India's first solar housing complex
Rabi Rashmi Abasan

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Green buildings are being seen as an emerging business opportunity in India. The construction industry is estimated to contribute about 10% of the GDP (gross domestic product). India Green Building Council (which is part of CII–Godrej Green Building Council) has undertaken the initiative of promoting the green building concept in the country. Today, a variety of green building projects are coming up in the country—residential complexes, exhibition centres, hospitals, educational institutions, laboratories, IT parks, airports, government buildings, and corporate offices. Many of these may use technically well-proven solar technologies in different ways. One of these is the BIPV (building integrated photovoltaic) application, which is well suited to such ambiences. By 2010, about $100 million would be generated through the use of solar PV in green buildings in India. Of late, the use of both solar PV and solar thermal systems in the urban buildings is gaining momentum. A common practice is to connect solar PV system to the grid.

PV grid system

The solar PV technology involves direct conversion of available solar energy into some useful electrical energy. It can realistically contribute to greater global sustainability in the medium to long term. PV is becoming more and more accessible both in urban and rural areas due to declining costs. One common PV application today is to connect a PV system with the conventional grid. This is called grid-connected PV. A grid-connected system works in parallel with the conventional grid network, and offers the following advantages.

- Supplies energy to loads at the point of generation
- Exports power when there is excess energy
- Allows the import of energy if there is a shortfall

Building integrated photovoltaics

Recently, there has been a worldwide focus on the architectural integration of PV modules in the building envelope. Such type of modules can effectively replace conventional building materials like roof tiles, shingles, facades, and normal glazing. PV building materials can be manufactured in a manner that they are quite similar to the conventional building products, blending well with the surrounding environment. Integration of PV materials means that the costs of the replaced building products can be

thereby improving the economics of the project. Such PV systems are often termed as BIPV (building integrated photovoltaics). Today, there are a large number of houses with such built-in features in countries like Germany, Spain, Japan, and California. The regulators also provide clear tariff orders for construction of such houses. This mainly relates to export of surplus solar power to the grid against a tariff structure fixed for the purpose.

The Indian scenario

West Bengal is the first state in India to come up with a well-formulated tariff order for promoting the use of small-capacity BIPV systems. The SERC (state electricity regulatory commission) of the said state issued such an order on 5 March 2008, which had many salient features.

- Rooftop solar PV systems with 2-kWp capacity can be put up for delivering power into the distribution system of a licensee.
- Institutional consumers comprising government hospitals, health centres, schools (including aided ones), academic institutions, offices, and organizations besides any housing complex already promoted for the purpose by the government or any government agency (includes local bodies like municipalities, panchayats, and cooperative societies) for development of renewable sources are eligible for the specially announced tariff structure.
- Such injection from rooftop solar PV sources of the above mentioned consumer(s) shall not be more than 90% of the consumption from the licensee's supply by the above mentioned consumer(s) in a financial year. It shall be settled on net energy basis at the end of each financial year.
- Any excess energy injected by the above mentioned consumer(s) from the rooftop solar PV sources more than the 90% of the consumption of energy by that consumer(s) from the licensee's supply in each billing period shall be carried over to the next billing period within that financial year.
- Slab tariff, as per tariff order, shall be applicable for the net energy supplied by the licensee in a billing period if the supplied energy by the licensee is more than the injected energy by the rooftop solar PV sources of the consumer(s). It will be so after taking into account the quantum of energy, if any, carried forward from earlier billing period(s) of that financial year.
- If in a billing period the supplied energy by the licensee is less than or equal to energy injected by the rooftop solar PV sources of the consumer(s) after adding the cumulative carried over injected energy from previous billing period(s) of that financial year the billed amount for energy will be nil for that billing period(s).
- At the end of the financial year, if the total energy supplied by the licensee to the consumer(s) for that financial year is found to be less than the energy injected by the rooftop solar PV sources of that consumer(s) for that financial year, the licensee shall not pay any charge to the consumer(s) for that net energy, injected by the consumer(s), in excess of 90% of consumption of that consumer(s) from the licensee's supply in that financial year and the same shall be treated as unwanted/inadvertent injunction.
- At the beginning of each financial year, the cumulative carried over injected energy will be reset to zero. Payment in a billing period by the consumer(s) (owning roof-top solar PV sources) to the licensee shall be

guided by the provisions of the regulations made by the Commission under section 50 of the Act.

