



## Experiences on structuring grid interactive Rooftopsolar (RTS) PPP Projects

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**Indian Railways Conference on green initiatives  
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# World Bank Group

	<b>IBRD</b> International Bank for Reconstruction and Development Est. 1945	<b>IDA</b> International Development Association Est. 1960	<b>IFC</b> International Finance Corporation Est. 1956	<b>MIGA</b> Multilateral Investment and Guarantee Agency Est. 1988
<b>Role:</b>	To promote institutional, legal and regulatory reform	To promote institutional, legal and regulatory reform	To promote private sector development	To reduce political investment risk
<b>Clients:</b>	Governments of member countries with per capita income between \$1,025 and \$6,055	Governments of poorest countries with per capita income of less than \$1,025	Private companies in 184 member countries	Foreign investors in member countries
<b>Products:</b>	Technical assistance Loans Policy Advice	Technical assistance Interest Free Loans Policy Advice	Equity/Quasi-Equity Long-term Loans Risk Management Advisory Services	Political Risk Insurance

*Shared Mission: To Promote Economic Development and Reduce Poverty*

# IFC Value Addition

## Long-term Competitive Financing

- ✓ Equity
- ✓ Fixed/Floating Rates on Loan, Local Currencies
- ✓ Up to 15 year Loan Maturity
- ✓ Flexible Amortization Profile
- ✓ Catalyst for other Investors and Lenders
- ✓ Equity Participation
- ✓ Capital Mobilization

## Regional Knowledge

- ✓ Extensive Local Office Network
- ✓ Local Transaction Experience
- ✓ World Bank Synergies

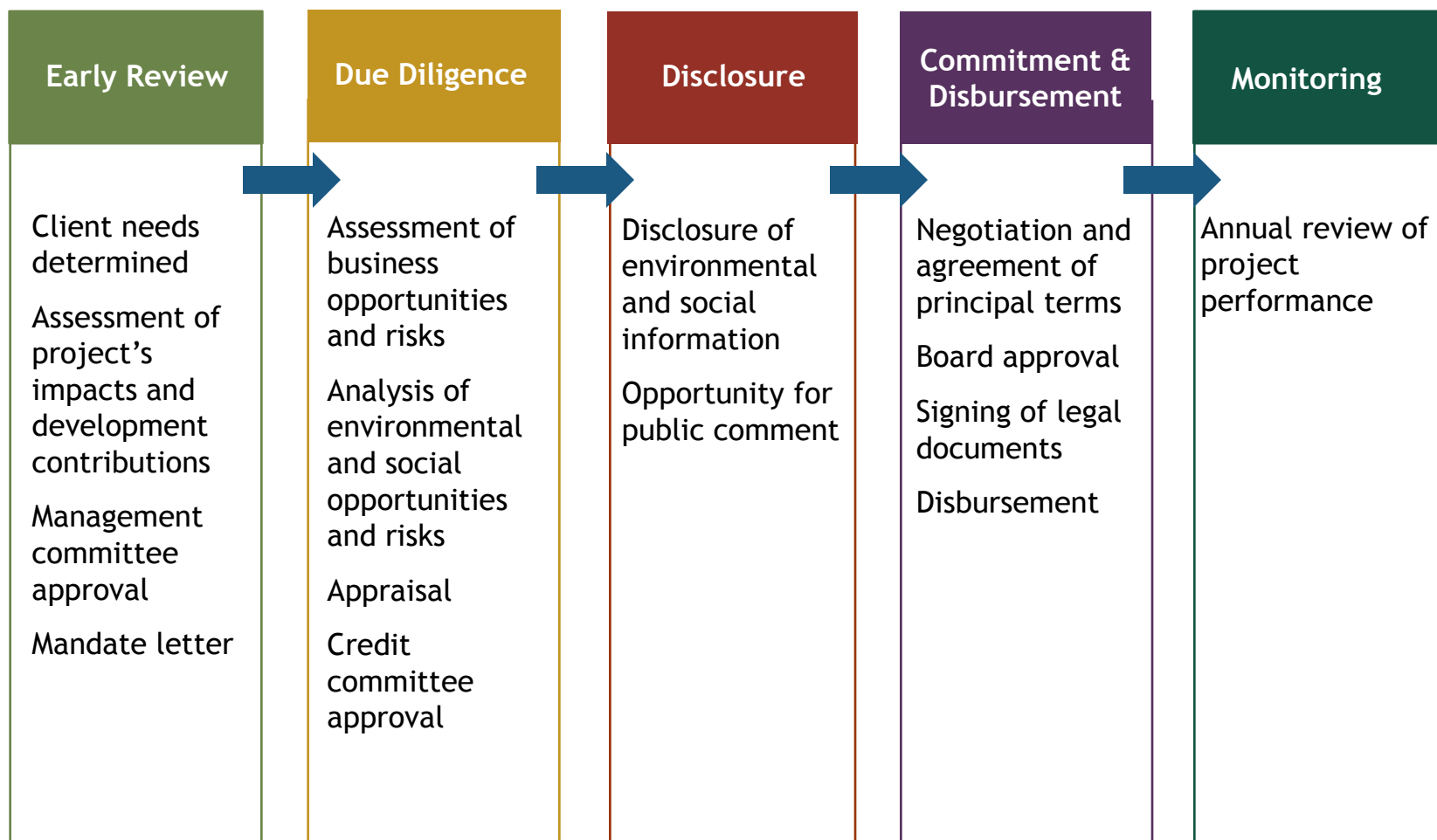
## Country Risk Mitigation

- ✓ Government Relations
- ✓ Neutral broker Role
- ✓ Reduced Risk of Expropriation, Breach of Contract, Convertibility

## Environmental & Social Risk Management

- ✓ Advice on Environmental and Social Best Practices
- ✓ Equator Principles Modeled after IFC Standards
- ✓ Local Consultation and Disclosure

# IFC's Investment Project Cycle



*IFC works on the specific timeline to meet client's needs*

# IFC Financial Products - From Equity to Debt



- Corporate and JV
- Typically 5-15% shareholding (not to exceed 20% of total equity)
- Long-term investor, typically 6-8 year holding period
- Not just financial investor, adding to shareholder value
- Infraventures (early stage equity investments)
  
- Subordinated loans
- Income participating loans
- Convertibles
- Other hybrid instruments
  
- Senior Debt (corporate finance, project finance)
- Fixed/floating rates, US\$ and local currencies available
- Commercial rates, repayment tailored to project/company needs
- Long maturities up to 15 years, appropriate grace periods
- Range of security packages suited to project/country
- Mobilization of funds from other lenders and investors
- Co-financings, syndications, underwritings and guarantees
- [Concessional Financing]

