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Grid Connected Solar Rooftop Systems

Government of India

Ministry of New and Renewable Energy

Road Map for Solar Power by 2022

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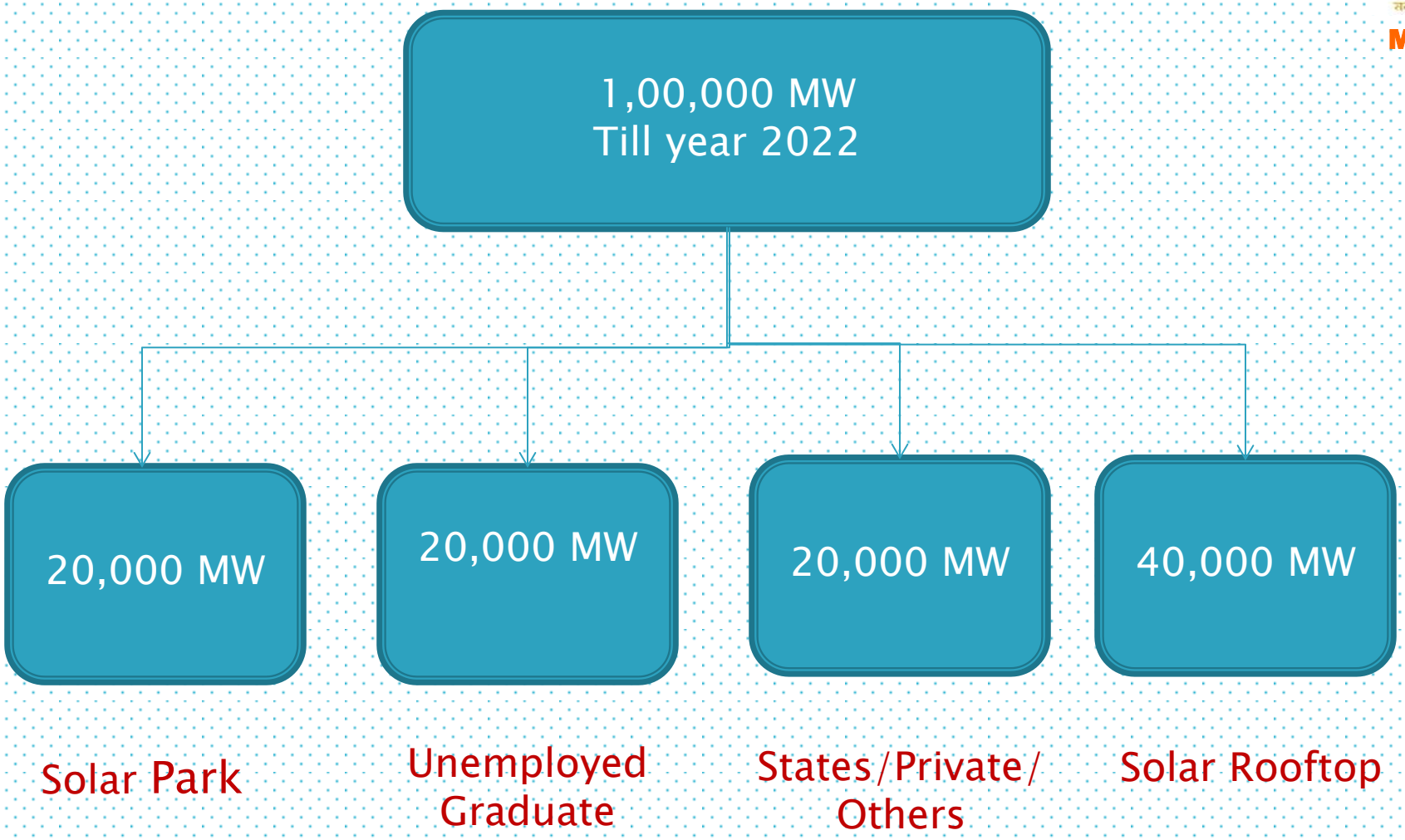

Solar Rooftop PV Systems

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- Solar systems installed on rooftops of residential, commercial, institutional & industrial buildings :



- **Electricity generated could be**
  -fed into the grid at regulated feed-in tariffs or
  -used for self consumption with net-metering approach

Advantages of solar rooftops

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- Savings in transmission and distribution losses
- Low gestation time
- No requirement of additional land
- Improvement of tail-end grid voltages and reduction in system congestion with higher self-consumption of solar electricity
- Local employment generation
- Reduction of power bill by supplying surplus electricity to local electricity supplier
- Battery elimination makes easy installation and reduced cost of system

All-India Rooftop SPV Potential

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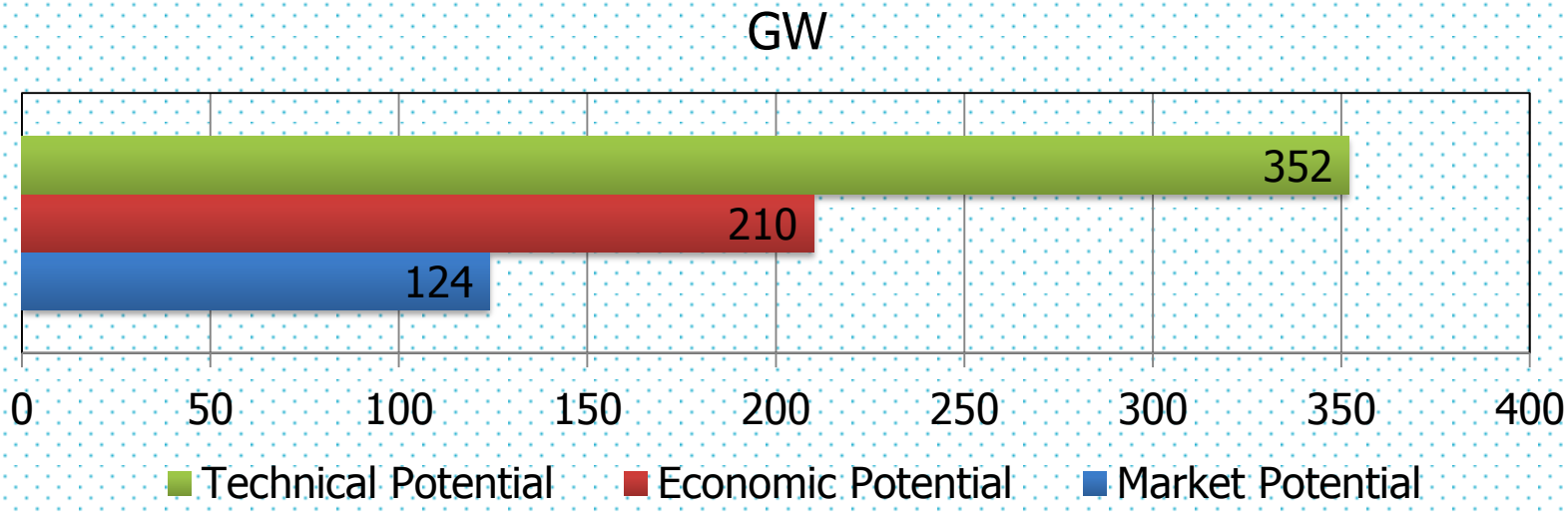
In India market potential for rooftop SPV is 124 GW.



