Opportunities for RE Powering Buildings

by

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About Us

What Is Idam?

इदम् - 'This' *'This Earth at This Time'*

The word **'Idam'** in Sanskrit means **'This'** and is used as a pronoun to refer earth and/or time as 'This Earth' or 'This Time'. We interpret it as 'This Earth at This Time' or 'Firmly Grounded'. Of course, that does not mean we are immobile, but it means that we are "Realistic". We believe this represents our corporate ethos. Our logo has Earth at the center, surrounded by five basic elements or panchmahabhutas according to Hindu Literature, i.e., air, fire, water, earth and space. The fins represent continuous churning around the earth ensuring that the earth is always stable.

Idam Group consists of **Idam Infrastructure Advisory Pvt. Ltd.** and **Enfragy Solutions India Pvt. Ltd.**

Idam's Vision

Core Values and Beliefs

- **Integrity**: We are honest, transparent, ethical, consistent and fair in dealing with all stakeholders.
- **Empowerment**: We are committed to employee development.
- **Sustainability**: We firmly believe in protecting environment and sustainable living
- **Quality:** We are dedicated to quality; quality of every output; be it a product or a service.
- **Innovation**: Continuous improvement/ innovations is at the core of our actions
- **Compassion**: We expect profit but not at the cost of core values.

Purpose

- Enable carbon minimal world through our products and services in energy domain.

Mission

- Be among top 3 companies providing carbon minimising services in India by 2027.
- Expand geographical presence in at least three continents
- Achieve 25% revenue from international work by 2027

Service Offerings

Electricity Market & Regulatory

- Electricity Markets Analysis
- Physical and Derivatives Market in Electricity
- Energy Modelling
- Power Procurement Strategies
- Policy & Regulatory Analysis
- Regulatory/ APTEL/ HC process support
- Adjudication, Appeals & Arbitration Support
- Institutional Strengthening and Capacity Building

Industrial Decarbonisation

- Decarbonization Technology Assessment
- Sectoral Decarbonisation Roadmaps
- Science Based Targets
- Energy and Water Audit Services
- Carbon Foot Printing
- Project Design and Implementation Support
- Techno-Commercial Feasibility Study, Due Diligence
- Risk Assessment and Due Diligence

Energy Transition

- RE Grid Integration Studies
- Energy Modelling
- Renewable Energy Procurement Strategy
- Flexibility Resource Assessment
- Renewable Energy Policy Analysis and Design
- Project Feasibility Development and Structuring
- Renewable Energy Transaction and Due Diligence Support
- Transmission Plannings and Assessment Studies

Information Technology

- Information Technology Consulting and Strategy
- Application Development and Support
- Database Development and Administration
- Offshore Software Development and Support
- Mobile Application Development
- Portal Development
- Website Design and Content Management Solutions
- Technical and Customer Support

Geomatics

- Underground Utility and Cadastral Survey
- Aerial and Satellite Mapping
- 2D and 3D Geodatabase Creation
- LiDAR Data Processing
- Orthophoto Generation
- Spatial Modelling
- Digital Elevation Model/ Digital Terrain Model Generation
- Cadastral Maps Geo-Referencing and Digitization

RE Technologies

- Solar + BESS
- Wind
- BIPV
- Solar Adsorption Cooling
- Water Heaters
- Biodegradable Waste to Energy
- Utility Tariffs for Supply of Green Energy
- Green Open Access
- IoT

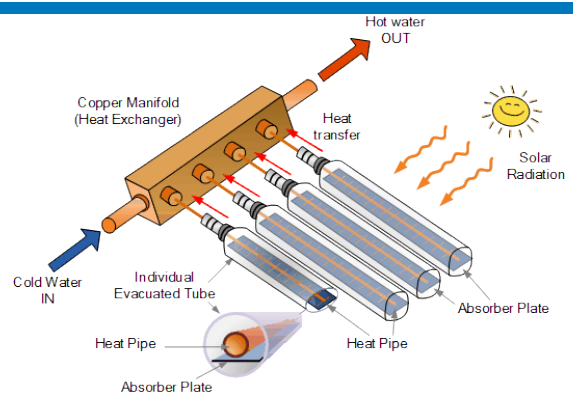
Need to use RE to Power Buildings

- Multi-story buildings are **great guzzlers** of power! Tall buildings are power hungry with the huge amounts of energy utilized for heating and cooling, waste management, elevators, lighting and much more.
- The buildings and buildings construction sectors combined are responsible for **30%** of total global final energy consumption and **27%** of total energy sector emissions (IEA). In **2021** direct and indirect **emissions** from buildings operation rebounded to about **10 Gt** (IEA).
- To align with the Net Zero Scenario, carbon emissions from buildings operations need to more than halve by 2030, requiring significant efforts to reduce energy demand through clean and efficient technologies in all end uses.
- It is clear that the use of renewable energy sources in buildings will provide environmental and economic benefits. Reducing this amount of energy as much as possible and obtaining it from renewable sources is one of the effective methods that provide buildings with energy efficiency and ecological characteristics.