# Strong and Differing Role in Supporting Each Renewable Technology

	Hydro	Wind	Biomass	Solar	Geo
Characteristics	<ul style="list-style-type: none"> <li>Established and cost competitive technology</li> <li>Large hydros have long development time</li> <li>Dams offer base-load</li> <li>Potential for local E&amp;S issues</li> </ul>	<ul style="list-style-type: none"> <li>Established technology</li> <li>Economics site specific</li> <li>Variable generation</li> <li>Dependent on suitable regulatory support</li> </ul>	<ul style="list-style-type: none"> <li>Technology risk varies with fuel type</li> <li>Long-term access to low cost fuel essential</li> <li>Opportunities for co-firing and co-generation</li> </ul>	<ul style="list-style-type: none"> <li>Costs declining quickly</li> <li>CSP w/ storage offers potential for low cost base load</li> <li>Potential for grid and distributed generation</li> </ul>	<ul style="list-style-type: none"> <li>Established and cost competitive base load technology</li> <li>High exploration risks and long lead times to develop steam fields</li> </ul>
IFC Role & Comp. Adv	<ul style="list-style-type: none"> <li>Taking construction risk</li> <li>Providing long-tenors to match asset life</li> <li>Innovative bundling for small hydros</li> <li>Ensuring best practice E&amp;S</li> </ul>	<ul style="list-style-type: none"> <li>Supporting (i) projects in new markets &amp; new regulations; (ii) supply chain expansion to reduce costs</li> <li>Structuring to support intermittent generation &amp; merchant risk</li> </ul>	<ul style="list-style-type: none"> <li>Structuring fuel supply agreements to enable project finance</li> <li>Understanding technology risk</li> </ul>	<ul style="list-style-type: none"> <li>Supporting supply chain expansion to reduce costs</li> <li>Supporting projects in new markets and new regulatory regimes</li> <li>Coordinating concessionary funding to buy down costs</li> </ul>	<ul style="list-style-type: none"> <li>Early stage equity and concessionary funding to share exploration risk</li> <li>Sector expertise and innovative structuring to enable project financing</li> </ul>

# Solar - Development models

## Capex model

- This is the plain vanilla 'Build Own and Operate' model where a developer incurs capital expenditure and owns and operates the plant for its entire life (usually 25 years).
- Suited for ground mounted ( concentrated) solar development

## PPA or Opex or RESCO model

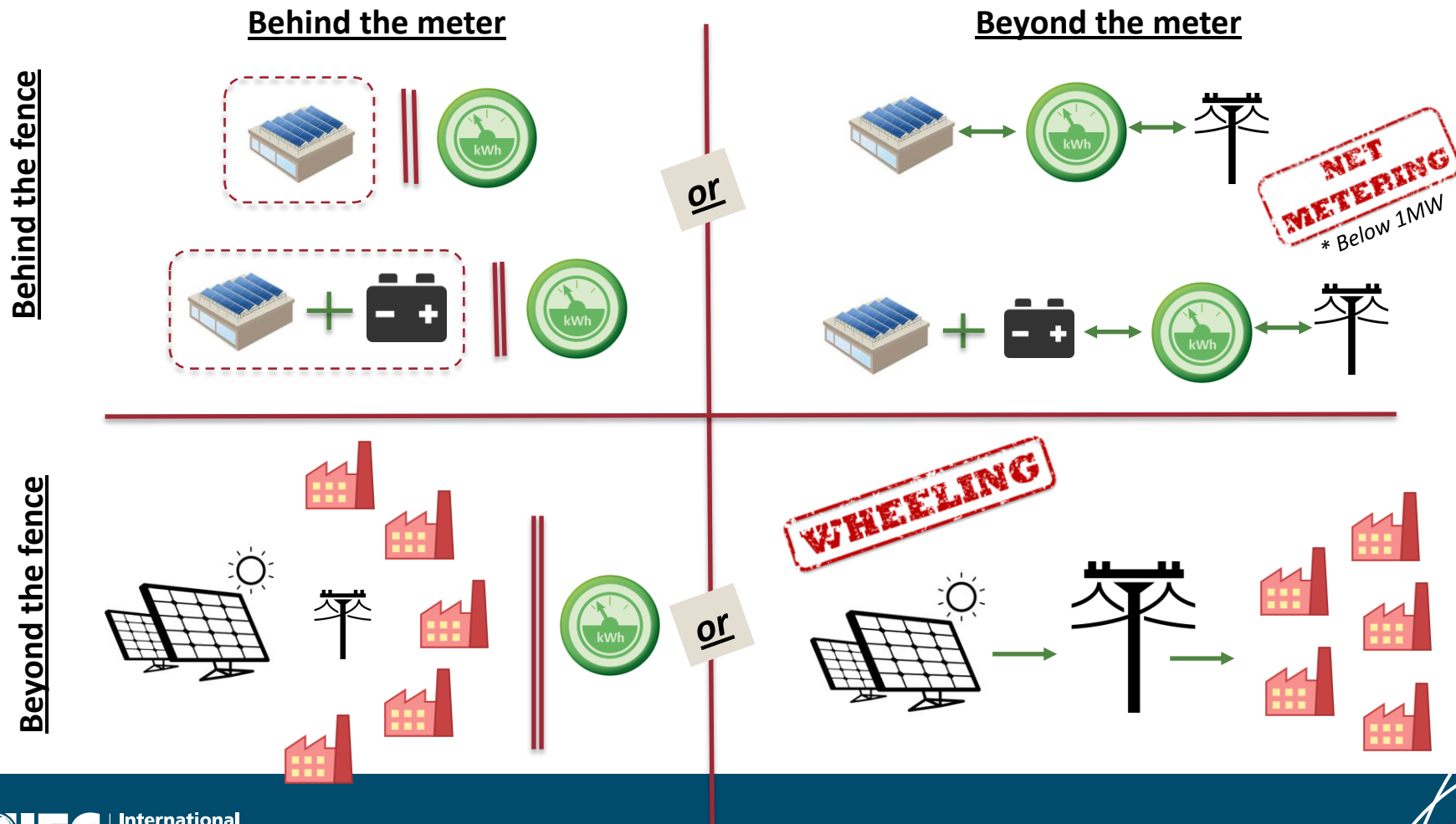
- Legal agreement (Power Purchase Agreement) between developer / IPP which will design, develop and operate the plant and the **only consumer (pure captive)** or **only Utility ( gross metering)** or **both consumer and Utility (net metering)**
- Power is supplied to the purchaser and billed for the power consumed
- IF no export provisions / grid interaction the developer should be able to sell the entire power generated to the consumer
- Suited for distributed generation like rooftop solar

## Leasing

- These is a recent model that is being offered by some IPPs.
- In this model, the entity desirous of purchasing solar power can lease the system from a provider and the purchaser will pay on the basis of energy produced every month.

# Develop the technical concepts...not your traditional IPP:

- The technical configuration of the solutions will vary by client, will depend on the regulations, and the respective DISCOM cooperation. Project sizing will also need to be optimized across a variety of energy supply sources based on cost and availability: grid; diesel gensets; solar; storage etc.



# Gandhinagar - 5 Mwp Roof top solar project

- The Business Case
- Background & Context
- Business Model/Transaction Structure
- Key activities & Current project Status
- Key learnings

# The Concept

## The Concept

- Every building whether home, industry, institution, commercial establishment can generate some solar power by installing PV panels on rooftop

## Key Benefits

- Promoting distributed power generation
- Savings in transmission and distribution losses and Savings in developing / Upgrading transmission infrastructure
- Ability to leverage a larger retail investor base and self-replicate
- Ease of development (permitting, siting & clearances)
- Creation of value from under-utilized rooftops



# Project Background

## Client Need

- The Government wanted to demonstrate technical, commercial and regulatory viability and sustainability of rooftop solar projects.
- A Grid Connected Photovoltaic Rooftop Program to mark the first distributed power generation programme in India in its true sense - *“Kilowatt-programme at a megawatt-scale”*
- Possibility of grant money to subsidize the capital costs

