@ Indian Institute of Metals, Delhi Chapter

Utilisation of Solar Energy in Industries

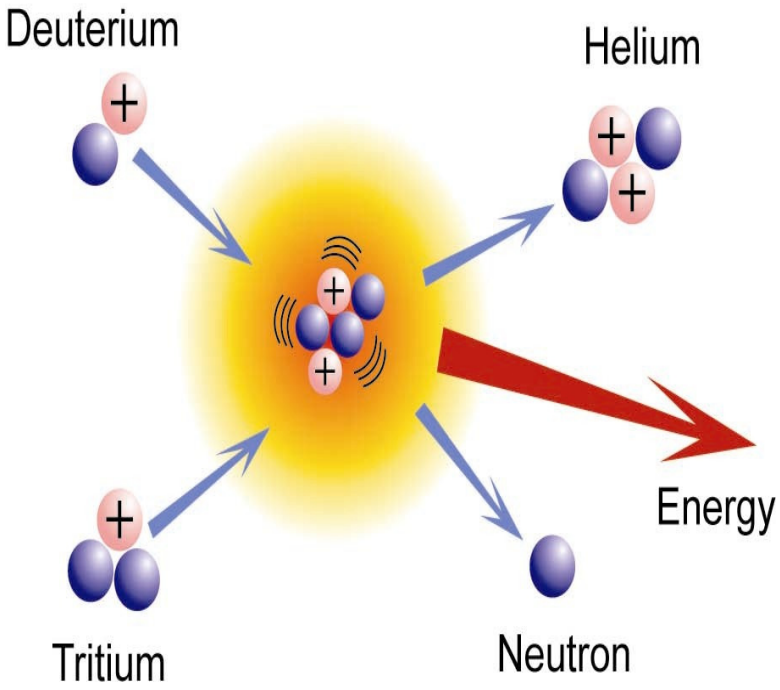
Dr. Shamik Baranwal

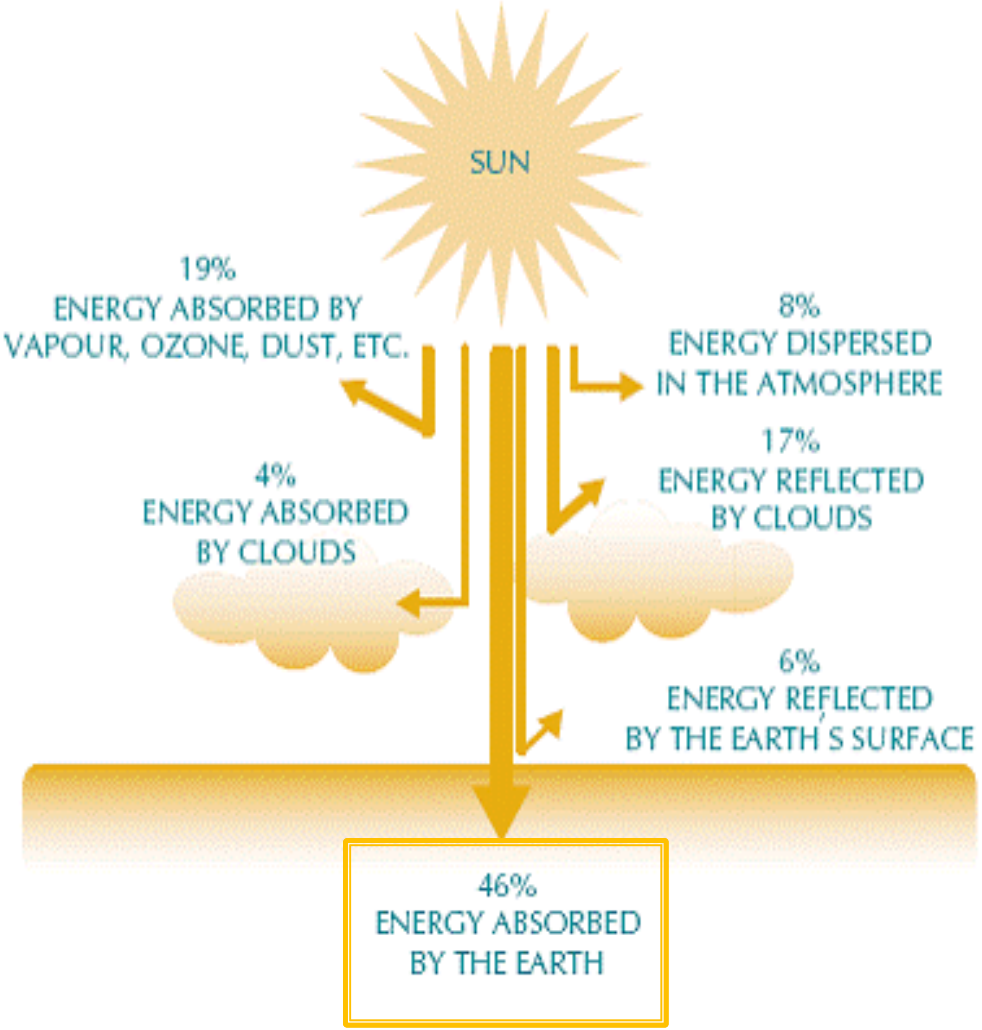
&

Ankit Malhotra


Welcome

Radiant Energy





Solar Energy

- Worlds Energy Requirement 567 Exajoules / year (2013)
- Total solar energy absorbed by Earth is approximate 3,850,000 exajoules (EJ) per year
- The amount of solar energy reaching the surface of the planet is so vast that in one