Estimated Rooftop Solar PV Potential for Central Government Buildings

Methodology

Identification/ Categorization

- Identification of Ministries, departments & facilities
- Categorization of structures for roof space mapping

Roof space GIS mapping

- Sample size
- Roof space mapping

Potential estimation

- Deriving average usable roof area
- Determining rooftop solar potential

Assumptions:

a) 40% of the identified roof space is usable for rooftop solar installation – shading, non-uniform north-facing tilt of roof, etc.; b) Roof has sufficient structural load-bearing capacity to support solar system; c) Sufficient capacity is available at distribution transformer level; d) Estimates based on roof-space image mapping from Google Earth.

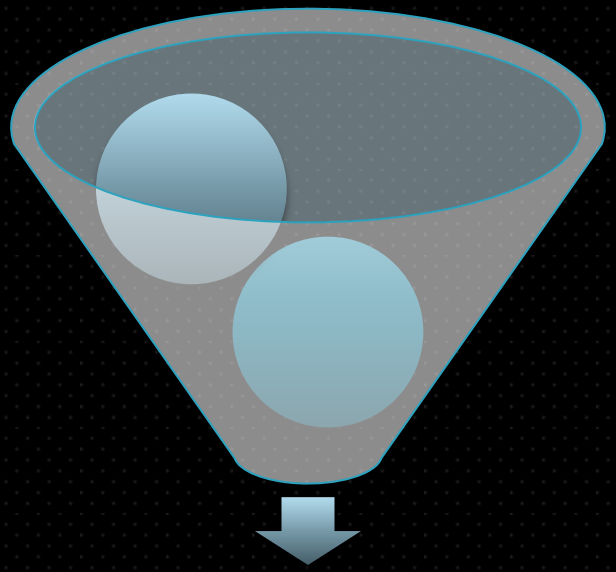
Estimated Rooftop Solar PV Potential

Ministry	MW Potential
Ministry of Agriculture	**12**
Ministry of Chemicals and Fertilizers	**401**
Ministry of Civil Aviation	**620**
Ministry of Coal	**53**
Ministry of Commerce and Industry	**2**
Ministry of Consumer Affairs, Food and Public Distribution	**2314**
Ministry of Culture	**2**
Ministry of Defence	**281**

Ministry	MW Potential
Ministry of Food Processing Industries	**22**
Ministry of Health and Family Welfare	**45**
Ministry of Heavy Industries and Public Enterprises	**271**
Ministry of Housing and Urban Poverty Alleviation	**2**
Ministry of Human Resource Development	**497**
Ministry of Micro, Small and Medium Enterprises	**4**

Estimated Rooftop Solar PV Potential

Ministry	MW Potential
Ministry of Petroleum and Natural Gas	1009
Ministry of Railways	1369
Ministry of Road Transport and Highways	0.4
Ministry of Shipping	51
Ministry of Steel	224
Ministry of Textiles	5
Ministry of Tourism	6
Ministry of Youth Affairs and Sports	6



TOTAL

7196.4 MW

Present Status in India

360.81 MW of Solar Rooftop Projects sanctioned by MNRE and 54.187 MW commissioned

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Sector	Installed by SECI (MW)	Installed by States (MW)	Total installed (MW)
Commercial	10.90	17.22	28.91
Government	3.04	4.893	7.253
Hospital	1.6	0.47	2.07
Institutional (Schools, Collages)	2.19	5.131	8.346
Religious institution	0.62	7.52	7.64
Residential	0	0.298	0.298
Total	**18.35**	**35.532**	**54.187**

Present Status: Policies and Regulations

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- **13 States have come out with Solar Policy supporting grid connected rooftop systems :**
- **Andhra Pradesh Chhattisgarh, Gujarat, Haryana, Karnataka, Kerala, Manipur, Punjab, Rajasthan, Uttar Pradesh, Tamil Nadu, Uttarakhand and West Bengal.**
- **SERCs of 19 States/UTs have notified regulations for net metering/feed-in-tariff mechanism :-**
- **Andhra Pradesh, Chhattisgarh, Delhi, Haryana, Karnataka, Kerala, Tamil Nadu, Uttarakhand and West Bengal, Andaman & Nicobar, Chandigarh, Dadra & Nagar Haveli, Daman & Diu, Lakshadweep, Pondicherry, Goa, UP, Rajasthan and Odisha.**
- **Remaining States are requested being pursued to come out with their policies/regulations.**

Present Status: Policies and Regulations

Following remaining States should notify regulations and policy for grid connected rooftop systems:-

Arunachal Pradesh, Bihar, Himachal Pradesh, Jammu & Kashmir, Gujarat, Jharkhand, Telangana, Assam, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Mizoram, Nagaland, Punjab, Sikkim, Tripura

Financing by Banks

- **Department of Financial Services has advised all Public Sector Banks to provide loans for grid connected rooftop solar systems as home loan/ home improvement loan.**
- **So far, nine PSBs namely Bank of India, Syndicate Bank, State Bank of India, Dena Bank , Central Bank of India, Punjab National Bank, Allahabad Bank, Indian Bank and Indian Overseas Bank have given instructions to their branches.**
- **However, it is yet to be made effective at field level as no branches of these banks are providing such loans.**
- **Department of Financial Services may issue appropriate instructions to make it more effective.**

Financing by Banks

- **Reserve Bank of India on April 2014 has included renewable energy projects under Priority Sector Lending for which bank loans up to a limit of Rs. 15 crore to borrowers will be available for renewable energy projects including grid connected solar rooftop and ground mounted systems.**
- **For individual households, the loan limit is Rs. 10 lakh per borrower.**
- **This is yet to be mad effective at field level.**

Fiscal and Financial Incentives

The following benefits are available in commercial & industrial categories:-

- Custom Duty Concessions
- Excise Duty Exemptions
- Accelerated Depreciation
- Fiscal and other concessions from State Governments

15% CFA is available for residential, institutional and social sectors

Guidelines under DERC (Net Metering for Renewable Energy) Regulations, 2014.

