

*Presentation at*

**THE WORLD FUTURE ENERGY FORUM (WFEF) 2016**  
**International Conference on**  
**Affordable, Reliable and Sustainable Energy for the Future**  
**Beijing (China)**

**CANAL TOP SOLAR POWER PLANT**  
**AN INNOVATIVE INITIATIVE**

*Presented by :*

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**29<sup>th</sup> June 2016**

***Chairman & Managing Director,  
Sardar Sarovar Narmada Nigam Limited,  
Government of Gujarat***

# Millennium Development Goal No. 7

Ensure access to affordable, reliable, sustainable and modern energy for all:

- § Make Solar Energy economical
- § Ensure safe nuclear power
- § Provide energy from renewable sources
- § Increase efficient use of energy



# Mission of SSP

*Harnessing the untapped waters of the Narmada for survival of millions of people and environmentally sound sustainable development of western India by providing the essence of life-Water and Energy.*



# Sardar Sarovar Project

## Bringing Growth and Prosperity

- § One of the largest multipurpose projects in the world
- § World's second largest concrete gravity dam – An engineering marvel and a massive human effort
- § Irrigation facilities to 1.8 million hectare of land serving 1 million farmers
- § Drinking water supply to 29 million people including parched areas of Kutch and Saurashtra
- § Hydro Power generation of 1 Billion KWH per year
- § One of the largest Canal networks with 458 km of main canal and 71,750 km total length
- § Enormous clean and renewable energy potential



# Hydropower

## § River Bed Power House – 1200 MW

- Six Units of Francis Reversible Turbines
- Penstock Diameter 7.6 m

## § Canal Head Power House – 250 MW

- Five Units of Kaplan Turbines
- Penstock Diameter 6.7 m

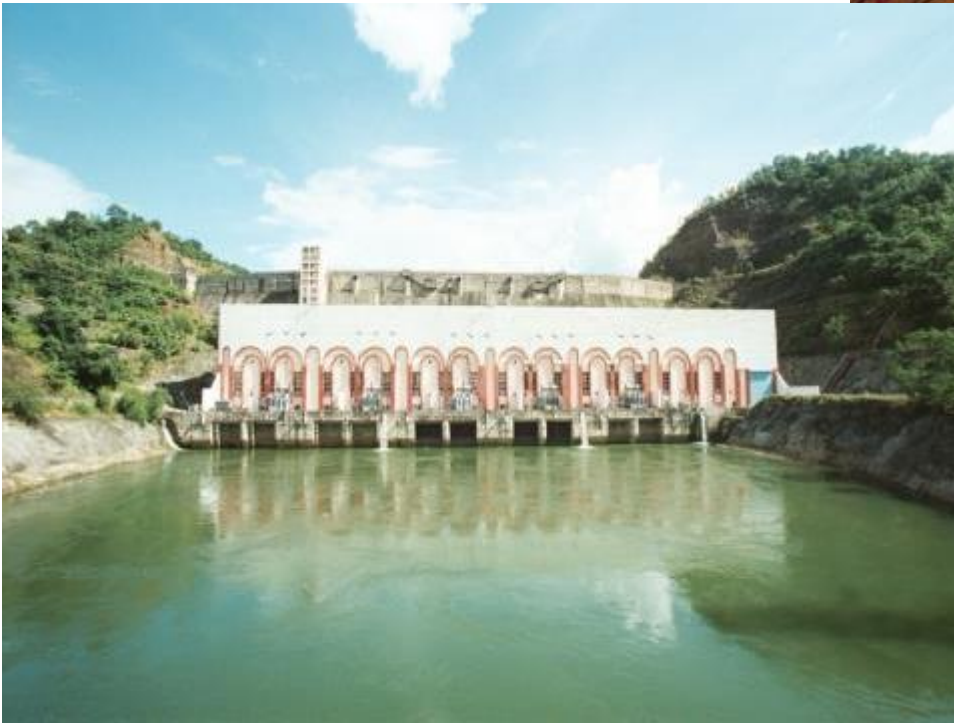
## § Both the Power Houses fully operational from June 2006 onwards

