

GREEN BUILDING

PEDA-SOLAR PASSIVE COMPLEX IN CHANDIGARH, INDIA



BUILDING & LANDSCAPE DESIGN
SOUTH-FACING ORIENTATION



ROOFING
DOUBLE INSULATION ROOFING, HYPERBOLIC SHELL SYSTEM & SOLAR SYSTEM



INTERNAL COOLING SYSTEM
WATER FOUNTAIN & COOLING TOWER

PUNJAB ENERGY DEVELOPMENT AGENCY [PEDA]



SUMMARY EXECUTIVE

During the visit to the Punjab Energy Development Agency (PEDA) green building in Chandigarh on 8th February 2016, the trip took almost 6 hours to reach from the hotel in Delhi. The three hours in PEDA green building, full with the informative demonstration of the green concepts applied and net metering is a new policy implementation has been introduced. This report describes in details the overall trip at PEDA green building in Punjab and the information of each concept.

Two major sustainable technologies are observed by the participants and well demonstration explained by PEDA's representative including the green building concept and net metering system.

INTRODUCTION

On 8th February 2016, the participants of ProSPER.Net Young Researchers' School have visited Punjab Energy Development Agency (PEDA) in Chandigarh for the green building field trip. The detail itinerary of the trip stated as below.

Trip's Itinerary

6.30 am	: Depart from the hotel
11.00 am	: Arrived Punjab Energy Development Agency (PEDA) Green Building
11:30 am	: Walked around the building with PEDA's representative
12.30 pm	: Question and answer session
2.00 pm	: Travel from PEDA to brick factory

PEDA's representative welcomed and guided the participants to visit the PEDA office green building. Inside the building, the participants observed the passive architecture building with the green concepts have been applied. Each concept and structure of the building have been explained clearly by PEDA's representative. After walked around the PEDA's building, the participants assembled at meeting room for the question and answer with Sir Balkar Singh the senior manager of PEDA. Many questions have been asked by the participants and the answers from him was very informative. The field trip was finished after this session and proceed for the next field trip to Bharat Brick Factory. The details of each green concept applied by PEDA and new policy implemented are explain in further section.

BACKGROUND [PEDA]

The Punjab Energy Development Agency (PEDA) was established in 1991 by the Government of Punjab in order to provide a long term perspective of future energy scenario. The **objectives** of PEDA includes:

- 1) Promotion, development and implementation of alternative / non-conventional energy technologies programs and projects.
- 2) Implementation of comprehensive energy conservation programe in the industrial, agricultural, commercial and household sector.
- 3) Promotion and development of new and emerging technology areas (e.g. biomass co-generation).
- 4) Collection of energy data to build a reliable database to provide required information to the State Government to form its energy policy and planning for future.



Many projects have been commissioned and covered wide range of alternative and renewable energy technologies including biomass, bio-methanation dairy waste-based power, co-generation system, small hydro power. Furthermore, the net metering scheme and solar roof top subsidy have recently been launched.

PEDA's GREEN BUILDING

PEDA-solar passive complex in Chandigarh is a five-star rated building under 'BEE Star Rating of Government Building Scheme'. Built in 2004 with a partial financial support from Ministry of New & Renewable Energy (MNRE) Government of Punjab, this building is a successful model of energy solar building with 68,224 sq.ft. floor area (including basement).

With a unique architecture, 90% reduction in lighting energy consumption and 50% saving in overall energy consumption can be achieved. Despite 10-15% increasing of initial construction cost, the recurring expenditure can be cut down from energy saving potentials. The special features of Solar Passive Complex are tabulated as below:

Green concepts	Building and landscape design	Roofing	Internal cooling system
Descriptions	In response to solar geometry to maximising solar heat gain in winter, the south-facing orientation is implemented. The floating and overlapping flap system allows free and quick natural air flow, and cavity walls facing south and west are filled with insulation material to increase thermal efficiency. In addition, light vaults in the south side provide daylight without glare and heat. Landscape horticulture both inside and outside the building is to minimize air/sound pollution, as well as improve air quality.	Double-insulation roofing help reduce the heat penetration, while the hyperbolic shell roof on Central Atrium allows penetration of natural light without glare and heat. The 25kWp roof top solar system provides the basic electricity requirement in the complex. Furthermore, wind tower coupled with solar chimneys helps with direct/indirect cooling and drafting of used air.	Water bodies with waterfall and fountain are placed in the central atrium cooling the complex in hot dry period. The cooling tower system is being constructed with the purpose to provide addition cooling.