- (1). Available Capacity at Distribution Transformer
- For Connecting Renewable Energy System for Net Metering by the Distribution Licensee shall not be less than 20% (Twenty percent) of the rated capacity of respective distribution transformer.

- (2). Procedure for Application and Registration (by DISCOMs)
- (i) Feasibility Analysis
  fee of Rs. 500/-, within 30 days
- ii) Registration
- Consumer To apply in 30 days with charges 1000 to 15000
- iii) Connection Agreement
- To be executed within 30 days from the date of registration between DISCOM and Consumer,

- (3) Interconnectivity, Standards and Safety
- shall be governed by the Central Electricity Authority (Measures relating to Safety and Electric Supply), Regulations, 2010, as amended from time to time.

- (4) Metering Arrangement and Standards
- Cost of the Net Meter, which is capable of recording both import and export of electricity to be borne by the consumer.

- Meters shall be Meter Reading instrument (MRI) compliant or AMR (Automatic Meter Reading) or AMI (Advanced Metering Infrastructure) compliant for recording meter readings.

Guidelines under DERC (Net Metering for Renewable Energy) Regulations, 2014.

- (5) Procedure of billing & accounting
- (a) Non Time of Day Tariff Consumers:
- surplus units injected by the consumer shall be carried forward to the next billing period as energy credit and shown as energy exported by the consumer for adjustment against the energy consumed in subsequent billing periods within the settlement period.

- (6) Tariff at the end of financial year for surplus energy
- The Consumer shall be paid for net energy credits which remain unadjusted at the end of the financial year at the rate of Average Power Purchase Cost (APPC)

- (b) Time of Day Tariff Consumers
- The electricity consumption in any time block (e.g., peak hours, off-peak hours, etc.) shall be first compensated with the electricity generation in the similar time blocks in the same billing cycle.

- If the consumer is injecting energy in the peak hours or in a time block when Distribution Licensee is having more demand than the available energy, Distribution Licensee with the approval of the Commission may propose incentives to such consumers

- (7) Theft and Tempering of Meter(s)
- As per Electricity Act 2003
- (8) Dispute Resolution : by DERC

- (9)Violation of guidelines : Penalty as decided by DERC

- (10) Powers to amend : DERC

Existing policies in different states

- **Andhra Pradesh Solar Power Policy, 2015**

- Implementation of projects on gross and or net meter basis
- Consumer(s) are free to choose either net or gross meter option
- Applicable tariff will be determined by APERC every year
- APERC tariff for FY 2013-14 is Rs 5.25 per unit for 25 years
- Metering facility will be extended for all Eligible Developers via online mode to DISCOM
- Approvals/clearances shall be disposed by the respective Discom within 14 days from the date of application
- The projects of capacity upto 1000 KWp at a single location will be permitted
- The DISCOMs will deduct energy from the consumed energy and balances (either excess or lower) can be billed on net metering basis.
- No Distribution losses and charges will be collected from the Group/Society/ individuals by the DISCOMs.
- Eligible Developers are allowed to avail the relevant subsidies and incentives from MNRE under JNNSM scheme
- Modalities for implementing the rooftop policy including metering, billing, settlement, payment(s) and technical aspect will be issued by APEPDCL

Existing Policies in Different States

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- Haryana Electricity Regulatory Commission (HERC) Regulations for the Grid Connected Solar Rooftop Photovoltaic System dated on 24th Nov, 2014:

- Implementation of projects on net meter basis
- Application processing fee Rs. 1000/- under net metering arrangement
- Permission shall normally be granted within 15 days from the date of submission of the application
- Maximum installed capacity shall not exceed 1MWp for a single eligible consumer
- Cumulative capacity of rooftop solar systems shall not exceed 15% of the peak capacity of the distribution transformer.
- Interconnection of the Renewable Energy System as per CEA (Technical Standards for connectivity of the Distributed Generation Resources)
- Meters shall adhere to the standards as specified in CEA (Installation and Operation of meters) Regulations, 2010 as amended from time to time.
- Electricity generated from a rooftop solar system shall be cumulatively capped at 90% of the electricity consumption by the consumer and settlement by the same financial year
- No carry forward to the next financial year.
- Licensee eligible for Renewable Purchase Obligation (RPO) under Net-metering policy
- Subsidy, if any, for Rooftop Solar Grid Interactive System based on Net Metering shall be in accordance with the prevailing policy of the Central/State Government or any other government agencies.

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International experience

Country, State	Metering	Incentive	Interconnection Agreement	Business Model	Ownership of assets	Contracting
Germany	Gross metered - self owned	Feed in tariff	Yes	Feed in Tariff	Self Owned	N/A
India, Gujarat	Gross metered - third party owned	Feed in tariff/ GBI	Yes	Feed in Tariff & Rooftop Lease (Green) Incentive	Third Party Owned	Rooftop Lease Agreement
Japan	Net metered - self owned	Net metering - capital subsidy	Yes - Net Metering	Savings in cost of energy	Self Owned	N/A
United States, California	Net metered - self owned	Net metering - tax rebates (ITC/ PTC) - RECs	Yes - Net Metering	Savings in cost of energy	Self Owned	Lease
United States, New Jersey	Net metered - third party owned	Net metering - tax rebates (ITC/ PTC/ Depreciation)	Yes - Net Metering	Tax rebates/ sale of power to host	Third Party Owned	PPA

International Experience: Tariff settlement

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Arizona	• Non Residential – Credited to customer's next bill at retail rate; excess reconciled annually at avoided-cost rate • Residential – Credited to customer's next bill at retail rate; excess reconciled annually in April at average annual market price minus price adjustment.
California	Credited to customer's next bill at retail rate (Option of roll over credit indefinitely or settlement @ 12-month average spot market price)
Hawaii	Credited to customer's next bill at retail rate; granted to utility at end of 12- month billing cycle