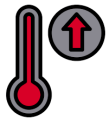
In 2014, buildings in midtown Manhattan in New York City consumed more power than the entire nation of Kenya!

Solar Water Heaters

- The **evacuated tube collector** (ETC) consists of a number of sealed glass tubes which have a thermally conductive copper rod or pipe inside allowing for much high thermal efficiency and working temperature compared to the flat plate solar collectors even during a freezing cold day.
- Evacuated tube collector operates at a much high efficiency and temperature for a much longer period than a conventional single flat plate collector installed system.



Overall operating efficiencies of **(30–45) %** are typical



Higher temperatures can be achieved at a **faster** rate

Suitable for **commercial** applications

Pic Credit: Alamy

Solar Rooftop + Battery Storage

- Solar alone can not provide reliable and firm power. Coupling it with Battery Energy Storage System (BESS) helps in overcoming these problems.
- Batteries can help, in particular, with driving down high energy costs by supplying energy when peak demand is highest and energy is most expensive. Drawing from an on-site battery at these times "shaves off" electricity use at those peak times and ensures that the utility only sees and charges for use at lower-demand, lower-cost times.

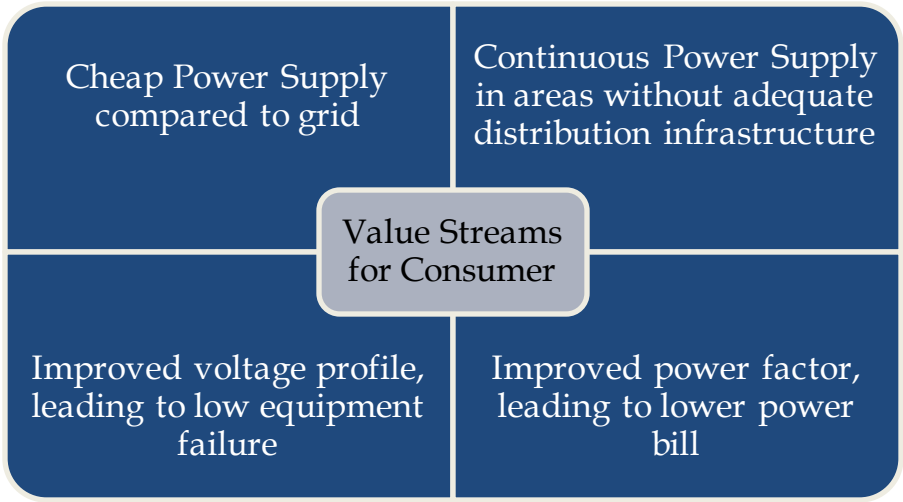


Fig: Value Streams for Consumers

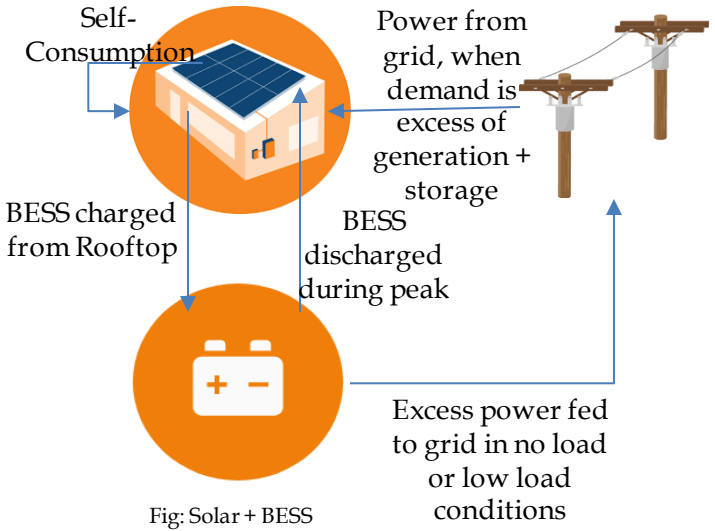


Fig: Solar + BESS

Building Integrated PV (BIPV)

- With the buildings growing vertically in almost all major cities, it is but natural to imagine the growth of solar on this vertical plane, with the falling of solar PV prices, this application is seeing a new spurt of growth.
- A BIPV system consists of integrating **PV modules into the building envelope**, such as the roof or the façade simultaneously serving as building envelope.
- The on-site production of solar electricity is typically greatest at or near the time of a building's and the utility's peak loads.

