Residential PV Rooftop in India - Motivation and Quality Assessment

Rooftop PV systems Survey Results
in cooperation with BSES Rajdhani Power Limited (BRPL)



Indo-German Energy Dialogue
Niche Market for Solar PV Rooftop and the Challenges
20th September 2017, REI Expo 2017

Survey Objective

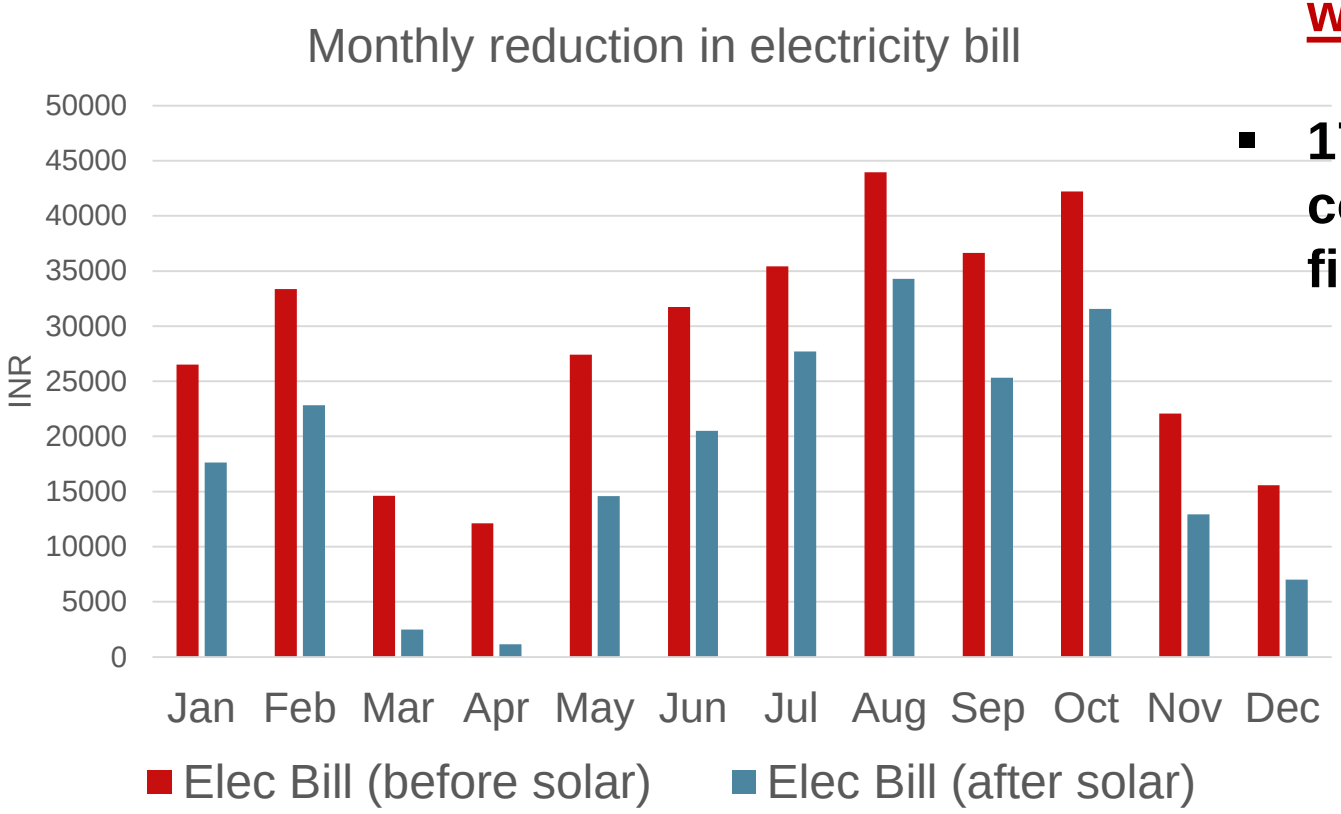
Evaluation of the technical criteria for the 40 GW rooftop solar

➔ Which standard PV components are most suitable for the Indian roof-top market?

➔ What are the best practices measures to ensure a good and sustainable PV-performance under the local conditions?

➔ Why people opted for solar rooftop system?

