Photovoltaics:
Helping Power Our Clean Energy Future

Dick Swanson
Safe Harbor Statement

- Certain statements in the following presentation relate to future results that are forward looking statements as defined in the Private Securities Litigation Reform Act of 1995.

- Actual results may differ materially from those projected as a result of certain risks and uncertainties, including but not limited to those noted in our Annual Report on Form 10-K and other filings with the SEC.
Greenland Ice Melt Accelerating
Need: Clean Renewable Energy

PV Perception:

Too Expensive

- Technology Development
- Increased Scale
- Manufacturing Excellence
- Incentives
- Financing

Too Small to Matter

- Lower Cost
- Increased penetration
- New markets
- New applications
  - New homes
  - Utility

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<td>Cost/kWh</td>
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0.18/kWh to $0.09/kWh
0.1% to 40%
TECHNOLOGY DEVELOPMENT
Solar Panel Cost Drops by 19% with Each Doubling in Manufacturing Capacity

- **1979**: $32/W (81% Progress Ratio)
- **2002**: $3.10/W
- **Silicon Shortage**

**Cumulative Production (MW)**

**Module Price (2002$)**

1979 $32/W

81% Progress Ratio

Silicon Shortage
Predictable Cost Reductions

Cumulative Production (MW)

- Historical
- Projected

- 1980
- 1990
- 2000
- 2010
- 2013

2002 Roadmap
SunPower’s Strategy to Reduce PV System Cost

1. Leverage value of efficiency
   – Improved efficiency leverages entire value chain

2. Reduce manufacturing cost at all points along the value chain
   – Decrease silicon consumption
   – New ingot and wafering technologies
   – Increased cell and module automation
   – Improved system designs

3. Increase energy delivery
   – Tracking for large ground mounted systems
   – Tilted, frameless panels for commercial roofs
Cost Reduction Roadmap Plan: 50% by 2012

- Panel: 25%
- Cell: 5%
- Silicon: 5%
- Efficiency: 10%
- Target: 60%
Cell Efficiency: 1% Gain = 5% System Cost Benefit

Gen 2 Cells Mean Efficiency = 22.4%

A 300: 20.8%
Gen 2: 22.4%
Cell Efficiency Roadmap

Cell Efficiency History and NREL Plan

% Conversion Efficiency v. Time

- SunPower
- NREL Monocrystalline
- NREL Polycrystalline

Sunpower has steadily improved cell efficiency both in the laboratory and in high scale production since the first all back contact cell prototype in 2003.

The transfer of the >22% Generation 2 product was completed in 2007.

The development team has manufactured a new record device on a 148.58cm² full area substrate of 23.4%.
Solaicx Continuous Ingot Growth

**Key Activities:**
- Continuous Cz ingot growth
- Low-oxygen, high-lifetime material
- Development of hot zone for N-type material
- FBR polysilicon process development and implementation
- Crucible durability

**Participants:**
Solaicx, Santa Clara, CA
Wafer Thickness Roadmap

![Wafer Thickness Roadmap Graph]

- **Monocrystalline**
- **Polycrystalline**
- **SunPower**

The graph shows the wafer thickness for Monocrystalline, Polycrystalline, and SunPower over the years from 2002 to 2012.
Improved Silicon Utilization

Silicon Utilization
Grams/Watt

Q105 Q205 Q305 Q405 Q106 Q206 Q306 Q406 Q107 Q207 Q307 Q407
SiGen Direct Cleave Process

Direct Cleave Process

Silicon Ingot

Cleaved Wafers

Same material → 2X to 3X more wafers

- Kerf-Free 50 µm c-Si wafer

- c-Si lifetime
- Excellent Edges/Surface
- High strength
T20 Tracker
Unitary Products and Systems Reduce Installation Cost

**Concept Overview:**
- Factory manufactured systems
- Module integrated mounting
- Optimized for automated assembly and rapid deployment

**Benefits:**
- **Lower cost:** Leverage standard manufacturing cost reduction practices
- **Higher quality:** Controlled manufacturing environment
- **Scalable:** Achieve economies of scale at relatively low volumes; fast installation, more productivity
SunPower can build 1 MW per day, from factory to field
UTILITY MARKET
PG&E Announces 800 MW PV Power Plants

PG&E orders photovoltaic plant
PG&E, a California power company, has placed an order for what are believed to be the world's two biggest photovoltaic solar farms, giving a strong endorsement to a technology that few power generators have yet considered to be ready for utility-scale use.

Two large solar plants planned in California
Companies will build two solar power plants in California that together will put out more than 12 times as much electricity as the largest such plant today, the latest indication that solar energy is starting to achieve significant scale.

Here comes the sun power
Pacific Gas and Electric Co. announced plans Thursday to buy 800 megawatts of photovoltaic solar power from two Bay Area companies - a giant deal that would provide enough electricity to power 239,000 homes and would create the country's first utility-scale photovoltaic plants.