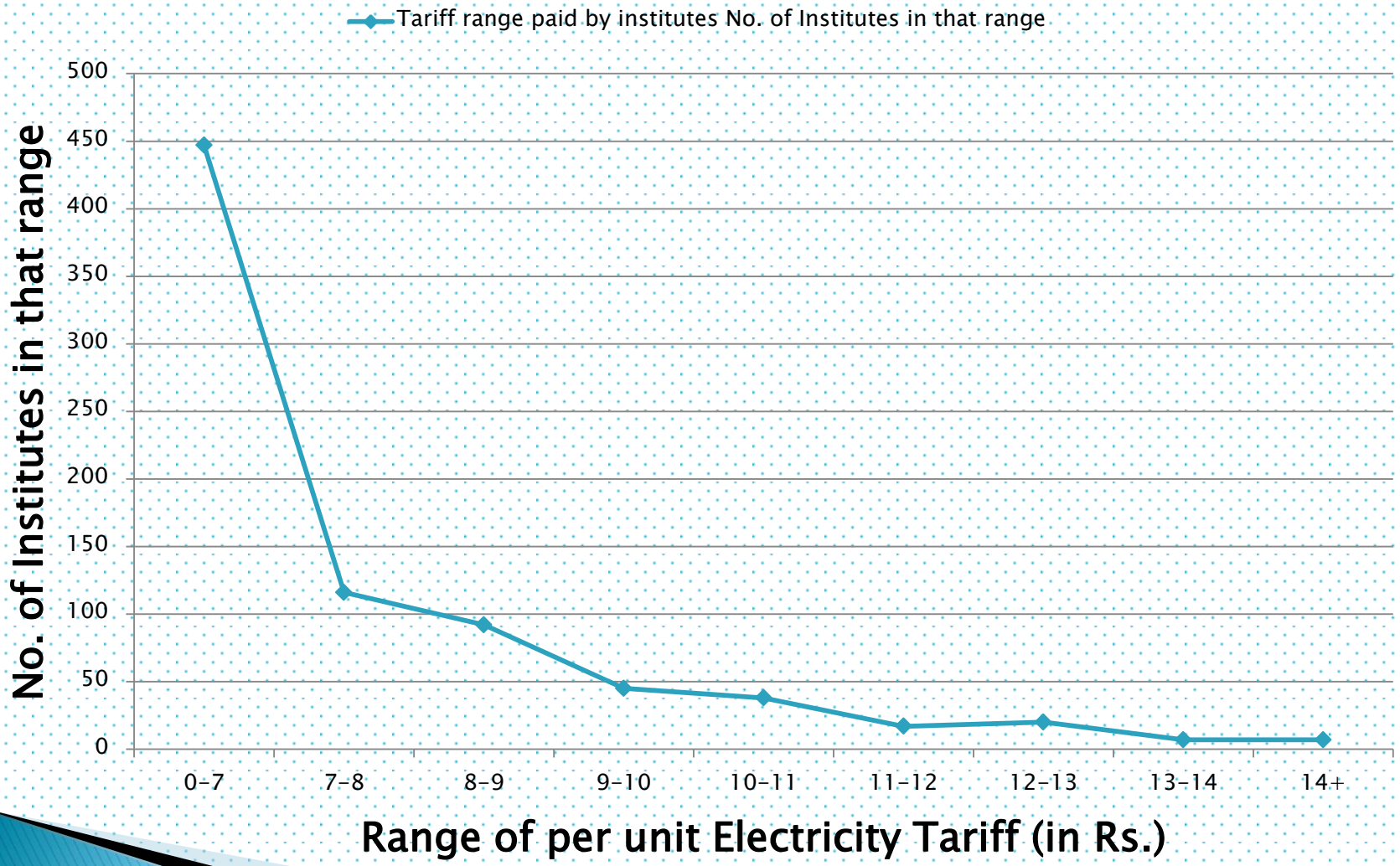
International Experience: Tariff Settlement

Italy	Mechanism does not result in direct payments and is based on the balance of the energy fed in and consumed – Credit is unlimited in terms of time.
France	Commercial settlement for a defined level of excess injection – limit is worked out according to formulas that take into account the installed peak capacity reached after a number of working hours for different types of installations and locations
Virginia, USA	· Settlement Period: At the end of 12-month period, customer has the option of carrying forward eligible excess NEG to the next net metering 12-month period or Selling to utility. · Credit to be carried forward to subsequent net metering period can not exceed amount of energy purchased during the previous annual period.

Summary of Survey Conducted in Govt. Buildings as per 30.06.2015

Data received from Govt. Buildings	844 nos.
Average Tariff	Rs. 9.37 per kWh
The maximum tariff paid by building	Rs 15.78 Per KWh
The minimum tariff paid by building	Rs 1.34 per KWh
The potential estimated for rooftop installation	1450.51 MW
No. of Institutes paying above Rs. 7.0/- per Kwh	394 nos. (46.7%)
No. of Institutes paying above Rs. 8.0/- per Kwh	226 nos. (26.8%)
No. of Institutes paying above Rs. 9.0/- per Kwh	134 nos. (15.9%)
No. of Institutes paying above Rs. 10.0/- per kwh	89 nos. (10.5%)
No. of Institutes paying above Rs. 11.0/- per Kwh	51 nos. (6.0%)