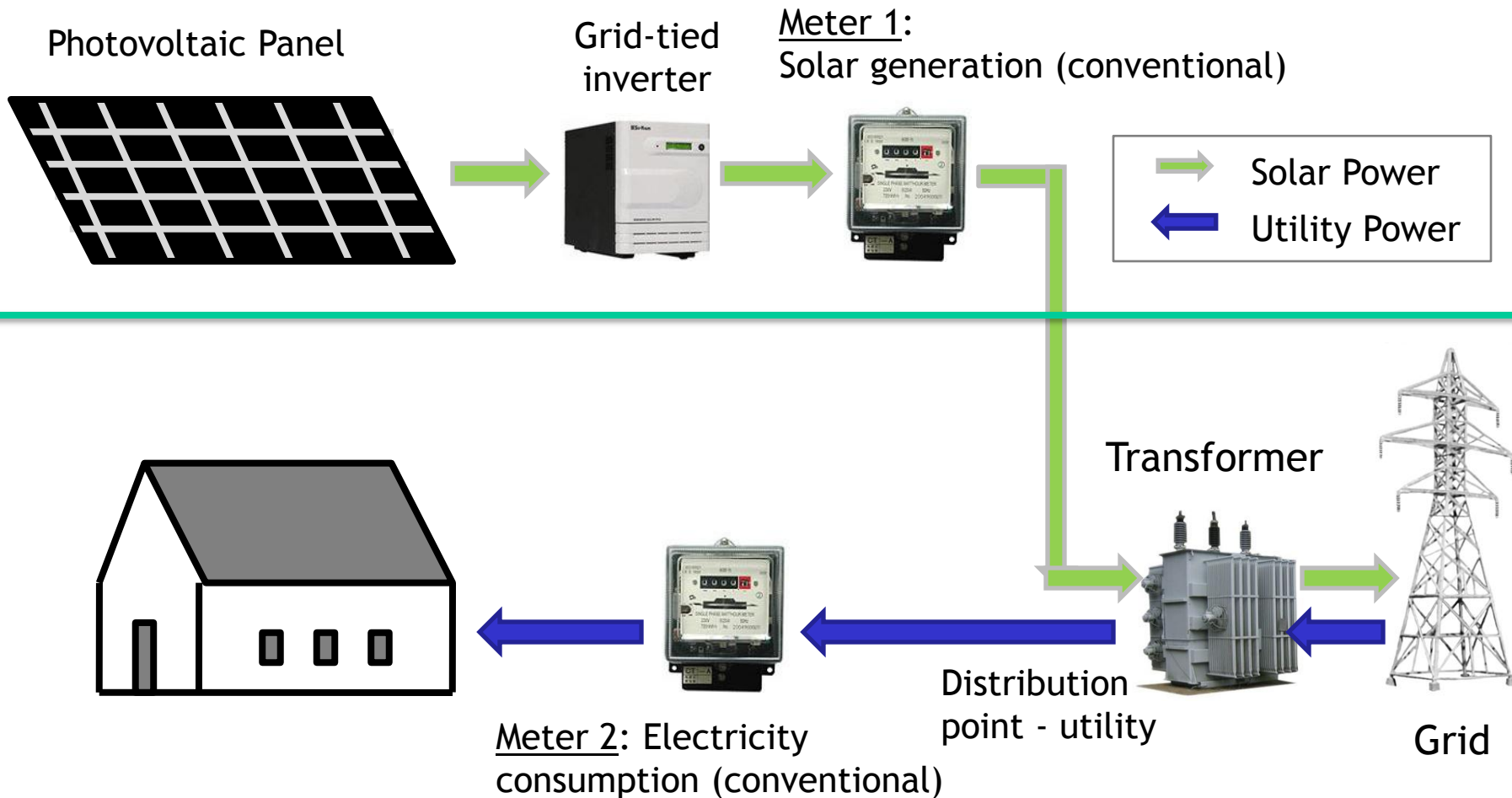
## The Solution

- IFC along with the GoG created a solution wherein both envisaged the implementation of a 5 MW distributed/grid connected rooftop solar project in Gandhinagar, Gujarat through a PPP model

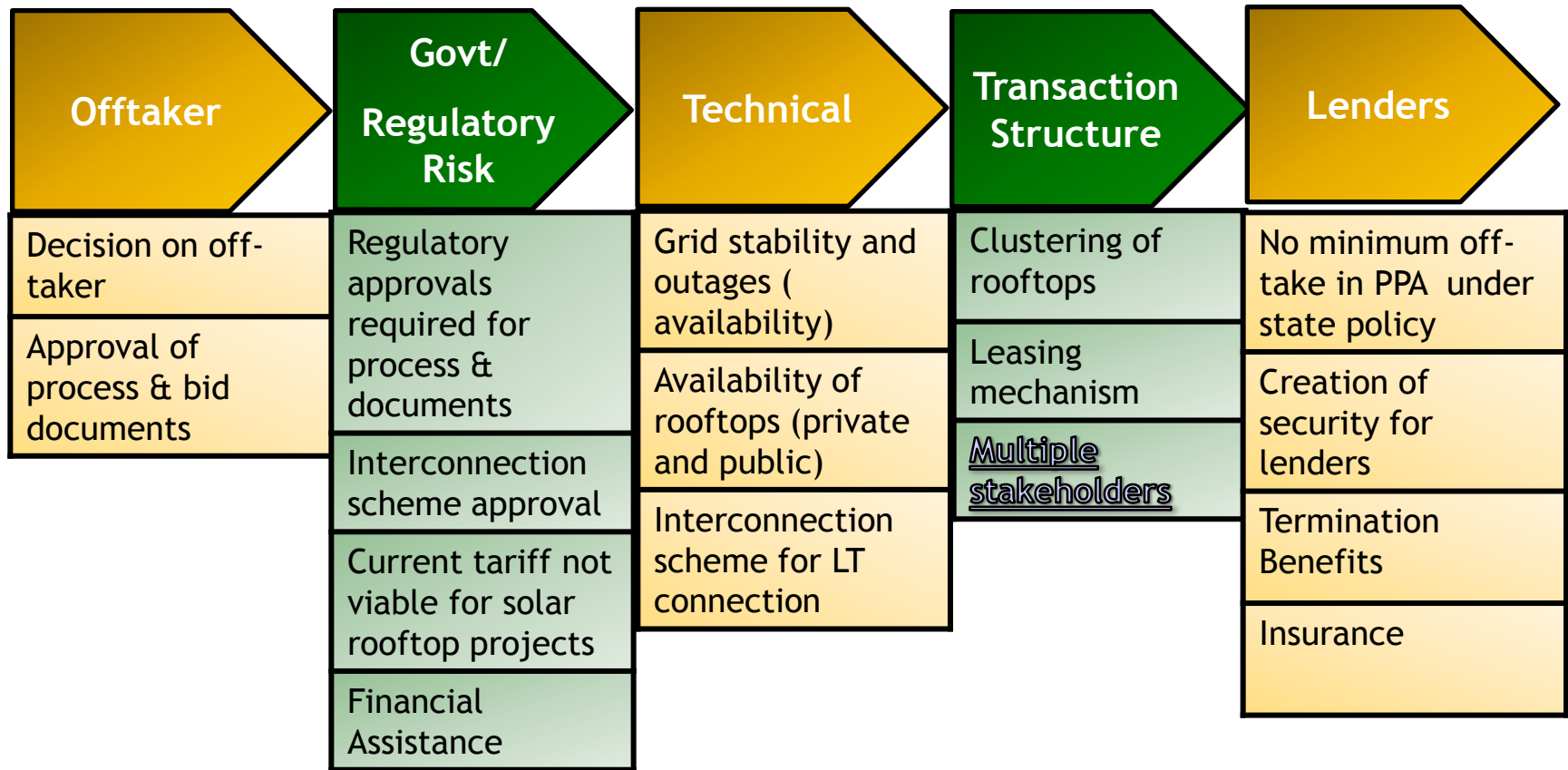
## Expected Outcome and Impact

- Establish a practice/ philosophy of distributed solar and other energy generation
- Bring a level of comfort to all stakeholders for further scale-up
- Encourage public participation
- Climate benefits attributable to GHG reduction (7,154 tons of CO<sub>2</sub>e /annum), investment of US\$10-12 M
- Potential for replication in Gujarat and beyond