BIPV

Opaque BIPV Technology
Utilizes a customizable tempered glass facing to mask the solar cells' appearance

Transparent BIPV Technology
Uses thin-film solar technology to seamlessly powers the structure

10-12 watts/ft²
of PV array area

4-5 watts/ft²
of PV array area

Pic Credit: Mitrex

Reference:
https://www.mitrex.com/technology/

Solar Trees

- Solar Tree is basically a collection of solar panels put together angularly on a pole / mounting structure which forms the shape of tree to absorb the maximum amount of sunlight.
- This is like a tree in structure and the solar panels are like leaves of tree which produces electrical energy from sun light. These trees have an aesthetically pleasing design and have the capacity to supply power to the electrical loads as per requirement. Solar Tree takes very less footprint area.
- Solar Power Tree System is mainly comprised of solar panels, mounting structure, inverter, junction box, cables, and battery bank for back up.
- The electrical energy generated from Solar Trees can be used for street lighting, to power water pumps/ fountains etc.
- These Solar Trees with lighting, Wi-Fi facility, and mobile charging sockets, serve as modern day 'Bodhi Tree' where people can gain knowledge by accessing internet and simultaneously charge their mobile phones during day or night

Figure: Solar Trees

Energy Floors

- Energy floors use human movement as a source of energy. The energy floor modules/ tiles flex slightly when stepped on. Inside each tile is an electromechanical system, which transforms the small vertical movement produced by people's movement into a rotating movement that drives a generator.
- Energy Floor is a pedestrian floor system which can be used in pavements and high footfall areas, such as sport arenas, airports, railway stations, shopping malls, and office and apartment blocks. Energy Floor enables people to generate their own energy to illuminate the space around them, or the energy can be used to power local systems such as streetlights.

Figure: Energy Flooring

Solar LED Street Lights

- As infrastructure facilities around the world are getting stronger, the usage of modern solar street luminaries is increasing rapidly.
- These lights come with inbuilt batteries, embedded solar panel, battery management system and automatic controls.
- There are multiple benefits of using **solar LED street lighting** fixtures, like conservation of energy, use of a renewable source of energy, and less dependence on the grid.
- Tropical countries like India, that receive ample sunlight most time of the year can be highly benefited from this source of light. Another advantage of Solar LED Street Lights is they do not require digging for cabling work and require less maintenance compared to conventional streetlights.

Biodegradable waste to Energy

- About **one third** of the world's food–nearly **1.3 billion tons**–is lost or wasted (FAO-UN). Organic waste sent to landfills decomposes and produces a large amount of methane gas emissions, in addition, composting and digestion of food waste are **inefficient and slow**. Hence, Waste to Energy technology is regarded as best solution to this ever-growing problem.
- One of the methodology is **Biomethanation**. It is a process by which organic material is microbiologically converted under anaerobic conditions to biogas. Other methods are Incineration, Gasification & Pyrolysis.

Advantages:

- Biomethanation has dual benefits. It gives biogas as well as manure as end product.
- Alternatively, the biogas can be cleaned to remove the carbon dioxide and other substances, to produce **BioCNG**

Application areas:

- This technology can be conveniently employed in a **decentralized manner** for biodegradation of segregated organic wet wastes such as wastes from kitchens, canteens, institutions, hotels, and slaughter houses and vegetables markets.