year it is about twice as much as will ever be obtained from all of the Earth's non-renewable resources of coal, oil, natural gas, and mined uranium combined.
- 5,000 Trillian KWh per year of Sun Energy over India. Most of the parts receives between 4 to 7 KWh per sq m per day.

Major Uses of Solar Energy

- Drying Agricultural Products
- Heating Water
- Space Heating
- Generating Electrical Energy

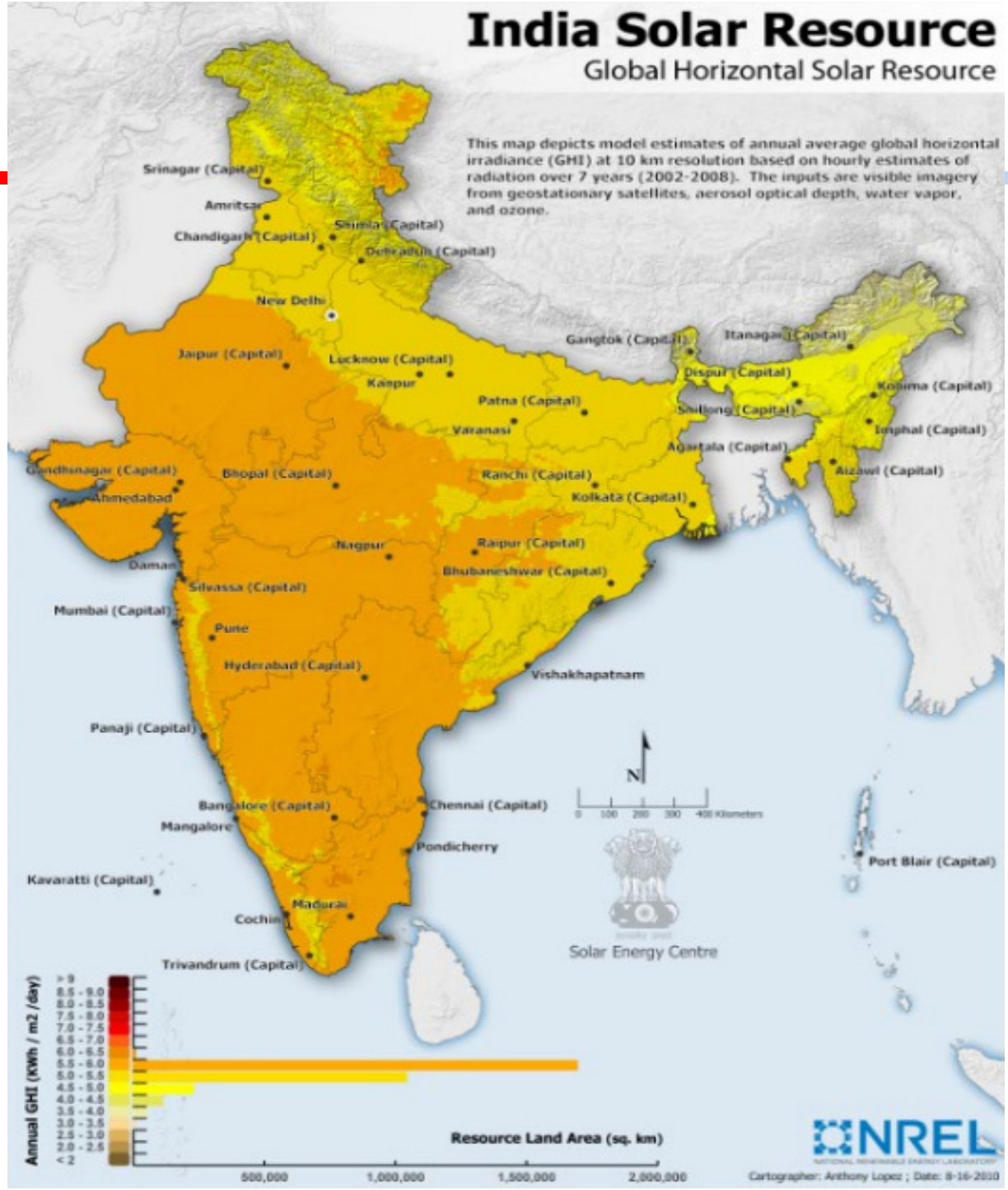
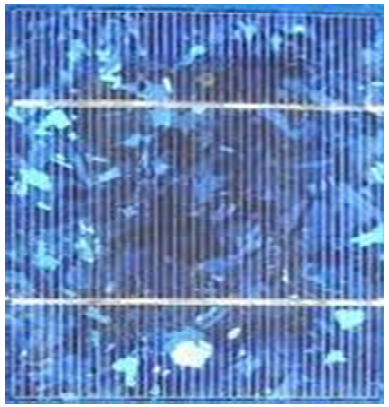