# Gross metering PV system



# Key Project Risks



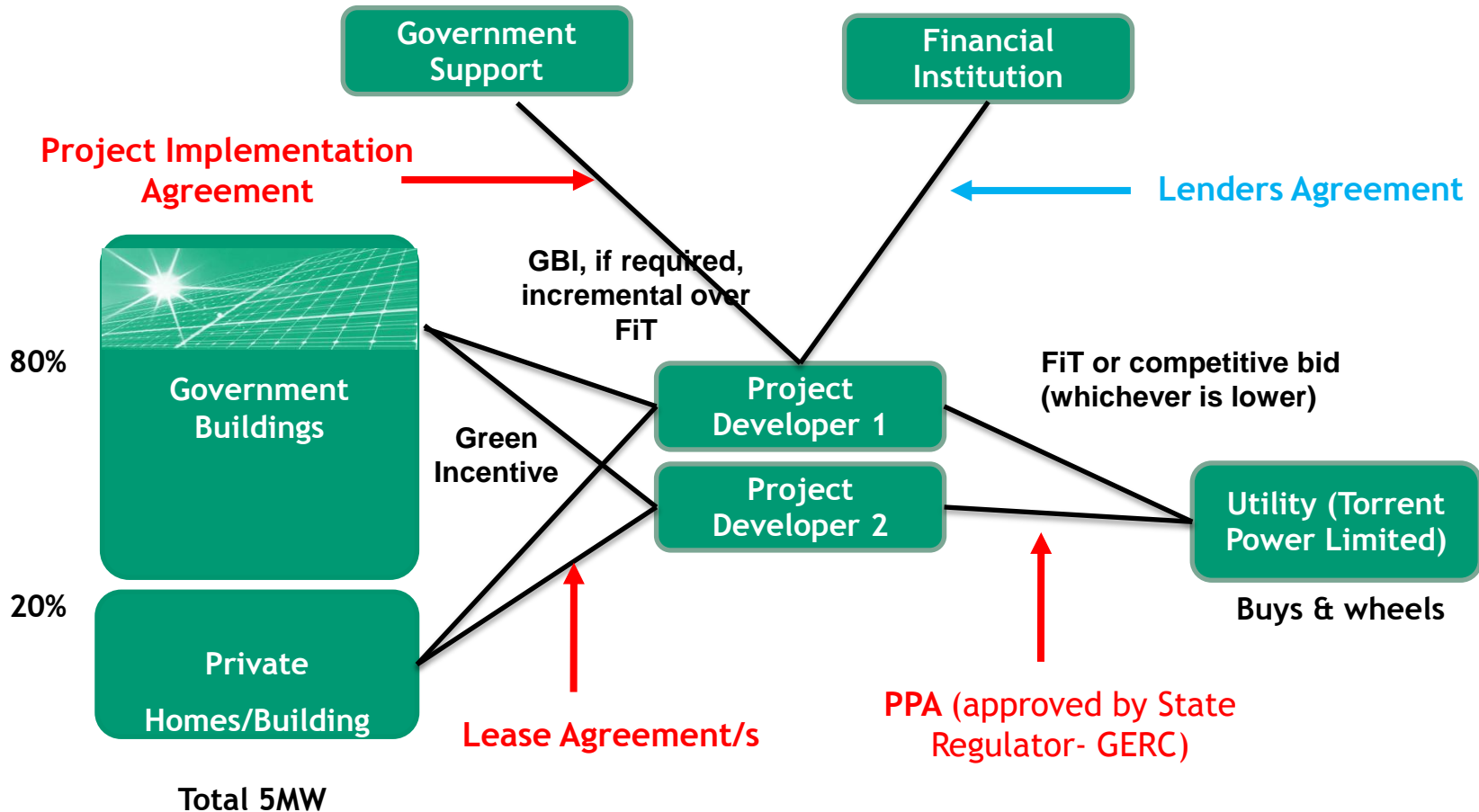
Detailed Feasibility undertaken and Project Documents prepared based on analyzing the above identified risks and extensive consultations with stakeholders

# Key Activities Undertaken

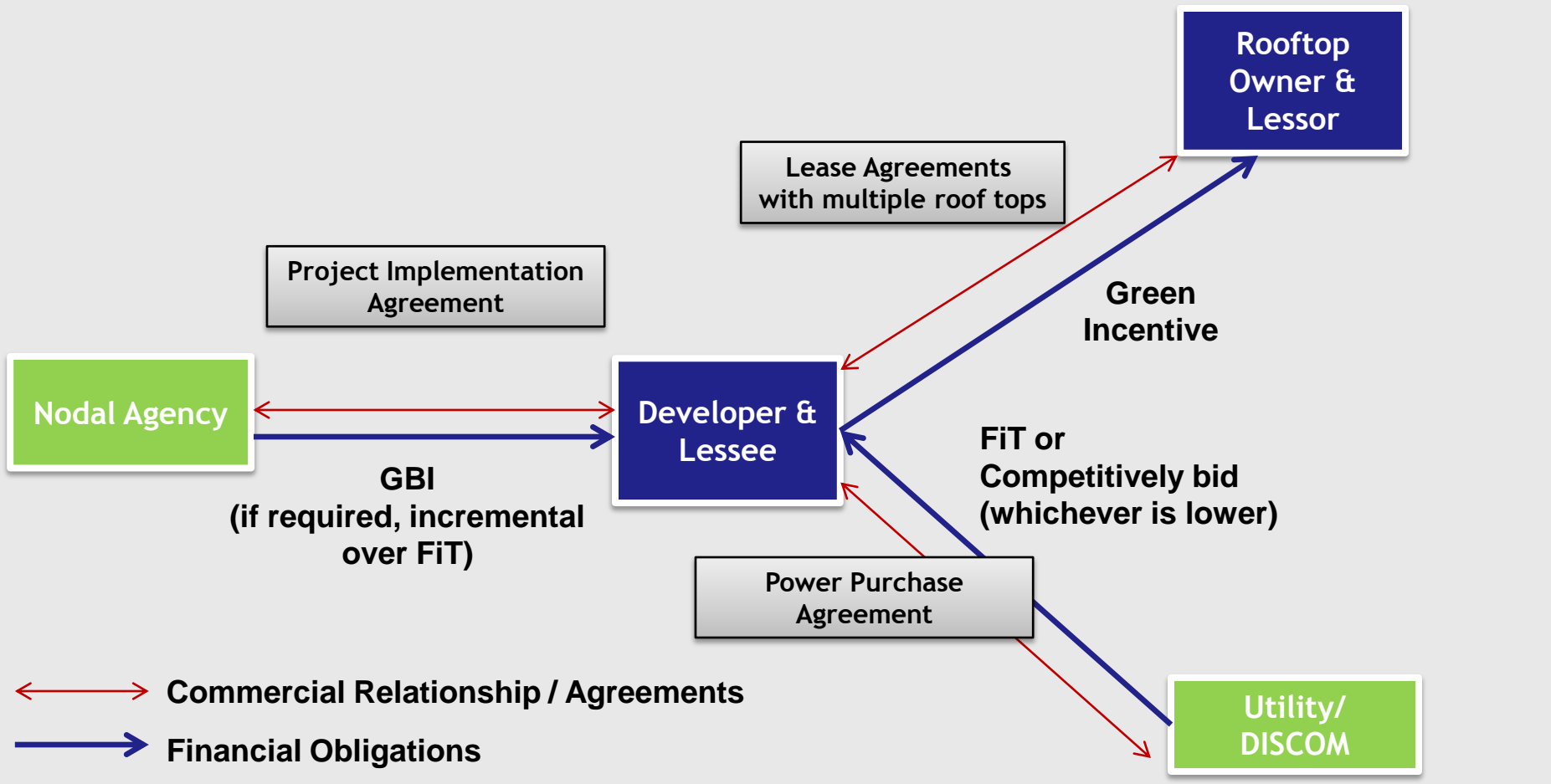
- Detailed Project Due-diligence (technical, commercial, legal & regulatory)
- Identification and survey of roof areas ( 80 % roofs on Govt buildings, 20 % residential roofs - bidder's responsibility)
- Financial analysis and Project Structuring
- Stakeholder consultations / Convening - Government, Bidders, Regulator, Rooftop owners, utility ( off taker)
- Visits to potential roof accompanied by GoG & oftaker
- Analysis and mitigation of various risks,
  - Off taker, Technical, regulatory, Commercial etc
- Finalization of Transaction Structure & Bid Documents
- Buy in from Regulator (Gujarat Electricity Regulatory Commission) for the bid process and the PPA (Power Purchase Agreement)
- Bid Process Management