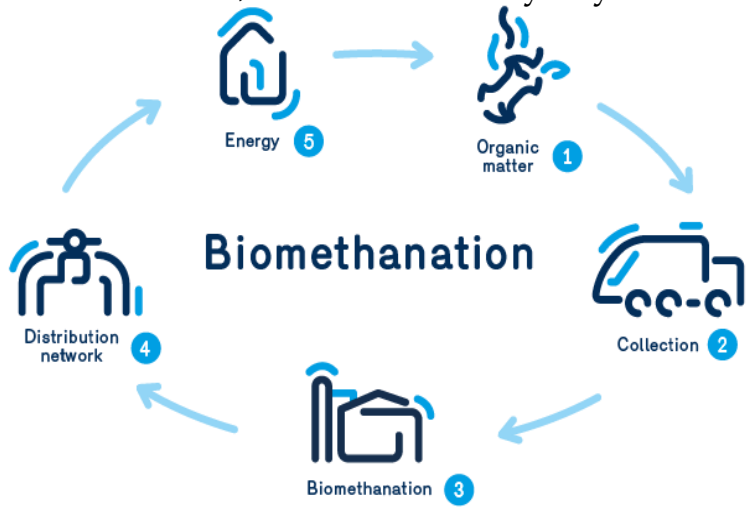


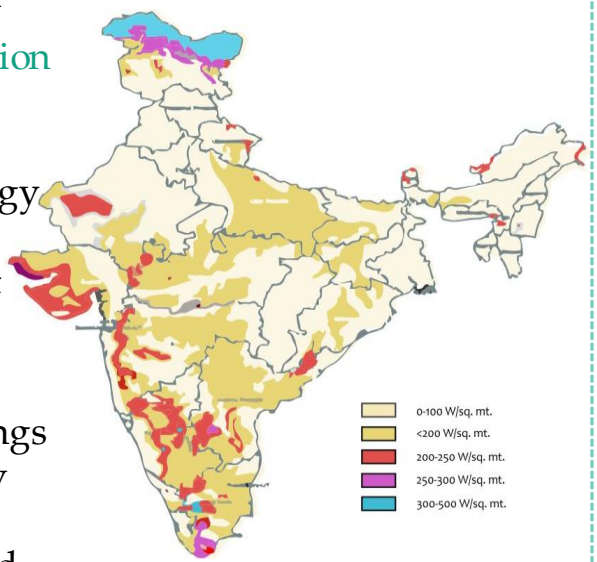
Figure: Biomethanation

Pic Credit: www.energir.com

Domestic Wind Turbines

- Small wind turbines used in residential applications typically range in size from **400 W to 20 kW**, depending on the amount of electricity you want to generate.

- Wind energy is a very **site specific** and location dependent form of energy. Hence harnessing wind energy onsite in densely populated areas is not always practical.
- Buildings in densely populated surroundings can offset their energy consumption through wind power generated **off site**.



- A new bladeless wind energy unit, patented by Aeromine Technologies can produce **50% more** energy than rooftop solar at the same cost.
- It captures and amplifies building airflow in wind speeds **as low as 5 m.p.h.**

Vertical Axis Wind Turbine

https://www.aerominetechnologies.com/

Pic Credit: Google

Solar Adsorption Cooling

- Solar adsorption air conditioning system (SADCS) is an excellent alternative to the conventional vapour compression system (VCS). It is a **green cooling technology** that utilizes solar energy to drive the adsorption/ desorption cycle, using **pure water as a green HFC-free refrigerant** especially for buildings in hot and humid countries.
- It is fairly new technology and only a handful of companies manufacture systems based on Solar Adsorption Technology. Below are some examples:

SolabChiller from SolabCool,

SOLACS08 from solarcombi+

Adref noa mayekawa Japan

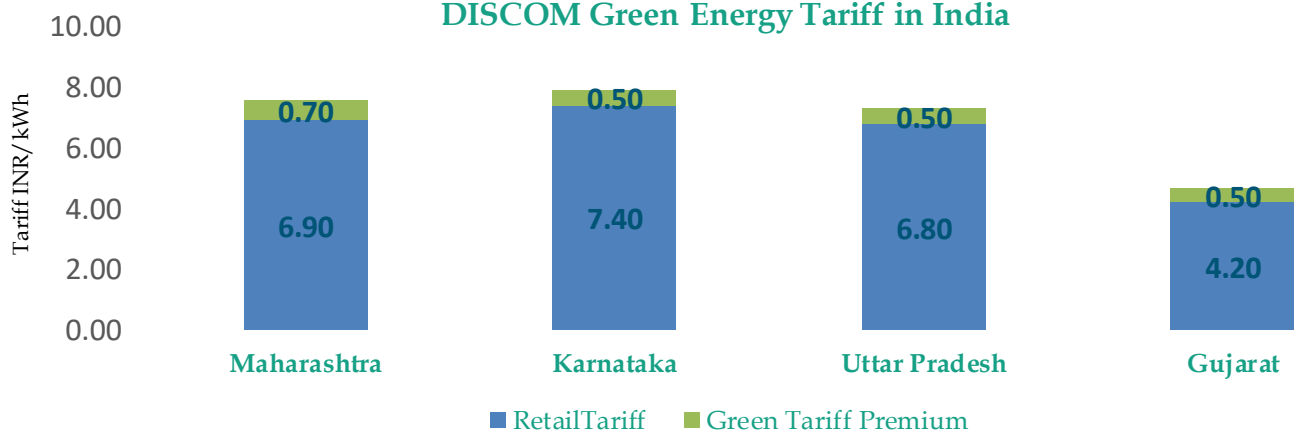
adsorption chiller by MITSUBISHI PLASTICS

Technology	SolabChiller from SolabCool	SOLACS08 from solarcombi+	Adref noa mayekawa Japan	adsorption chiller by MITSUBISHI PLASTICS
Sorption- refrigerant pair	**N/A**	**Silica Gel - Water**	**Zeolite - Water**	**Zeolite - Water**
Cooling Capacity (kW)	**2.5 – 5**	**7.5**	**90**	**10**

Utility Tariffs for Supply of Green Energy

- Commercial and Industrial (C&I) consumers have multiple options of going green. One of these methods is the purchase of electricity through **green energy tariff**. The Discoms procure electricity on behalf of consumer from RE project developers.
- Green tariff is a price structure offered by an electricity distribution company (DISCOM) which enables a consumer to purchase electricity **bundled with RE** attributes.