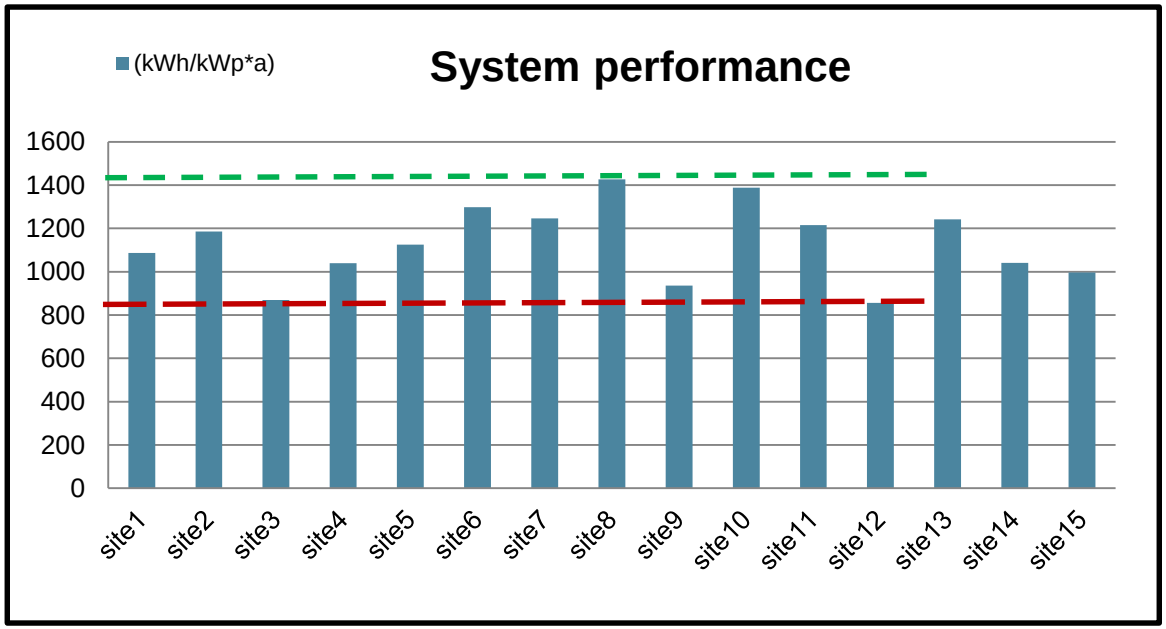
43% average annual electricity bill saved



- **Pay back – 5 years <u>without Subsidy</u>**
- **17% of the capital cost recovered in first year**

Specific Yield of ~1400 for best performing and ~850 for worst performing system

➔ System Performance significantly lower than indicated by simulations based on satellite data (~1800 kWh/kWp)



➔ The highest yield is seen in the months of Feb to April and September

Survey Approach

- Sample size 15 systems (3-120 kWp)

Inspection on Site	
	1. Fast Check
	2. Visual inspection of the roof-top PV-system
	3. Electric inspection of the DC site

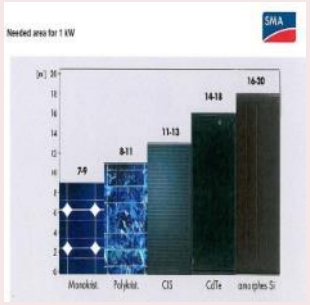
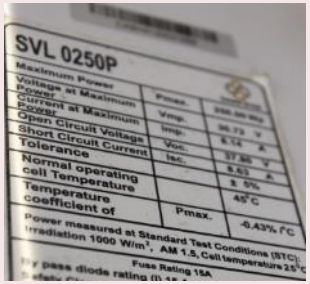
Study Results: Key Findings

➔ Correlation between quality of the inverter, the cleaning frequency and the mounting structure and the system performance.

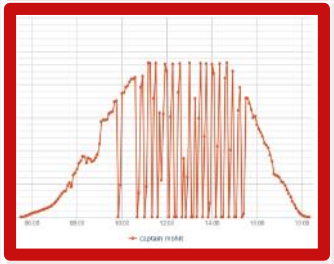
Ranking	Site	Monitoring system	Maintenance contract	European inverter	Installation on superstructure	Cleaning weekly	Privately owned
1.	Site 8						
2.	Site 10						
3.	Site 6						
4.	Site 7						
…							
12	Site 15						
13.	Site 9	*					
14	Site 3	*					
15 **	Site 12						

**Monitoring system was installed, but the interview showed that the owner did not sufficiently know how to handle the data. ** The owner was aware about the low performance of the system and intended to the take measures to increase the performance.*

