FORUM OF REGULATORS

Evolving Model Guidelines on Energy Accounting, Commercial/Tariff Arrangement for Proliferation of Rooftop Solar PV Projects

August 2013

IFC International Finance Corporation World Bank Group

With support provided by NTFPSI NORWEGIAN TRUST FUND FOR PRIVATE SECTOR AND INFRASTRUCTURE

Deloitte.

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- Model Guidelines for Net-metering based solar rooftop project
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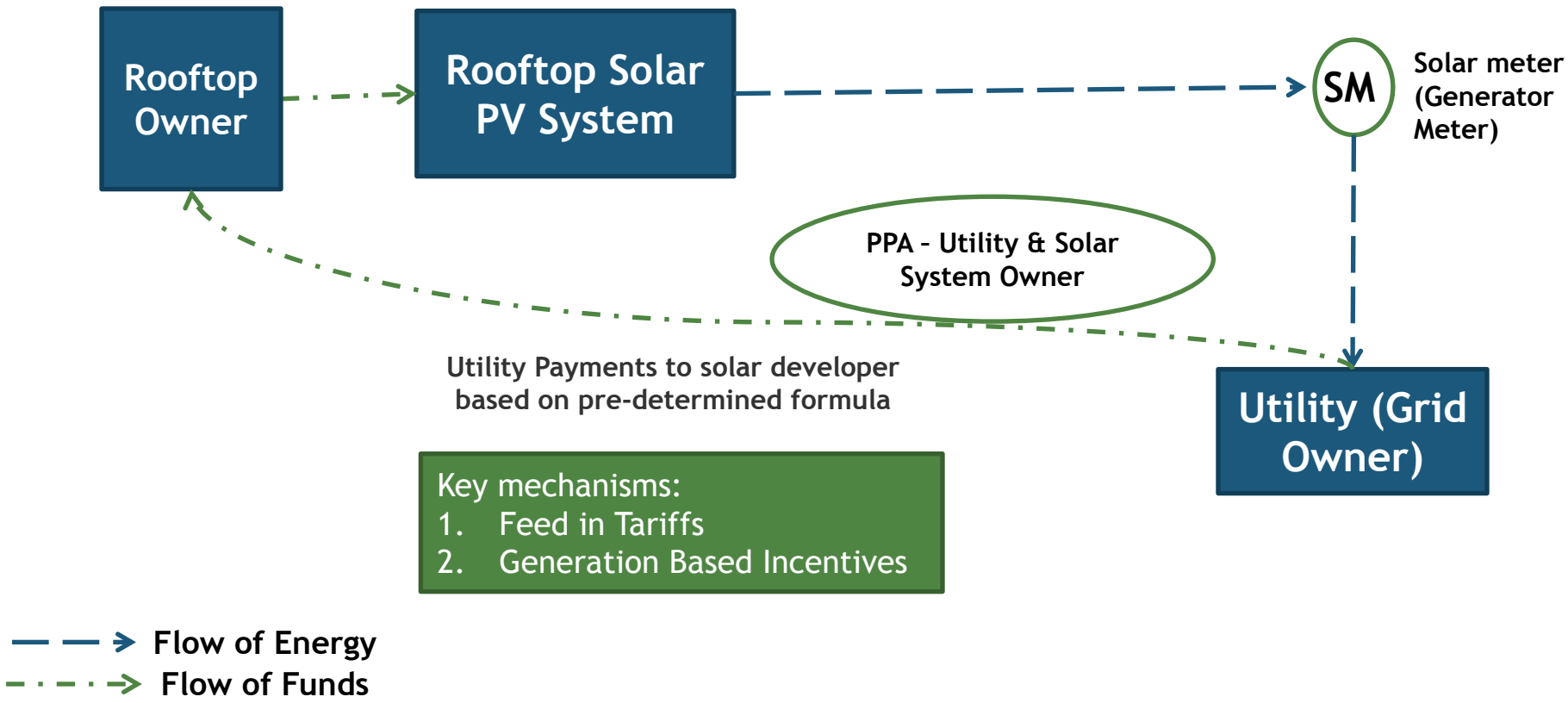
- Metering configurations

Business Models

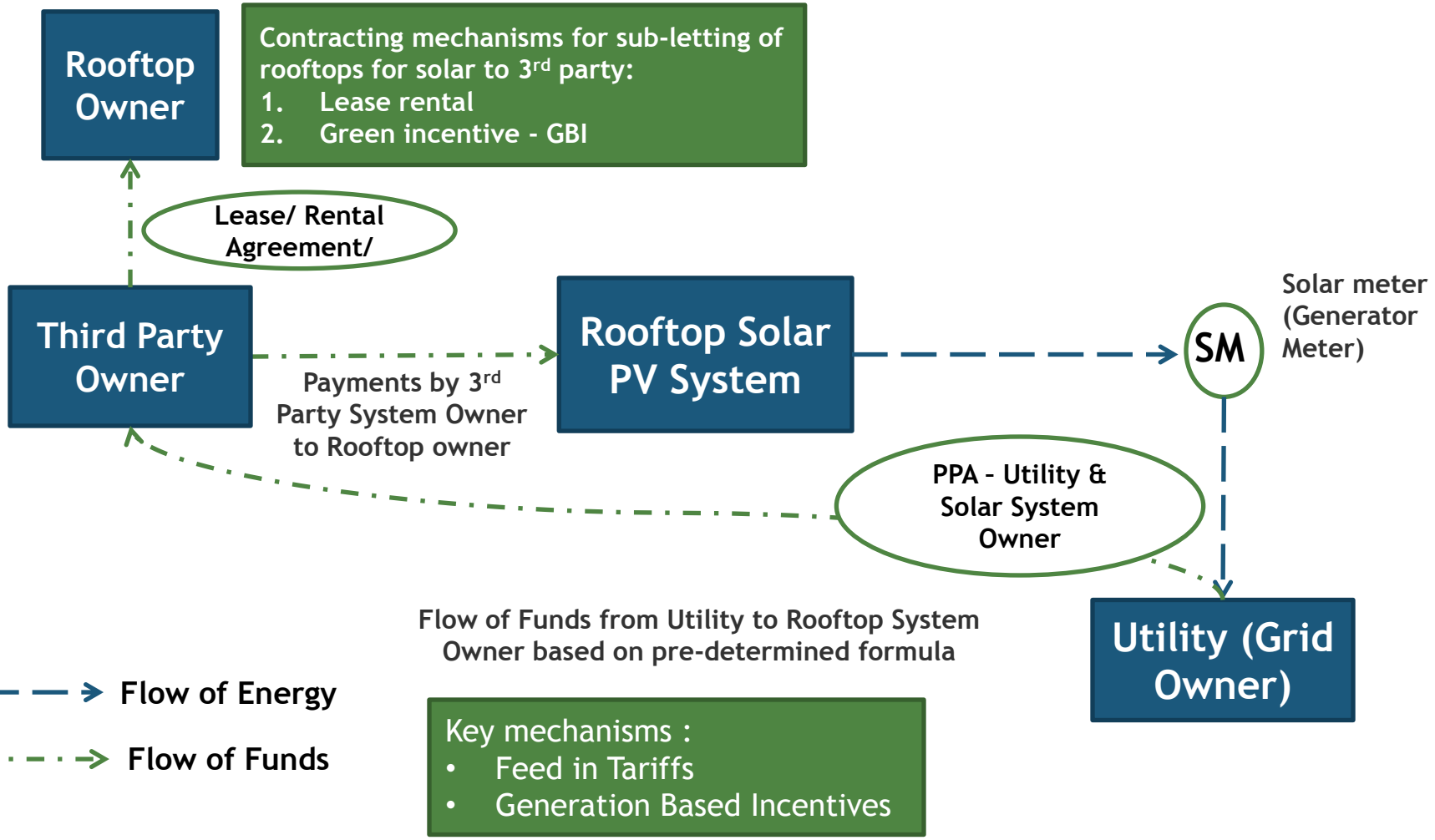
Comparison – Gross metering & Net-metering for rooftop solar