DISCOM Green Energy Tariff in India



- The green tariff is priced higher than the conventional retail tariff, with the premium over the retail tariff ranging from INR **0.5-0.7/kWh.**

Source: Tariff regulations of various State Electricity Regulatory Commission (SERCs)

Green Open Access

- Open access (OA) allows **corporates** (commercial and industrial electricity consumers), typically with a load of 1 MW or above, to directly enter into a contract with an RE project developer or set up their own power generation project (captive) and use the state grid to transport electricity.

Pic Credit: Google

- Ministry of Power has notified Electricity Rules, 2022 in order to further accelerate our ambitious renewable energy programs.
- The salient features and benefits to common consumers from 'Green Energy Open Access' are as follow:
  - The Green Open Access is allowed to any consumer and the limit of Open Access Transaction has been reduced from **1 MW to 100 kW** for green energy, to enable small consumers also to purchase renewable power through open access.
  - Consumers are entitled to demand supply of Green Power from Discoms.
  - **Commercial and Industrial consumers** are allowed to purchase green power on voluntarily basis.

Energy Saving through IoT

- Buildings consume **60%** of global electricity. There's been intense focus on ways to reduce consumption through the use of technology. Internet of Things (IoT) is one such technology.
- Building sensors connect physical building components wirelessly to a cloud-based management system (the internet of things) create what are known as smart buildings.
- IoT enables the collection and analysis of an enormous amount of data points on how a building is being used and enables adjustments that **drive further efficiencies**.
- The rapid development of computing power via the cloud has made IoT a vital part of the green building movement

Fig: IoT for Green Buildings

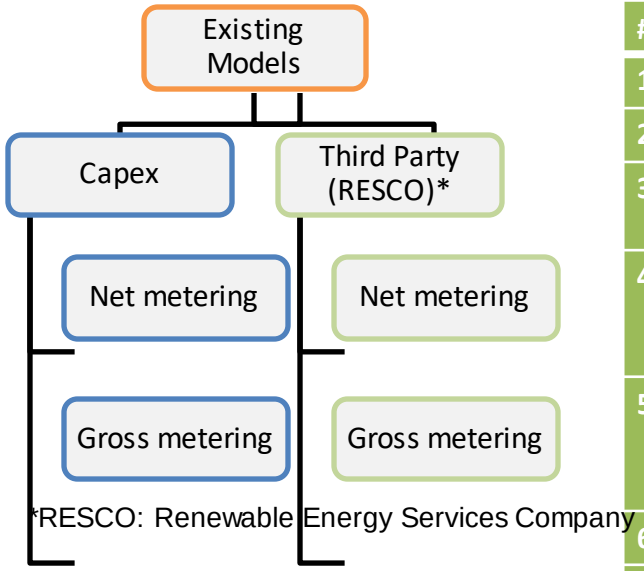
IoT provides following Advantages:

- Motion, space, & desk utilization
- Temperature controls
- Power optimization and analytics
- Smart lighting control & light level measurement

Business models for rooftop solar

Capex
Opex (RESCO)

CapEx and OpEx (RESCO)



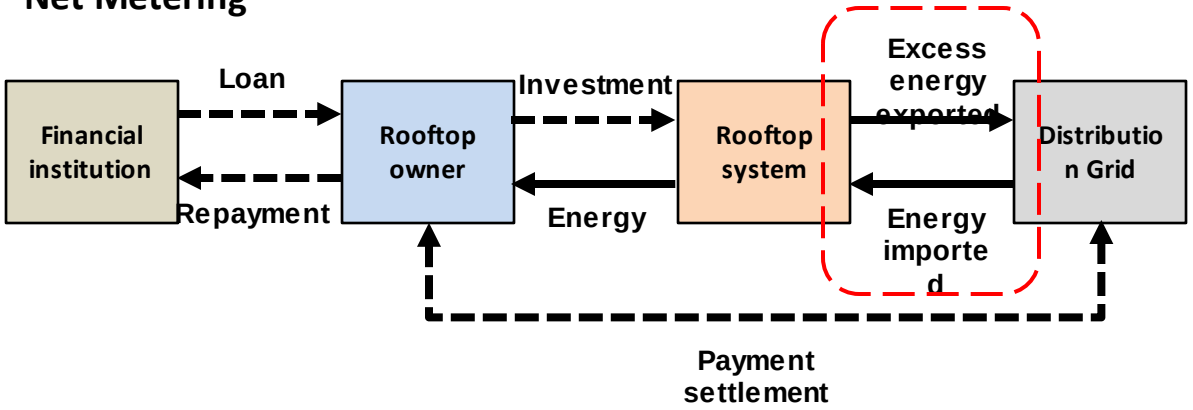
#		Capex	Opex
1	Ownership of plant	• Consumer	• RESCO
2	Installation by	• EPC contractor	• RESCO
3	Cost to consumer	• Upfront capital investment	• Monthly solar energy bill payment to RESCO
4	Means of investment recovery	• Savings on energy bill	• Savings as a difference between DISCOM tariff and solar tariff
5	Benefits	• No RESCO profits to be paid; • Full control over system components	• Negligible investment required; • Full plant ownership after around 15 years.
6	Payback period	• Around 4-6 years	• Not applicable
7	Challenges	• Securing funds/loans; • Selection of EPC contractor	• Selection of RESCO player