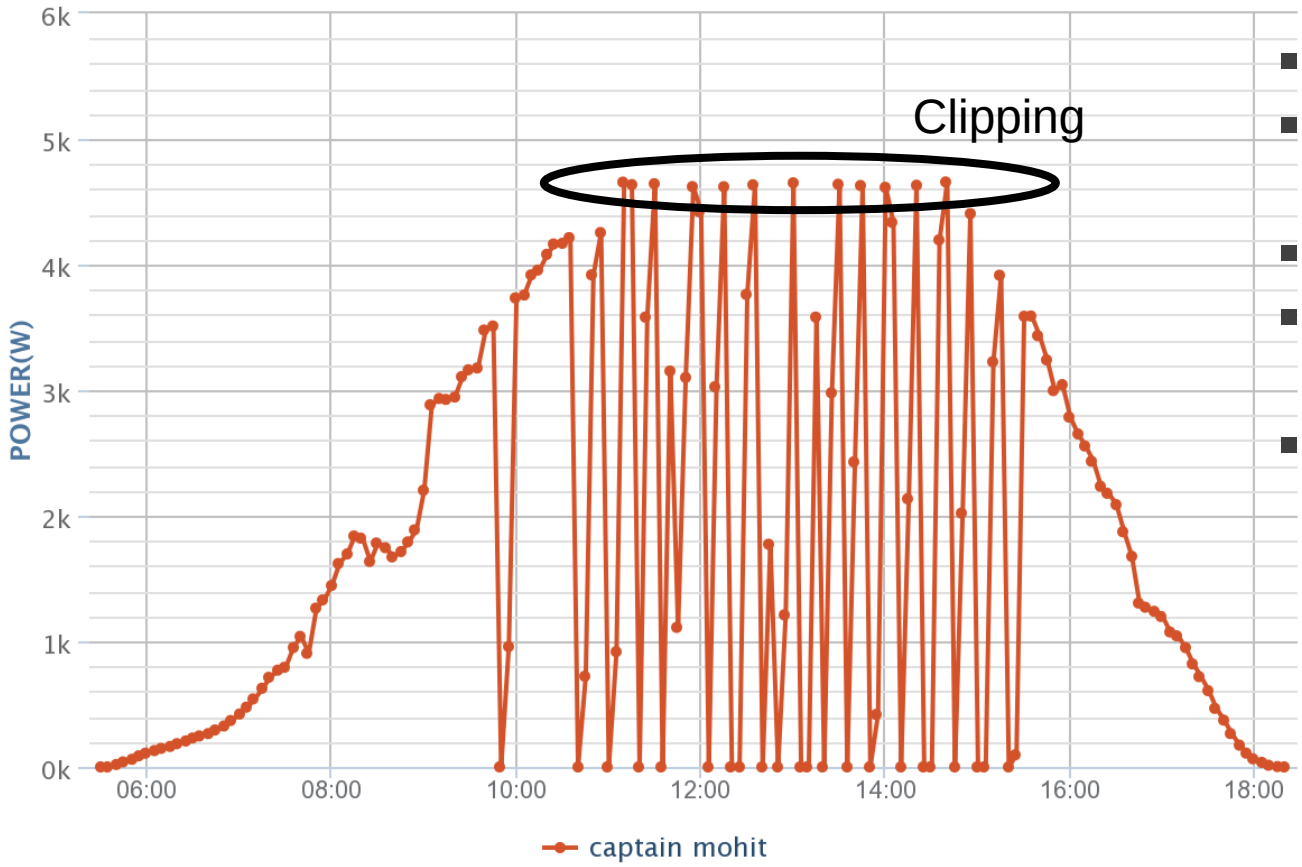
Study Results: Planning

Choice of Module			Choice of Inverter	
Polycrystalline dominates	Unused glass-glass-technology	Lack of positive tolerance modules	Single MPP dominates	Top 5 use high end European inverter
				
Promote the use of monocrystalline modules	Educate on the advantages of glass-glass-module technology	Raise awareness towards benefits of positive power tolerance	Train on the benefits of multiple MPP	Educate on the advantages of quality inverters

Study Results: Planning

Mounting Structure			System Sizing	Grid Instabilities
Corrosive materials used	Shading	Multiple use of roofs	Unfavorable inverter sizing	High voltage fluctuations
				
Promote use of aluminum (freestanding) or gal. steel (Superstructure)	Train on the influence of shading on the performance	Promote the use of PV-Superstructures	• Conservative DC to AC ratio of 90–110% • Use of sizing programs can help	• Adjustment of inverter settings • Net analyzing data logger • Reactive power control

Optimal Inverter Sizing



- PV size – 8kWp
- Inverter – 4.6 kW
- DC:AC - 173%
- Contracted load – 7kW
- Specific Yield = 874kWh/kW_p