Tariff range paid by Govt. Buildings



Grid-connected SPV Rooftop systems

Business Models for Rooftop SPV

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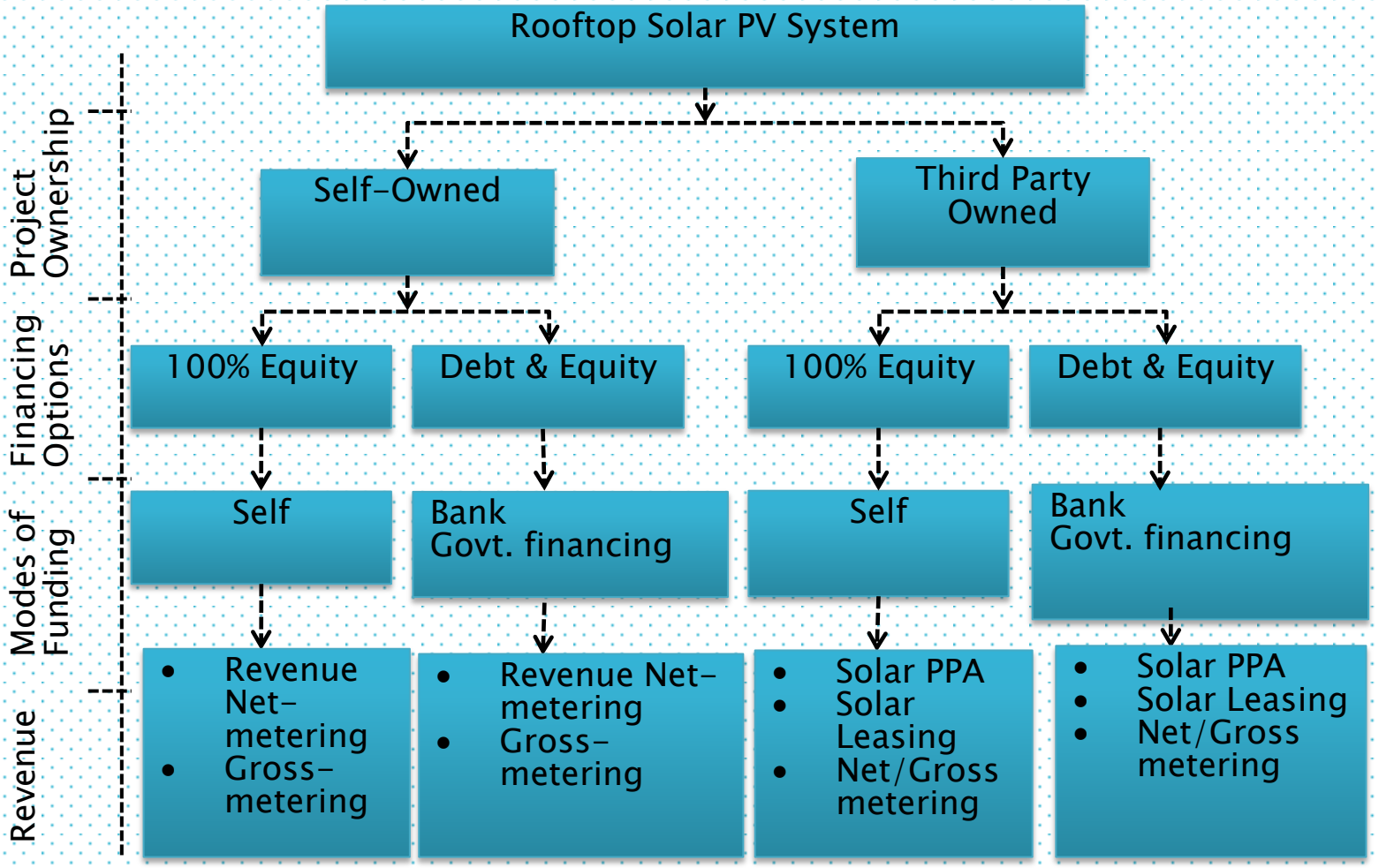

