The National Academy of Sciences

Making Big Solar Work: Achievements, Challenges and Opportunities

U.S. State Solar Policy Trends:
New State Initiatives

Lew Milford, President
Clean Energy Group
Clean Energy States Alliance

July 29, 2008
Clean Energy States Alliance (CESA)

www.cleanenergystates.org

- Multi-state consortium of 18 states
- Nearly $4 billion to invest in next ten years
Renewables in perspective

PV is 0.1% world market share of electric utility capacity

Global Electricity Generating Capacity, GW, 2003
(excluding buildings and transportation)

- Nuclear, coal, oil, gas: 2826
- Hydro: 786
- Wind: 40
- Biomass: 35
- Geothermal: 9
- Photovoltaics: 4

Source: Eric Martinot, World Bank; PV Energy Systems
Close-up view of PV’s 4 GW

Compound annual growth:
22% 20-year
43% 5-year
61% in 2004

Source: PV Energy Systems
Germany, Japan dominate

CAGR:
- Rest of Europe (42%)
- Rest of World (15%)
- USA (36%)
- Japan (32%)
- Germany (85%)

Source: Solarbuzz, Evergreen analysis
On-grid applications drive growth

Source: Solarbuzz
U.S. market somewhat more balanced

- Off-grid still nearly 40%
- On-grid fastest growing, particularly commercial

Source: Solarbuzz, 2003 data
CEG: Mainstreaming Solar Report

- Highlights policies and programs that states can implement to advance local solar photovoltaic (PV) markets.

- Funded by DOE and CESA

- Download at:
### Top States for PV Installations in 2006 (Grid-Connected)

<table>
<thead>
<tr>
<th>State</th>
<th>2006 (MW)</th>
<th>2007 (MW)</th>
<th>06-07%</th>
<th>Incentives Paid in 2007</th>
</tr>
</thead>
<tbody>
<tr>
<td>California</td>
<td>69.5</td>
<td>87.1</td>
<td>25%</td>
<td>$198.1 million</td>
</tr>
<tr>
<td>New Jersey</td>
<td>17.9</td>
<td>19.2</td>
<td>7%</td>
<td>$ 64.5 (1)</td>
</tr>
<tr>
<td>New York</td>
<td>2.9</td>
<td>4.4</td>
<td>52%</td>
<td>Not available</td>
</tr>
<tr>
<td>Nevada</td>
<td>3.2</td>
<td>14.6</td>
<td>356%</td>
<td>Not available</td>
</tr>
<tr>
<td>Arizona</td>
<td>2.1</td>
<td>2.8</td>
<td>33%</td>
<td>Not available</td>
</tr>
<tr>
<td>Massachusetts</td>
<td>1.5</td>
<td>1.4</td>
<td>-7%</td>
<td>$ 5.4 million</td>
</tr>
<tr>
<td>Colorado</td>
<td>1.0</td>
<td>12.5</td>
<td>1150%</td>
<td>$ 3.5 million</td>
</tr>
<tr>
<td>Texas</td>
<td>0.6</td>
<td>0.7</td>
<td>20%</td>
<td>$ 14.8 million</td>
</tr>
<tr>
<td>Connecticut</td>
<td>0.7</td>
<td>1.8</td>
<td>157%</td>
<td>$ 7.7 million</td>
</tr>
<tr>
<td>Oregon</td>
<td>0.5</td>
<td>1.1</td>
<td>120%</td>
<td>$ 1.9 million</td>
</tr>
<tr>
<td>All Others</td>
<td>3.0</td>
<td>4.4</td>
<td>47%</td>
<td></td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>103.0</strong></td>
<td><strong>151.7</strong></td>
<td><strong>47%</strong></td>
<td></td>
</tr>
</tbody>
</table>

(1) Incentives in addition to Solar-REC

IREC, March 08
Top 10 States for Cumulative Per Capita PV

Why States are Supporting Solar

- **PV** – a growing success because of state incentive programs
  - High visibility
  - Most practical technology for residential sector
  - Desirable in long-term capacity mix – energy security, fuel diversity, environment, peak coincidence
Barriers Facing States in Mainstreaming Solar

- **Public’s lack of knowledge and confidence in solar technology**
- **Large initial investment**
  - Residential systems average $35-$40k
  - Commercial systems: $50k to $6 mm
- **Lack of streamlined interconnection standards and best permitting practices**
State Solar Policy Tools