## § More than 37,826 Million Units of electricity generated till date

## § Even at Rupees 2.05 (US 3.4P) per Unit, USD 1286 million

*Substantially recovered the cost of the Main Dam*

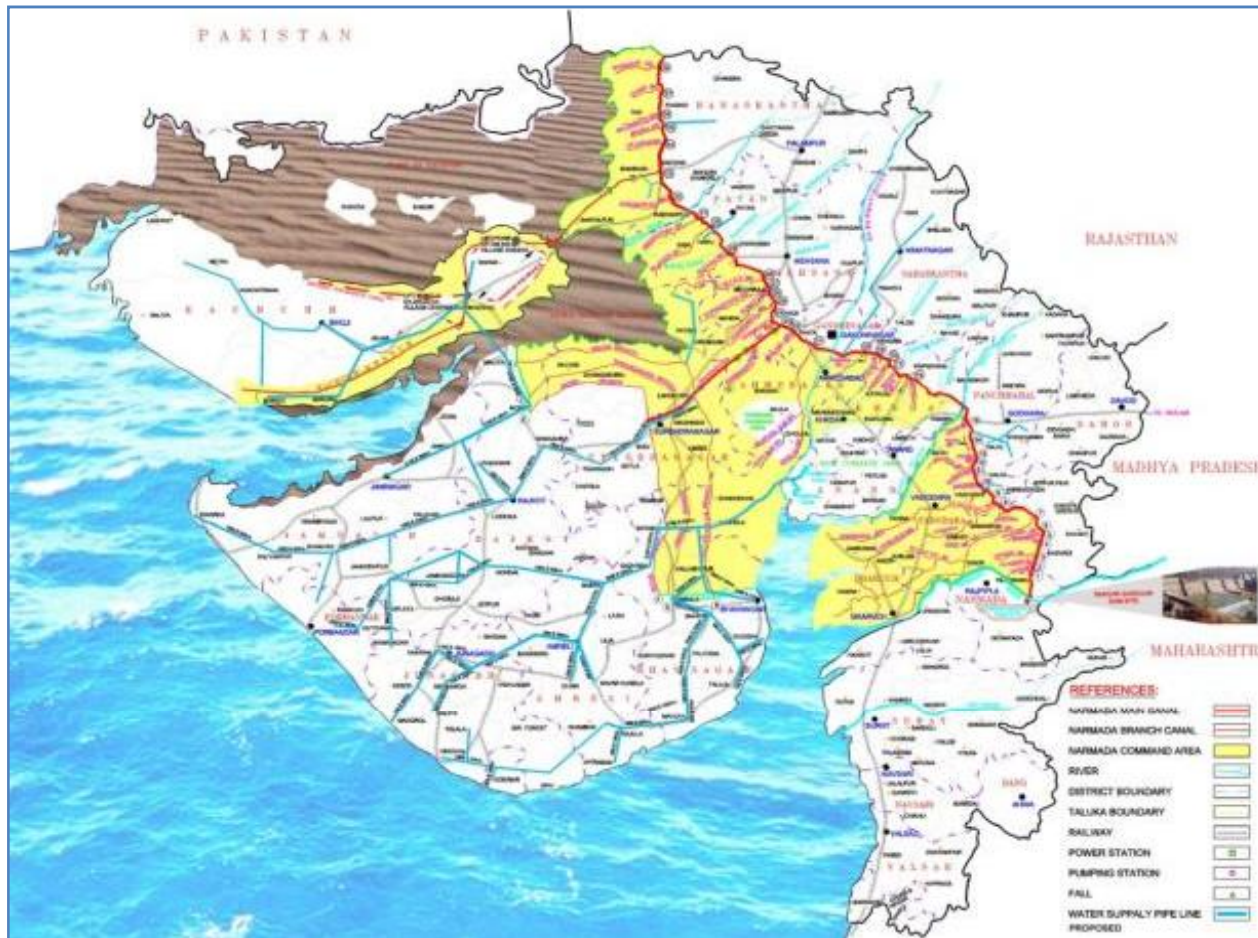
1200 MW RBPH



250 MW CHPH

*More than 37,826 Million Units of Electricity Generated*



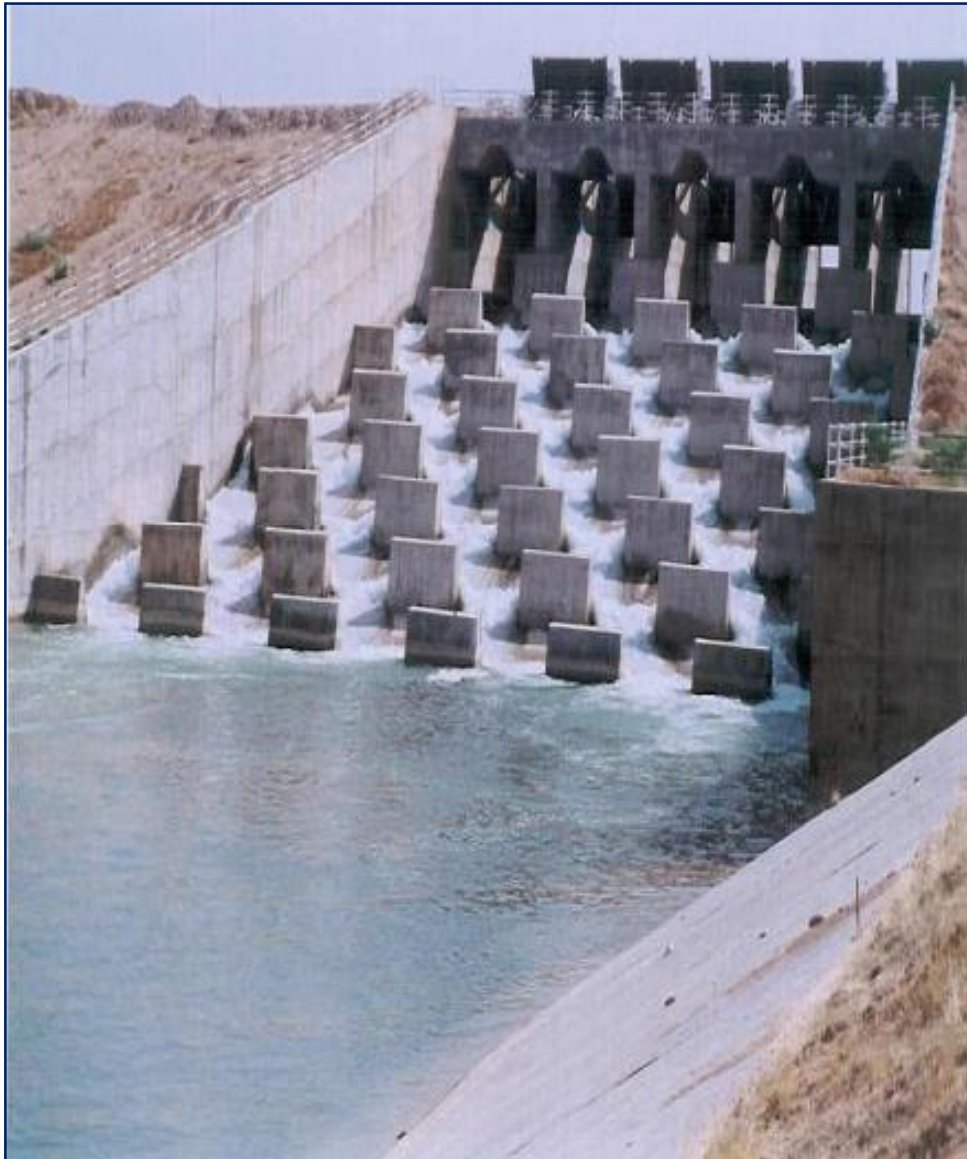


# Small Hydro Power Projects under progress

Sr. No.	Package	No. of Locations	Power Potential
1	Vadodara Branch Canal Package	6	(7 x 0.35 MW 4 x 0.30 MW 2 x 0.75 MW) Total 5.15 MW
2	Miyagam Branch Canal Package	6	(16 x 0.75 MW) Total 12 MW
3	Saurashtra Branch Canal Package	3	(9 x 5 MW) Total 45 MW
4	Kachchh Branch Canal Package	3	(7 x 3.33 MW) Total 23.31 MW
Total		18	85.46 MW