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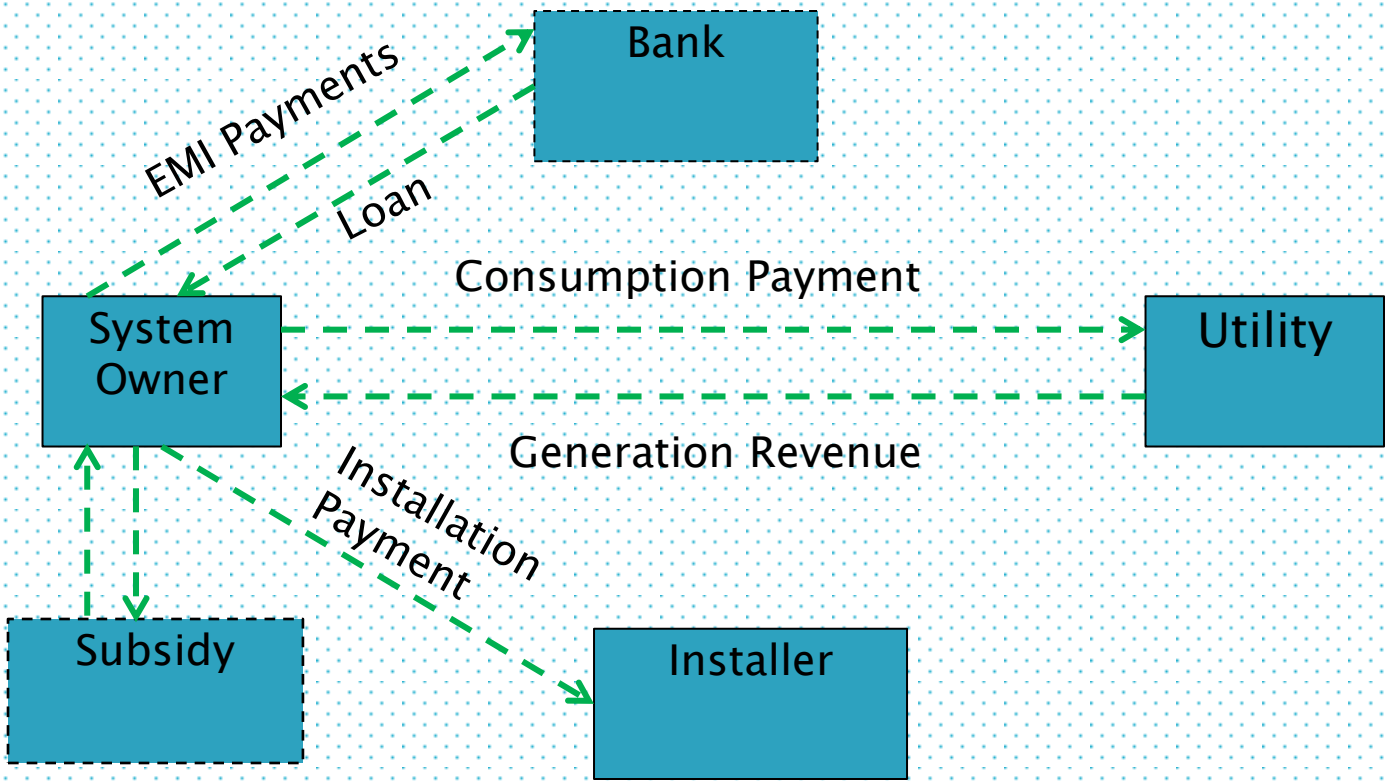
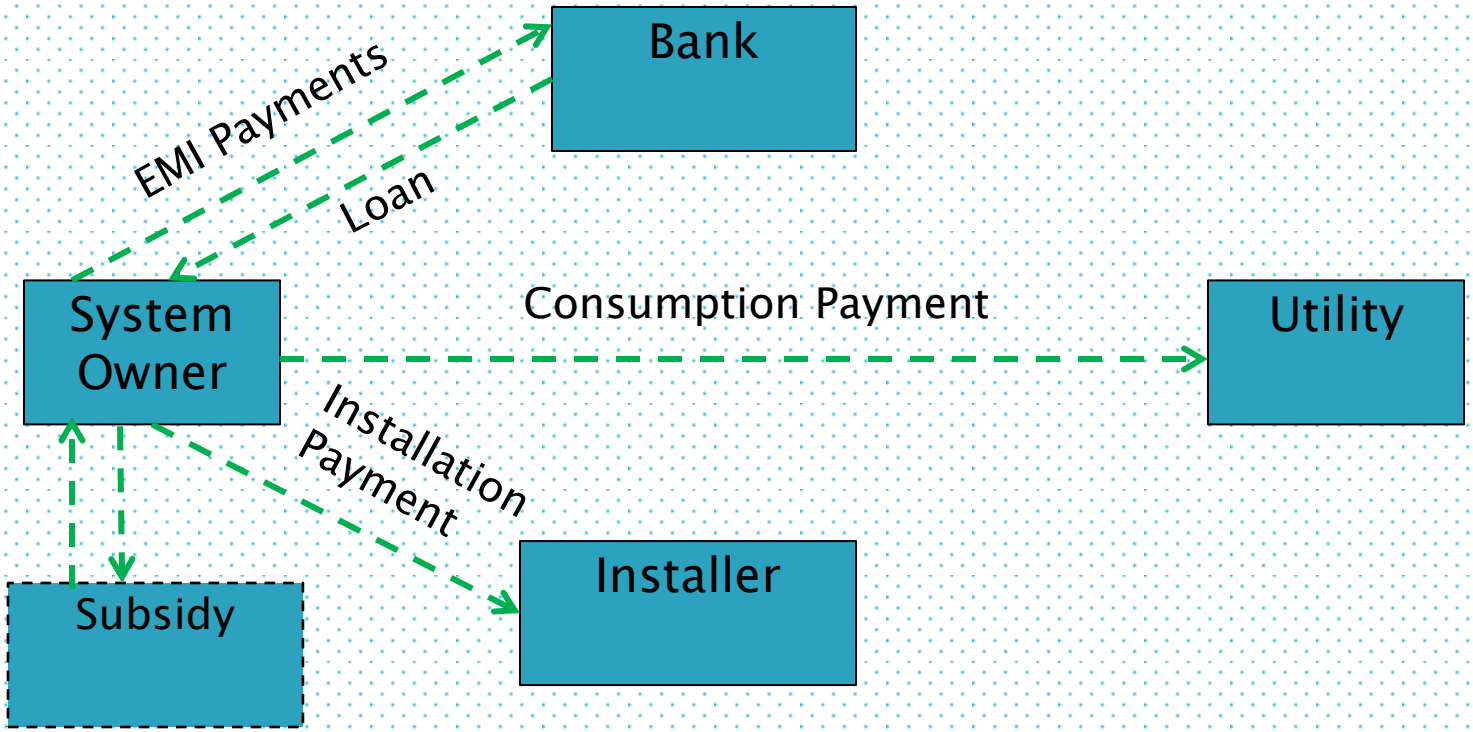
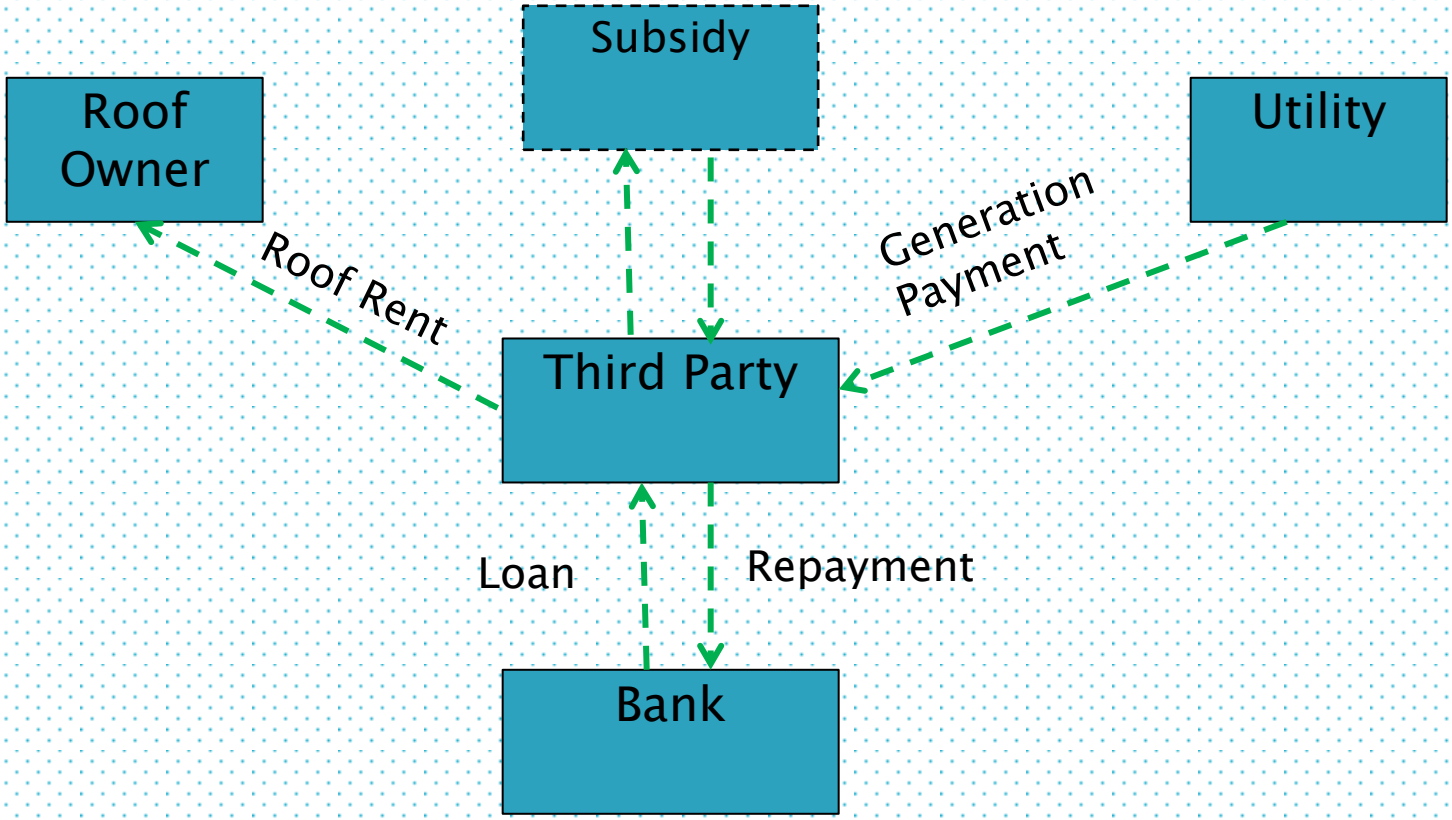
Business Model Gross Metering – Self Owned