Parameter	Gross Metering	Net-metering
Objective	• Electricity sale to utility	• Self-consumption of electricity
Tariff Arrangement	• PPA with the utility – utility to pay as per PPA price (FIT)	• No payment by utility for electricity injected into the grid, beyond a limit
Financial burden	• Cost borne by utility & then passed through to the consumer	• Usually Govt. bears burden for any incentive/subsidy to bridge viability gap
Energy Accounting	• Metering arrangement to measure generation only	• Metering arrangement to measure generation as well as respective consumption
Beneficiary	• Assist utility in meeting Solar RPO compliance	• Assist consumer directly to reduce its electricity billing
Project Selection	• Tariff based competitive bidding	• First-cum-first basis (to start with)
Utility's Concern	• Not keen on signing PPA with small rooftop projects – higher FiT & administrative burden.	• Loss of revenue for utility – reduced grid consumption by consumers
Developer's Concern	• Grid unavailability to impact revenue	• Low level of incentives may impact viability of project for certain consumer segments

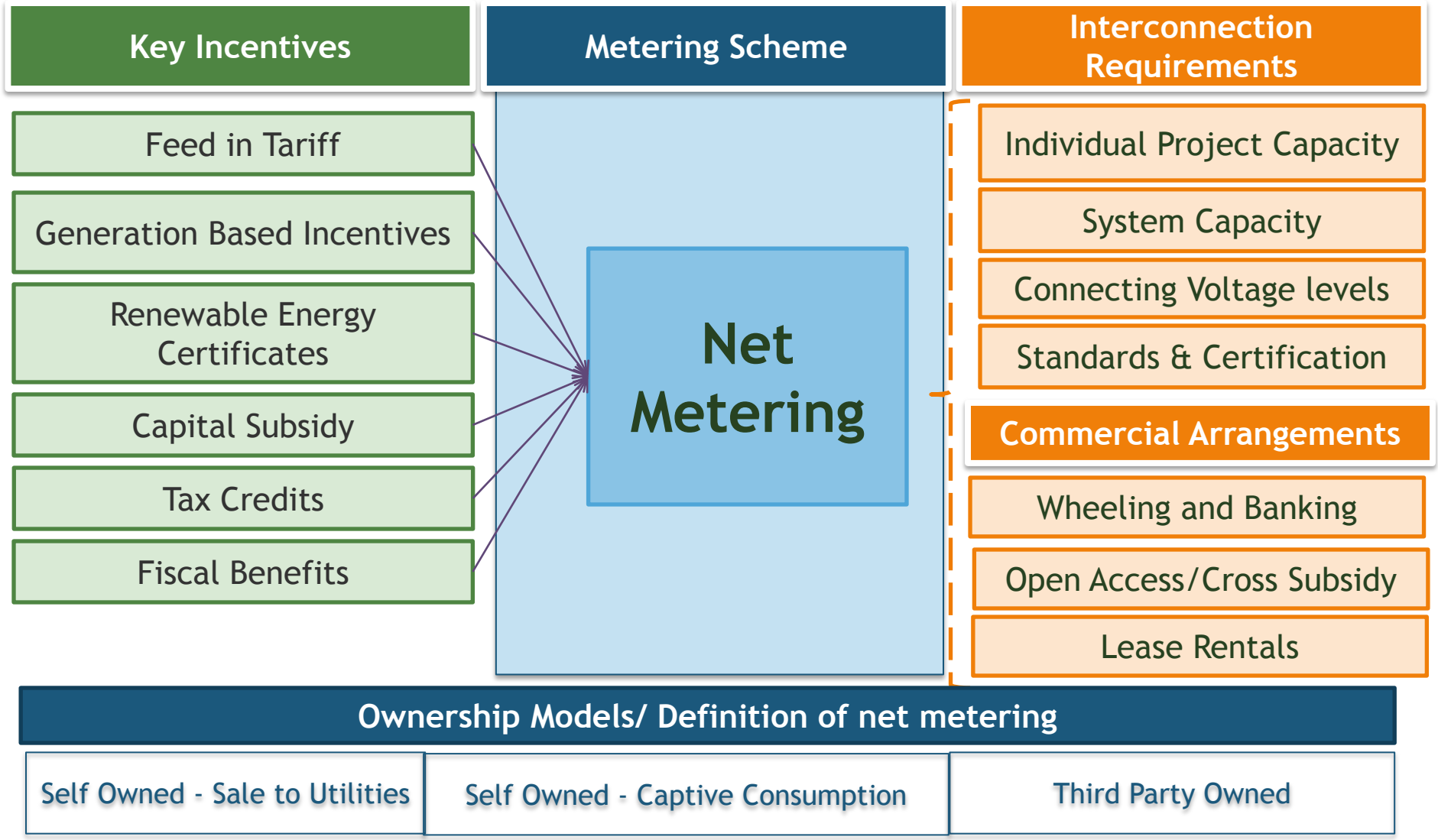
Gross Metering - Self Owned



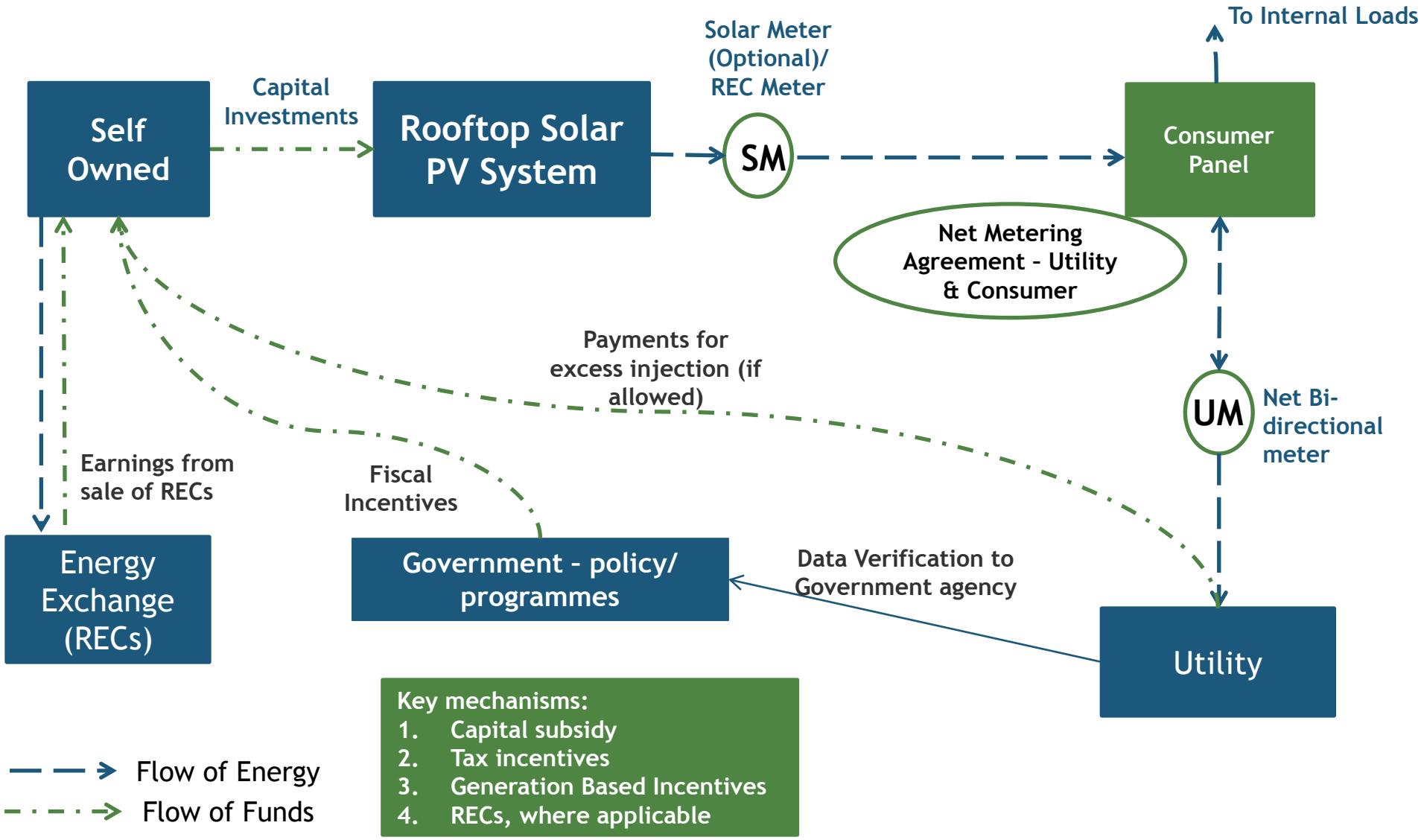
Gross Metering – Third Party Owned



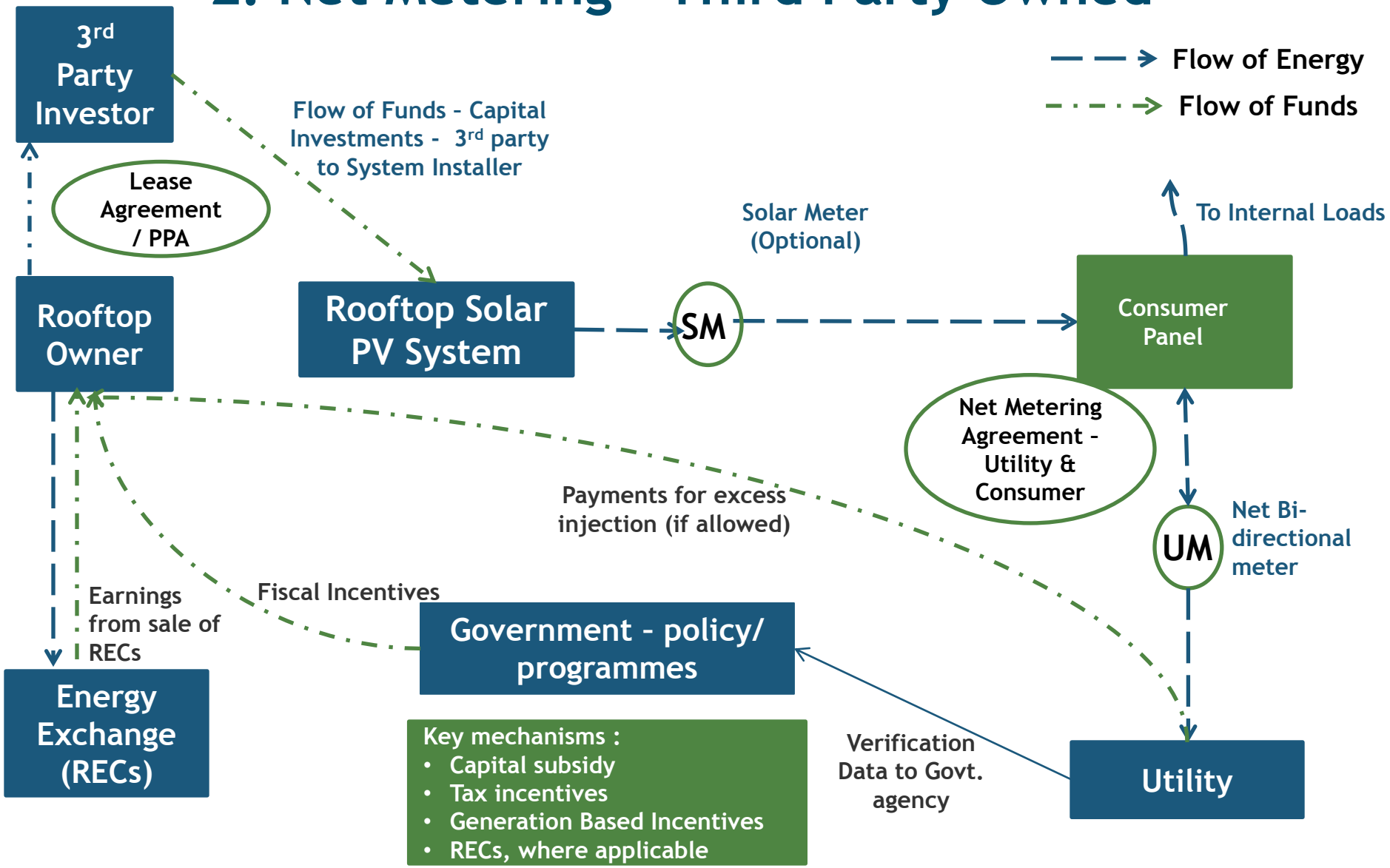
Key Parameters - Net-metering for rooftop solar



1. Net Metering - Self Owned



2. Net Metering - Third Party Owned



Model Guidelines for Net-metering based Solar rooftop project

Key Discussion Points and Recommendations

Key Discussion Points

- **Energy Accounting and Commercial arrangements**
- Definition of eligible net metered consumer – Should net-metered consumer definition allow for both self-owned and/or third party owned facilities to qualify for net-metering?