PG&E Announces Two Huge Solar Deals
SunPower, Optisolar Plan Nation's Biggest Plants in San Luis Obispo County
For more than a year, San Jose's SunPower has been touting a 14-megawatt photo voltaic solar array at Nellis Air Force Base in Las Vegas as the largest in the nation. That's about to change in a big way. Pacific Gas & Electric announced two deals Thursday that will result in 800 megawatts of power from massive facilities using PV panels — enough to power nearly a quarter-million homes, according to the utility.
Solar PV Is Cost Competitive

Levelized Cost ($/MWh)
2009-2012 Timeframe

- Solar PV: $96 - 154
- Solar Thermal: $90 - 145
- Wind: $44 - 91
- Gas Peaking: $221 - 352
- Gas Combined Cycle: $73 - 112

Source: Lazard, June 2008
From a utility perspective, what matters is not grid parity, but rather the lowest marginal cost for new capacity.
PV Utility Scale Conclusions

- Utility scale PV competitive on LCOE basis
- High efficiency silicon offers compelling cost structure
- High capacity factor due to tracking
- Vertical integration drives cost reduction across value chain
High Efficiency Reduces Cost & Conserves Resources

6 MW solar plant

SunPower: 21 Acres, 19.3% efficiency

Conventional: 32 Acres, 12.6% efficiency

Thin Film: 41 Acres, 9.5% efficiency
SunPower Increases Capacity Factor

- Deliver Power When You Need It

**Fixed Tilt (19.8%)**
**SunPower T20 Tracker (26.7%)**

+30% more capacity factor

Capacity Factor

1:00 AM 6:00 AM Noon 6:00 PM Midnight

Summer Peak Demand

27
Segments and Channels

Residential Retrofit

New Production Homes

Commercial & Public

Power Plants
Renewables Portfolio Standards

State Goal
- PA: 18% by 2020
- NJ: 22.5% by 2021
- CT: 23% by 2020
- MA: 15% by 2020 + 1% annual increase (Class I Renewables)
- WI: requirement varies by utility; 10% by 2015 goal
- TX: 5,880 MW by 2015
- AZ: 15% by 2025
- CA: 20% by 2010
- CA: 10% by 2017 - new RE
- NV: 20% by 2015
- ME: 30% by 2000
- ME: 10% by 2017 - new RE
- HI: 20% by 2020
- DC: 11% by 2022
- DC: 10% by 2017 - new RE
- OH: 25%** by 2025
- OH: 10% by 2020 (co-ops & large munis)
- NV: 20% by 2015
- DE: 20% by 2019
- DE: 10% by 2018 (co-ops & munis)

Minimum solar or customer-sited RE requirement
- Increased credit for solar or customer-sited RE
- **Includes separate tier of non-renewable “alternative” energy resources
Solar Participation in RPS Solicitations is Increasing

Source: Hal LaFlash, PG&E
RPS Contracts: 2002-2008

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<tr>
<th>Technology</th>
<th>#</th>
<th>MW</th>
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<tr>
<td>Geothermal</td>
<td>8</td>
<td>553-711</td>
</tr>
<tr>
<td>Wind</td>
<td>9</td>
<td>674</td>
</tr>
<tr>
<td>Bioenergy</td>
<td>14</td>
<td>129-154</td>
</tr>
<tr>
<td>Small Hydro</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Solar Thermal</td>
<td>4</td>
<td>1,337-1,737</td>
</tr>
<tr>
<td>Solar PV</td>
<td>4</td>
<td>807</td>
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<tr>
<td>Wave</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>42</td>
<td>3,503-4,086</td>
</tr>
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~24% RPS-eligible renewables under contract

Source: Hal LaFlash, PG&E
RPS Generation Statewide by Fuel Type

Source: Hal LaFlash, PG&E
Resource Patterns

Source: Hal LaFlash, PG&E
Solar in the CAISO Transmission Queue

Source: Hal LaFlash, PG&E
SunPower--Power Plant Pioneer

Germany

Portugal

Spain

Korea
Examples of European Projects with SunPower Tracking Technology
(all of those plants are now fully connected to the grid)

Isla Mayor, Spain, 8.4 MW SunPower T0 Tracker

Muehlhausen, Bavaria, Germany, 6 MW SunPower T0 Tracker

Trujillo, Extremadura, Spain-Elecnor, 23 MW SunPower T0 Tracker

Jumilla, Murcia, Spain-Elecnor, 23 MW SunPower T0 Tracker

Serpa, Portugal, 11 MW SunPower T0 Tracker

Lebrija, Spain, 3.84 MW SunPower T0 Tracker
Nellis AFB, Nevada
To achieve 80% CO2 reductions by 2050, PV growth needs to be far less than what is possible, given the rise of other renewables and energy efficiency.

2040:
- What is Possible – 5000 TWH/yr PV (Moderate Growth case)
- What is Needed – 2000 TWH/yr PV

Sources: McKenzie Report, 2007 for starting points and energy efficiency; AWEA for wind; internal SunPower calculations for DPV, CPV, CSP
THANK YOU