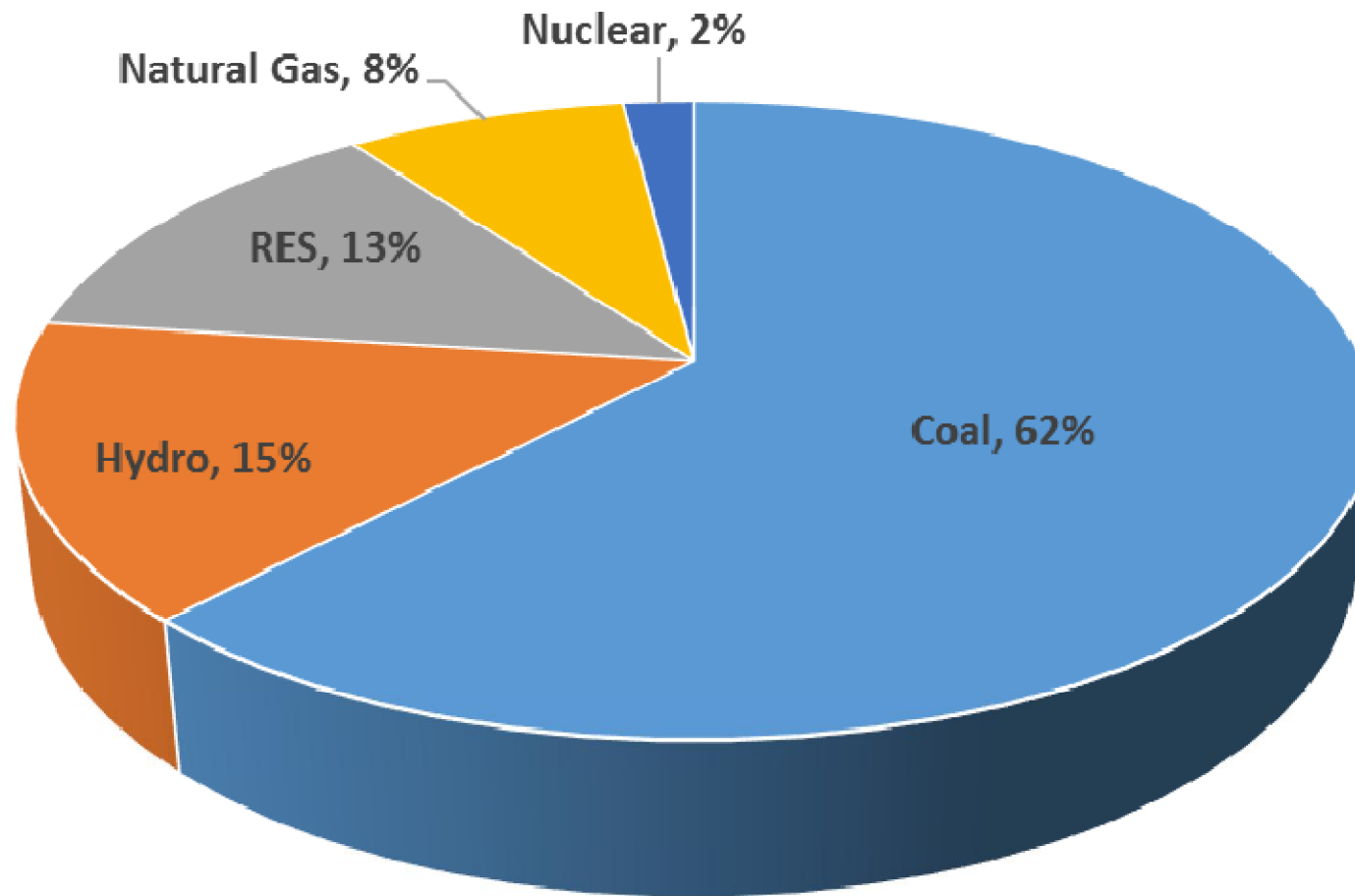


# Harnessing the Potential of Small/Micro Hydel

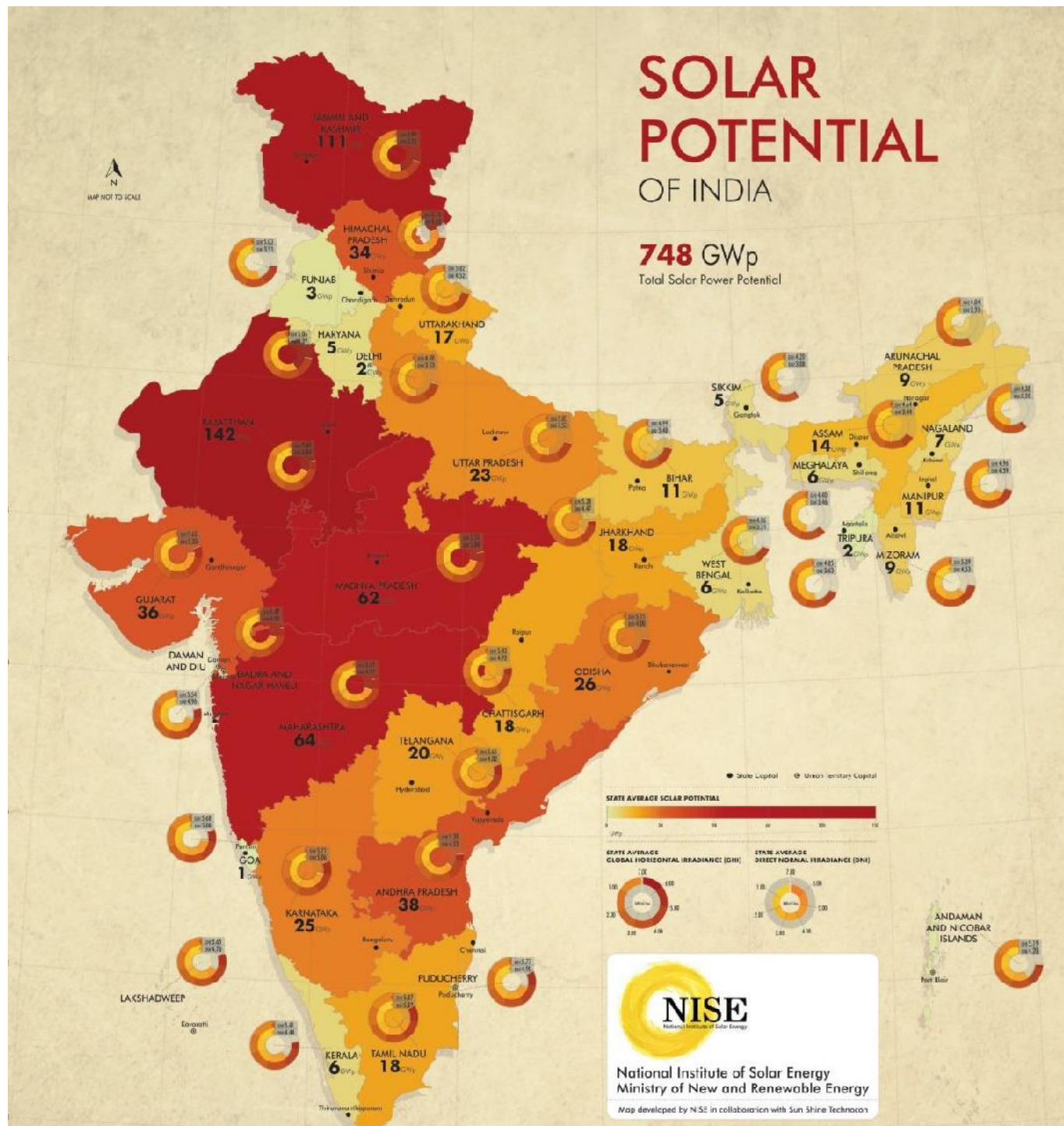


# Sources of Electricity (India) in 2016

## § Sources of Electricity in India by Installed Capacity



*Source: Govt. of India's Central Electrical Authority Report , Dt. 31-01-2016*



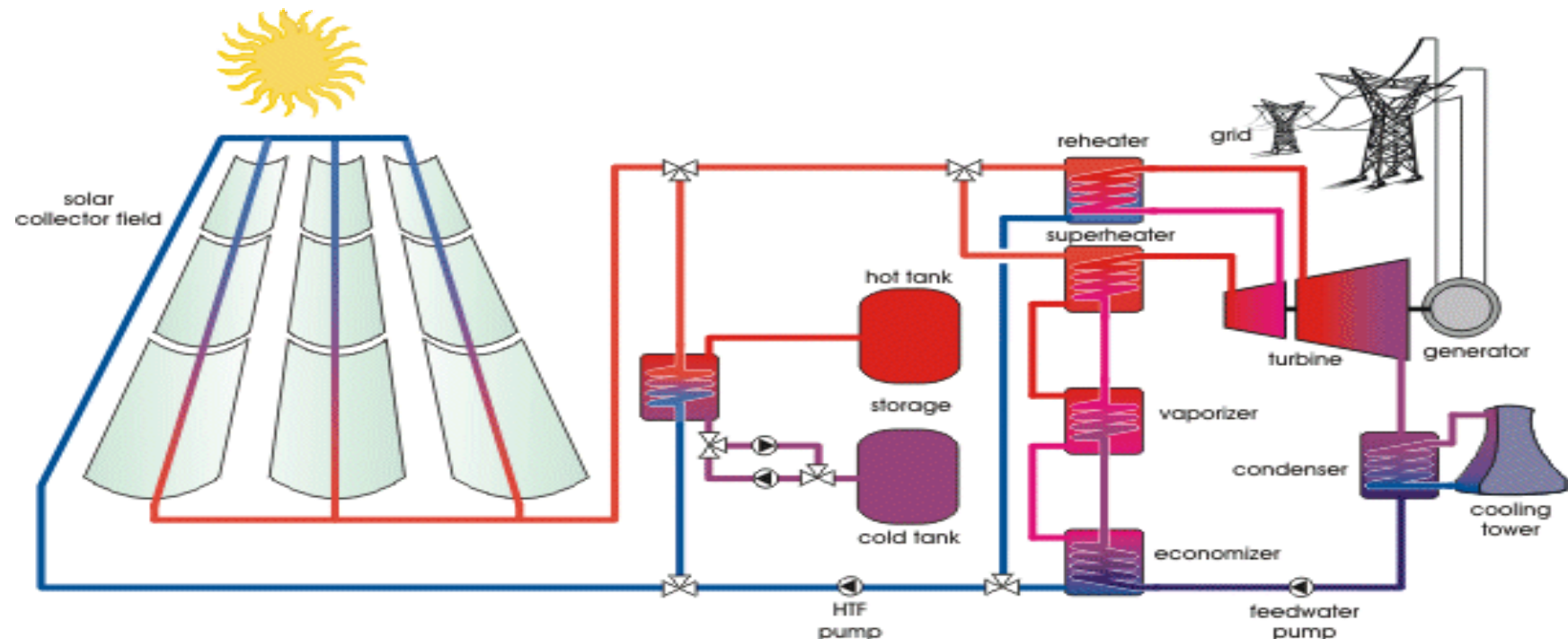


# Solar Power Generation

Solar power is the conversion of sunlight into electricity, either directly using photovoltaics (PV), or indirectly using concentrated solar power (CSP).

