Scientific Understanding Produces Improved New technologies

High Risk, High Payoff

Office of Science

EFRCs

ARPA-E

Energy Innovation Hubs

Venture Capital & Small Businesses

Loan Guarantee Program

Private Equity/Capital & Large Corporations

Gov. Procurement

Scale up of Business-ready Technologies by Private Industry

Risk

Basic Science → Feasibility Research → Technology Development → Technology Demonstration → Small Scale Deployment → Large Scale Deployment

U.S. Department of Energy
Clean and Inexpensive Electricity
Scale without subsidies

- Sunshot: 15-20¢
- Wind: 5-20¢
- Geothermal: 10-15¢
- Clean Coal: 10-15¢
- Nuclear: 6-13¢
- Natural Gas Combined Cycle (NGCC): 4-10¢

5 cents/kWh

U.S. Department of Energy
Revitalizing American Competitiveness in Solar Technologies
So what is the SunShot Initiative?

- SunShot Initiative
- 5 - 6¢/kwh without subsidy
- A 75% cost reduction by the end of the decade

U.S. Department of Energy
~50% of the world record cell efficiencies from 1975-2011 were made by researchers supported by the DOE
Manufacturing

“Abandoning today's ‘commodity’ manufacturing can lock you out of tomorrow's emerging industry.”

- Andy Grove, co-founder, former CEO, Intel
To compete in the clean energy race, we have to do more than invent technologies, we have to make them, sell them, and use them too.

Secretary of Energy
Steven Chu
Plug-and-Play Vision

Vision: PV as an Appliance
- Automated permitting & Inspection
- Easy installation
- Seamless grid integration

Plug-and-Play Modes
- Electrical Only
- Electrical + Structural
- Electrical + Grid Interconnect + Structural
BOS-X: Transformational BIPV

**Roofing membranes using CIGS or thin-film c-Si cells**

$2M
(Federal Funds)

**Roof shingles utilizing high efficiency, flexible c-Si cells; low cost distributed circuitry at the cell level; integrated micro-inverters**

$2.8M
(Federal Funds)

**Roof shingles utilizing high efficiency, thin-film GaAs cells; heat management and recovery; integrated power electronics**

$2.8M
(Federal Funds)

**Logos:**
- Carlisle
- Solexel
- Owens Corning
- Dow
SUNPATH goals and the SunShot portfolio

<table>
<thead>
<tr>
<th>SUNPATH</th>
<th></th>
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<tbody>
<tr>
<td><strong>Contract Duration</strong></td>
<td>2 years</td>
</tr>
<tr>
<td><strong>Max Contract Award ($)</strong></td>
<td>$25M, 75% cost-share</td>
</tr>
<tr>
<td><strong>Maximum Cost to DOE ($)</strong></td>
<td>$50M</td>
</tr>
</tbody>
</table>

**Objective**

Domestic industrial scale manufacturing demonstration of a PV technology:

- 15% lower in cost per watt when compared to the industry leader
- progressing significantly towards the SunShot goal of $0.50/W modules
- >25 year lifetime and sufficiently high efficiency for low Balance of Systems costs.

Replication and expansion of commercial manufacturing of products and technologies in the US.
Multiple Incubator Rounds

<table>
<thead>
<tr>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
</tr>
</thead>
<tbody>
<tr>
<td>Round 1 PV Incubator</td>
<td>Round 2 PV Incubator</td>
<td>Round 3 PV/Pre-Incubator</td>
<td>Round 4 PV Incubator</td>
<td>Round 5 PV Incubator</td>
<td>Round 6 SunShot Incubator Soft Cost</td>
<td>Round 7 SunShot Incubator</td>
</tr>
</tbody>
</table>
Incubator Startups

- Alta Devices
- Sempra
- Solar Junction
- TetraSun
- 1366 Technologies
- Ascent Solar
- Banyan Energy
- Epir Technologies
- Lightwave Power
- Luna Innovations
- MicroLink Devices, Inc.
- SpectraWatt
- Tigo Energy
- SolFocus
- Spire Semiconductor
- innovaLIGHT
- Solexel
- abound solar
- Solexant
- Solaflect Energy
- Solo Power
- Plectronics
- Crystal Solar
- Halotechnics
- STION
- PrimeStar Solar
- Calisolar
- Caelux
- Clean Power Finance
- Urban Glue
- Tigo Energy
- mosaic
- Simply Civic
- Genability
- EnergySage
- Clean Energy Experts
Catalyzing Private Investment

Incubator Round 1 Companies Only

Follow on Private Investment

$17.5M DOE Investment

The Issue:

“Even if you paid nothing for the hardware, you'd still pay thousands of dollars to install a residential solar power system” - Secretary Chu

2010 PV System Prices

Non Hardware costs:
- Customer Acquisition
- Financing and Contracting
- Permitting, Inspection, and Interconnection
- Installation and Performance
But Why so Pricey?

- Complicated and confusing process
- Process is different for every local
- Unnecessarily high permit fees
- In-person application submission and inspection
- Long wait times for inspection and approval
Unlike physics, where we can fundamentally figure out the upper limit for the efficiency of solar cells, there is no such limit to bureaucracy.
Germany’s Success

As long as housing structure is built to code, no permits filed for residential PV in Germany

U.S. Department of Energy
Rooftop Solar Challenge

The Problem

- 18,000+ local jurisdictions with different PV permitting requirements
- 5,000+ utilities implementing interconnection standards and net metering programs
- 50 states developing interconnection standards and net metering rules

The Solution

The Challenge invests in 22 teams comprised of jurisdictions, utilities, and local stakeholders to develop the same requirements and processes across large geographic areas (500,000+ population). The Challenge also measures each team’s progress to identify approaches that work.

U.S. Department of Energy
$2/W SunShot Residential Prize

Residential PV in Germany costs ~$2.50/W
Residential PV in the US costs ~$6/W
THANK YOU

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