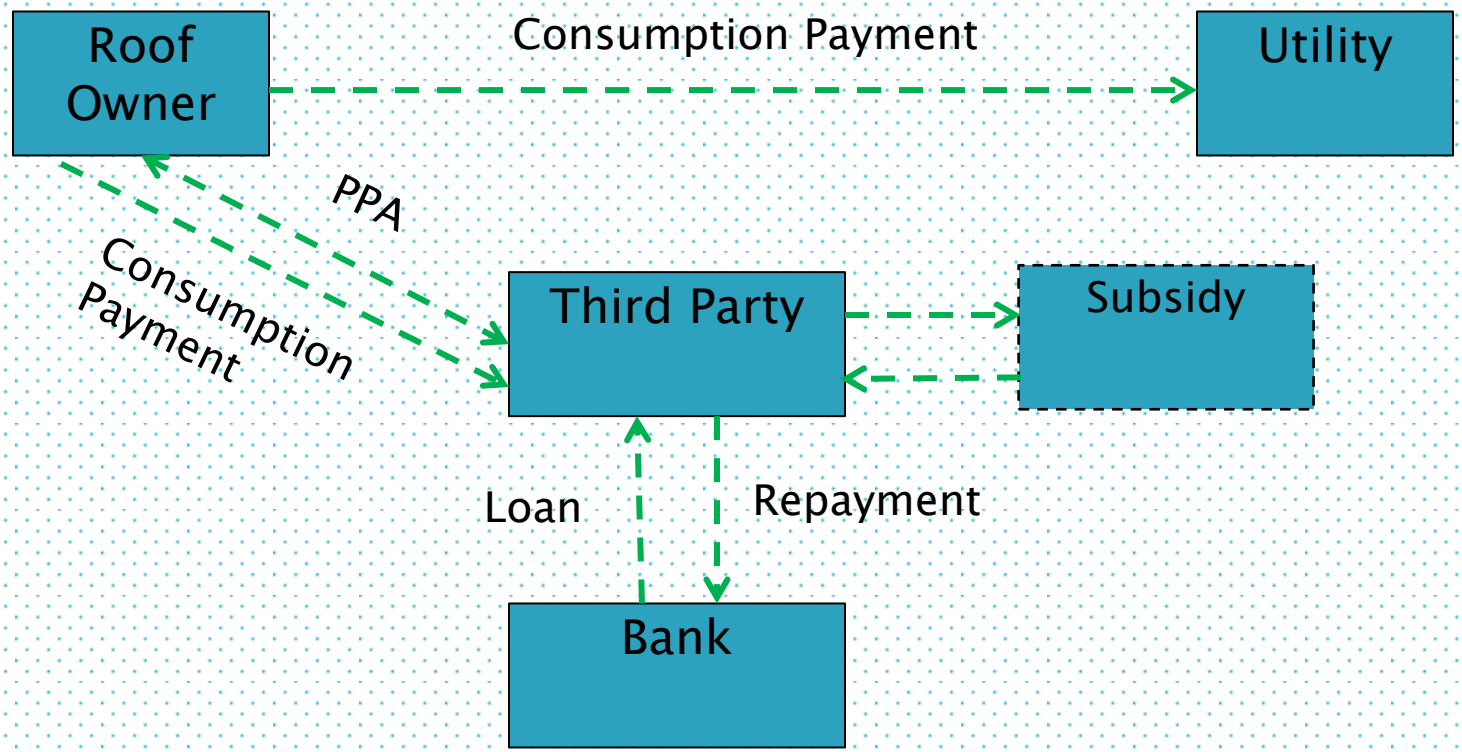
Business Models Net Metering – Self Owned



Business Models Gross Metering – Third Party Owned



Business Models Net Metering – Third Party Owned



Few Large rooftop installations

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Location of PV POWER STATION	COUNTRY	Capacity (MWp)
Radha Soami Satsang Beas, Amritsar	India	7.52 MW (Single Roof)
Constellation energy- Toys R Us Flanders, NJ	USA	5.38 MW
Boeing 787 assembly building South Carolina	USA	2.6 MW
Southern California Edison, Fontana, CA	USA	2.0 MW
Antwerp Belgium	Belgium	40 MW (In Campus)
Bay Resort DLR Group -Mandalay Convention Center, Las Vegas NV	USA	6.4 MW

Role of DISCOMs

- Simplification of process for inviting Applications
- Fast Track approvals for feasibility, connectivity and installation of meters
- Not to treat rooftop as their competitor but to come forward to become facilitators.
- DISCOMs to take lead in implementation of rooftop scheme
- Can set annual targets for themselves and work with MNRE and SECI

Role of DISCOMs
Contd….

- **DISCOMs to form a dedicated Cell / team for coordinating with various entities (both internal and external agencies).**
- As the number of plants increase, there may be requirement of frequent coordination with different entities, consumers etc.
- DISCOMs to earmark at least 10% of IPDS and Deendayal Uppadhayay Gram Jyoti Yojana (DDUGJY) scheme funds for rooftop
- Consumers awareness about benefits of installations of rooftop systems

Role of DISCOMs
Contd….

