Clean Energy Transition through Solar Photovoltaics: A Way Forward

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Contents

Electricity Scenario of India

Total Electricity Consumption:
~ 1300 TWh or 1300 BU

500 gm

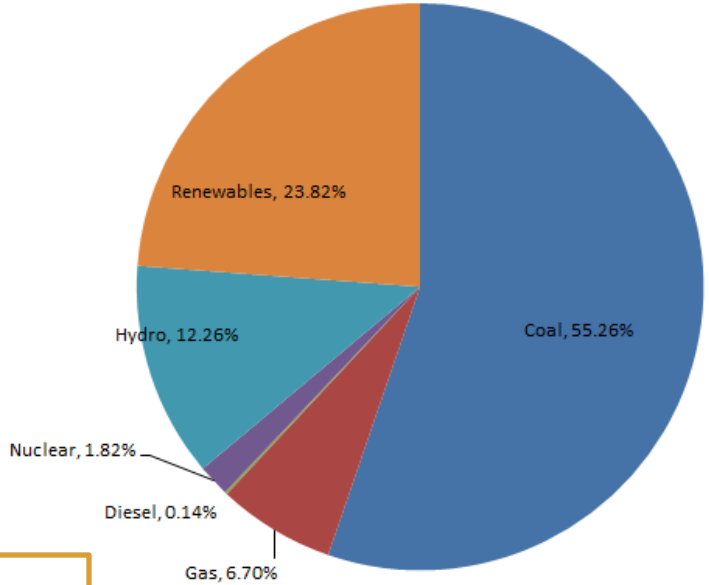
1 unit of electricity

***Emission Factor**: Coal- 0.98 t CO_2/MWh*
Grid- 0.82 t CO_2/MWh

Now imagine the impact of burning **390 Million Tons of Coal** to generate 60% of 1300 BU.

→ **784 Million tons of** CO_2

Renewable Energy Share in Indian Power Sector-Installed Capacity ***(as on Aug 2020)***



Renewables (MW)

Solar	35,739
Wind	37,999
Small Hydro	4,740
Biomass	10,146
Waste to Energy	169
Total	**88,793**

