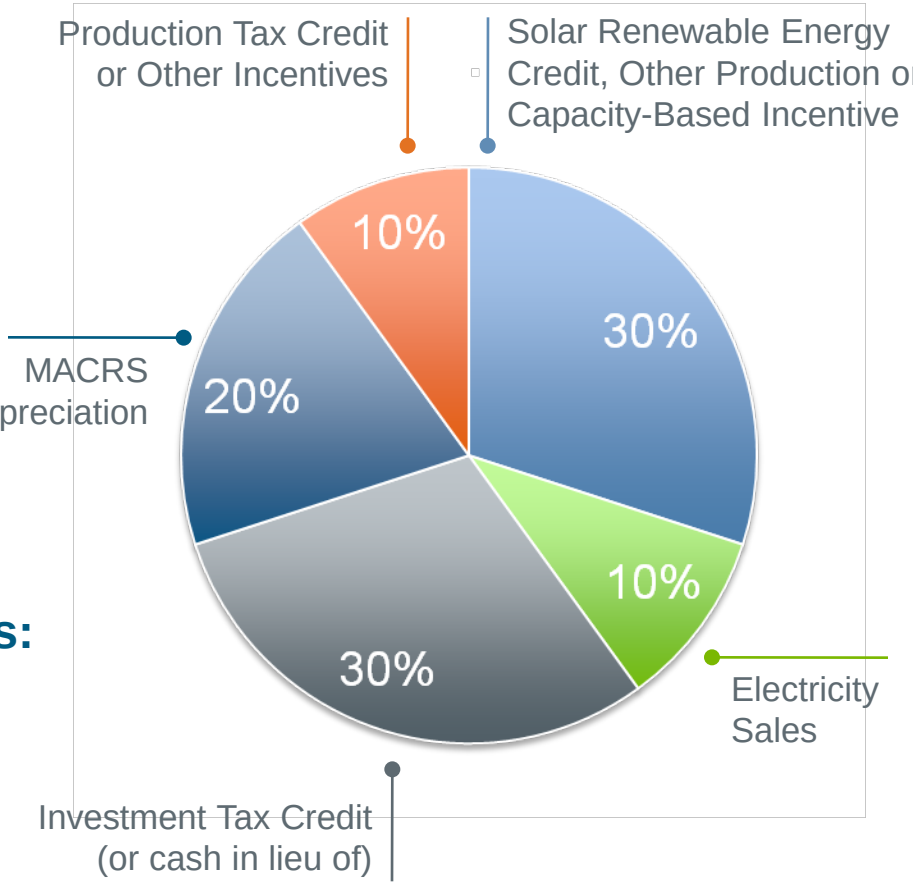
- Long term revenue streams
- Private sector tax appetite
- State/Utility incentives
- Electricity sales

While the revenue stream from the long term electricity sales to the host agency is important, from an economic perspective, it ranks low compared to the other revenue streams.

Equity investors in PPAs are able to monetize federal and state tax credits:

- The Federal Investment Tax Credit
- MACRS (Accelerated Depreciation)
- Depreciation as an expense that reduces taxable income.

The ideal combination of these factors should provide the energy purchaser with a PPA price that is competitive with current energy prices.



*The percentages vary greatly from state to state and are only intended for demonstration purposes

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Four *Economic* Drivers of PV Deployment

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System Cost

- Decreasing module and BOS costs
- Efficiency improvements in modules and Inverters
- Manufacturing advancement
- Installation and process improvements

Financing

- Innovative finance/procurement mechanisms (PPA, EUL, ESPC,)
- Improved rates and terms
- Increasing demand

Retail Price of Electricity

- Inflationary cost increases
- Transmission constraints
- Volatile fuel prices
- Increasing peak demand

Incentives & Mandates

- Rebates, grants, RECs, FIT, tax credits/exemptions
- RPS requirements

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Thank You

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