Supported by consultants: Deloitte(technical/commercial) & CMS/HSA(legal)

# Business Model: Gandhinagar Pilot Project



# Gross Metering - FIT Based commercial structure



# Contract Structuring

## Key Terms

### PPA

- Inter-connection scheme defined
  - Delivery point defined(meter)
- System specs. Defined
  - Panels/Inverters/Meters
- Assured 90% Grid Availability
- Off take limits:13-22% CUF
  - Penalty below 13%
- Payment Security (LC)
- Deemed Generation
- Assignment (lenders)

### PIA

- Facilitate Implementation
  - Identify rooftops
  - Regulatory approvals
- Clustering of rooftops
- Project Supervision
  - Independent Engineer
  - Monthly monitoring
- Pay GBI if required
- Provide alternate rooftops with transfer benefits
- Phased Commissioning
- Assignment allowed
- Termination benefits (default of both parties)

### RLA

- Provide terms of access to rooftops
- Rent Structure (per unit basis to encourage participation of owners)
- No change for first five years
- Uninterrupted access
- Broad technical specs. Pre-defined

Key terms like effective date, term, termination etc. Interrelated among the three agreements

## Market discovered Tariff & Implications

- Azure Sun Energy Pvt. Ltd. (“Azure”)
- Ananth Solar Power Maharashtra Pvt. Ltd. (SPV OF “SunEdison”)

	Azure	SunEdison
Quoted Tariff	Rs. 11.21 /kWh	Rs. 11.793 /kWh
GERC relevant tariff	Rs. 11.14 /kWh ( availing AD)	Rs. 12.44 /kWh (without AD)
Torrent pays:	Rs. 11.14 /kWh	Rs. 11.793 /kWh
GoG-PIA (GPCL) Pays :	Rs. 0.07 /kWh	---

- Liabilities to GoG/GPCL :- Rs.0.07/kWh Generation of Rooftop Solar capacity (Max. up to 2.5 MW) generation
- Revenue to Buildings :- Rs. 3 Per KWh ( For 4 MW Govt & 1 MW private residential ) - Developer pays