Source: MNRE, Ministry of Power, Government of India

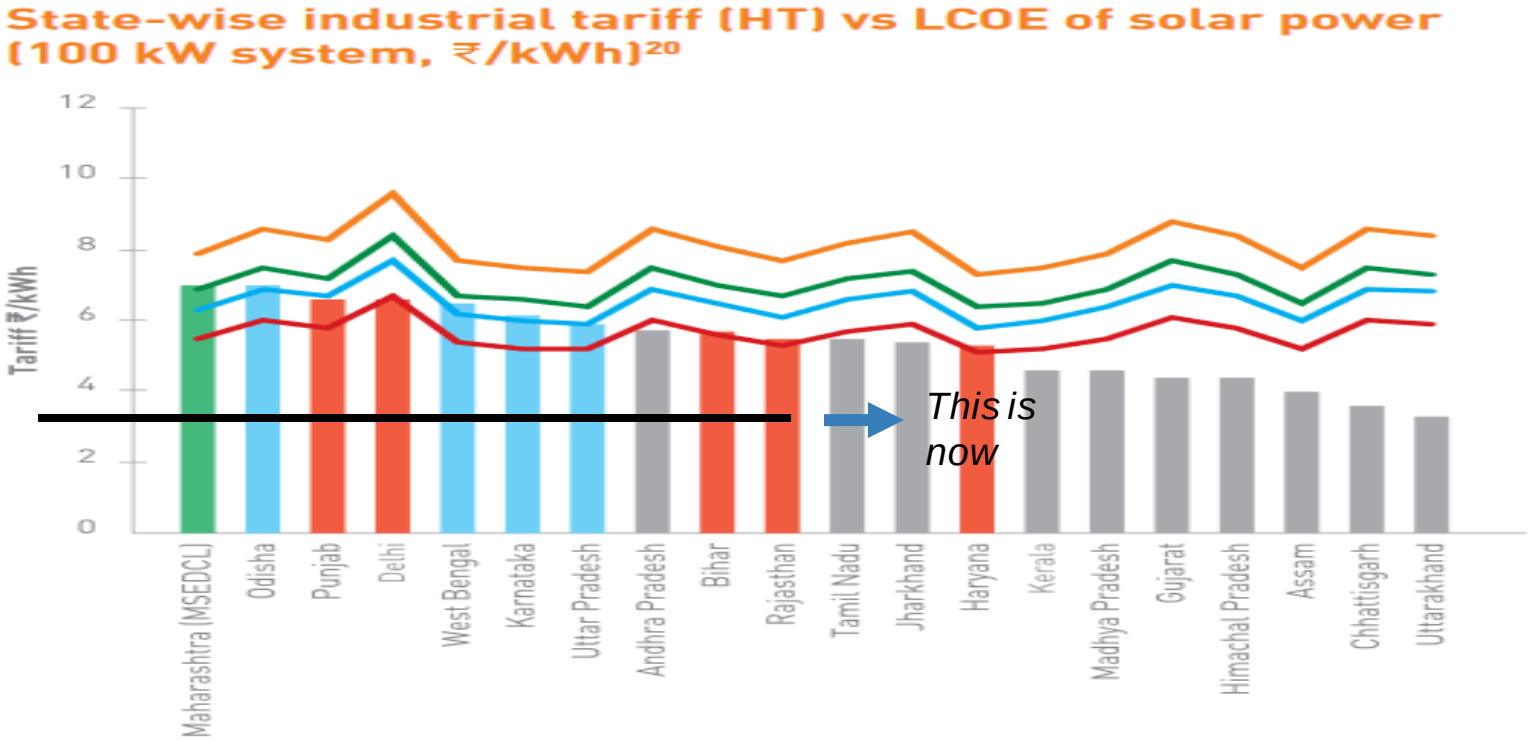
Solar is the Future

Total Area of India
3,287,469 sq kms

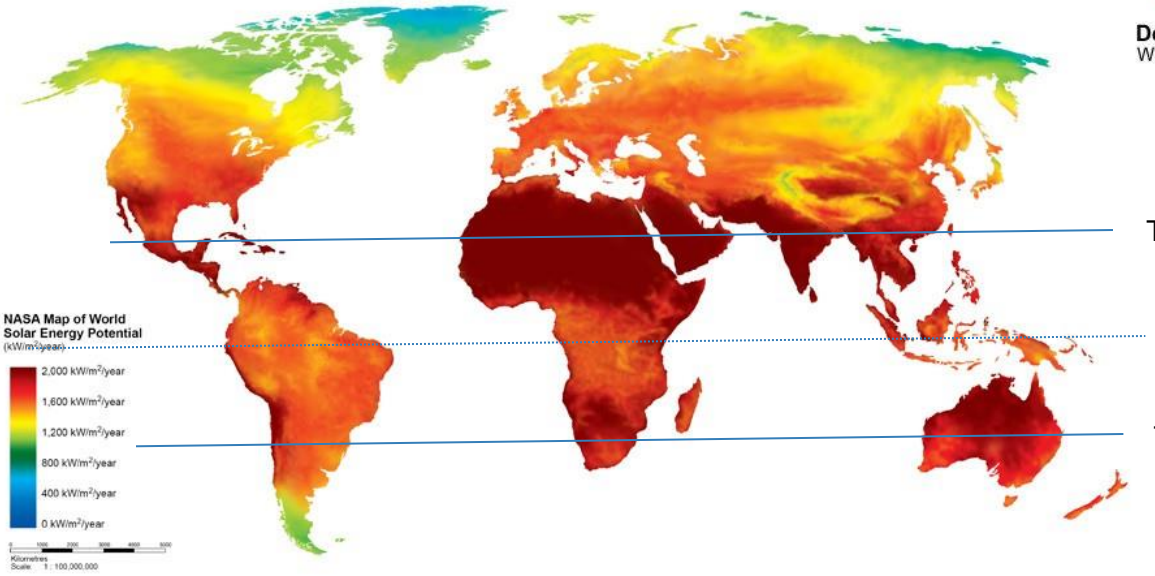
Out of which only 1300 sq km of land required for solar panel installation