- Defining the electricity generation limits & energy accounting options – how to account for the excess generation from the net metered solar projects and what could be the possible energy accounting options for the same?
- Time of Day (TOD) Settlement – How to align the energy settlement under net metering with the existing framework under TOD regime?

- **Interconnection arrangements**
- Interconnection Voltage – What are the maximum permissible generation system sizes in MW permitted for interconnection at different voltage levels of the distribution network?
- Defining the permitting capacity limits for Individual Projects – Whether to define an individual project capacity limit at consumer level?
- Level of overall/local grid penetration – What could be the maximum capacity eligible for net-metering in a particular state/ distribution area? Should there be a limit on additions based on the level of connection voltage, type of feeder, etc?

Key Discussion Points

- **Regulatory Instruments**
- Whether the solar energy generated by net metered consumers who are not defined as obligated entities, be considered for meeting the RPO targets for the utilities?
- Are there any issues in the issuance of RECs to the net-metering consumers? Is there a requirement to change the REC framework in case the net metered projects are to become REC compliant?

- **Metering schemes**
- What type of metering arrangement would be best suited for the net metered project?
- What would be the role of utility for net metering based systems?
- Is the concept of meter aggregation possible under existing regulations in India?

1. Eligible Consumer Definition

Discussion Points

- Permit third party ownership
  - waiving open-access or supply (without license) implications
- Qualification for open access (eligibility requirements)
  - Not allowed below 1 MW by SERCs