# Installations under 5 MW Gandhinagar rooftop PPP Program



**264.04 kW @ Jivraj Mehta Bhavan Nos. 1, 2 and 4, Sector 10-b**



**60.48 kW @ Lokayukta,  
Sector 10**

**80.61 kW @ Govt. Arts College,  
Sector 15**

**80.61 kW @ Govt. Arts College,  
Sector 20**

# Installation on J.M. Bhavan



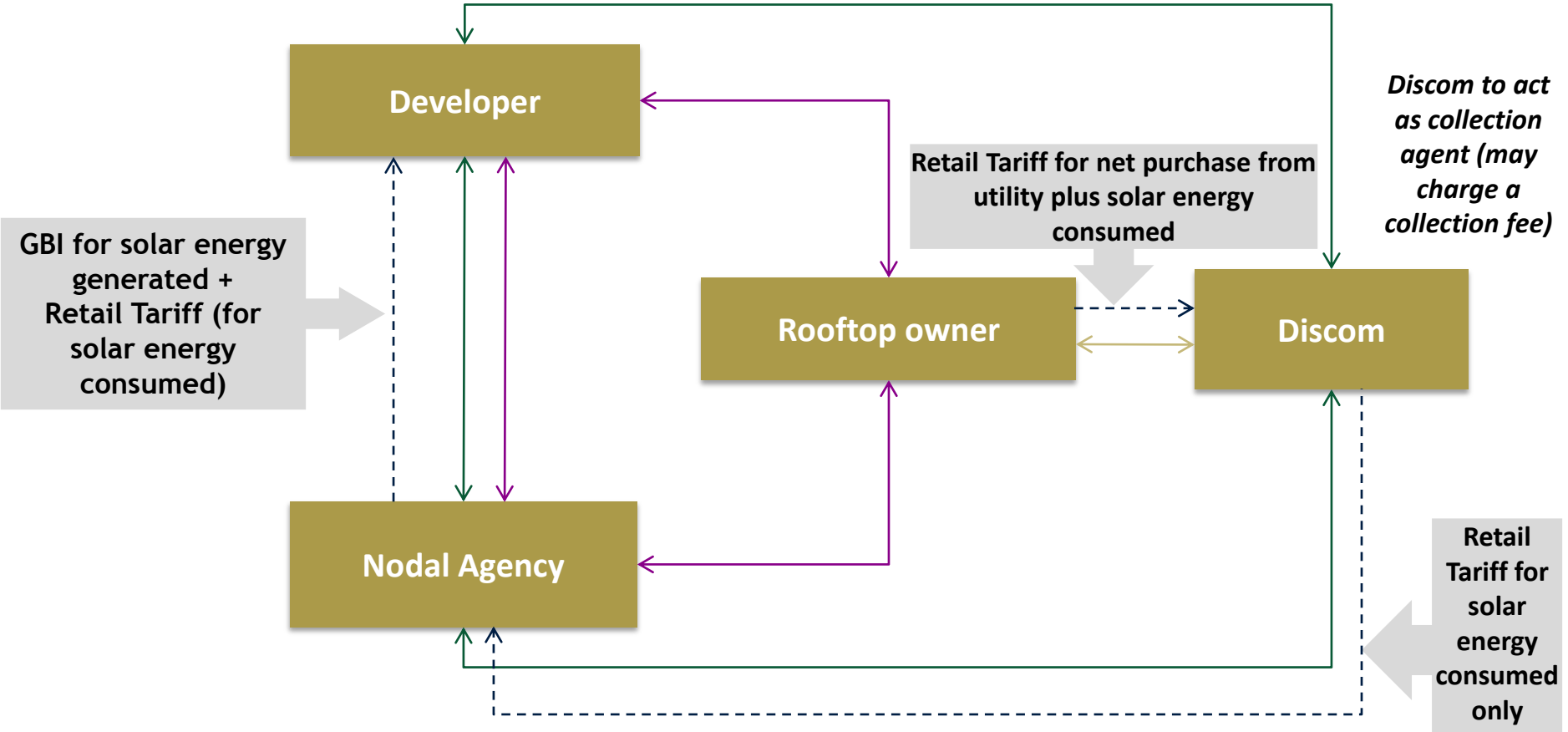
# Residential installations, Metering



# Installations ( residential) under 5 MW Gandhinagar Program & GPCL Outreach Centre

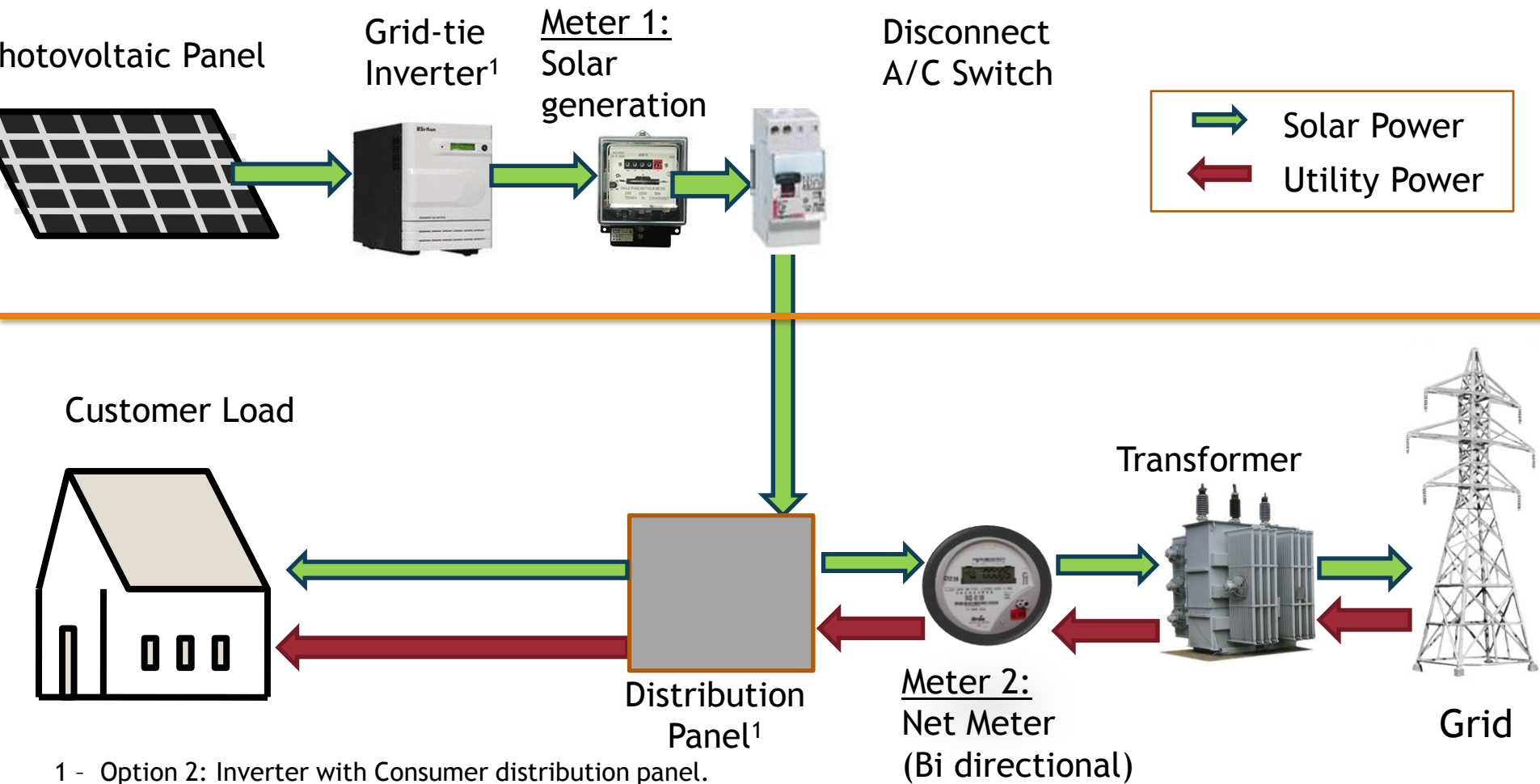


# Net Metering Structure (GEDCOL Project)



- Tripartite Project Implementation Agreement between Nodal Agency, Developer and Discom
- Tripartite Lease Agreement between Nodal Agency, Developer and rooftop owner ( Govt of Orissa)
- Connection Agreements between Discom and the respective Rooftop Owner / consumer
- - - Funds Flow

# Net metering PV system



# Stakeholder Concerns

Stakeholder	Description	Benefits	Concerns & Mitigation
<b>Nodal Agency</b>	Implementing Agency	<ul style="list-style-type: none"> <li>○ Contributing to the RE programme of the Govt.</li> <li>○ New business model which may led to market transformation</li> <li>○ Promoting clean solar energy</li> <li>○ Fulfillment of the objectives under the Solar Policy</li> </ul>	<ul style="list-style-type: none"> <li>○ Creating consensus amongst various stakeholders</li> <li>○ Determining a viable business model which is sustainable and can be replicated</li> <li>○ Payouts, if required, depending upon quoted tariff</li> </ul>
<b>Lessor</b>	Rooftop Owners	<ul style="list-style-type: none"> <li>○ Rent income from unutilized roof / potentially reduced bills</li> <li>○ Proper maintenance of rooftops</li> <li>○ Contributing to clean energy</li> </ul>	<ul style="list-style-type: none"> <li>○ Concerns about future expansion of buildings</li> <li>○ Allowing access to the rooftop for regular maintenance</li> <li>○ Structural strength of the rooftop and changes to the structure</li> </ul>
<b>Regulator</b>	Regulatory Authority	<ul style="list-style-type: none"> <li>○ Contributing to clean energy</li> </ul>	<ul style="list-style-type: none"> <li>○ Facilitating implementation and achievement of targets</li> <li>○ Tariff expectation</li> </ul>
<b>Discom</b>	Distribution Utility	<ul style="list-style-type: none"> <li>○ Adding solar as new form of power</li> <li>○ Contributing to clean energy</li> <li>○ Regulatory obligations</li> </ul>	<ul style="list-style-type: none"> <li>○ Expensive power</li> <li>○ Revenue loss</li> <li>○ Decentralized injection of power into the grid</li> </ul>