- For each billing period in a financial year the licensee shall show the quantum of injected energy from rooftop solar PV sources in the billing period, supplied energy from its source in the billing period, net billed energy for payment by the consumer(s) for that billing period, and net carried over energy to the next billing period separately.
- Any delay in payment shall attract surcharge at the agreed rate. The MoU/PPA to be signed between the licensee and developer of rooftop solar PV sources shall include necessary terms and conditions of meter reading, billing, payment, payment of security arrangements, rate of delayed payment surcharge, and so on.

The birth of Rabi Rashmi Abasan

Rabi Rashmi Abasan (meaning a solar housing complex), India's first solar complex came into being mainly due to the above-mentioned tariff order. This complex conceived by WBREDA (West Bengal Renewable Energy Development Agency) is located at New Town Kolkata and is spread over an area of 1.76 acres. Each house owner within the complex will produce his own power for domestic use and feed any surplus power into the local grid. He can also draw power from the grid as and when needed. The utility will pay the house owner and vice-versa on net monthly metering.

Solar systems at the complex

There are 25 independent apartments in the complex, each of which has been provided with a rooftop solar PV system of 2-kWp capacity. Sixteen single crystal silicon modules of 125 Wp have been put up in each case. These will produce power during the day and any surplus power that is not consumed by the individual household will be supplied to the local grid. In addition, each household has a 100-litre solar water heating system. Seventeen solar streetlights have been installed to light up the entire area. The streetlights are unique in the sense that batteries are placed on the top with a proper nicely designed colourful fabricated pole. The community centre has a solar swimming pool and an 8-kW BIPV in the southern side of the building.

This specially designed complex not only uses active solar

systems but also incorporates solar passive features.

Passive solar components

About 25% of the total commercial energy in India is spent on lighting, air-conditioning and ventilation, and so on. The Rabi Rashmi complex incorporates several features specific to solar passive architecture. This keeps houses cool during summer months, and also reduces the daily peak demand. A unique feature is the use of solar chimney. A small lily pool in the southern side with proper ducting arrangements has been kept in the building for smooth flow of hot air in and out of the building. This also ensures proper ventilation inside the room. Natural lighting has been arranged in all rooms as far as possible.

Insulated walls and windows

Thermal comfort of the buildings is enhanced through insulation on the south-, west-, and east-side walls of each individual unit in the housing complex. The insulation material used here is extruded polystyrene block of 50-mm thickness inside walls that are 250 mm thick. Double-glazed windows have also been provided in the openings on such walls to exercise radiant energy control in the buildings. Double-glazing has been done maintaining complete vacuum inside.

Intelligent water supply system

The housing complex has also been provided with energy-efficient hydro pneumatic pumping arrangement to supply pressurized water. This intelligent system design based on auto-start/auto-off mode and installed centrally is expected to match the end user requirements fully. The underlying idea is to do away with the conventional individual household pumping arrangement and thus save some energy in the process. The system comprises a pump-motor set, micro processor/controller-based control unit, pressure gauge, pressure transmitter, pressure tank, and different control valves. There is also an emergency tank for each house.

Clean ride: electric vehicle

Two battery-powered vehicles will be available to the residents to commute within the surrounding areas. The basic idea is to showcase the green spirit of the complex in every possible manner.

Present status of the Rabi Rashmi project

This aesthetically done solar complex is expected to be completed by June 2008. It would be handed over to the residents after a formal inauguration. The solar systems will be maintained by the system supplier for a period of five years from the date of its commissioning and thereafter the resident's body is expected to care for it.

Conclusion

Rabi Rashmi Abasan is expected to serve as an example of transition to the sustainable use of energy. Use of both active and passive solar devices will lead to energy savings of about 60%. It will prove to be a role model for upcoming housing complexes and encourage them to adopt clean energy technologies for a sustainable future.