- **Net Metering:**
  - Energy generated from solar rooftop system is adjusted against energy consumption from DISCOM (Electricity Distribution Company)
  - Excess energy from solar is transferred to the grid, which may be redeemed later during conditions of shortfall (energy banking)
- **Gross Metering:**
  - All energy generated from solar is transferred to the grid
  - Settlement is done via Feed in Tariff (FiT) mechanism

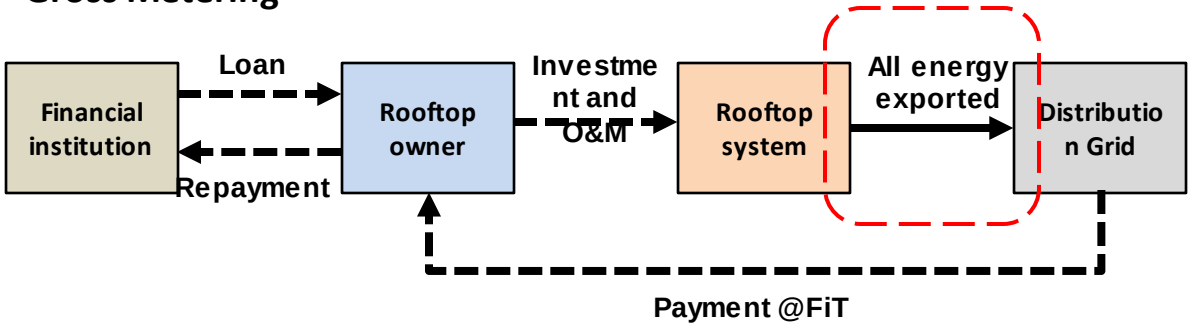
Capex Model

- Capex
  - All investments done by consumer
  - O&M also taken care of by the consumer
  - System set up by the selected EPC contractor
  - Expected payback period of 4-6 years

Net Metering



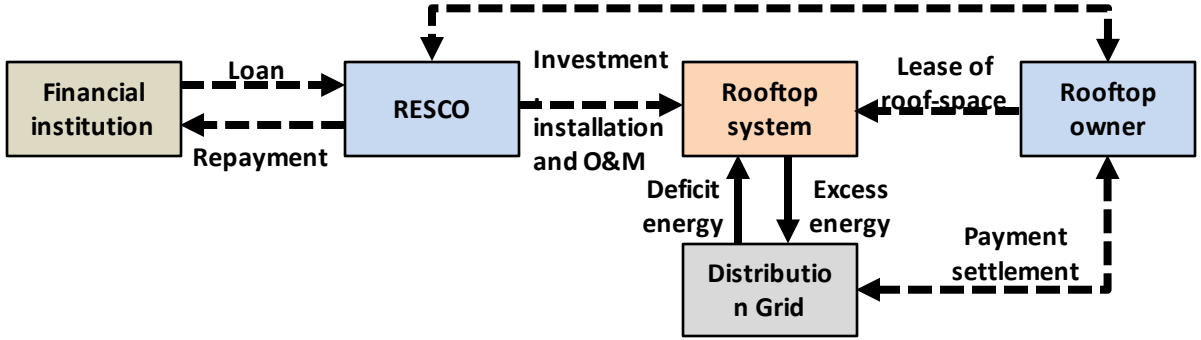
Gross Metering



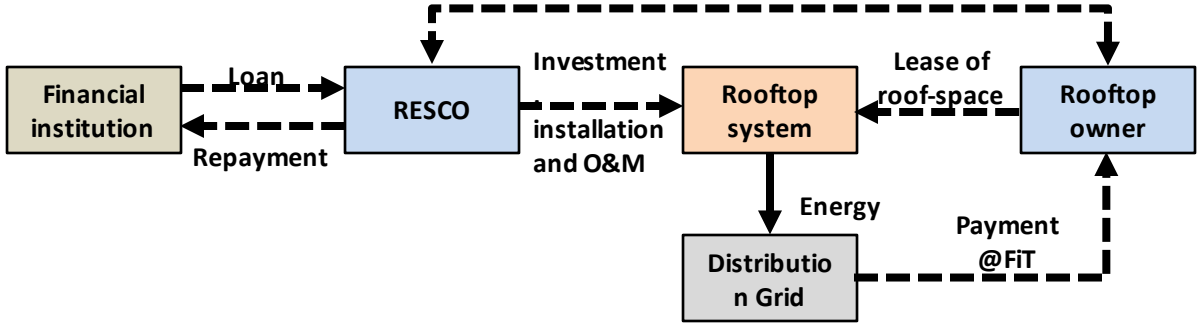
Opex Model

- Opex
  - All investments done by the RESCO
  - O&M undertaken by the RESCO
  - Usual contract tenure between RESCO and the consumer is 10-15 years
  - Beyond the contract tenure, consumer owns the plant