## Bid results over time

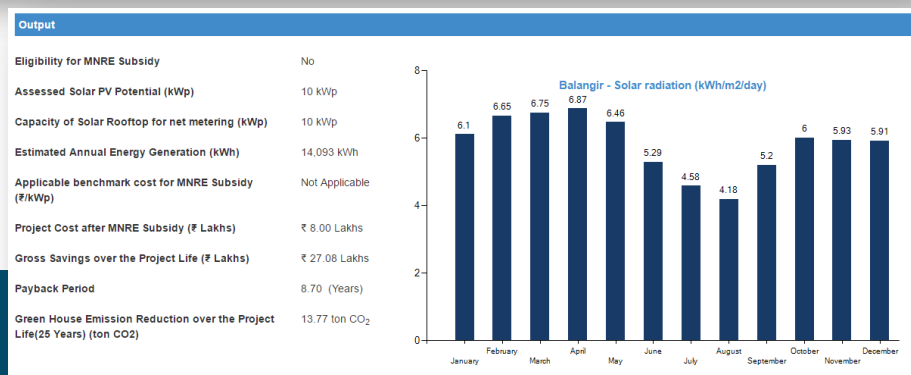
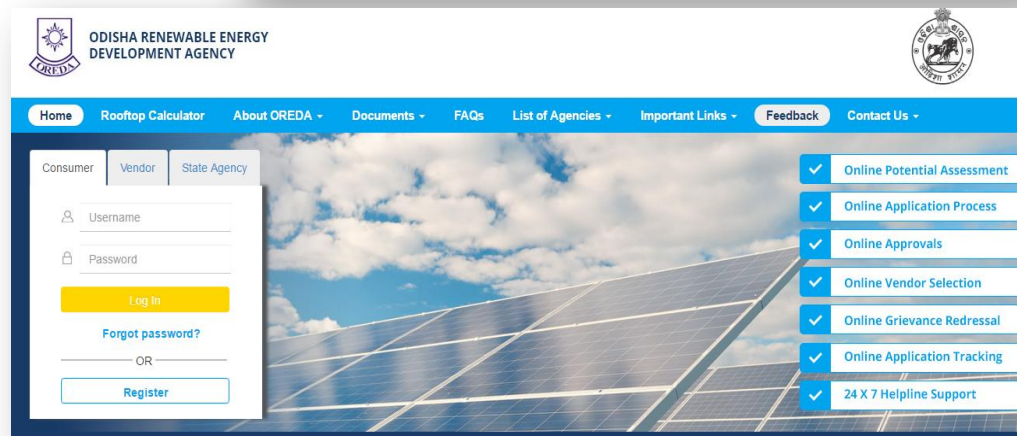
Project	Projects bid out in	Bid Price (INR per unit)	Client
Gandhinagar (80% roofs assured by Government)	2012	Rental - 3 Tariff - 8.2 Effectively INR 11.2 per unit	GERMI & GPCL (GoG)
Vadodara (no assurance with private developer to identify roofs)	2013	Rental - 2 Tariff - 8.76 Effectively INR 10.76 per unit	GPCL (GoG)
Odisha (Bhubaneswar and Cuttack) ( only on Govt buildings, net metering)	2016	INR 5.69 per unit (with 30% capital subsidy on quoted capital cost per MW - INR 8 crores / MW); DCR based	GEDCOL (Govt of Odhissa)

*Due to the steep decline in the prices of RTS systems third party net metering based RTS makes financial sense*

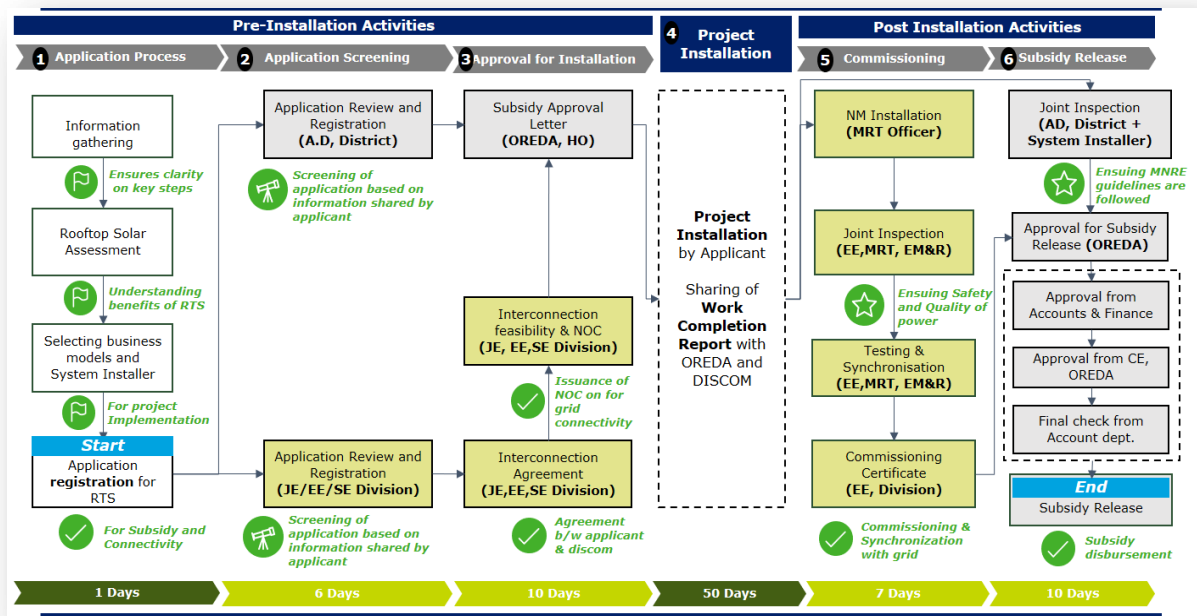
# Rooftop Solar PV Proliferation with OREDA, Odisha

Objective – support OREDA on rooftop solar proliferation (*in the residential sector with net metering regulation*)

- ✓ Preparation of **As-Is** comprising **To-Be** Structure to OREDA
- ✓ Presentation of As-Is Report to OREDA / OERC / Discoms and other Stakeholders
- ✓ Finalization of standardized process flow with time
- ✓ Development of Web-based IT tool
- ✓ Launch of Web based IT tool by Hon. CM
- ✓ Audit and LIVE process for consumer proliferation



# Rooftop Solar PV Proliferation with OREDA, Odisha



Standardize Process Flow

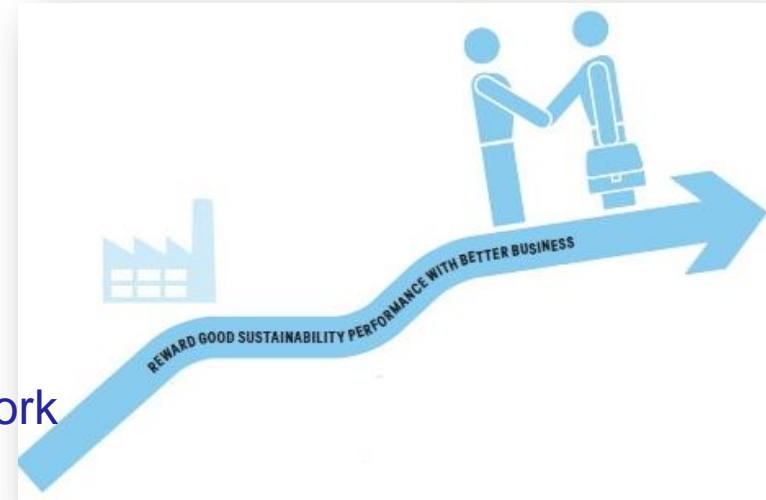
## Processing Timelines - Proposed

Phase	Activity	Subsidy (1)	Connectivity (2)	Both (3)*
<b>1. Application Process</b>	1. Application to OREDA	1	x	1
	2. Application to DISCOM	x	1	
<b>2. Application Screening</b>	1. Application Screening at OREDA	6	x	6
	2. Application Screening at DISCOM	x	3	
<b>3. Installation Approval</b>	1. Signing of Interconnection Agreement by DISCOM	x		10
	2. Interconnection Feasibility Check by DISCOM	x	7	
	3. Issuance of NOC by DISCOM	x		
	4. Issuance of Subsidy Sanction Letter	3	x	
<b>4. Project Installation</b>	1. Installation of RTS Project by Applicant		50	50
	1. Installation of Net Meter	x		
	2. Inspection by DISCOM	x		
<b>5. Site Inspection</b>	2. Testing and Commissioning	x	7	7
	3. Issuance of Commissioning Certificate	x		
	1. Inspection by OREDA	5	x	
<b>6. Subsidy Release</b>	2. Subsidy Release by OREDA	5	x	10
<b>Total Processing time from Zero Date</b>		<b>70</b>	<b>68</b>	<b>84</b>
<b>Processing time for Administrative Approvals</b>		<b>20</b>	<b>18</b>	<b>34</b>

\* In this case, some of the activities of OREDA and DISCOM will run in parallel

# “Low Carbon Roadmap” of H&M: Solar Rooftop PV

IFC is developing Low Carbon Roadmap of Supply Chain of H&M focusing on Three Countries (India, China and Bangladesh)