- State incentives – capital rebates or performance-based incentives
  - More than 30 states with solar incentives
  - Funded by system benefit charge
  - “Come & Get It” approach

- Simplified interconnection standards, net metering, and rate structures that reward solar production during critical peak periods

- Exemption from state and local property taxes

- RPS & Renewable Energy Credits create new demand and revenue streams

- www.dsireusa.org provides database of incentives
State Solar Program Objectives

- Encourage PV system cost reductions through increasing manufacturing volume, with progressively lower levels of public support needed
- Directly engage public with minimal transaction costs
- Set incentive level right
- Encourage PV system performance
- Build local market infrastructure
Common State PV Support Programs

- Buy-down programs (most states)
- Low interest loans (NJ, OR)
- Technical support (WI, NY)
- Installer training/certification (NY)
- High-value PV installations (NY)
- Low income housing (MA, CA, NJ)
- Funding of PV manufacturers (MA)
- Marketing (CA)
Characteristics of Effective Solar Incentive Programs

- **Incentives**
  - Sufficient scale to drive investment:
    - CA 3000 MW by 2017
    - NJ 2300 MW by 2021
    - MD 1400 MW by 2022
    - NY 100 MW PV and 1100 SHW by 2011
  - Long-term program with rational phase-out plan so market can plan
  - Decrease incentives over time
  - Grow local infrastructure: lower costs of marketing, distribution, installation
  - Kick-start financing programs
# Leading State Solar Programs

<table>
<thead>
<tr>
<th>State</th>
<th>Incentive</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arizona</td>
<td>$2 - $3/W system rebate</td>
</tr>
<tr>
<td>Massachusetts</td>
<td>$2+/W &lt;10kW, $2.25+ &gt;10kW rebate</td>
</tr>
<tr>
<td>Colorado</td>
<td>$2/W rebate + $2.50 REC payment</td>
</tr>
<tr>
<td>New Jersey</td>
<td>$3.80/W to $4.40/W rebate + SREC payment</td>
</tr>
<tr>
<td>New York</td>
<td>$4/W to $4.50/W rebate</td>
</tr>
<tr>
<td>California</td>
<td>$2.50/W ($2.60 new homes), expected performance-based payment, 10% declining block incentive</td>
</tr>
</tbody>
</table>
State Program Strategic Bet: Reduce Non-module Costs

- Incentive programs can drive down *non-module* costs
- LBL study found that, in CA, non-module costs dropped $0.30/W/yr from 1998 – 2005

30-50% Local Content

- Marketing, distribution, margins
- Labor
- BOS
- Inverters
- Modules
- Local
- National
- International
California Experience: Economies of Scale Have Driven Down Costs as System Size Increases

**CEC**
Largest systems are $\sim$2.5/$W_{AC}$ cheaper, on average, than 1 kW installations

**CPUC**
Largest systems are $\sim$1.5/$W_{AC}$ cheaper, on average, than smaller installations funded by the CPUC

<table>
<thead>
<tr>
<th>System Size (kW)</th>
<th>Installed Cost (2004 $/WAC)</th>
<th>Mean</th>
<th>+/- 1 Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 2 kW (n=3720)</td>
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<tr>
<td>2-5 kW (n=10,233)</td>
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<tr>
<td>5-10 kW (n=3,068)</td>
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<tr>
<td>10-15 kW (n=495)</td>
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<tr>
<td>15-20 kW (n=165)</td>
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<tr>
<td>20-25 kW (n=77)</td>
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<tr>
<td>&gt; 25 kW (n=131)</td>
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<th>Installed Cost (2004 $/WAC)</th>
<th>Mean</th>
<th>+/- 1 Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 40 kW (n=234)</td>
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<tr>
<td>40-60 kW (n=169)</td>
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<tr>
<td>60-100 kW (n=209)</td>
<td></td>
<td></td>
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<tr>
<td>100-200 kW (n=192)</td>
<td></td>
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<tr>
<td>200-300 kW (n=70)</td>
<td></td>
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<tr>
<td>300-450 kW (n=65)</td>
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<tr>
<td>450-600 kW (n=47)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>600-800 kW (n=23)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt; 800 kW (n=44)</td>
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</table>
Systems Installed in New Construction Have Had Substantially Lower Costs

Compared to the general retrofit market, certain applications demonstrate higher, or lower, average installed costs