  - these consumers are liable to pay wheeling charges, cross-subsidy surcharge and additional surcharge (if applicable)

Proposed Action: Model Net-metering Guidelines

1. 'eligible consumer' means a consumer of electricity in the area of supply of the distribution licensee, who uses a rooftop solar system installed in the consumer premises, to offset part or all of the consumer's own electrical requirements, given that such systems can be self-owned or third party owned;
2. Exemption from banking, wheeling & applicable cross-subsidy charges for such consumers

Net metering regulations shall apply to all the existing consumers of distribution utilities viz. residential, commercial, industrial and agriculture

2. Defining permitting capacity limits & connection voltage for individual project capacities

Discussion Points

- Address boundary conditions/ constraints presented by service line capacities
- Standard connection voltage ranges may require changes to Distribution Codes – easier to address by linking to respective state distribution codes
- Who bears the cost of infrastructure up-grade, if required, at distribution level and who should bear the cost of such upgrade?

Proposed Action

Model Net-metering Guideline

1. Define Individual project capacities to be allowed : shall be linked to connected consumer load (kW) and connection voltage levels (Single/Three Phase) - ***aligned to respective State's Electricity Supply Code as applicable for loads.***
2. Define maximum capacity size for each rooftop project - **proposed to be capped at *1 MW for single metering point*** to qualify under net-metering

Covered under State Regulation/ Codes

- Consumer load revision guidelines: Developer to bear costs of service line upgrade if higher than existing service line capacity is sought to be evacuated.