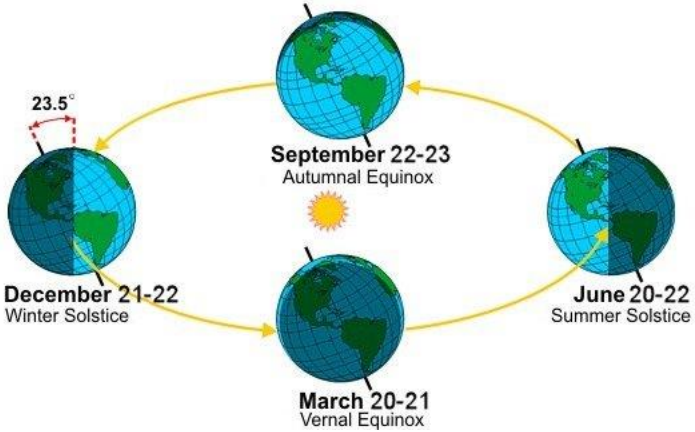
To produce 1300 TWh of electricity

The Cost of Going Solar



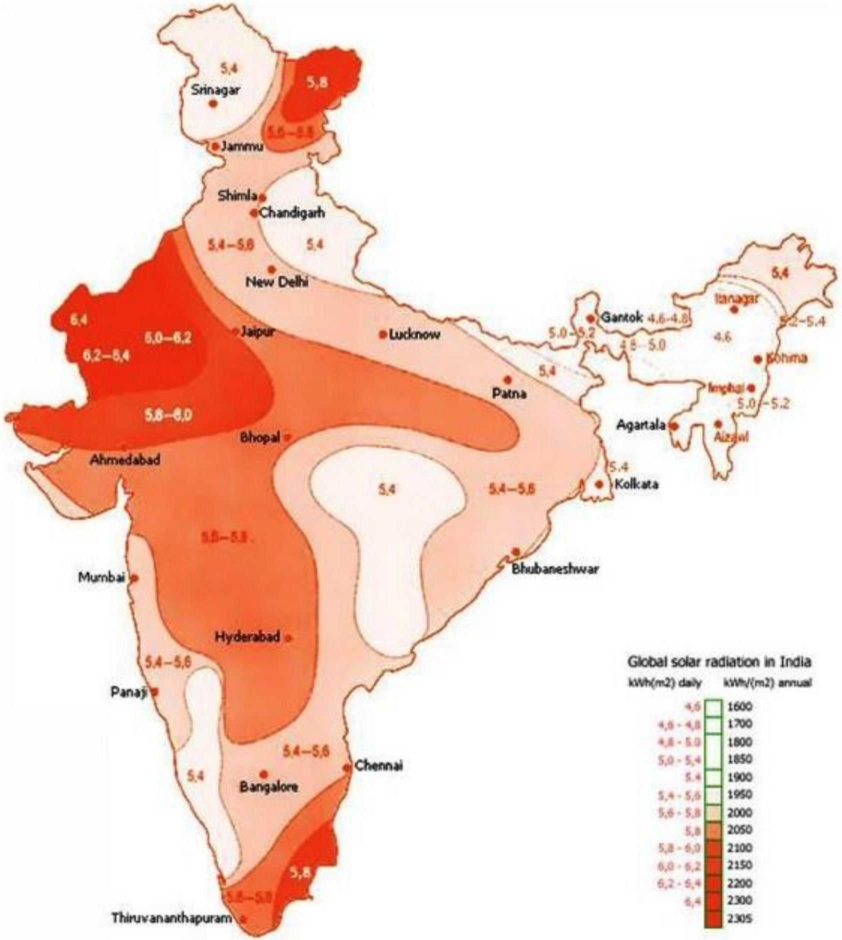
India is in the Solar belt of the World

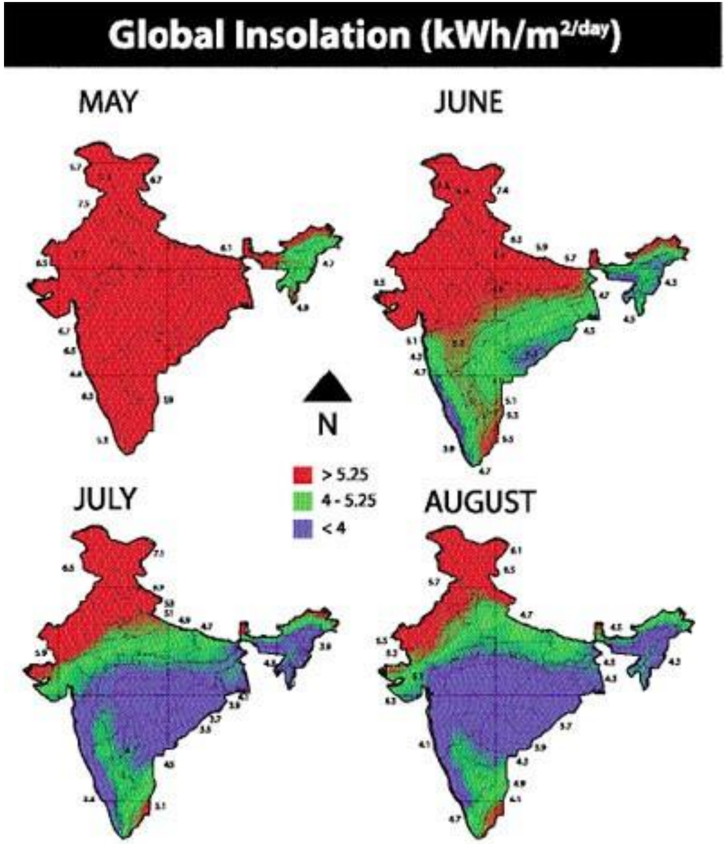




Tropic of Cancer

Tropic of Capricorn


Srinagar
Jammu
Shimla
Chandigarh
New Delhi
Jaipur
Lucknow
Gantok
Itanagar
Kohima
Imphal
Patna
Agartala
Aizawl
Kolkata
Ahmedabad
Bhopal
Bhubaneshwar
Mumbai
Hyderabad
Panaji
Chennai
Bangalore
Thiruvananthapuram
Global solar radiation in India
kWh(m2) daily
kWh/(m2) annual
4,6 1600
4,6 - 4,8 1700
4,8 - 5,0 1800
5,0 - 5,4 1850
5,4 1900
5,4 - 5,6 1950
5,6 - 5,8 2000
5,8 2050
5,8 - 6,0 2100
6,0 - 6,2 2150
6,2 - 6,4 2200
6,4 2300
2305