India Solar Resource
Global Horizontal Solar Resource
This map depicts model estimates of annual average global horizontal irradiance (GHI) at 10 km resolution based on hourly estimates of radiation over 7 years (2002-2008). The inputs are visible imagery from geostationary satellites, aerosol optical depth, water vapor, and ozone.
Srinagar (Capital)
Amritsar
Chandigarh (Capital)
Shimla (Capital)
Dehradun (Capital)
New Delhi
Jaipur (Capital)
Lucknow (Capital)
Kanpur
Patna (Capital)
Varanasi
Gangtok (Capital)
Itanagar (Capital)
Dispur (Capital)
Kohima (Capital)
Shillong (Capital)
Imphal (Capital)
Agartala (Capital)
Aizawl (Capital)
Gandhinagar (Capital)
Ahmedabad
Bhopal (Capital)
Ranchi (Capital)
Kolkata (Capital)
Nagpur
Raipur (Capital)
Bhubaneshwar (Capital)
Daman
Silvassa (Capital)
Mumbai (Capital)
Pune
Hyderabad (Capital)
Vishakhapatnam
Panaji (Capital)
Bangalore (Capital)
Chennai (Capital)
Mangalore
Pondicherry
Port Blair (Capital)
Kavaratti (Capital)
Madurai
Cochin
Trivandrum (Capital)
N
0 100 200 300 400 Kilometers
Solar Energy Centre
Annual GHI (KWh / m2 /day)
> 9
8.5 - 9.0
8.0 - 8.5
7.5 - 8.0
7.0 - 7.5
6.5 - 7.0
6.0 - 6.5
5.5 - 6.0
5.0 - 5.5
4.5 - 5.0
4.0 - 4.5
3.5 - 4.0
3.0 - 3.5
2.5 - 3.0
2.0 - 2.5
< 2
Resource Land Area (sq. km)
500,000
1,000,000
1,500,000
2,000,000
NREL
Cartographer: Anthony Lopez ; Date: 8-16-2010

Photo Voltaics

- Photovoltaic material generate electricity when light falls on it
- Silicon is commonly used PV material in solar panels

