Solar Electricity: Problem, Constraints and Solutions

Student E
Current Generation: 4,110 TWh
- Fossil fuel based
- Price volatility and national security
- Environmental impacts
  - 2.5 billion tons of carbon dioxide
  - Sulfur dioxide and nitrogen oxides
- Presence of Solar
  - 536 MW capacity
  - 0.843 TWh net generation

Diagram of a photovoltaic cell removed due to copyright restrictions.

Image created by Robert A. Rohde / Global Warming Art.
## 3.003 Principles of Engineering Practice

### Issues: Performance, Manufacture, and Application

<table>
<thead>
<tr>
<th>Technology</th>
<th>Efficiency</th>
<th>Installation cost per Watt</th>
<th>Module cost per Watt</th>
<th>System cost per Watt (1MW)</th>
<th>Efficiency improvement</th>
<th>Change in installation cost per Watt</th>
<th>Change in material cost per Watt</th>
<th>Change in capital cost per Watt</th>
<th>Change in system cost per Watt</th>
<th>New system cost per Watt (1MW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organics</td>
<td>7%</td>
<td>$2.80</td>
<td>$0.60</td>
<td>$3.40</td>
<td>4%</td>
<td>($0.81)</td>
<td>$0.01</td>
<td>$0.10</td>
<td>($0.70)</td>
<td>$2.70</td>
</tr>
<tr>
<td>a-Si</td>
<td>9.1%</td>
<td>$2.08</td>
<td>$1.08</td>
<td>$3.16</td>
<td>2%</td>
<td>($0.35)</td>
<td>$0.01</td>
<td>$0.10</td>
<td>($0.24)</td>
<td>$2.92</td>
</tr>
<tr>
<td>CdTe</td>
<td>12.2%</td>
<td>$2.03</td>
<td>$0.71</td>
<td>$2.74</td>
<td>0%</td>
<td>$0.00</td>
<td>$0.01</td>
<td>$0.10</td>
<td>$0.11</td>
<td>$2.85</td>
</tr>
<tr>
<td>CIGS</td>
<td>13.2%</td>
<td>$1.99</td>
<td>$0.81</td>
<td>$2.80</td>
<td>0%</td>
<td>$0.00</td>
<td>$0.01</td>
<td>$0.10</td>
<td>$0.11</td>
<td>$2.91</td>
</tr>
<tr>
<td>thin film c-Si</td>
<td>13.0%</td>
<td>$1.99</td>
<td>$1.00</td>
<td>$2.99</td>
<td>1%</td>
<td>($0.12)</td>
<td>$0.01</td>
<td>$0.10</td>
<td>($0.01)</td>
<td>$2.98</td>
</tr>
<tr>
<td>p-Si</td>
<td>14.0%</td>
<td>$1.89</td>
<td>$1.00</td>
<td>$2.89</td>
<td>0%</td>
<td>$0.00</td>
<td>($0.15)</td>
<td>$0.10</td>
<td>($0.05)</td>
<td>$2.84</td>
</tr>
<tr>
<td>c-Si</td>
<td>15.4%</td>
<td>$1.78</td>
<td>$1.31</td>
<td>$3.09</td>
<td>-1%</td>
<td>$0.11</td>
<td>($0.31)</td>
<td>$0.10</td>
<td>($0.10)</td>
<td>$2.99</td>
</tr>
</tbody>
</table>

**Numbers in green** are taken from either Prometheus or Deutsche Bank as indicated

**Numbers in light green** are estimates by Thin Film Si Team

**Numbers in blue** are estimates by Thin Film Si Team

**Numbers in black** are calculated values
Markets and Applications

- Cannot produce power at night
- Peak load consists of 22-36% of maximum load
- Goals for Solar PV:
  - 30% of 752 GW U.S. peak capacity
  - Can produce 10% of total electricity.
Timeline for Deployment

Assumptions
- Only considering CdTe from First Solar
- 308 MW in 2007, 60.4% growth rate
- 2% growth in electricity demands

Limits
- Amorphous Silicon
- Materials availability
- Exports to foreign countries