3. Permitting limits on individual projects' generation & Tariff settlement

Discussion Points

- Should excess injection into the grid be recognized for commercial settlement as sale of electricity to utility – if so what should be the settlement mechanism and price ? – retail tariff, APPC, avoided cost?
  - Increases the complexity of energy accounting, contracting arrangements & pricing
- Whether to have cap on PLF - Impact on the overall quantum of subsidy/ incentives – impact on Government
- Settlement period to be defined

Proposed Action : Model Net-metering Guideline

1. Proposed limit for commercial settlement of electricity : ***Generation as 90% of the total consumption in a financial year***
2. ***Any excess injection (above 90%)*** at the end of financial year to be considered ***as free energy***
3. No carry forward of energy allowed to next financial year

The net metering credit is proposed to be settled at the full retail tariff which is set by the respective state's regulatory commissions on periodic basis. There will not be any payment by the utility at the end of settlement period

4. Level of grid penetration (i)

Discussion Points

- *Overall Cap:* Driven by consideration of Utility's loss of revenue; overall variability of generation & grid stability; cost of up-gradation

Local level cap

- Distribution system configuration not geared for reverse flow of power – can impact transformer performance, phase balance
- Diversity of consumers at feeder DTR level can assist in accommodating generation up to a limit without reversal in the network
- HVDS may require separate considerations as diversity is low (e.g., can be excluded in Phase 1 until effect of reversal of power flows are examined on HVDS transformers)

Proposed Action - Model Net-metering Guideline

1. Define Overall Cap: SERC to decide in capacity terms or % of demand of the Discom
2. Define local Level Cap : Define limits for connecting solar rooftop projects - Linked to the Distribution Transformer (DTR) capacity ~ 15% of the peak capacity in Phase 1
3. Discoms to update DTR level capacity available regularly – display on website

4. Level of grid penetration (ii)

Other Initiatives required

Phase 2

- CEA to define limits based on study

Phase 3

- In the long term, the distribution utilities may be directed to undertake appropriate network architecture / infrastructure upgrades : Ring / meshed architecture, auto-tap changing transformers, etc.

In the initial phase of implementation, no specific targets for up gradation of DTs is proposed. The overall limit of 15% of feeder capacity for connecting DG will ensure no bi-directional flows. In the subsequent phases, these issues shall be addressed once the distribution utilities develop the requisite capabilities

5. Solar Renewable Purchase Obligation (RPO) (i)

Discussion Points

- Solar RPO targets fixed by State Regulators
- Definition of obligated entities

Types of Captive Consumers

Category 1

- Defined as Obligated Entity under State RPO Regulation – generally for captive capacity of 1 MW and above (e.g. industrial consumers)
- May like to claim Solar RPO through self-consumption from net-metered based rooftop solar project

Category 2

- Not defined as Obligated Entity under State RPO Regulation – generally for captive capacity less than 1 MW and other consumers
- This form of captive consumption not covered under RPO framework currently
- ***Discoms can be given benefit of deemed RPO under this category***
  - This will encourage Utilities to facilitate implementation of small capacity net-metering based rooftop solar

Solar Renewable Purchase Obligation (RPO) (ii)

Discussion Points

- If Deemed RPO allowed for net-metering systems, such consumers (generator) cannot get benefit of RECs
  - will result in double accounting of same electricity
- In case excess injection is allowed for commercial settlement, issues will revolve around :
  - Need to demarcate capacity under net-metering and sale to utility - Utility may sign PPA for a defined capacity to have clarity to meet Solar RPO target
    - Segregating capacity for sale to utility will be gross metering rather than any form of net-metering
  - No defined RPO target for rooftop solar separately – may not be a preferred option for utilities over ground mounted solar

Proposed Action : Model Net-metering Guideline

1. **Allow Deemed RPO for utilities** against the electricity consumption from net-metering based solar rooftop - **only against self-consumption by consumers not defined as obligated entities**

6. Renewable Energy Certificate (REC)

Discussion Points

- Small projects not under REC framework - not having adequate energy accounting systems in place
- Net-metering projects would be more of captive consumption – will need banking exemption and hence will not qualify under current REC regulation eligibility criteria

Proposed Action

REC Regulation

1. Allow small capacity size projects to participate under REC mechanism
2. No changes in REC eligibility Condition
   - Only eligible projects can claim REC benefit
   - Given the fact that net-metered based projects need to be necessarily exempted from banking & wheeling/open access charges – ***such projects may not qualify for REC benefit***

7. Time Of Day(TOD) settlement

Discussion Points

- Commercial settlement across periods for the banked energy & energy accounting
  - Whether the excess energy generated by the solar installation and exported to the grid during a particular time period can be used to net energy imported in other time period in TOD regime?
- Availability of TOD meters across consumer categories: TOD metering done in most States for HT/ commercial consumer levels - LT level consumers not covered under TOD metering in general

Proposed Action: Model Net-metering Guideline

- Commercial settlement to be mapped as per the State Regulation on TOD periods : peak to peak, off-peak to off-peak, etc.
- Consumer to pay the differential tariff across periods at the lowest applicable tariff (if applicable)
  - Will safeguard commercial interest of utility & in line with existing regulatory framework

8. Metering requirements (i)

Discussion Points

- Process of meter reading for generation & consumption
  - Whether Joint meter reading is required for Net metered systems?
  - Whether utility will recognize all the meters (in case of 2/3 meter systems) for commercial settlement
- Minimum features required for net metering?
  - Metering standards; Requirement for Backup stand by, check meters
  - Bi-directional meters for LT Level are currently not available in India
- Do all meters need to be at utility voltage level? Case of solar generation and consumption at auxiliary voltage

Proposed Action:

Model Net-metering Guideline

1. Cost of meter to be borne by the consumer or as per the provisions of the state supply code which lays down the meter installation & recovery mechanism
2. Meter reading to be taken by utility only & accepted for commercial settlement

8. Metering requirements (ii)

Proposed Action :

Modifications in Supply Code

- Position & sealing of Solar Meter will be guided by the same provisions as applicable to consumer meter in Supply Code.
- Acceptance of net-meters for commercial settlement
- Net-meter should be downloadable (i.e. Meter Reading instrument (MRI) compliant or wireless equipment for recording meter readings)
  - If bills are prepared on the basis of MRI downloads or if meter reading is taken on the basis of remote meter-reading and the consumer wishes to have a record of the reading taken, he shall be allowed so by the licensee.
- Installation of bi-directional meters at LT level
- Main Solar Meters shall be of 0.2s class accuracy and with facility for recording meter readings using Meter Reading Instrument (MRI).
- Net meters specifications as per CEA's Regulations (proposed as Class 1.0 or better)
- Solar Check meters shall be mandatory for rooftop solar installations having capacity more than 20 kW.
  - For installations size of less than and equal to 20 kW, the solar Check meters would be optional.