- Creating a consumer Helpline for resolving customer's queries related to grid connectivity
- A telephone helpline will be quite useful to the consumers, as they can call and resolve there queries readily
- Putting a list of permissible meters with costs and vendors on their website
- Putting a list of distribution transformer capacities along with permissible solar PV capacities on their website
- Updating the respective billing mechanisms

Actions desired from States/UTs

- **States to bring out policies which have not announced so far. (Bihar, Delhi, Gujarat, Jammu & Kashmir, Jharkhand, Madhya Pradesh, Maharashtra, Odisha, Arunachal Pradesh, Assam, Sikkim, Nagaland, Tripura, Mizoram, Meghalaya, Andaman & Nicobar, Chandigarh, Daman & Diu, Puducherry, Lakshadweep, Dadra & Nagar Haveli, Goa).**
- **Issue Governments orders to ask Urban Local Bodies to make solar rooftop mandatory in building bye-laws.**
- **Provide rebate on property tax.**
- **Ensure capacity building of concerned State Officials including DISCOMs.**
- **To simplify procedure for installation of solar rooftop systems preferably through single window clearance mechanism.**

Actions desired from States/UTs

- **Ensure publicity, marketing, capacity building and awareness for solar rooftop systems.**
- **Conduct survey for assessment of rooftop potential in the State, District wise.**
- **Interact with banks to ensure low cost financing for solar rooftop systems.**

Scheme for setting up 1000 MW of Grid-connected Solar PV Power Projects by CPSUs under various State Schemes with Viability Gap Funding

- This scheme is to motivate CPSUs to procure equipment from domestic manufacturers.
- Target Capacity: 1000 MW of solar PV power projects.
- Necessary Condition to avail VGF:
  - Solar PV Power Projects by Central Public Sector Undertakings (CPSUs) and Government of India Organizations under various Central/ State Schemes/ self-use/ 3rd party sale/ merchant sale.
  - Domestic Content Requirement:
    - ✓ VGF of Rs. 1 Cr/MW with Cells, Modules and Inverters of indigenous source;

      OR
    - ✓ VGF of Rs. 0.5 Cr/MW if only Modules and Inverters are of indigenous source.

Scheme for setting up 1000 MW of Grid-connected Solar PV Power Projects by CPSUs under various State Schemes with Viability Gap Funding

- PPA to be signed between the CPSU and the concerned State Discom.
- Duration of the Scheme: 2015-16 to 2017-18.
- Solar Energy Corporation of India (SECI) to manage VGF.
- VGF will be released in two tranches as follows:
  - 50% on successful commissioning of the plant;
  - Balance 50% after one year of successful operation of the Plant.

Funds Requirement

* **Total requirement of funds of Rs. 1000 Cr. will be as per the details given below:**

Year	Amount (Rs.Cr.)
2015-16	150
2016-17	300
2017-18	350
2018-19	200
Total	1000

Status- Capacity Allocated to CPSUs and GOI Organisations

S.No	Name of Organisation	Capacity Allotted (MW)
1	All Ministries/Department of GOI	83*
2	NTPC Ltd	250
3	Indian Railways	200
4	KVIC	10
5	NEEPCO	100
6	National Seeds Corpor.	25
7	BHEL Hyderabad& Trichi	4
8	SECI	80
	Total	752

*All Ministries/Departments have been allocated 1 MW Solar Power Project. Proposals from Ministry of Agriculture, Mines and Silk Board Mysore have been received.

Capacity Under Consideration

Sl.No	Name of Organisation	Capacity
1.	Visakhapatnam Port Trust, Visakhapatnam	15 MW
2.	Cochin Shipyard Ltd., Kochi	1060 KW
3.	HPCL, Bangalore	348 KW

Some Installations of Grid Connected Rooftop Systems in India

Business Models for installations by Ministries/Departments

- **MNREs incentive – 15%**

- Model 1: Self financing of balance cost
- Model 2: Installation through RESCO Mode
- Model 3: Installation through leasing model
- Model 4: Installation through concessional loans
- Model 5: Self financing of complete cost without MNRE incentive

Module	India Make
Aggregate Plant Capacity	404 kWp
Rooftop Owner	Manipal University
City	Jaipur
State	Rajasthan
Project Cost	Rs. 2.86 Cr
CFA through SECI	Rs. 86 Lakh

Module	India Make
Plant Capacity	115 kWp/85 kWp
Rooftop Owner	DMRC
Project Site	Anand Vihar/Pragati Maidan
City	Delhi

Module	India Make
Plant Capacity	130 kWp
Rooftop Owner	ISBT Kashmere Gate
City	Delhi
State	Delhi
Project Cost	Rs. 114.3 Lakhs
CFA through SECI	Rs. 30.3 Lakhs

Module	India Make
Plant Capacity	360 kWp
Rooftop Owner	Super Auto Forge Pvt., Ltd.,
City	Chennai
State	Tamilnadu
Project Cost	Rs. 3.06 Cr
CFA through SECI	Rs. 92 lacs

Module	India Make
Plant Capacity	100 kWp
Rooftop Owner	Rockwell Industries
City	Hyderabad
State	Andhra Pradesh
Project Cost	Rs. 0.74 Cr
CFA through SECI	Rs. 22.2 lacs

Module	India Make
Plant Capacity	300 kWp
Rooftop Owner	IIT Madras
City	Chennai
State	Tamilnadu
Project Cost	Rs. 2.49 Cr
CFA through SECI	Rs. 75 lacs

Module	India Make
Plant Capacity	500 kWp
Rooftop Owner	Medanta Hospital
City	Gurgaon
State	Haryana
Project Cost	Rs. 4.15 Cr
CFA through SECI	Rs. 1.24 Cr

Module	India Make
Plant Capacity	100 kWp
Rooftop Owner	NIAS
City	Bengaluru
State	Karnataka
Project Cost	Rs. 83 lacs
CFA through SECI	Rs. 25 lacs

Government House, Sector – 7, Chandigarh

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1.0 MW Rooftop plant at Punjab Engineering College, Chandigarh

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Government Hospital, Sector – 16, Chandigarh

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495 kW Rooftop plant at Govt. College for Girls, Sector – 11, Chandigarh

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Largest rooftop plant in the world on single roof*

- 7.52MW plant installed by Larsen & Toubro construction in Punjab
- L&T installed more than 30,000 PV panels on the rooftop
- Power from the plant being fed to the local grid through a PPA signed with the state distribution company
- * Claims L&T

IGP Office, Sector – 9, Chandigarh

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Thank You