Solar Energy in India:
On its feet, but can it win the marathon?

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THE ENERGY AND RESOURCES INSTITUTE
6 DECEMBER 2010, CANCUN, MEXICO
Energy Security, Climate Change and Potential

TERI’s modeling results
- 2.23 tCO$_2$/capita during 2010-2051
- 28 GW by 2020, 2000 GW by 2051

Official estimates
- 5000 trillion kWh/year
- 1% land: 1500GW
National Solar Mission

Solar mission targets

<table>
<thead>
<tr>
<th>Application Segment</th>
<th>Phase I (2010-13)</th>
<th>Phase II (2013-17)</th>
<th>Phase III (2017-22)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solar collectors (million sq meters)</td>
<td>7</td>
<td>15</td>
<td>20</td>
</tr>
<tr>
<td>Off grid solar applications (MW)</td>
<td>200</td>
<td>1000</td>
<td>2000</td>
</tr>
<tr>
<td>Utility rid power, including roof top</td>
<td>1000-2000</td>
<td>4000-10000</td>
<td>20000</td>
</tr>
</tbody>
</table>

On track till 2020.
Beyond 2020......??????
Strategy to achieve Mission targets

- **Feed-in-Tariff**
  - Rs. 17.91 per unit (PV), Rs. 15.31 per unit (solar thermal)

- **Renewable Purchase Obligations:**
  - 0.25% in Phase I—3% by 2022 (min 25 yrs)

- **Tradable Renewable Energy Certificates**

- **Subsidy**
  - 90% for solar lighting systems in 10,000 villages and hamlets.

- **Soft re-finance through IREDA**
  - Less than 5% interest

- **Special Incentive Package (SIPs)**
  - Custom duty and excise duty exemption
  - 10 yrs tax holiday
Strategy …….  

- Up to Rs. 50 lakh financial assistance to develop Solar Cities for:
  - Preparation of a Master Plan;
  - Setting-up institutional arrangements;
  - Awareness generation, capacity building and other promotional activities; and
  - Oversight of implementation during five years

- Cess on Coal to pay for financial support approx USD 14 billion till 2022.
  - Other estimates: USD 20 billion by 2040, USD 54 billion by 2051.
<table>
<thead>
<tr>
<th>State</th>
<th>FIT (INR / unit)</th>
<th>Tariff period (years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chhatisgarh</td>
<td>15.84 for solar PV and 13.26 for solar thermal</td>
<td>10</td>
</tr>
<tr>
<td>Gujarat</td>
<td>14 for PV and 10 for thermal for first 12 years and 4 for PV and 3.5 for solar thermal for next 13 years</td>
<td>25</td>
</tr>
<tr>
<td>Haryana</td>
<td>15.16 for solar PV</td>
<td>5</td>
</tr>
<tr>
<td>Kerala</td>
<td>15.18</td>
<td>10</td>
</tr>
<tr>
<td>Maharashtra</td>
<td>12 for solar PV and 10 for solar thermal</td>
<td>10</td>
</tr>
<tr>
<td>Tamil Nadu</td>
<td>12 for PV</td>
<td>10</td>
</tr>
<tr>
<td>Uttar Pradesh</td>
<td>(i) Under MNRE scheme: 12 for solar PV and 10 for thermal power</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>(ii) Other plants: 15 and 13 for Solar PV and solar thermal, respectively</td>
<td></td>
</tr>
<tr>
<td>Uttarakhand</td>
<td>17 for solar PV and 13 for solar thermal</td>
<td>20</td>
</tr>
</tbody>
</table>
Strategy: state RPOs from 2010/11 to 2012/13

0.25 – 1%

Gujarat, Jharkhand, , Uttaranchal, Uttar Pradesh:

0.25 – 0.25%

Maharashtra, Manipur, Mizoram:

0.0 – 0.2%

Tripura, Himachal Pradesh:, Assam (draft)

All RE 9 – 14%

Tamil Nadu, Karnataka, Rajasthan, Madhya Pradesh,

Haryana

All RE 1-5%

J&K, Delhi, Andhra Pradesh, Punjab
Experience: Long term guarantee

- **11th Five Year Plan:** 50 MW target, Rs. 15 per unit FIT over 12 yrs, no new project.

- After JNNSM, RPO and FIT: 450 applications, 5000 MW
  - 365 MW in Gujarat, 36 MW in Rajasthan, 1000 MW in Andhra Pradesh.

  ➔ **Azure Power plant in Punjab (1 MW) and Gujarat (15 MW):**
  - 1 MW, 20,000 households.
  - Sells to the state-run utility under a 30-year agreement
  - Rs. 15 per unit for the first 10 yrs (Punjab), 12 yrs (Gujarat)
  - Rs. 8.93 per unit in Punjab and Rs. 5 in Gujarat for remaining period.
  - Per MW installation cost going down by 10-12%
Experience: rural electrification
March 2010: 95% of 5348 villages, 1408 hamlets

- **Two models:**
  - Solar home lighting system (SHLS)
  - Centralized Solar Lantern Charging System (SLCS)

  (TERI’s Lighting a Billion Lives Campaign)

<table>
<thead>
<tr>
<th>For 30000 systems</th>
<th>SHLS</th>
<th>SLCS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost (INR)</td>
<td>195,000,000</td>
<td>132,000,000</td>
</tr>
<tr>
<td>Subsidy + Grant</td>
<td>105,000,000</td>
<td>132,000,000</td>
</tr>
<tr>
<td>Community investment</td>
<td>30,000,000</td>
<td>-</td>
</tr>
<tr>
<td>Monthly installment</td>
<td>128 (18% interest, 18 months)</td>
<td>60-150 (2-5 per day)</td>
</tr>
<tr>
<td>Emission reduction/year</td>
<td>4176t/CO₂</td>
<td>4176t/CO₂</td>
</tr>
<tr>
<td>Capacity building+</td>
<td>-</td>
<td>yes</td>
</tr>
<tr>
<td>Ownership</td>
<td>yes</td>
<td>rental</td>
</tr>
</tbody>
</table>

(Source: CTRAN-2010)
Challenges:

- Can this story be scaled up to 1500GW?
  - Finance
  - Competing demands on land (price of land)
  - Import dependency
TERI’s Lighting a Billion Lives (LaBL) Campaign

- 16 states, 570 villages, 32000 lanterns, 160,000 lives. [500 lanterns in Myanmar]

- Each Solar lantern saves: 40-60 liters of kerosene/year and 100 Billion Rupees burned each year in kerosene and wick lamps

- INR 234 billion required to provide solar lanterns to 65 million rural households in India. The amount is less than half of total implied subsidy on kerosene consumption in the country

- 46 students of the Sciences Po and Europe Ecologie contributed EUR 2320: enough to light a village.