9. Meter Aggregation

Discussion Points

- Aggregation of meters for net metering, also known as “group metering.” - for group housing societies
  - Meter aggregation under net-metering may amount to supply of electricity by the aggregator across consumers
- Definition of project having multiple metering points - Whether it qualifies under group captive?
- Need to define the metering point for commercial settlement with utility

Proposed Action:

Model Net-metering Guideline

1. No specific provision required - Meter aggregation allowed if eligible as per the definition of net-metering

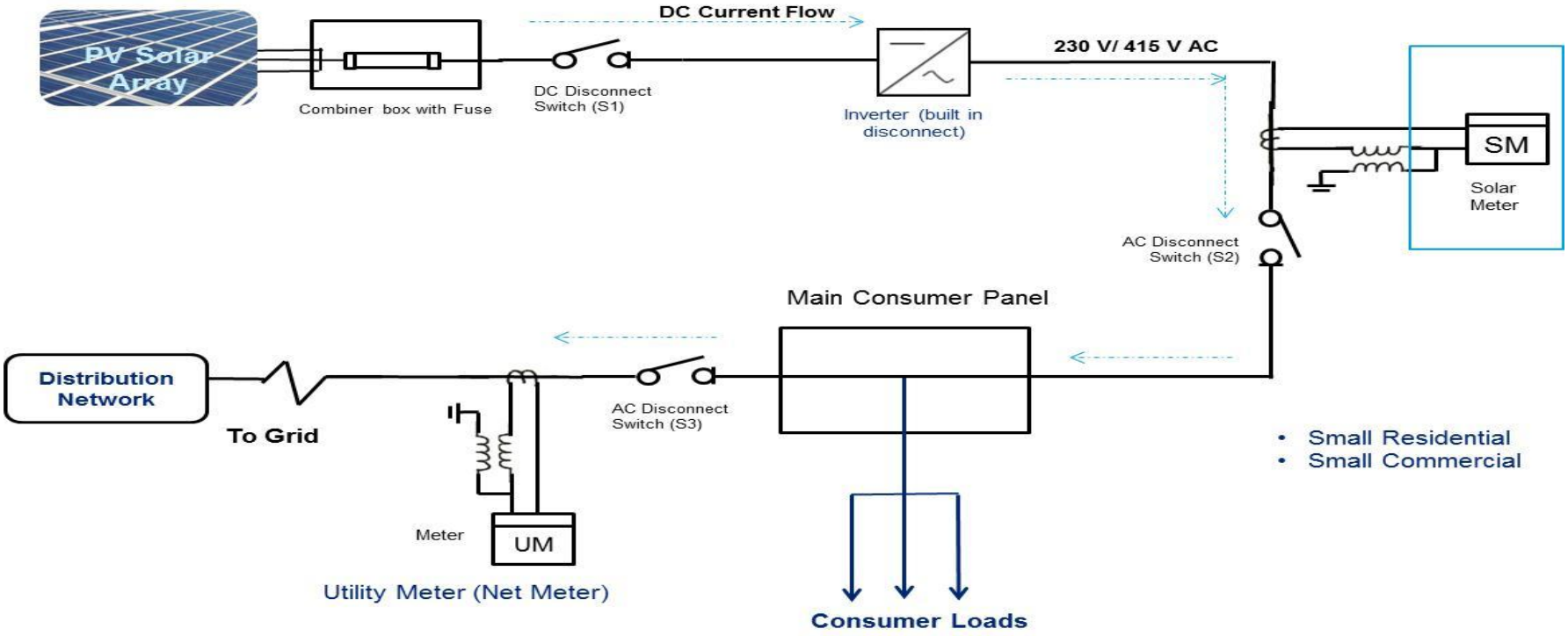
Metering Configuration

Proposed Metering Arrangement - Net-metering

- 2 Meter Configuration
  - without Storage
  - with Storage

Net metering w/o storage backup:

2 Meter Configuration : 230 V Single Phase/ 415 V 3 Phase Connection

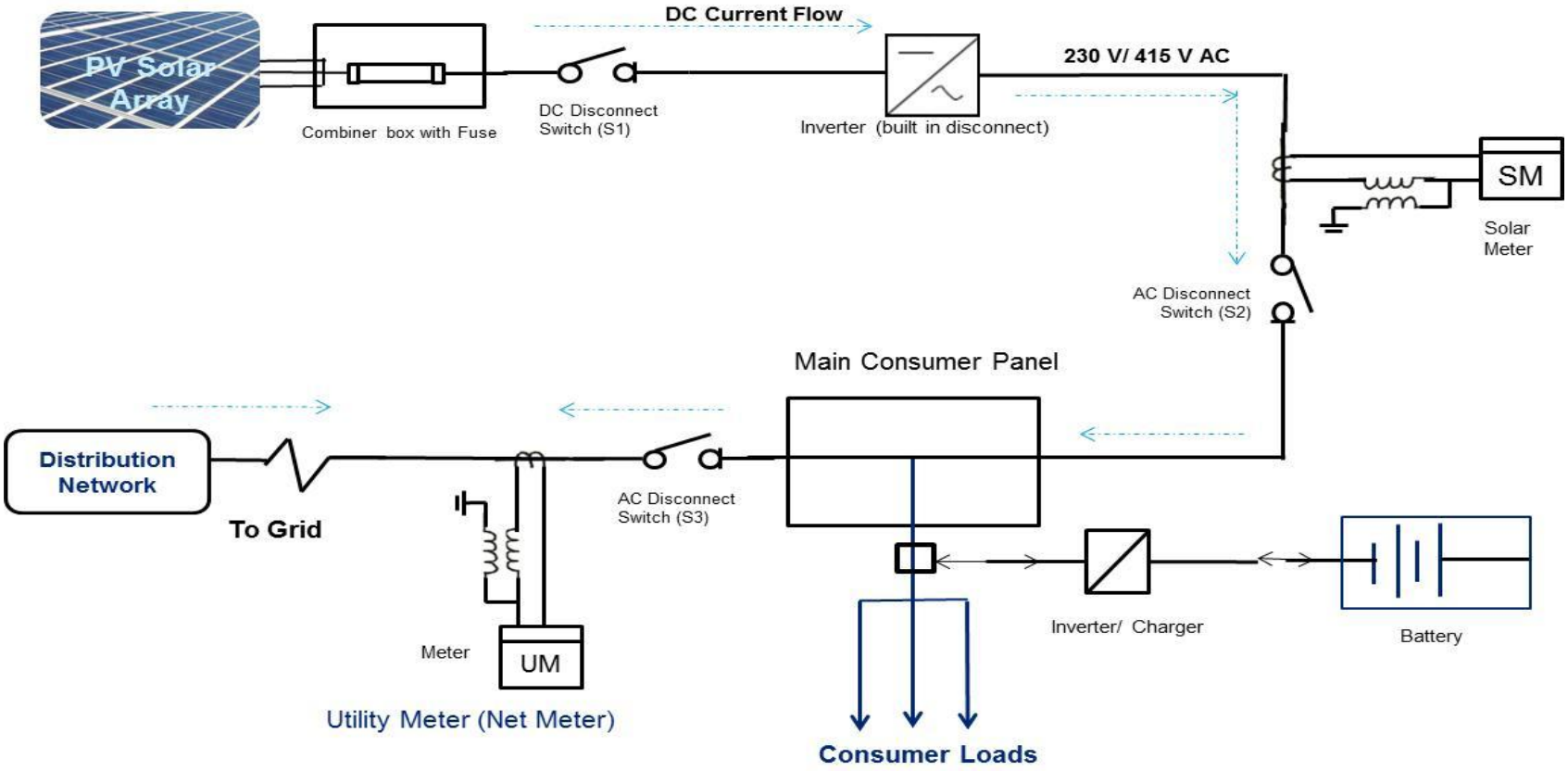


Key observations

- Two meter configuration is most optimal configuration – allows discrete & separate measurement of both solar and utility power
- The presence of the solar meter allows use of generation based incentives like REC/ GBI etc.
- Key issues – 1) Acceptability of solar meter as a commercial meter; 2) placement of the solar meter – should it be next to the main utility meter or next to the solar inverter; 3) need for a solar check meter; 4) Need for an easily accessible external AC disconnect switch

Net metering with storage backup

2 Meter Configuration : 230 V Single Phase/ 415 V Three Phase Connection



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Definition of Net Metering using third party - International Experience

- California addressed third party ownership via a legislative decision – the exempted energy corporations using non-conventional energy sources (meaning all renewables) to supply a maximum of two consumers located on the same property
- Colorado addressed the issue of allowing third party owned systems by allowing non-conventional systems sited on consumer premises which did not generate more than 120% of the annual consumption of the consumers annual demand
- Oregon exempted the power from solar and wind energy systems from being designated as licensees.

Solar rooftop implementation business models

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

National Experience (Not specifically for net metering)

Gujarat

- GERC Solar Tariff order 2012 specifies the level of connection with capacity
  - upto 6 kW (Single Phase)
  - above 6 to 100 kW (415 V)
  - above 100 kW to 1 MW (11 kV)

West Bengal

- WBERC 2010 Order
  - Net-metering arrangement in Roof-top Solar PV sources of capacity ranging from 2 KW (peak) to 100 KW (peak)
  - Eligible consumers : Government hospitals, health centers, Government aided schools, Government offices, local bodies, etc

Tamil Nadu

- Tamil Nadu Solar Policy 2012 specifies

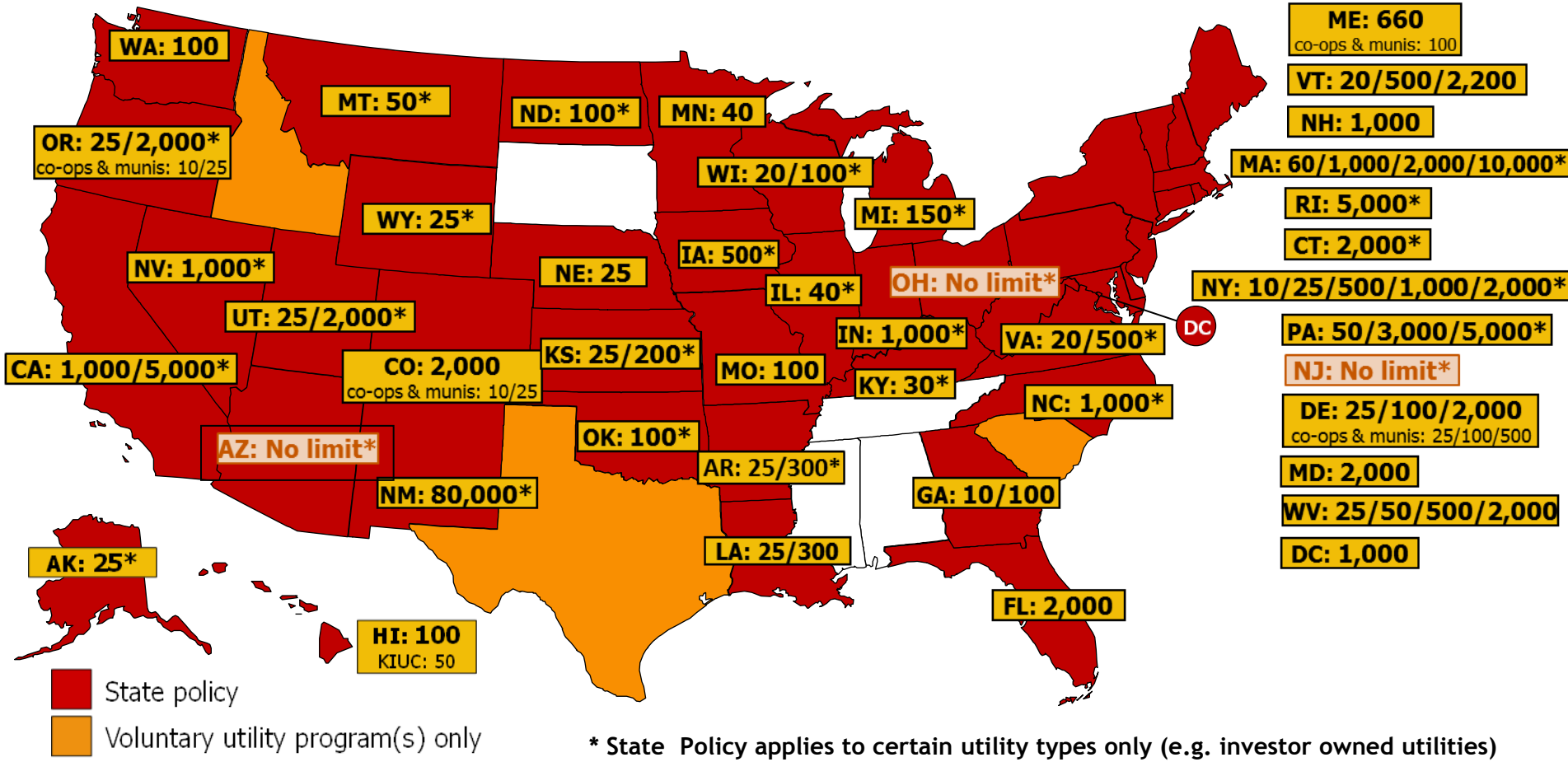
Capacity	Evacuation
< 10kWp	240V
10 kWp to <15 kWp	240V/415V
15kWp to <50 kWp	415V
50kWp to <100 kWp	415V
> 100 kWp	11 kV