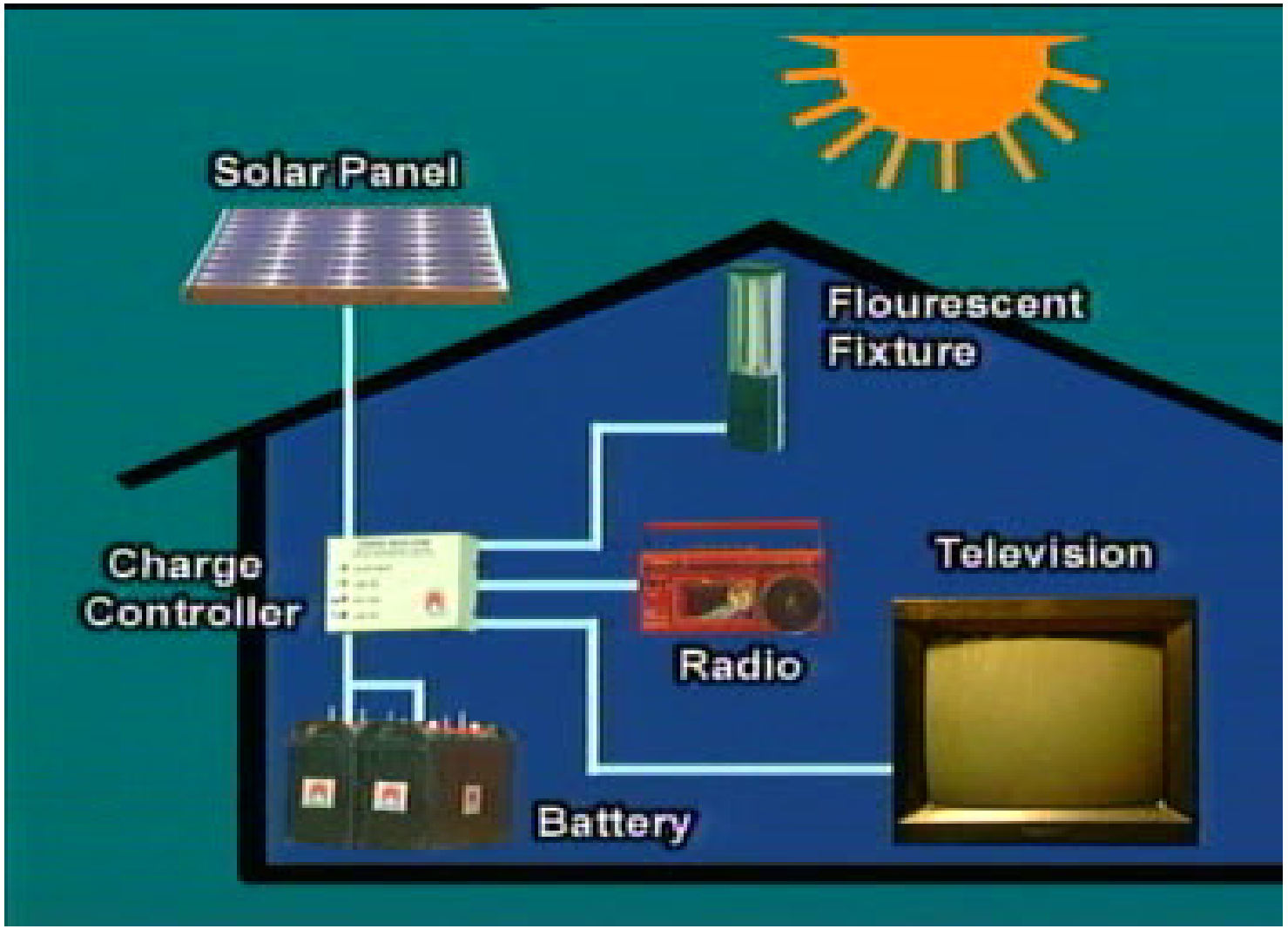
Polycrystalline



Amorphous

Monocrystalline

Solar PV system - Working



LESSONS LEARNT

Site Selection

Site Selection at many times changed after start of work due to some unforeseen issues

Soil Testing

Annupur, Madhya Pradesh

✓ Battery weight sunk the floor of control room

Civil works & Infrastructure Preparation

- Civil works are very important and proper planning will result in good saving
- **Main civil works**
  - Terrain levelling
  - Accesses and inside roads/paths
  - Trench opening (AC & DC)