**Step-1:** Development of the Corporate Framework for the Low Carbon Roadmap



**Step-2:** Development of Country Specific Low Carbon Roadmap for India



**Step-3:** Designing and Implementing RE Demonstration Projects



**Step-4:** Facilitate Implementation and Supervision

## Key Takeaways

- Ground mounted systems and roof mounted systems need different treatment
- For a given geography, availability of rooftop inventory based on reliable, scientific & accurate rooftop survey
  - Assurance of availability of roofs would result in attractive bids where as any uncertainty on inventory would be priced accordingly by reputed players
- Technical parameters like availability of grid
- Assured offtake, Take or Pay clauses
- Upfront work is time consuming & in depth
- Regulator buy in, Utility Buy in & Capacity building of utility staff - Key for rolling out the projects
- Contractual structure and legal agreements - Key elements
  - Robust payment security mechanism for investors (letter of credit, Escrow, reliable credit ratings of off taker)
- Given the trend in declining tariffs, there remain no margins for error, risking financial closure
- For scale up clear permitting provisions and procedures are a must
- Access to finance is key: Need to design appropriate financing schemes targeting aggregators as well as individual rooftop owners as the sector grows

# Phases in rooftop market development

- Market transformation - bridge between proof of concept and mature self-replicating phase  
Focus of the phase to build capacity in market
- Government or public agencies play an active role as market facilitator.

- Markets in self replication & self sustaining phase (e.g. Japan and Germany).
- New implementation models emerge which drive the market towards greater efficiency
- Government inputs are minimal with focus on providing a facilitating regulatory environment



Key focus on implementation of demonstration projects in Gujarat to:

- showcase technical and financial feasibility of rooftop solar PV projects.
- provide insights to policy makers to envisage implementation models and capacity targets.
- reveal implementation issues to move market towards next phase

**Railways - Opportunities with existing stations, Platforms, Parking lots, Station redevelopment, residential colonies and their redevelopment**

**Innovative opportunities on bogies, storage and Water bodies**

# Thank You

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# Back Up

# Policy/Regulatory & Rooftop owners

## Policy/Regulatory

- Commitment to Climate change
- Clarity on regulations with respect to grid connectivity-
  - net-metering/ gross metering
- Appropriate incentives- RPO, GBI, subsidies , tax incentives, concessional financing
- Enforcement of RPO

## Rooftop owners

- Adequate incentives for rooftop owners i.e. tax exemptions, lease rentals, savings on electricity bills
- Access to power
- Access to Finance
- Ease of inter-connection, O& M

# Investors & Utility

## Investors/Developers

- Commitment from rooftop owners to allow access and lease- Public & Private
- Robust Payment Security from Discoms /Rooftop owners & Government (incentives)
- Access to Finance- important issue for small/distributed project

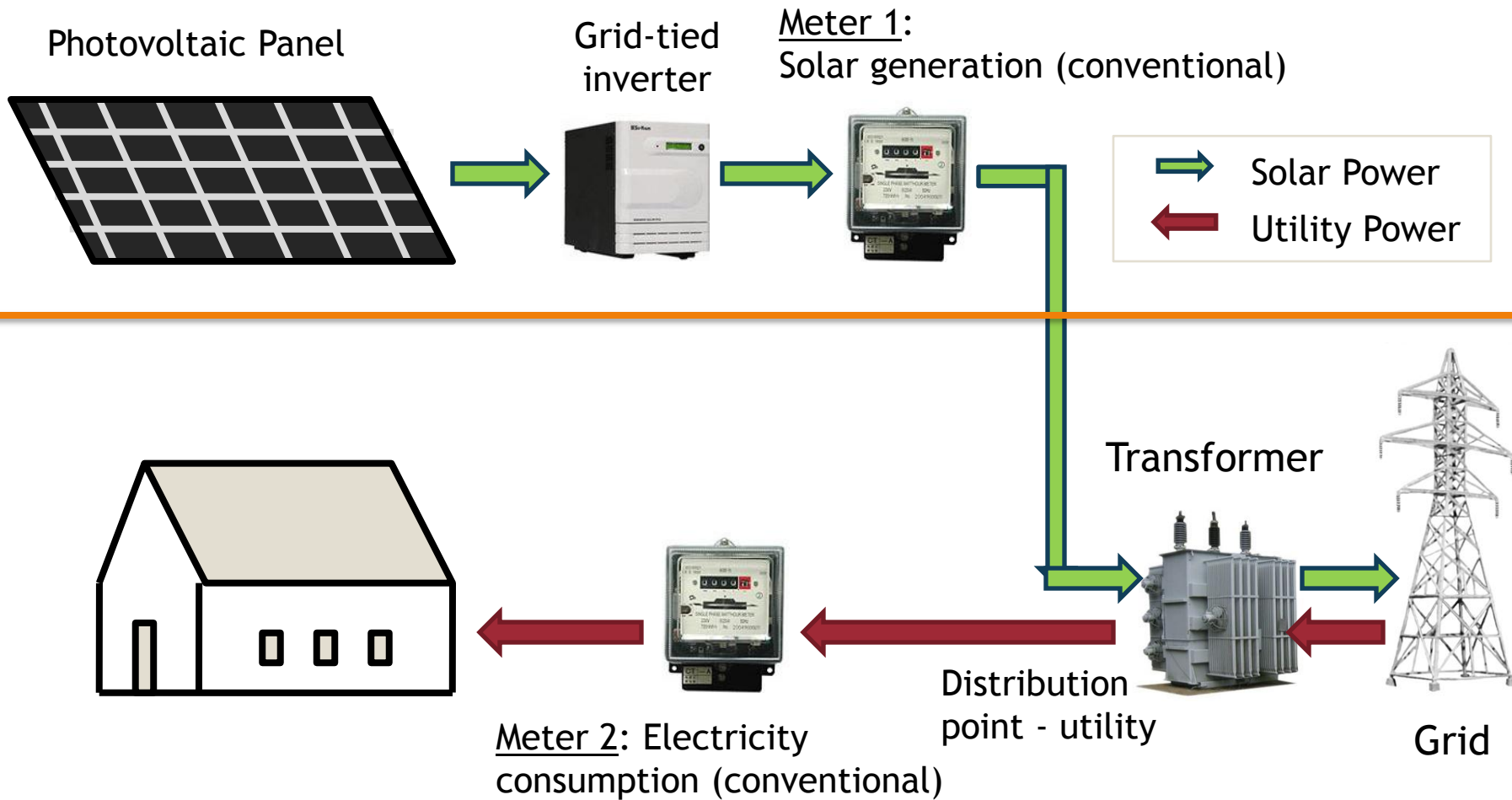
## Utility

- Utility
- Compliance with RPO
- Savings in T&D losses
- Impact on revenues (in case of net-metering)
- Impact on Annual Revenue Requirement due to higher cost of solar (in case of gross metering)
- Clarity on regulations with respect to inter-connection

## Long term financing is key to private sector participation ( RESCO/Third Party Investor)

- **Bankable Project Structure**
  - Size & location
  - Take or Pay
  - Credit worthiness of the off taker- appropriate payment security
  - Reliable and secured dispensation of incentives by Government, if any
  - Substitution and Termination Remedies
- **Reliable Resources and Technical Standards**
  - Assured long term availability of shadow free rooftops
  - Assured availability and stability of the Grid
  - Standard technical specifications for system, inter-connection and appropriate Metering
  - Reliable resource assessment- solar insolation levels

# Gross metering PV system



# Net metering PV system