Kerala

- KSERC Discussion Paper 2012 proposes following capacities for rooftop projects

Capacity	Evacuation	Scale
Upto 5 kW	1- phase, 230 V	Kilowatt Scale
5 kW - 100 kW	3- phase, 415 V	Kilowatt Scale
100 kW - 1 MW	3 - phase, 11 kV	Kilowatt Scale

International Experience: Net Metering with individual system capacity limits adopted by most US states



*** State Policy applies to certain utility types only (e.g. investor owned utilities)**

- **Numbers indicate individual system capacity limit in kilowatts (kW)**
- Some limits vary by customer type, technology, application. Other limits might also apply.

Source: www.dsireusa.org / February 2013

Limit on project level electricity generation

International

Net-metering

- New Jersey: Energy production should be limited to customer's annual on-site energy consumption
- Colorado - allows net metering for systems sized up to 120% of the customers average annual consumption
- Virginia, USA : Excess energy production allowed - Credit to be carried forward to subsequent net metering period can not exceed amount of energy purchased during the previous annual period
- Italy – Excess energy injection allowed – but no commercial settlement & only energy settlement in next period
- France - Excess energy injection allowed – commercial settlement allowed for a defined limit

National

Gross metering:

- Upper cap on maximum electricity (in terms of PLF) that can be sold to utility ensures higher limits for electricity injection –JNNSM, Gujarat experience

Net-metering:

- WBERC 2010 Order:
  - Electricity injected shall not be more than 90% of the consumption from the licensee's supply within a financial year

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.
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

Defining Local & Aggregate Capacity

State	Capacity cap
Hawaii, USA	15% per circuit distribution threshold for distributed generation penetration (Local level)
California, USA	5% of aggregate customer peak demand
New Jersey, USA	BPU – Regulator is permitted to allow utilities to cease offering net metering if statewide enrolled capacity exceeds 2.5% of peak electric demand
Michigan, USA	0.75% of utility's peak load during previous year
Connecticut, USA	No limit specified

REC Ownership - United States

- Installations as low as 1 kW have also been allowed to trade RECs using normative energy generation - Examples such as Hawaii, New Jersey allow REC trading

State	REC Ownership
Arizona	Customer
California	Customer but not for credited excess generation
Connecticut	Customer
Hawaii	Not addressed
Michigan	Customer
New Jersey	Customer
Virginia	Customer – PPA with utility for net excess generation with one time option to sell RECs to the utility

Different time slabs for ToD in different states

State	Type	Hours
Bihar	Normal	05:00-17:00 Hrs
	Evening Peak	17:00-23.00 Hrs
	Off Peak	23:00-05:00 Hrs
Chhattisgarh	Normal	05:00-18:00 Hrs
	Evening Peak	18:00-23.00 Hrs
	Off Peak	23:00-05:00 Hrs
Maharashtra	Off Peak	22.00-06.00 Hrs
	Normal	06.00-09.00 Hrs
	Morning Peak	09.00-12.00 Hrs
	Normal	12.00-18.00 Hrs
	Evening Peak	18.00-22.00 Hrs
Gujarat	Morning Peak	07.00-11.00 Hrs
	Evening Peak	18.00-22.00 Hrs
Uttar Pradesh	Off peak	22.00-06.00 Hrs
	Normal	06.00-17.00 Hrs
	Peak	17.00-22.00 Hrs

TOD arrangement - International Experience

New Jersey (USA)	• Commercial settlement based on TOD meter mapped with the period of use (peak/off-peak)
	• Meter contains register group to account the period of consumption & injection into the grid
	  • Register ID 05 = kWh Delivered to Customer - On Peak
	  • Register ID 07 = kWh Delivered to Customer - Off Peak
	  • Register ID 45 = kWh Received from Customer - On Peak
	  • Register ID 47 = kWh Received from Customer - Off Peak

California	• Consumers with TOU – billing based on period of use/injection (peak/off-peak) • charges and credits are computed for each TOU period

International Experience - Meter Aggregation

State	Meter Aggregation
Arizona	Not Addressed
Arizona SRP	Not Allowed
California	Virtual net metering allowed for multi-tenant properties
Connecticut	Yes (virtual net metering allowed for municipal customers)
Hawaii	Not addressed
Michigan	Not addressed
New Jersey	Permitted for public entity PV systems (implementing rules not yet in place)