The German solar rooftop experience – Applicability in the Indian context

Indo-German Development Cooperation

June 7th, 2016
Energy transition in Germany and India
A natural partnership arising from different challenges yet similar goals

A mutual goal to...

- Significantly increase the share of renewables in their energy generation portfolio, focusing on solar (rooftop) and wind
- Improve energy efficiency
- Reduce climate gas emissions

...all while ensuring a sustainable energy supply which does not undermine economic growth or international competitiveness

India is moving towards its own Energiewende – and Germany is a crucial partner on this way...

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### Status quo of PV in Germany

Solar energy and wind as drivers of the German Energiewende

#### Current situation

<table>
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<tr>
<th>Topic</th>
<th>Details</th>
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<tbody>
<tr>
<td>Total generation of PV in 2015</td>
<td>36.6 TWh (≈ 7.7% of net energy consumption in Germany)</td>
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<tr>
<td>Installed capacity</td>
<td>ca. 40 GW (#1 worldwide), about 74% of that mounted on rooftops</td>
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<td>Number of PV plants</td>
<td>1.5 million</td>
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<td>70% of rooftop systems</td>
<td>&lt; 10 kW and mounted on one-or two-family houses</td>
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<td>Yearly planned expansion</td>
<td>corridor of 2.4 – 2.6 GW until 52 GW are reached</td>
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#### Installed capacity per km²

![Map with installed capacity per km²]

Source: [www.strom-report.de](http://www.strom-report.de)

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The German Energiewende is largely driven by the residential sector
Development of the German PV market

Fastest growth from 2009 to 2012

PV energy generation and installed capacity, Germany 2000 - 2025

- Fastest growth from 2009 to 2012
- Changes in expansion rate were determined by market but even more so by regulatory factors

Source: www.energy-charts.de, 2016
Market driver: The price erosion of PV systems
Decrease of investment costs by 75% since 2006

Average net end customer price for turnkey solar PV rooftop systems of 10 – 100 kWp

Orange: Module cost as % of total cost

- Average annual decrease of system costs by 14% since 2006
- On average, prices of PV modules reduced by 20% for every doubling in installed capacity
- Minimum price regulation for Chinese modules in 2013 slowed down further price erosion

Source: BMWi, 2014

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Regulatory driver (1/2): Favourable conditions for RE feed-in
Feed-in tariffs that drove initial expansion are now replaced by market mechanisms

EEG 2000
- **Fixed feed-in tariffs** to be paid over a period of 20 years
- **Purchase guarantees**
- **Priority feed-in** of renewable electricity into the grid

EEG 2014
- **Expansion corridors** for annual capacity increase (2.4 to 2.6 GW for solar)
- Feed-in tariff gradually replaced by direct marketing under the **market premium model**
- **Switch to auctions** (starting in 2017); pilot auctions for solar parks in 2015

The German Energiewende is policy, not technology driven – over time a more market-based approach is required

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Source: Greentech Media, 2014
Regulatory driver (2/2): Funding programs
KfW is the most important financier of the German Energiewende

Current loan conditions

- Reduced interest loans for solar PV installations of up to EUR 25 million per project
- Long term financing up to 20 years, up to 3 years repayment-free start-up period
- Combination with storage funding programs possible
- Targets individuals, NGOs, private and public enterprises, self-employed professionals and farmers

“Energiewende. We promote that.”

More than 50% of new capacities for electricity production from renewables in Germany are (re)financed by KfW
Solar power generation capacity growth in India
Declining trend of module price has paved way for adoption of rooftop solar

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Case analysis: RESI(dential) RTPV
Economic calculation for RTPV in residential sector of Delhi

Payback computation
- Incentive for RTPV: 30% no cap
- Discounted payback – 4.35 years
- Internal Rate of Return – 23%
- Saving per annum – INR 134000
- Net present value – INR 2.3 million

Assumptions
- Size of the system – 15 kW
- Building size – 2000 ft² using 40% area
- Energy inflation – 6% per annum
- Inflation – 4% per annum
- Electricity generation – 23,330 kWh/year
- Average cost/ kWh – Rs 5.74
- O&M – 3% of upfront investment cost
- Upfront investment cost – Rs 70,000/ kW
Benefits should reach the last mile consumer

- Quality control mechanisms
- Process streamlining
- Impact on distribution network
- Demand side energy efficiency

- Promotional lending by banks/ FI’s
- Innovative models/instruments
- De-risking investments through technology

- DISCOM capacity
- Educational curriculum
- Skill development
- Public awareness

- Third party verification
- Transparent rating and certification
- Industry association

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Indo-German Solar Energy Partnership

Broad range of partners and activities with special focus on rooftop solar

1. Cooperation in the field of solar rooftops
   - Rooftops in commercial, industrial & residential segment
   - Captive use (feed in for long term)

2. Development of solar parks/ zones
   - Solar park infrastructure financing
   - Land neutral solar: irrigation, floating, …

3. Solar off-grid applications
   - Solar powered mini-grids
   - Solar Home Systems
   - Agricultural water pumps

India to receive concessional loans in the range of EUR 1 billion over the next 5 years through KfW

GIZ to provide technical assistance, policy advisory services, pilot project promotion, capacity building and training

PTB to support skill development curriculum as well as the quality control framework for solar power components