## Concentrated Solar Power Plant:

CSP is same as like other thermal power plant but the fuel used is solar energy, solar energy is collected through troughs and is concentrated on a particular point containing fluid and the heat carrying fluid in turn converts the water into steam, which then rotates turbine and generates electricity.



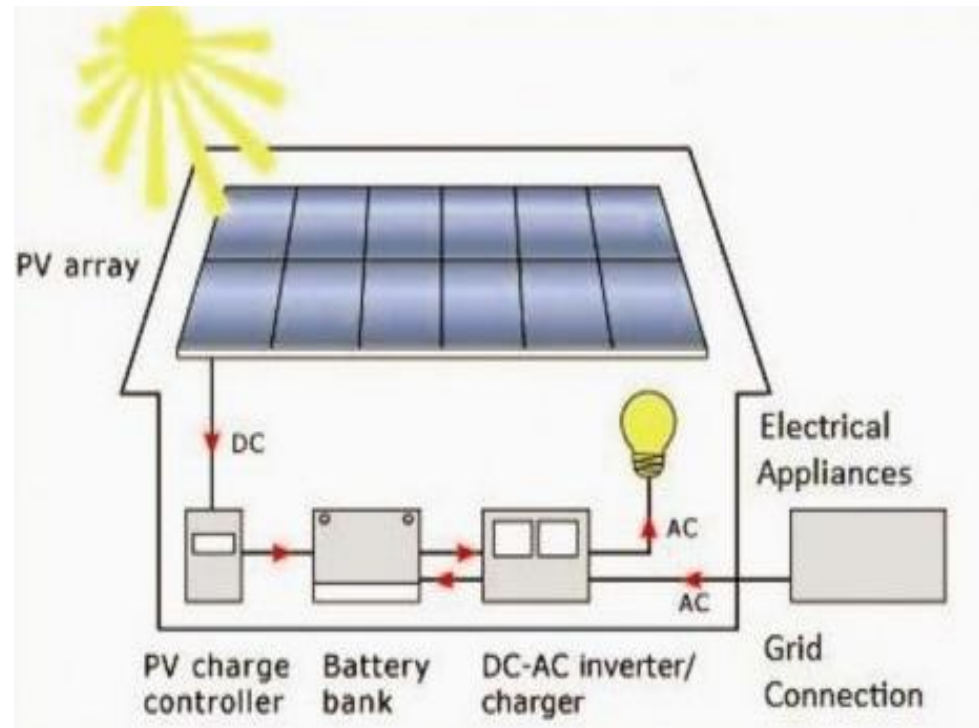
# Solar Photovoltaic Power Plants

The word Photovoltaic is a combination of the Greek word for Light and the name of the physicist Allesandro Volta. It identifies the direct conversion of sunlight into energy by means of solar cells.