<table>
<thead>
<tr>
<th>Application Type</th>
<th>Number</th>
<th>Relative Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Large new residential developments</td>
<td>1,946</td>
<td>$1.2/WAC</td>
</tr>
<tr>
<td>Single new homes or small clusters</td>
<td>771</td>
<td>$0.18/WAC</td>
</tr>
<tr>
<td>Affordable housing projects</td>
<td>340</td>
<td>$1.9/W_{AC}</td>
</tr>
<tr>
<td>Schools</td>
<td>60</td>
<td>No Impact</td>
</tr>
</tbody>
</table>
Policy Implications

Reducing non-module costs should be a primary goal of local PV programs

- Unlike module costs (which are set in a worldwide market, and passed through directly to customers), non-module costs may be affected by local programs.

- Policymakers should consider programmatic activities aimed specifically at improving the PV installation infrastructure and driving down non-module costs.
  - Examples: encourage “plug-and-play” standardized products; provide consumer tools to evaluate costs and select suppliers; help remove regulatory and technical barriers; support installer training and certification; encourage system performance; focus on new construction.
Policy Implications

Sustained, long-term programs may enable more significant cost reductions

- Cost reductions in CA are significant, but experience from Japan demonstrates that a sustained, long-term program may yield greater reductions
- Annual average cost declines from 1999 through 2004 were greater in Japan (8.9%) than in California (5.2%) for similar-sized residential systems
Policy Implications

Targeted incentives that account for the relative economics of different systems may be appropriate

- Significant cost variations by system size, application type, and installer type suggest that a further targeting of incentives may be appropriate
- This may be especially true with Federal ITC, which offers incentives whose value is highly variable by system size and customer type
New Solar Financing Approach: New Jersey Solar RPS

- NJ – a national leader
- Fastest growing state solar market
  - Generous rebates
  - Best state rules on net metering
  - Solar REC revenues
- Ambitious RPS Solar Set-aside
  - 2.12% of electricity use from solar by 2021; 2300 MW (cumulative)
- Rebate popularity: program too expensive
New Jersey’s New Solar Financing Approach

- NJ adopts solar REC-based financing program
- Goal: phase out rebates in favor of market-based financing program
- De-couple solar program from annual state budget fights
- Retain rebates only for small systems
- Set 8-year, competitive Solar Alternative Compliance Payment
  - Increase investor certainty in solar REC market
  - Reduce regulatory risk that state will change RPS rules
State Innovation: California Solar Initiative

- **Ambitious**: 3000 MW (new generation) goal
- **Comprehensive**: combined utility, PUC and CEC effort
- **Regulatory Bargain**: 10 year, declining incentive structure for solar industry to become self-sufficient
- **New Home Emphasis**: solar on 50% of new homes; 50+ home developments must offer PV as option in 2011
- **Reward System Performance**: transition to performance-based incentives
- **Leverage Energy Efficiency**: exceed building standards to receive incentive
New Directions for State Solar Programs

- **Primary goal of incentive programs**: encourage cost reductions
- **Traditional solar buy-down programs**: not driving cost reductions fast enough
- **States now targeting incentives to encourage high value applications**
  - Using solicitations and differing incentive levels
  - Targeting large new residential & affordable housing projects with lower average installed costs and economies of scale
- **States establishing financing and lease programs**
New State Focus: Solar on New Homes

- **Advantages of residential new construction**
  - Better performance (no shading, proper orientation)
  - Easy to roll solar costs into mortgage
  - Lower up-front costs (bulk purchases, standardization)

- **But also unique barriers**
  - Builders risk averse to new technologies
  - Builder concerns:
    - Impact on home prices & profits
    - Scheduling delays
    - Perceived lack of interest by homebuyers
Emerging State Strategies: PV on New Homes

○ **Target adequate program funding to large homebuilders**
  - CA New Solar Homes Partnership

○ **Provide higher incentives for new homes**
  - MA, NJ, NY provide higher incentives for BIPV and PV on high efficiency homes

○ **Adopt builder-friendly program rules**
  - CA, NJ & MA provide longer reservation periods
  - CA simplifies documentation
State Strategies: PV on New Homes

- **Fund outreach to building professionals**
  - NYS funds training for builders, lenders, appraisers, inspectors
  - Oregon and Wisconsin conduct builder outreach

- **Other state program strategies**
  - Builder mandates
  - Financing programs
  - Entitlements for local permitting

- **See LBNL/CESA case study**: *Supporting PV In Market-Rate Residential New Construction (2006)*
Contact Information

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