Net Metering



Gross Metering



Virtual Net Metering

- "**Virtual Net Metering**" means an arrangement whereby entire electricity generated from a Solar Project installed at Consumer premise or any other location is injected through Solar Electricity Meter and the electricity exported is adjusted in either **one or more than one** electricity service connection(s) of participating Consumer(s) located within the same Distribution Licensee's area of supply.
- Since the power flow is virtual, parties need not set up the system on consumer premises rather it can be anywhere within the Distribution Licensee area . This gives the opportunity for the system to serve more than one consumer.

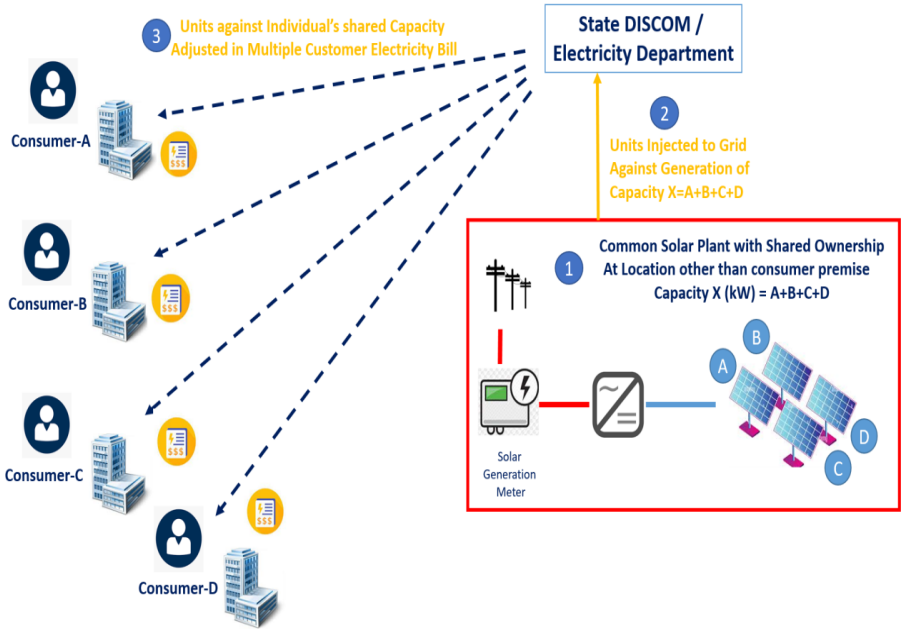
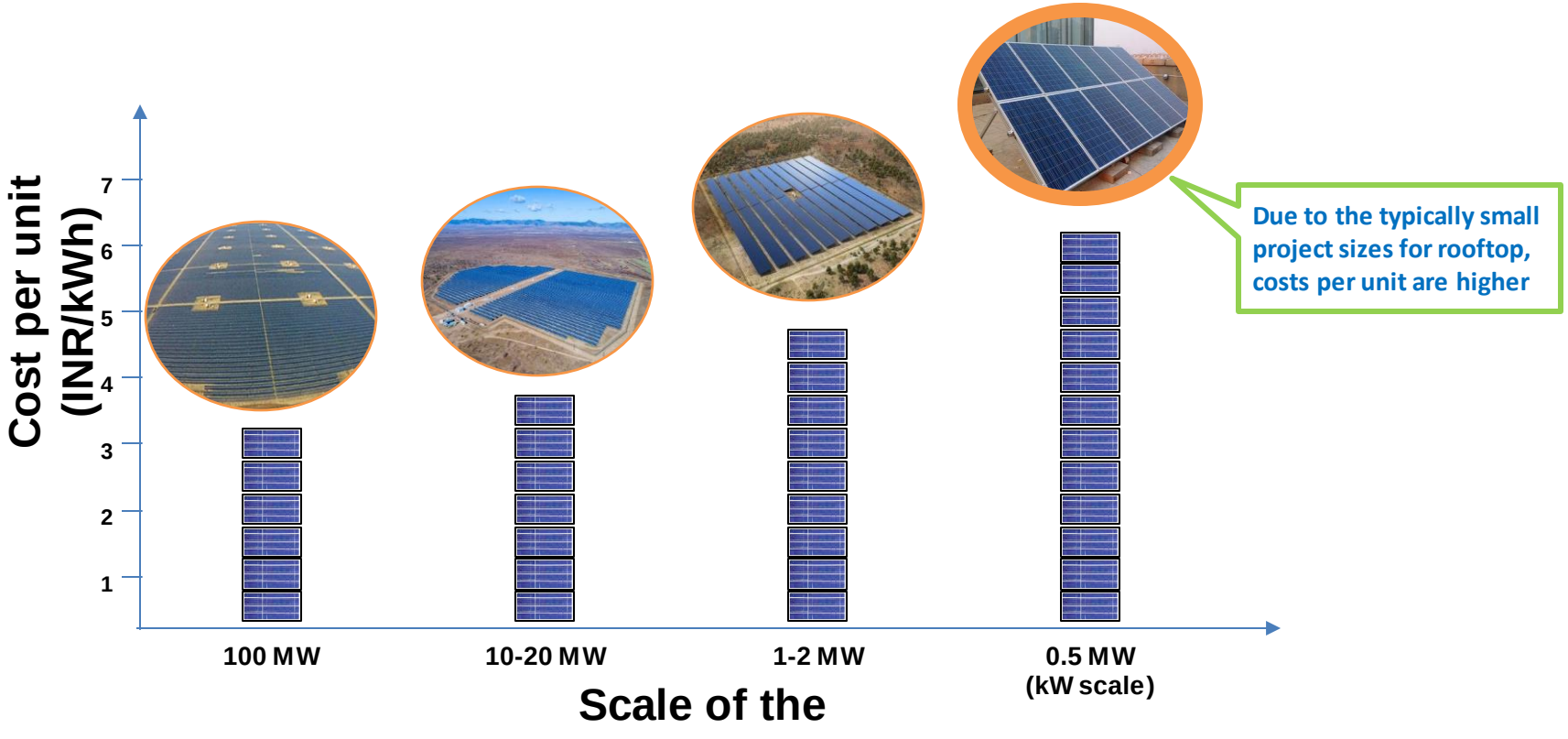