PV based solar power plants are constructed mainly of three types as mentioned below:

## A) Roof Top Solar Power Plants:

- These power plants are of captive use and are constructed on top of the roof of houses/buildings.

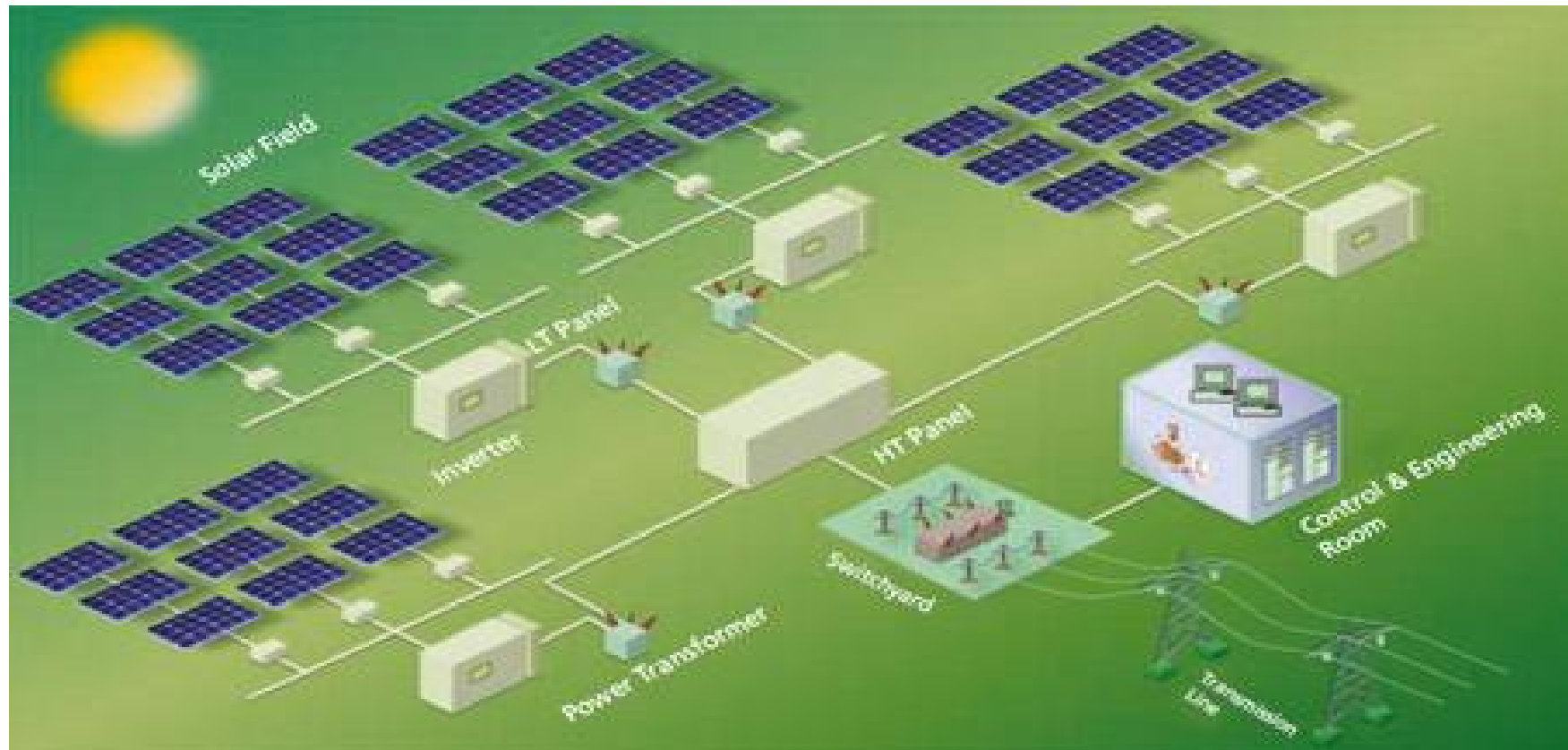


# Solar Photovoltaic Power Plants

## B) Ground Mounted Solar Power Plants:

These grid connected solar power plants are constructed in the open lands and the mostly commonly used technology/method for solar power generation.

Main disadvantage of these type of ground mounted power plants is it requires more land for construction.





# Solar Photovoltaic Power Plants

## C) Canal Top Grid Connected Solar Power Plants:

In future with the extinct of fossil fuels, solar power plant may tend for the major source for the power generation.

Since the Ground mount solar power plants occupies more land and to decrease the consumption of the useful lands and better use of the available space Gujarat Government implemented a pilot project by constructing 1 MW solar power plant on the top of canal.

Following its successful operation, second project with higher capacity and on higher width of Canal i.e., 10 MW canal Top Solar Power Project has been implemented on Vadodara Branch Canal.

Another 35 MW Canal Top Solar Power projects are on going

# Solar Powered Semington Dock Kennet & Avon Canal - UK



# Solar Cover for Swimming Pool





# PILOT PROJECT

## 1 MW CANAL TOP SOLAR POWER PROJECT

# 1MW Pilot Project



# Project Data

Length of branch canal occupied by solar structure:	750 m.
Bed width of canal:	3.5 m.
FSD of canal:	1.6 m.
Side slope:	1.5:1
Free board (total):	0.6 m
Top width of canal @ FSL:	8.3 m

## *Solar Panel Data*

### ***Panel Size:***

*16 m X 4 m*

### ***No. of Panels:***

*113*

### ***Total area of structure :***

*$750 \times 16 = 12000 \text{sqm}$*

### ***Area occupied by Panels :***

*$113 \times 4 \times 16 = 7232 \text{sqm}$*

### ***Water area under Panels @ FSL:***

*$4 \times 113 \times 8.3 = 3751.6 \text{sqm}$*





Innovative Idea: Cover the canal with Solar Panels to

- § Minimize evaporation from canal
- § Produce eco-friendly power using solar panels as the cover
- § Save Land

Benefits from the project:

- § 1.6 million units of power to be generated annually
- § 9 million litres Water to be conserved annually
- § 6 acres of Land Conserved
- § Less Algae Growth in the canal water