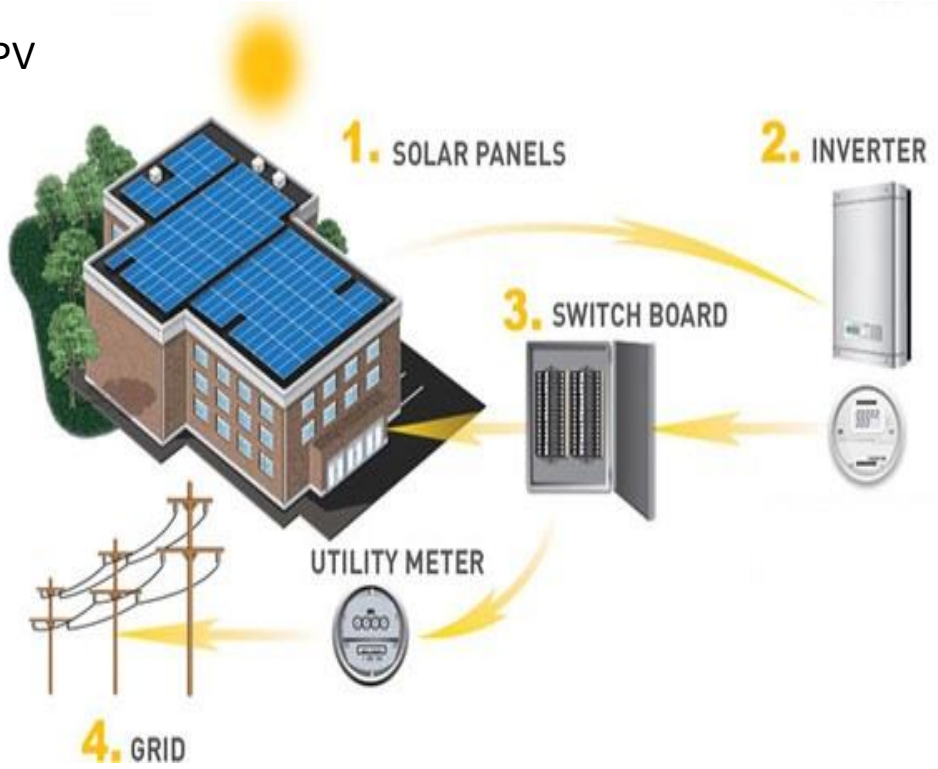

Global Insolation (kWh/m2/day)
MAY
JUNE
JULY
AUGUST
N
> 5.25
4 - 5.25
< 4

What is Solar Roof top System ?

A rooftop photovoltaic power station, or rooftop PV system, is a photovoltaic system that has its electricity-generating solar panels mounted on the rooftop of a residential or commercial building or structure.

Components of Roof top System

1. Photovoltaic (**PV**) Modules
2. Solar inverters
3. Mounting systems
4. Cables .



Benefits of Rooftop Solar

- Because makes economic sense
- Fossil fuel based electricity would continue to get costlier
- Comply with government policies
- Renewable Purchase Obligations compliance will become stricter
- Business is more than just profits
- You may have your own sustainability goals
- With increasing consumer awareness Indian consumers will get more demanding – this has already been happening in the west.

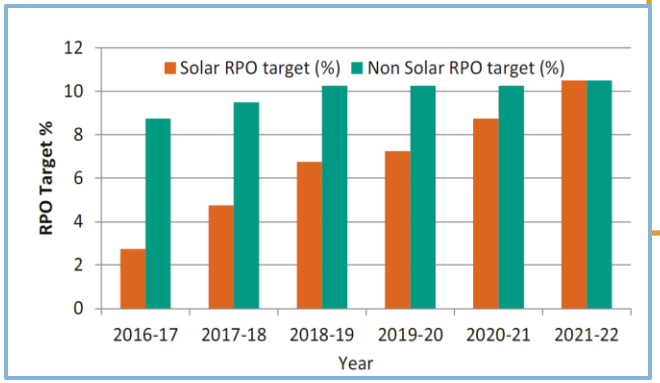
Why Rooftop Solar Makes Sense for DISCOMS?

- Regulatory Complaince
- Meeting RPO obligations

- Infrastructure Benefits
- Reducing the budren placed on grid infrastructure

- Customer Satisfaction
- Addressing national concerns and consumers' preferences for cleaner energy

- Direct Financial Benefits
- Availing of performance based incentives

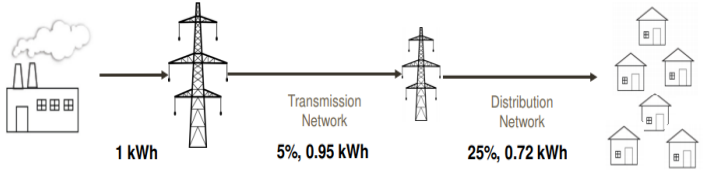


RPO targets released by Ministry of Power

- Address demand side issues (Storage)
- RTS provides ancillary services
- Address financial losses (T&D)

- National Solar Mission- 100GW Solar by 2022
- Preference over fossil fuel based power to clean power

Benefit of Rooftop Solar Photovoltaic to the DISCOM



1 kWh generated at load centre can save generation of 1.5 kWh by fossil fuel based plants