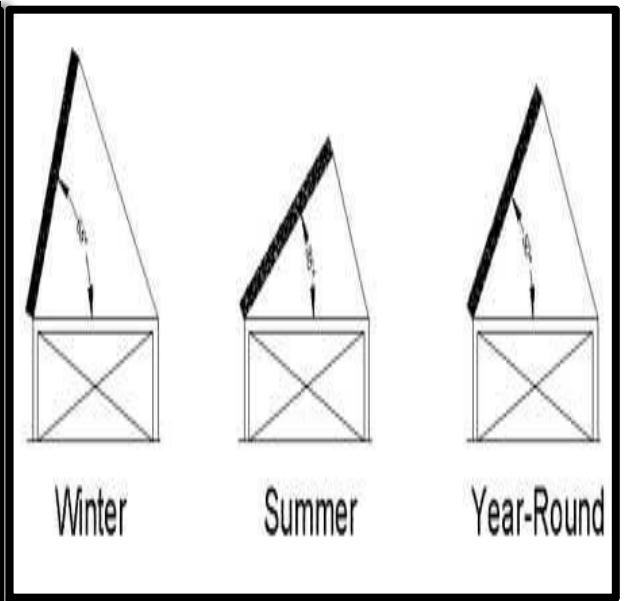
Load Analysis

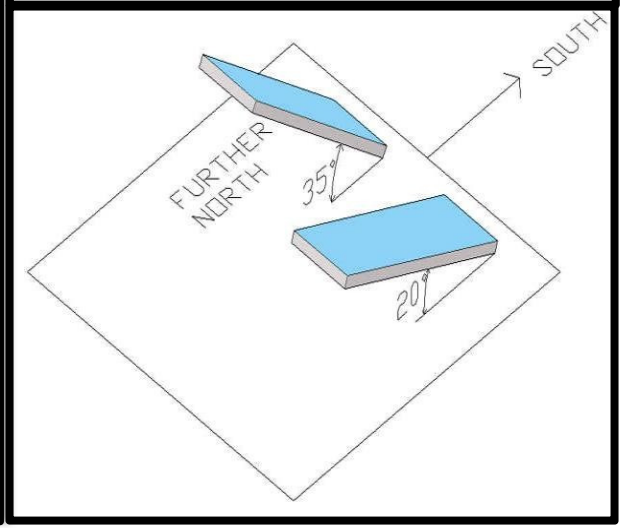
Material weight (average weight per square meter)

Element	Weight
Structure	2 KG
Crystalline panels	15 KG
Thin film glass-glass panel	22 KG
Thin film laminated panel	6 KG

- Wind effect
- During the design, both panel height and exposed surface must be considered
- Extra loads during the execution: Tools, workers, materials etc.
- Accesses: The accesses will be distributed all along the roof surface, guaranteeing the worker safety and allowing them to carry up small materials and tools

Survey & Shade Analysis





Mechanical works

- For fixed installations, the structure can be set parallel to the surface where it is to be installed (flat) or with the optimum tilt for each latitude (Tilted)

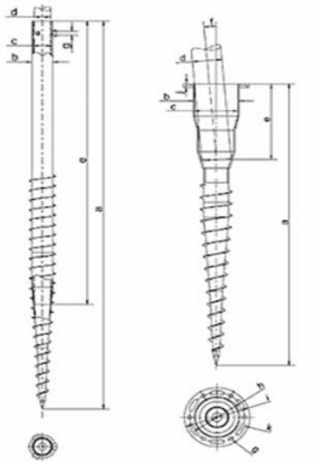
Flat	Tilted
No wind action	Important wind action
Worse cooling	Best natural cooling
Lower cost (Both for structure & mounting)	Higher cost (Both for structure & mounting)

Mechanical works

The structure anchor for a ground installation may have the following possibilities

Ground anchor

- These screws have an average length between 1 to 1.6 meters
- Easy dismounting
- Can be adapted to the terrain profile
- They can't be used in a rocky terrain



Concrete base

- Above or under the ground
- It requires a flat surface
- Easy to Install

Roof Mount

- Penetrate the roof as little as possible
- Weather proof all holes to prevent leaks
- Leave 4-6” airspace between roof and modules
- On sloped roofs, fasten mounts to rafters not decking

Structures

- ✓ Design wind speeds up to 180 kmph
- ✓Extruded aluminium or GI structure
- ✓Structure Design Life 25 years

Roof Installation

- Cable canalization might be done under hot galvanized cable tray or tubular conduit
- Cable tray canalization simplifies mounting works, and eases the maintenance tasks.
- Indoor, plastic(or metallic) cable tray might be used, as well as halogen-free cable

Ground Installations

- **Electrical works** will be done in the **trenches**, so the cable must be designed for this use.
- **It is recommended to use anti-mice cable, inside a tubular conduit.**
- Cable trenches might be really long, so the trench design, number of cables by pipeline, extra space by pipeline, manholes, etc.. Could be decisive to optimize the electrical works duration
- The cable should be nicely marked in order to avoid connecting issues
- It is important to avoid corners or any element which may cause any damage to the cable isolation.