# Inverter (4 Nos. 220 kW) & Control Room



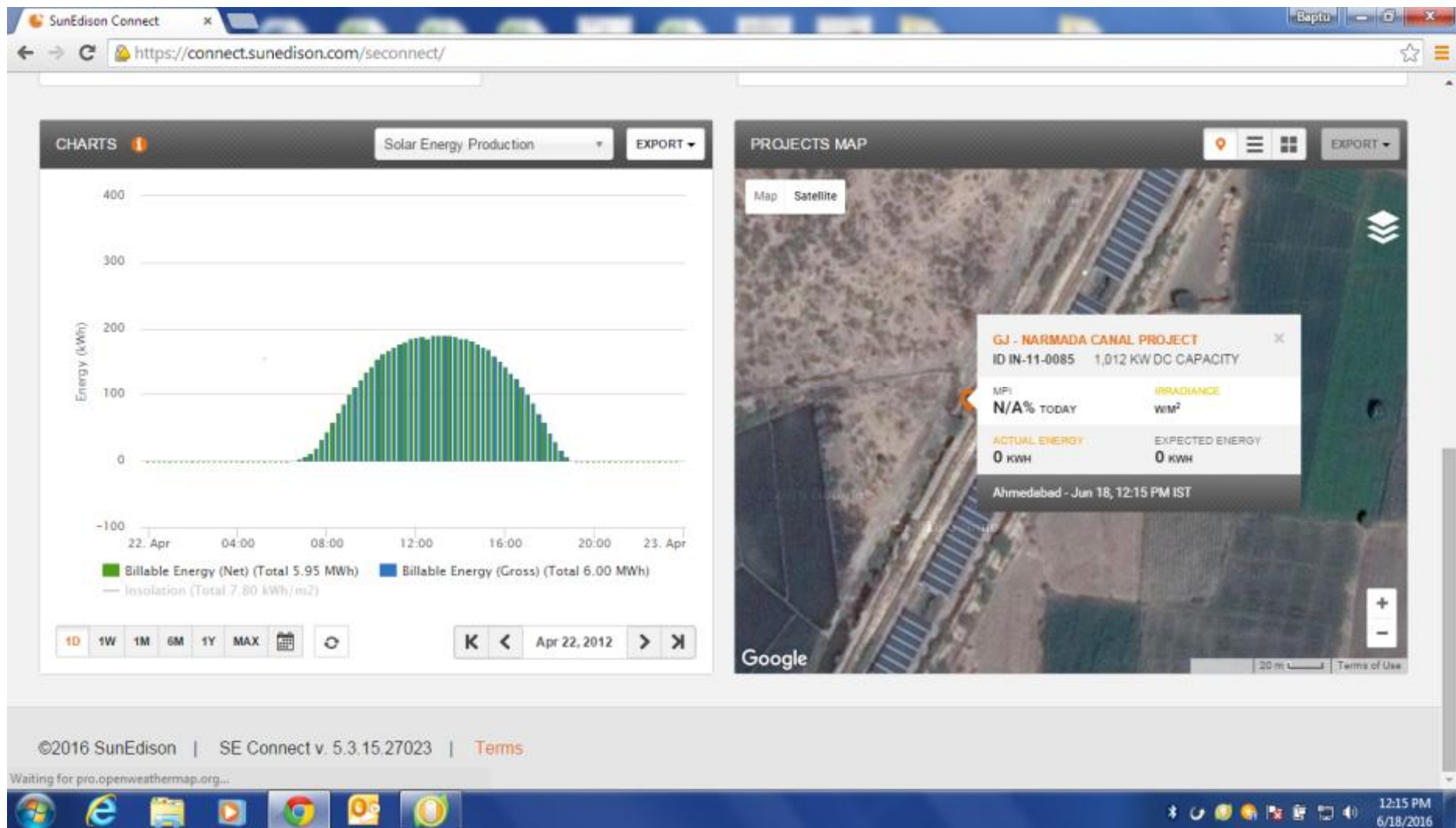


# Intermediate Gap left for Canal Maintenance





# Screen shots of 1 MW Canal Top Solar Power Plant



# 1MW Pilot Project



# 10 MW CANAL TOP SOLAR POWER PROJECT

# Project data

Length of branch canal occupied by solar structure:	3600 m.
Bed width of canal:	5.5 m.
FSD of canal:	3.7 m.
Side slope:	1.5:1
Free board (total):	0.9 m
Top width of canal @ FSL:	16.6 m
Top width of canal @ TBL :	20.2 m

## *Solar Panel Data*

### ***Panel Size:***

*1.956m X 0.992m X 0.04 m*

### ***No. of Panels:***

*33816*

### ***Total area of Structure:***

*75000 sqm*

### ***Area occupied by Panels :***

*65600 sqm*

### ***Water area under Panels @ FSL:***

*52162 sqm*



# Benefits

- § 16.2 million units of power to be generated annually
- § 90 million litres Water to be conserved annually
- § 25 acres of Land Conserved
- § Less Algae Growth in the canal water



# Selection of Photovoltaic Modules

- § Mainly two types of solar PV modules are used for the construction i.e. Thin film and Crystalline modules.
- § Generally the efficiency of the crystalline modules is more as compared to Thin film and the watt of the cell is higher for crystalline with the same space.
- § Hence Poly Crystalline modules are used in the 10MW Canal Top Solar Power Project , Vadodara.