Grid Connected Rooftop Solar Programme- Phase-II

Central Financial Assistance (CFA)

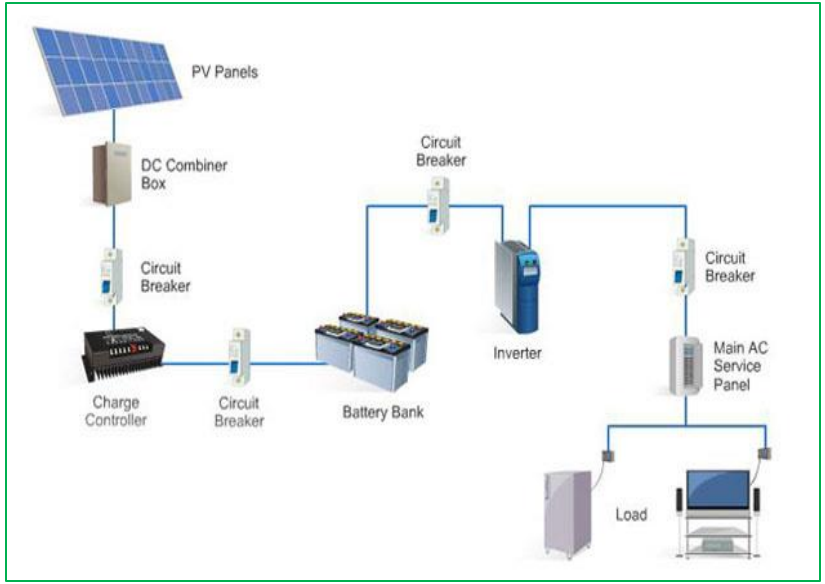
System Size	CFA Allowed
Solar Rooftop systems up to 3 kW capacity	40% of benchmark cost
Solar Rooftop systems between 3 kW to 10 kW capacity	40 % of benchmark cost up to 3 KW; Plus 20% for RTS system above 3 kW and up to 10 kW
Group Housing Societies/Residential Welfare Associations (GHS/RAW) with solar rooftop plants for supply of power to common facilities (capacity of 10 kW per house and maximum total capacity of 500kWp)	20% of benchmark cost

DISCOM Incentive Structure

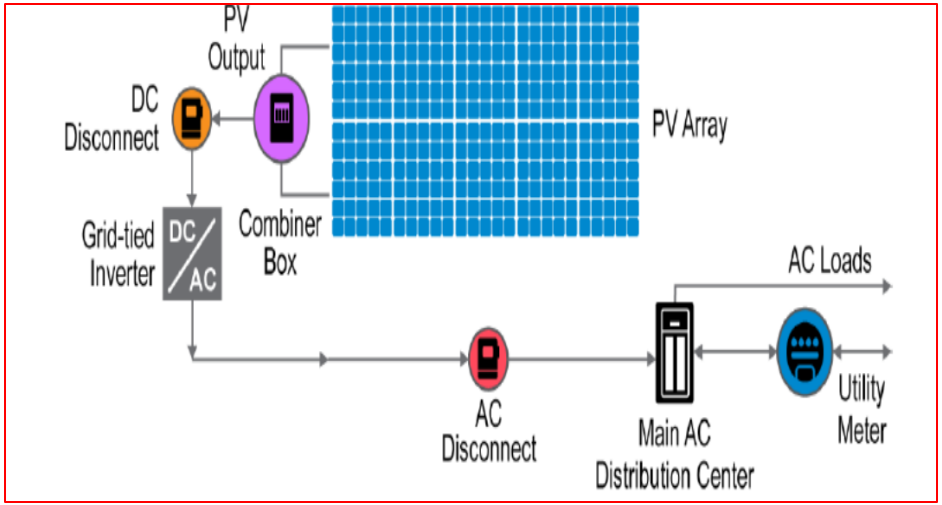
Parameter	Incentives to be Provided
Installed capacity above 10% up to 15% of installed base capacity	5% of applicable cost
Installed capacity over 15% of installed base capacity	5% of applicable cost for additional capacity above 10% and below 15% of installed base capacity; and 10% of applicable cost for additional capacity over 15% of installed base capacity

Operational Guidelines for implementation of Phase II, page 1 (2019); MNRE; https://mnre.gov.in/sites/default/files/schemes/Notification-20082019-184419.pdf.