Figure: Concept diagram of Virtual Net Metering

Economies of scale for solar PV projects



Case Studies

- Indira Paryavaran Bhawan
- Mumbai airport
- Atal Akshay Urja Bhawan

India's first net zero energy building

- Indira Paryavaran Bhawan is India's first and highest green rated building.
- The project adopted green building concepts including conservation and optimization of water by recycling waste water from the site.
- It uses **70%** less energy compared a conventional building.

Pic Credit: Google

75% space is Day Lit

Energy efficient lighting system **LPD = 5 W/m²**

930 kWp Capacity

Annual Energy Generation :

14.3 lakh unit

Optimized Energy & HVAC system:

- Room temperature is maintained at **26 ±1 ° C**
- Total energy savings of about **40%** met through **Chilled beam system**
- **Geothermal cooling** for HVAC system

50% area outside the building is a soft area with plantation and grass

Reference: The Hindu

India's 100 per cent sustainable airport

- The Mumbai airport now* entirely runs on electric power generated by green, renewable sources of energy.
- CSMIA plans to adopt the following technologies to conserve energy further in their quest to reduce approximately **3,000 tonnes of GHG emissions**:
  - Conversion of belt-driven fans of Air handling units (AHUs) with **Electronically Commutated fans**
  - Replacement of cooling tower fills with **energy efficient fills**
  - Replacement of conventional lamps with **LEDs**
  - **IoT** based **temperature monitoring system** at Terminal 2 to optimise the energy consumption of the air conditioning system
  - Conversion of conventional fuel vehicles with electric vehicles (**EV**).

Pic Credit: Google

Electricity Requirement:

5%* from onsite Solar

95%* from Hydro & Wind

**As of August 2022*

Green Energy Tech Deployed:

2 kWp TurboMill

8 kWp Solar PV

36 kWhr/day

Transition to RE ensures a reduction of **1.20 lac tCO_2/year**

Reference: Business Today

Akshay Urja Bhawan, HAREDA

- Atal Akshay Urja Bhawan is an iconic landmark building symbolizing energy efficiency and renewable energy.
- Net-ZeroEnergy Green Building is designed on the concept of **solar passive architecture**.

Pic Credit: Google

All workspaces of the building are daylit. Efficient lighting with 25% reduced lighting energy use.

Spaces divided into zones as per desired temperature set points

- Apex offices (25 ± 1 °C)
- Controlled office and public areas (25 ± 3 °C)
- Passive zones (25 ± 5 °C)

42.50 kW Installed BIPV (including Rooftop)

- Energy required by HAREDA 62415 kWh
- Energy production from solar PV 67343 kWh
- **Excess energy produced 4928 kWh**

Solar chimneys aid ventilation in some of the non air conditioned spaces

CO2 Credits **308 tonnes/year**

Reference: MNRE

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