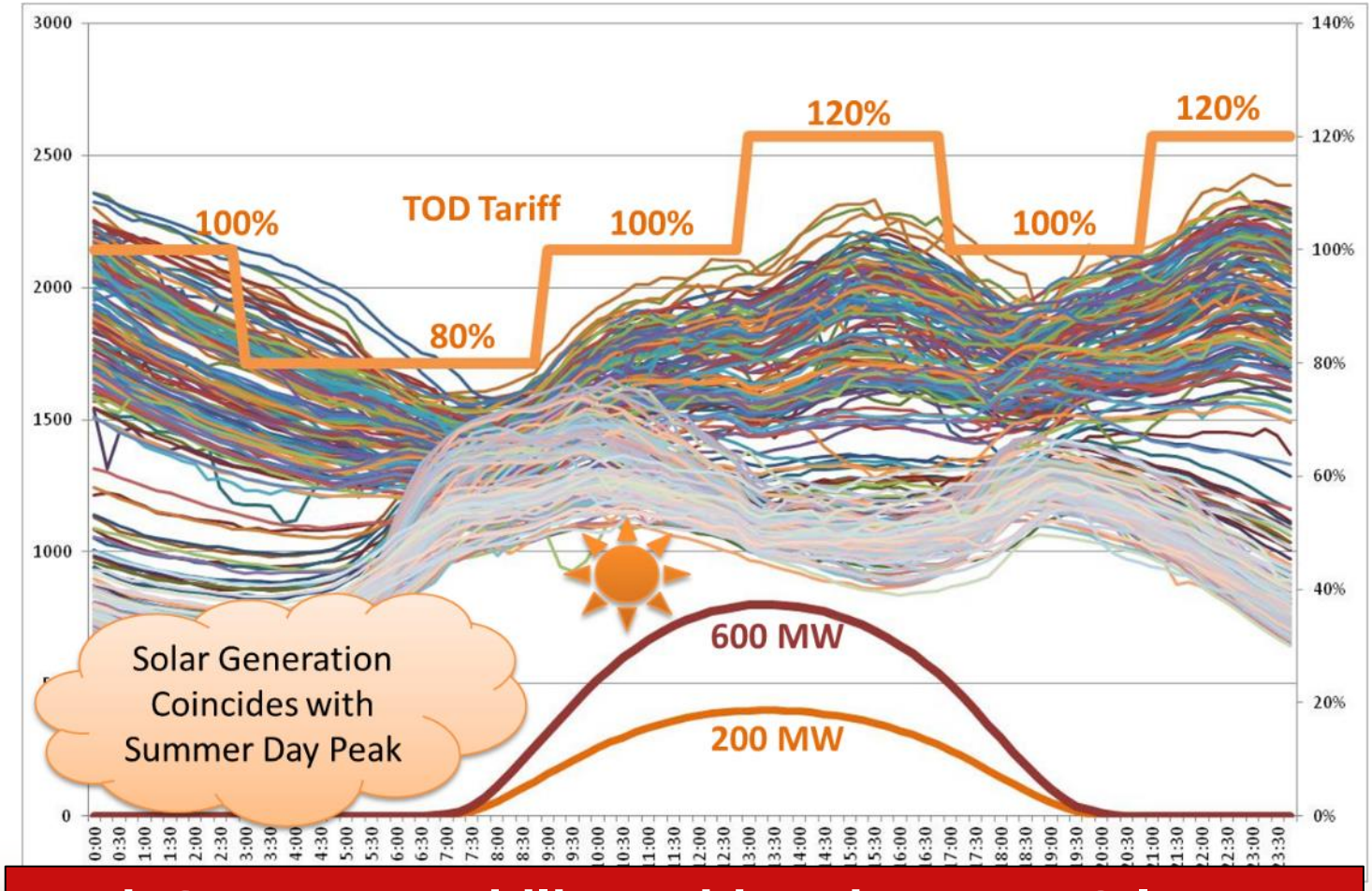
Study Results: Installation

Components			Mounting Style	Cable Sizing
Breaking cable conduits	Non UV resistant cable ties	PV connectors and crimping tools	Usage of predrilled boreholes	Small diameters
				
Guidelines on material and positioning of conduits	Enhance the use of UV resistant cable ties	Promote tool less connectors or give incentives for regular crimping tools	Educate on the advantage of using module clamps	Recommend 4 mm^2 as a standard up to 10 kWp and 6 mm^2 for larger

Study Results: Operation and Maintenance

Monitoring		Cleaning	
Best performing systems use remote monitoring	Best performing systems have maintenance Contract	High Impact of dust and dirt	Insufficiently maintained inverter
			
• Mandatory remote monitoring	Introduce mandatory maintenance contract with annual inspection	• Weekly cleaning • Introduce mandatory instructions to owners by installer	Educate on the negative impact of congested ventilation

PV rooftop distributed generation offsets peak demand



Peak Support, stabilise grid, reduce AT&C loss

Source: BSES Solar Strategy

Rooftop Solar Photovoltaic project under Indo German Energy Programme

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