Types of SPV Systems



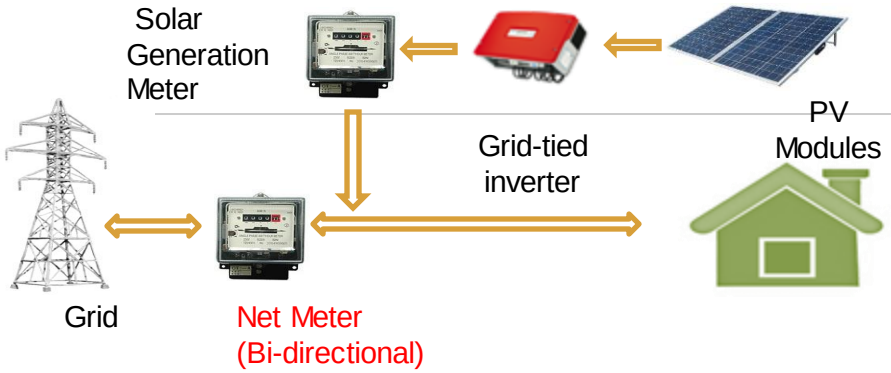
Typical Off-grid Solar PV Arrangement

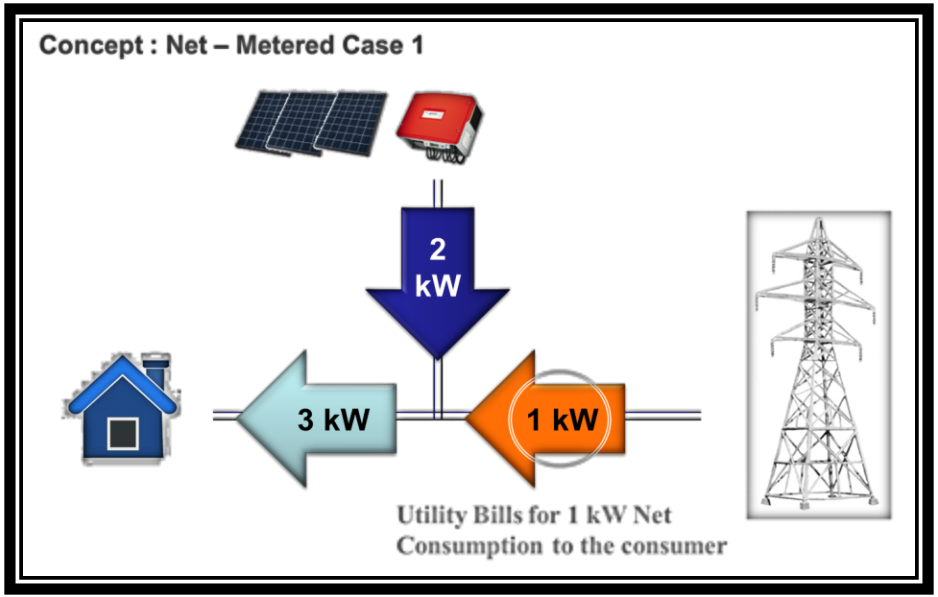


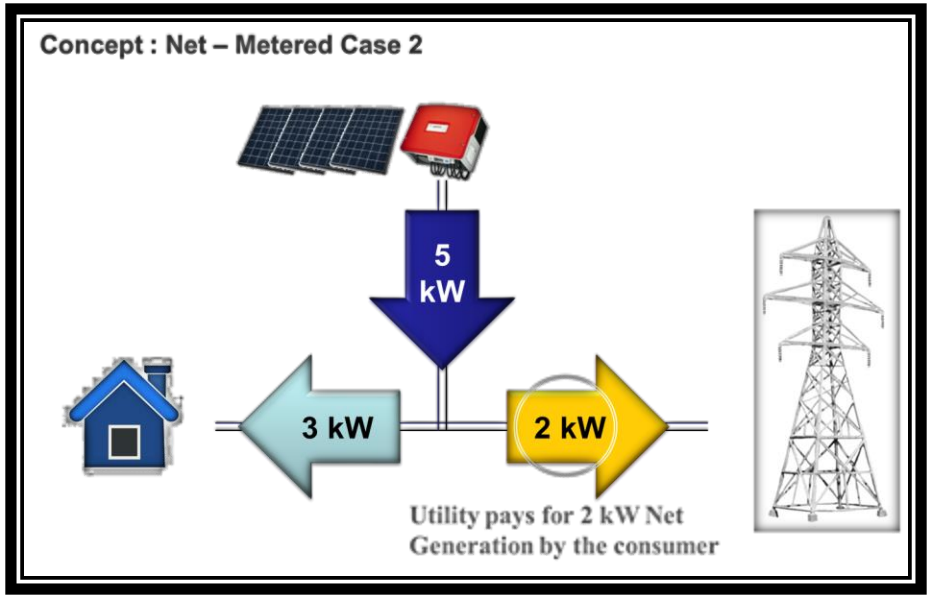
Typical On-grid Solar PV Arrangement

Net Metering

- Consumer-centric
- Utility acts as a bank for excess generation