NET METERING

Net metering is a method whereby excess solar electricity generated in solar photovoltaic system is fed into the grid, the amount of electricity fed into the grid is monitored by a special bi-directional meter and this electricity can then be fed back to the household at no charge during a particular billing period. In Punjab this is measured over a year but typically it is implemented over one month intervals.

Net metering was first developed in the United States (reference) and Minnesota is credited as passing the first net metering law in 1983 allowing users of systems < 40 kW to roll over their generated kWh credits monthly. Some other countries that have implemented net metering include Canada, Philippines, India and the United Kingdom; however in UK there were challenges due to the issues with of implementing the value added tax.

In the Punjab state in India, the Punjab Energy Development Agency (PEDA) is responsible for managing the setting up of net-metering based solar PV installations in Punjab. This starts with an online application on the PEDA site who then give online approval for the installation of the required capacity of the plant (the range of capacity that can be installed vary between 1.25kW and 12.5 MW). The applicant then pays a fee and enters into an agreement with the Punjab State Power Corporation (PSPCL) who again gives approval for the project. After approval the applicant will commission the project from selected suppliers and submit online a work completion report. Following this a bi-directional meter is installed by PSPCL and the project is considered commissioned. This program has been running in the Punjab for the last 6 months and in this way already 4MW of solar PV have been installed with an intended total of 22 MW planned.

So who benefits from net metering? To understand the advantages of net metering it's best to consider the three various ways of pricing electricity generated by grid connected PV systems (Yamamoto, 2012).

Source: Yamamoto, Y. (2012). Pricing electricity from residential photovoltaic systems: A comparison of feed-in tariffs, net metering, and net purchase and sale. *Solar Energy*, 86(9), 2678–2685. <http://doi.org/10.1016/j.solener.2012.06.001>

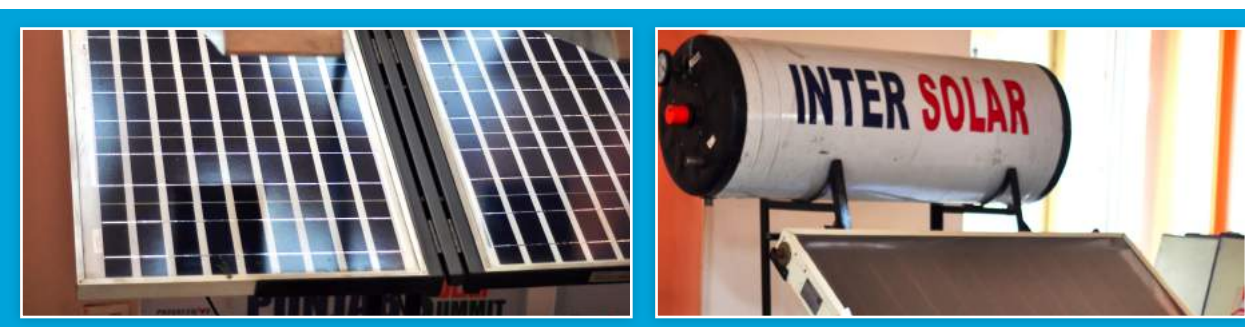
	Benefits	Disadvantages	Countries implementing
Feed in tariff (FIT)-utility companies obliged to purchase all PV generated electricity at a set price for a number of years	Consumer is generally paid above retail encouraging them to minimise grid electricity use	Requires long term fixed contracts	Germany, some states in the USA
Net metering - utility purchases net amount generated from PV - meter runs backwards during time of excess	Requires only one power meter - implemented as simple accounting procedure	Always at retail price - consumer not encouraged to reduce grid use	India, Philippines, USA
Net purchase and sale - utility pays for excess PV only at times when in excess - compared moment by moment not over a time frame	Requires two power meters		Japan

So net metering is a simple way to encourage private investment in solar PV technologies however the disadvantage is that it does not directly discourage use of the grid electricity as consumers feel they can consume more at night because they generated electricity during the day.



SOLAR-RELATED PROJECTS

Besides the major project implementation, PEDA also pursues as the hub for solar education and project outreach. Many interactive devices help explain new policy and technology initiatives including the energy conservation, the energy efficiency and the net metering system. Nonetheless, many solar-related devices are demonstrated i.e. solar thermal for hot water system, solar cooker and solar lantern.



CONCLUSION

The field trip to PEDA green building was really comprehensive. On top of that, the participants gained a new knowledge regarding the net metering policy system. The participants were impressed with the structure of PEDA green building especially the building using the natural light inside and ceiling with the air trap design. Moreover, this field trip exposed the participants with the state agency in direct engagement to better understanding on India State government effort in promoting sustainable renewable energy.

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