# Land Levelling and Clearing For Approach





# Excavation for Piling





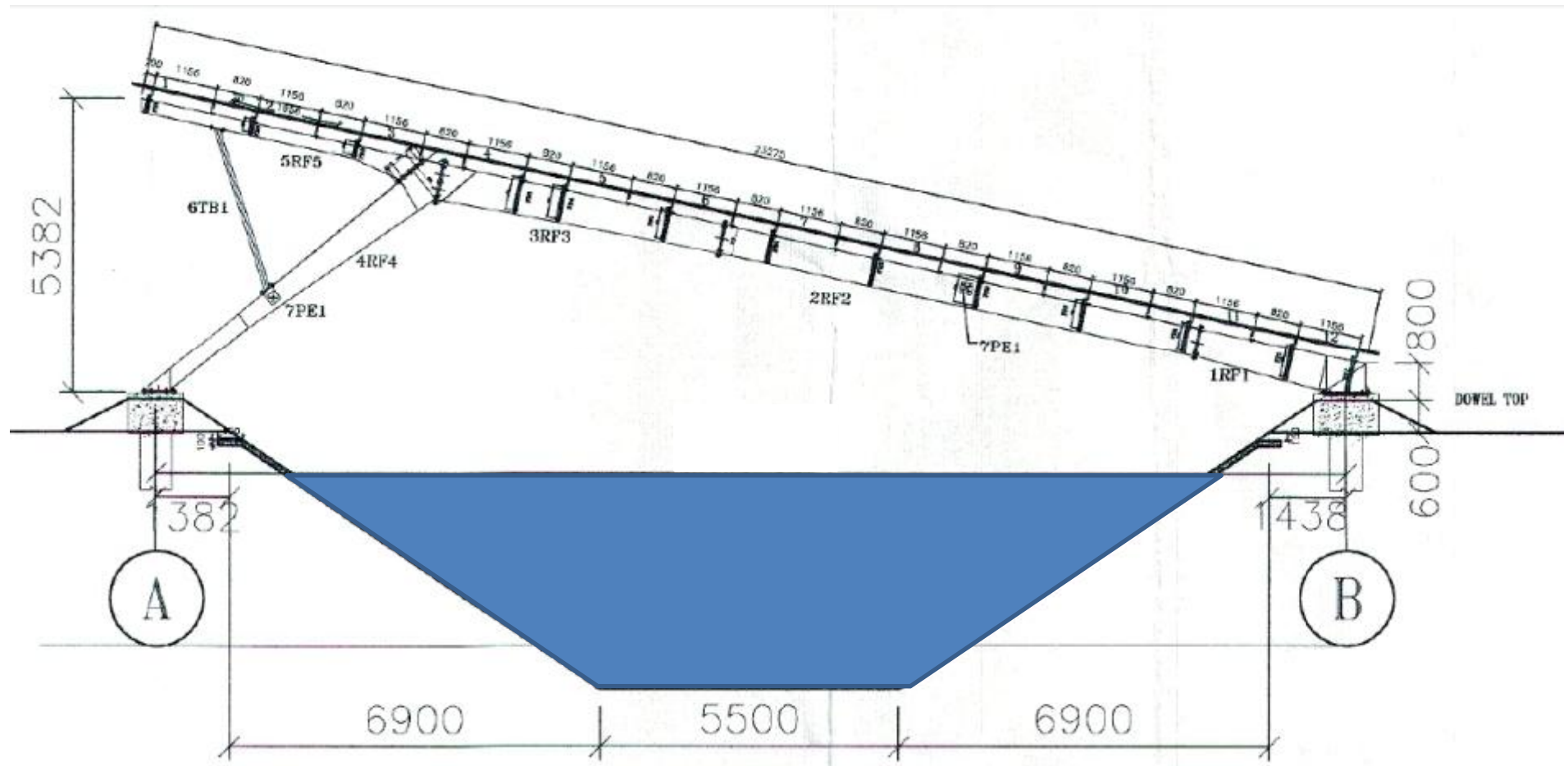
# Pile Concreting



# Pile Capping



# Cross Section of the Structure





# Structure Erection





# Structure and Purlin Erection





# Module Erection



# Modules Erection





## Placing Of Cells For PCCBP Road (Plastic Cell Filled Concrete Block Pavement)





# Canal Top Solar Power Plant



# 66kv Switchyard



# Control Room





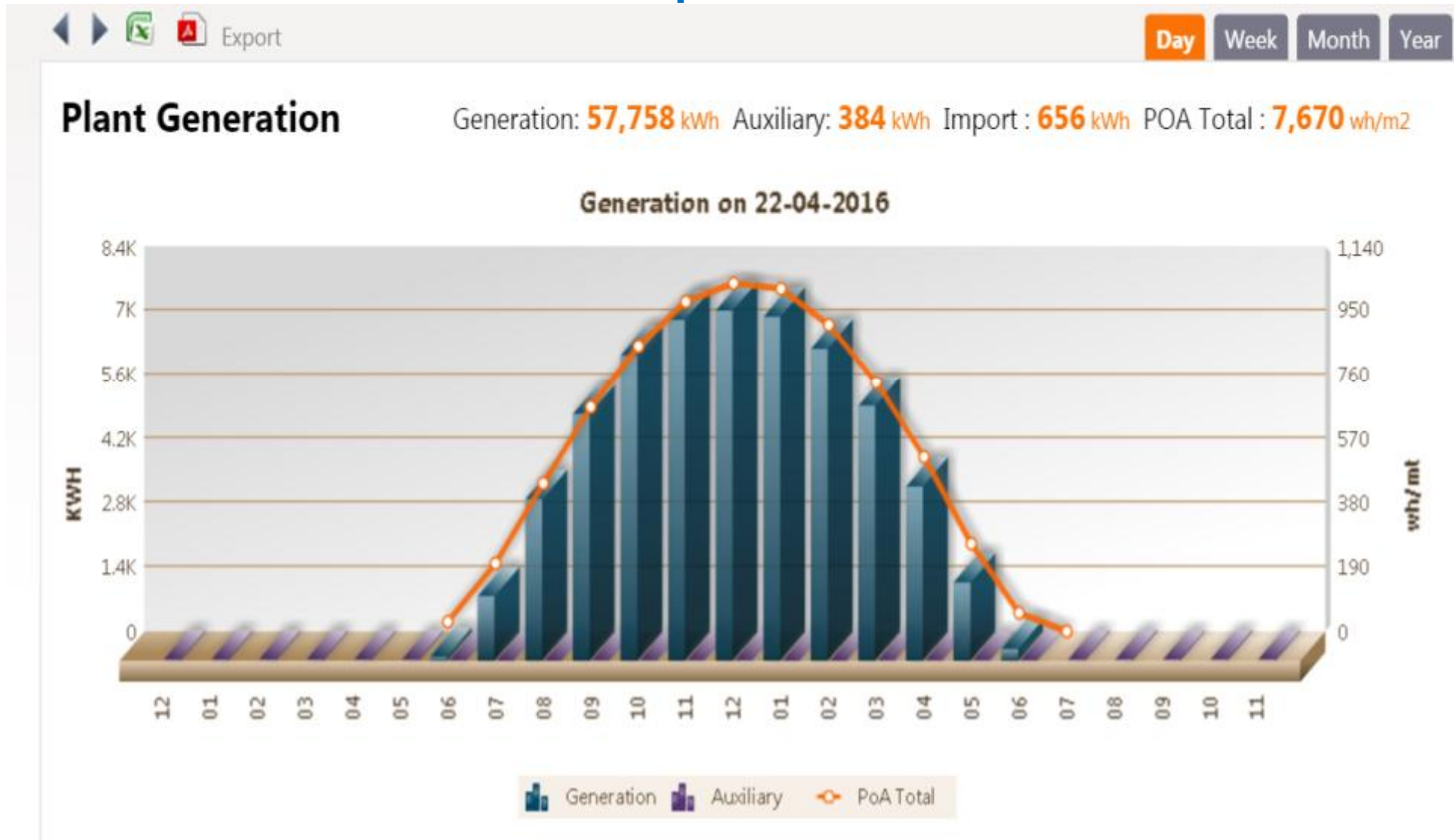
# 11kv HT Switchgear Panel



# C&R Panel and Inverter in MCR



# Screen shots of the existing 10 MW Canal Top Solar Control Panel



Highest Daily Generation on 22-04-2016



# 10MW Canal Top Solar Power Plant Photo



# 10MW Canal Top Solar Power Plant Photo

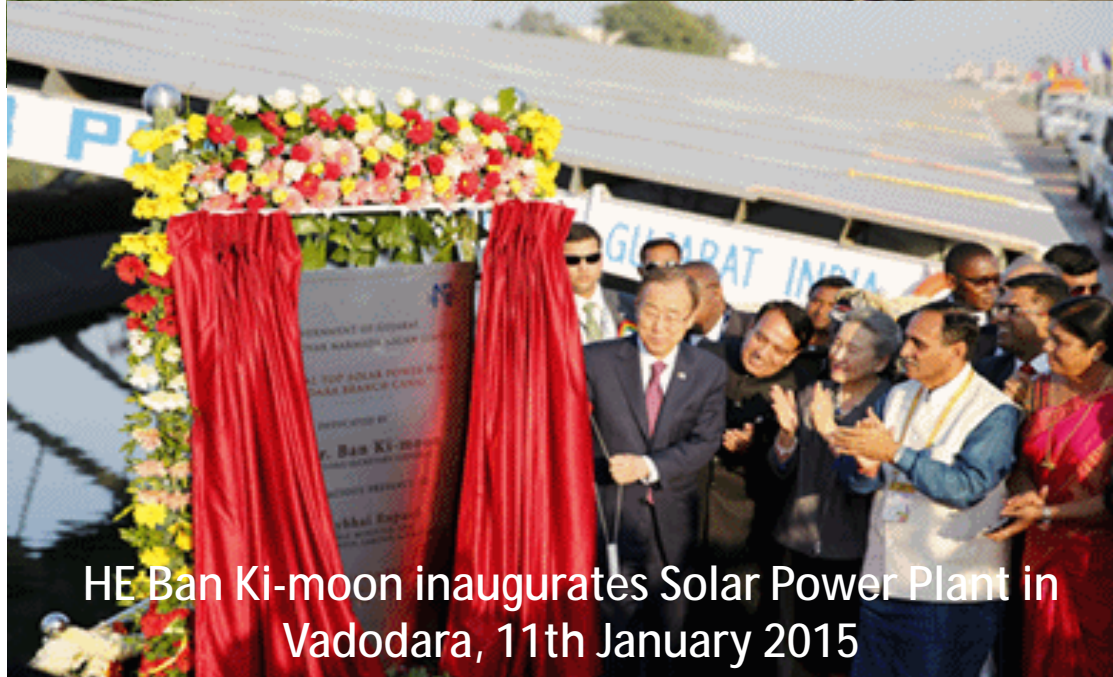




# 10MW Canal Top Solar Power Plant Photo







HE Ban Ki-moon inaugurates Solar Power Plant in  
Vadodra, 11th January 2015

“Looking out at  
the Canal Top  
Solar Power Plant,  
I saw more than  
glittering panels – I  
saw the future of  
India and the  
future of our  
world.”  
UN Secretary  
General

# Glimpses of inauguration of 10MW Canal Top Solar Power Plant





# Inauguration Day Video





# New Funding Policy of the Govt. of India

- § Looking to the success of these Canal Top Solar Power Projects, Government of India has announced a new funding Policy in December 2014 to encourage such Projects.
- § Ministry of New & Renewable Energy will provide Central Financial Assistance of
  - Rs. 3 Crore (0.44 Million US\$)/MW or 30% of the Project Cost whichever is lower for the Canal Top Solar PV Project
  - Rs. 1.5 Crore (0.33 Million US\$) /MW or 30% of the Project Cost whichever is lower for Canal Bank Solar PV Projects.

# Ongoing Three Canal Top Solar Projects

Type of Project	Capacity
Canal Bank Based Solar project	15 MW
Canal Top Based Solar project	10 MW
JICA Assisted	10 MW

# Ongoing Canal Top Solar Project





# Ongoing Canal Top Solar Project



# Ongoing Canal Top Solar Project





# Ongoing Canal Top Solar Project





# Positive Response

http://www.energynext.in/uttar-pradesh-plans-... EnergyNext -

Solar | September 24, 2012 1:59 pm

## Uttar Pradesh plans to set up canal-top solar power plants

Notu Tweet +1 Share



On the lines of innovative canal-top solar power project on Narmada canal in Gujarat, the Uttar Pradesh (UP) government is planning to take advantage of its vast canal network by covering them with solar panels.