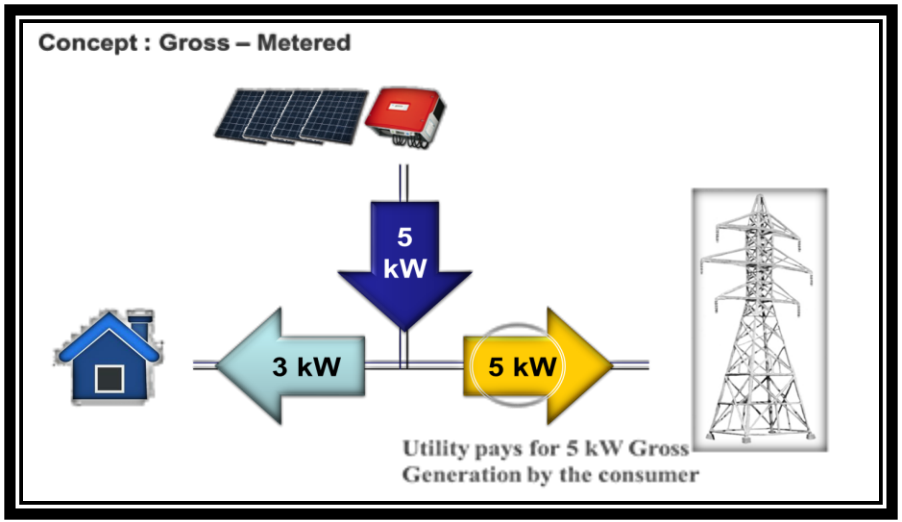


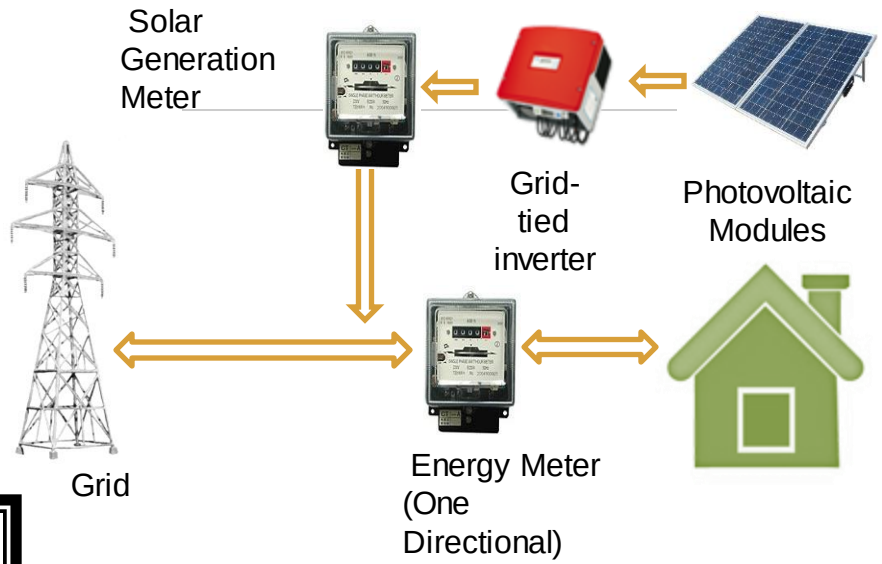




Gross Metering

- Energy meter
  - Uni-directional
- Solar meter
  - Check meter (Discom)



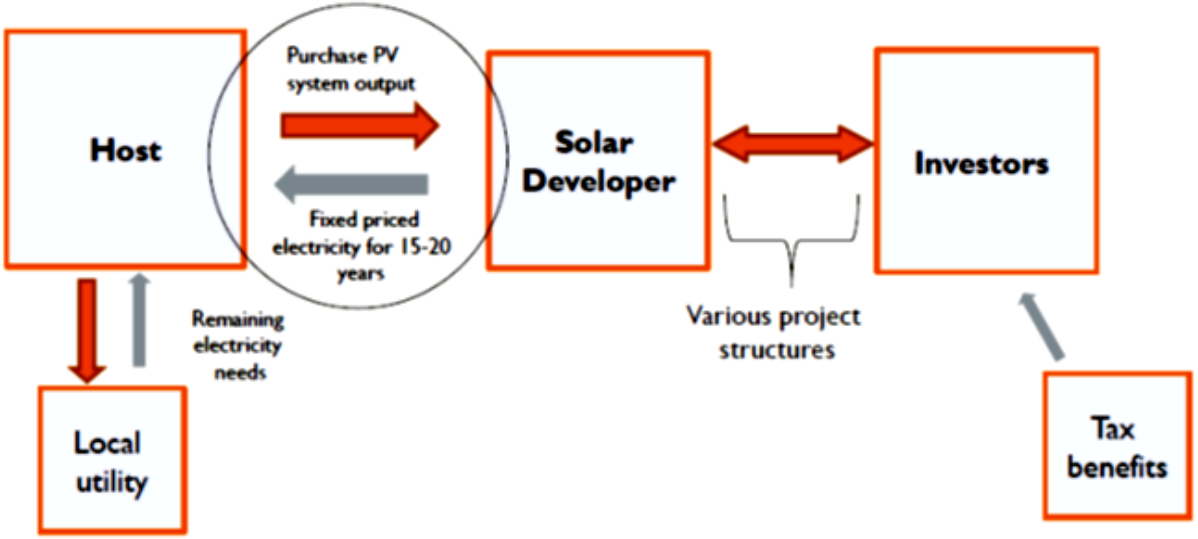


FIT – A feed in tariff used to denote the price paid by a utility for power under the gross metered regime