Lightening

- Experience of a lightning bolt very close to the plant resulting in:
  - Damaged Inverters
  - Burnt Grass
- Lightening arrestors should be sufficient to cover the entire plant
- External Surge Protection Devices must be used both at the DC input and AC output

Battery

- Battery is sized to give desired autonomy.
- Ensure autonomy of at least 3 days
- Use Gel Tubular batteries
- Prolong lifetime by ensuring proper charge and discharge cycle
- Ensure tenders have specifications built-in for 10 year maintenance contract

Weather Monitoring System

Outdoor temperature
(Optional)

Irradiance

AC Power (at the meter output)

TEMP. PANEL FV

Case Studies

BOOND ENGINEERING & DEVELOPMENT PVT. LTD.

Boond

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सत्यमेव जयते
Government of India
Ministry of New and Renewable Energy

ISO 9001 CERTIFIED

Marketing Associates:
AdviZ Consulting & Solutions Pvt. Ltd.

Milk Testing

In collaboration with Purica, a for-profit milk co-operative based in Unnao, Uttar Pradesh, Boond innovated and re-engineered the Milk collection chain by centralizing milk storage at a smaller number of chilling facilities while using a large number of small, rural solar-powered collection centers.

Traditionally, dairy supply chains involved an intermediary, who bought from small farmers, transported the milk and re-sold it to dairy companies. However, this intermediary stage adds extra cost and often leads to quality control problems as intermediary milk buyers may be tempted to alter the milk by adding water or other substances in order to inflate volume.

- Supply chain became more efficient
- Improved Quality Control
- No Middle-man, profit directly to the seller
- Reduced cost and Energy use

Micro / Pico Grids

Boond has developed innovative technology solutions that can cater to basic energy needs of households in a very cost effective manner. The solution is analogous to modern day grid based energy, where a centralized solar unit produces the energy that is distributed to a number of households. Boond realized that different family demographics have different kinds of energy requirements relevant to their households or businesses and therefore implemented the distribution of power primarily in 3 different payment system, ensuring that the poor households don't have to pay for the solar assets and can enjoy energy as a service.

- 3 Payment system – Pre Paid, Post-Paid, Dynamic Pricing based.
- Controlled / Charged by customised mobile application
- Direct online update of CRM system via internet to know user requirement and usage
- Successfully implemented model in many villages of Unnao district of Uttar Pradesh

Light for Education (LFE)

LFE seeks to provide a reliable, clean and safe lighting source for the benefit of students and their education. In this programme, students are given portable LED study light powered by a solar charging station installed inside school premises, with the expectation of increased attendance and positive externalities for households in the areas of indoor air pollution, productive utilisation of light and resource-sharing with parents and younger siblings.

- Centralized charging station at a school
- The study light, kept in the student's house
- A pocket size battery pack, charged at school to power the study light

Unique Projects

BOOND ENGINEERING & DEVELOPMENT PVT. LTD.

Boond

Marketing Associates:

AdviZ Consulting & Solutions Pvt. Ltd.

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सत्यमेव जयते

Government of India

Ministry of New and Renewable Energy

ISO 9001 CERTIFIED

150kW Solar On Grid Power System
Delhi Metro Station, Badkal Mor, Faridabad

150kW Solar On Grid Power System
Delhi Metro Station, Badkal Mor, Faridabad

40kW Solar On Grid Power System
Jesus & Mary College, Chanakyapuri, New-Delhi

55kW Solar On Grid Power System
Palwal, Haryana

AdviZ Consulting and Solutions Pvt. Ltd.
FOR THOSE WHO CARE FOR THE SOCIETY
Mobile: ***+91 99 535 23849, +91 98 197 26402***
Email: ***info@adviz.in***