This plan on the part of the UP government is a firm step towards its ambition of becoming one of the leading solar power producing states in India. The canal network in the state is immense spanning over 74,000 km, and in the first phase, solar panels will be installed on canals in five districts- Jhansi, Ghaziabad, Etawah, Ballia and Lucknow, producing 10 MW of solar power each.

According to sources from UP New Energy Development Authority (UPNEDA), this ambitious project is a part of the state's new solar power policy that is almost in its final stages. "By making use of the canals, we will not only be replacing the need for acquiring land, which is anyway a disputed issue these days, but we would also prevent the loss of water from the canals through evaporation," a senior official from UPNEDA

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## Damodar Valley to replicate Gujarat's canal-top solar plant

Press Trust Of India / New Delhi May 22, 2012, 00:03 IST

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In a rare compliment from a UPA Minister for the BJP government in Gujarat, New and Renewable Energy Minister Farooq Abdullah on Monday said the solar power plant atop a water canal in the state has shown the nation the way and it will be replicated by Damodar Valley Corporation.

"Gujarat has shown the way" with the commissioning of the world's first 1 MW canal-top solar power plant in Mehsana district, he said during Question Hour in Rajya Sabha. The Gujarat project virtually eliminates the requirement to acquire vast tract of land and limits evaporation of water from the 750 meter long canal.

# Positive Response



# Assessment of Potential

For different types of canals, the potential can be assessed as under :

Type of Canal	Total Length in Km.	Completed Length in Km.	30% Length having potential for Solar Power Generation (km)
Main Canal	458	458	137
Branch Canal	2,585	2412	724
Distributaries	5,112	3692	1108
Total	8,155	6562	1969

- Top width of these canals range from 110 m to 10 m, can facilitate installation of Solar PV Panels with an installed capacity of 2,000 MW.
- Such installation on canal top can thus cover a water surface area of about 50 to 60 million square meter.

Saving of about 60 to 90 million cubic meter per annum due to reduced evaporation loss.

Equivalent to 96 to 144 Million Units of electricity which otherwise would have been consumed to fetch this much water from underground aquifers!



*Thank you..*