Generally the Feed in Tariff is determined by the regulatory commission

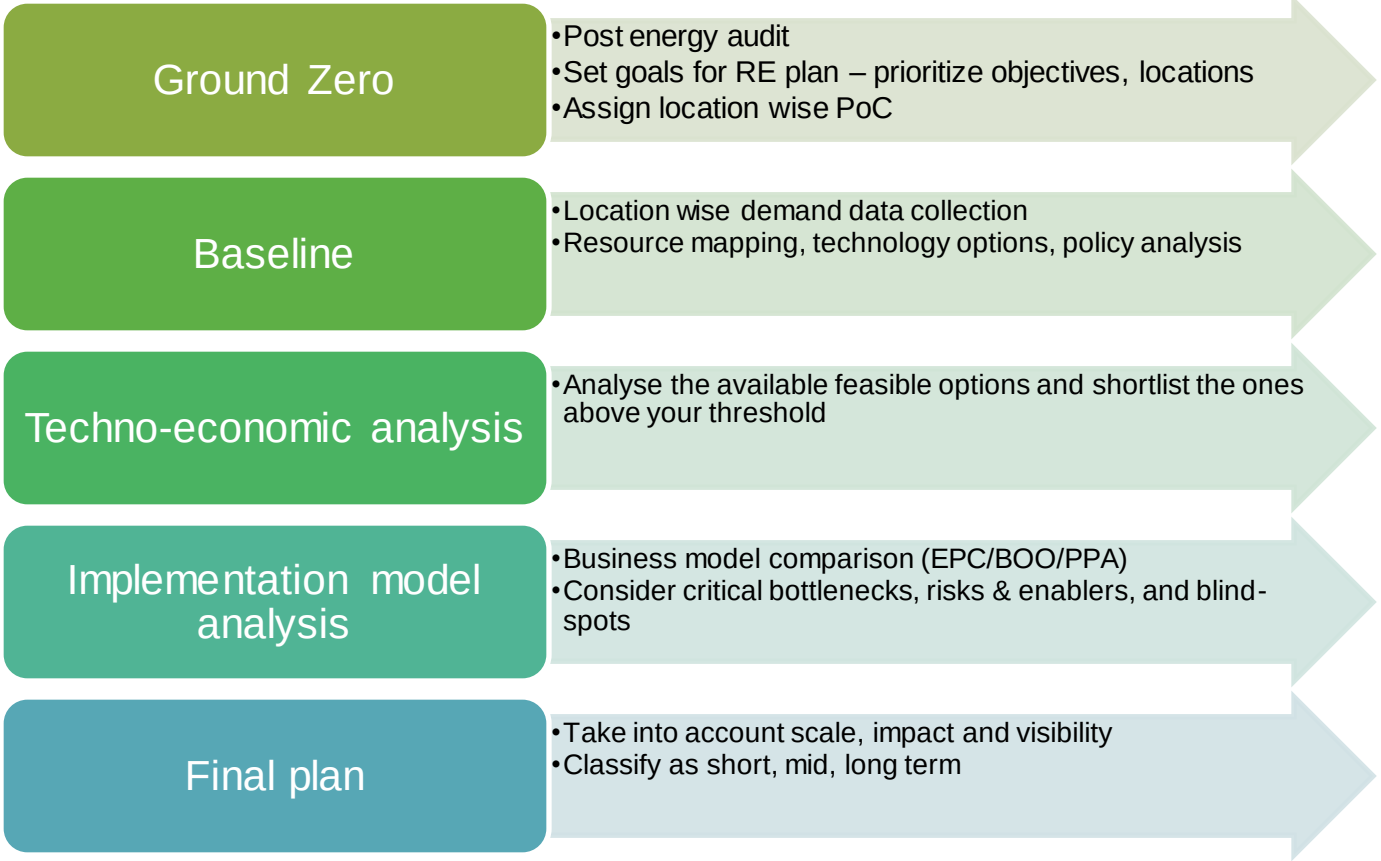
Third Party Solar PPA Structure

Instead of purchasing a PV system, the property owner agrees to host the system and purchase the electricity instead. The contract to purchase this electricity is often called the Power Purchase Agreement or PPA.

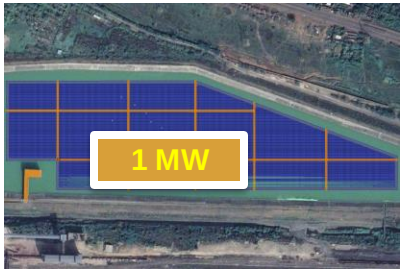


- The third parties take the various incentives in these transactions
- May also hear the term "Solar Power & Services Agreement"

Planning your RE plan: Way Ahead



Success Stories: RE Roadmap for a Steel Company



- TERI has aggregated over **180 MW** of feasible RE capacity along with optimal best suited technology, cost benefit analysis for adopting RE; after assessing more than 40 locations in 20 cities in India.

- Being an **obligated entity**, it was found to have in-house solar PV systems feasible to meet the electricity requirement rather than purchasing RECs.

Thank You

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