We are gradually realizing that only energy from the sun can ensure the survival of our civilization. Solar power has the potential to be a remarkable energy source for the future. Of course, there are some challenges on the way. However, with continuous Research and Development (R&D) we are approaching towards our goal of ensuring survival of our future generations. ‘Carbon Neutral Solar PV’ street lights for urban areas is a unique example of innovative solar photovoltaic (PV) device. Like rooftop solar PV, this innovation may be termed as pole-top solar PV.

Under the MNRE programme, the country has installed more than 100,000 battery-based solar street lights both in rural and urban areas (Picture 1). While such street lights have benefitted a large number of people both in rural and urban areas, these lights have some inherent limitations, such as:

- Mostly low powered and not suitable for urban areas.
- Illumination level and burning hours reduce with the passage of time mainly due to short life of battery.
- Battery is stolen in many of the cases and thereafter the street light becomes non-functional which also results in theft of PV modules and other items subsequently.
- In most of the cases batteries are not replaced after 4–5 years, resulting non-functionality of the street-light.
- Maintenance levels of such street lights are very poor.

A recent study in the Sundarbans carried out by the author of this article shows that about 80 per cent of the solar street lights installed before 2009 are non-functional or only a skeleton of the solar street light exists. Recently, it has been observed, even in urban areas, that such types of street lights are being installed in large numbers. In a recent study, it has been observed that more than 10,000 of such street lights have been installed in cities, such as Kolkata, Delhi, and Bangalore where average power availability is for more than 95 per cent of the day and these cities do not need battery-based solar street lights. The reason behind the idea of the battery-based street lights in the early 1990s was the non-availability of electricity in more than 70 per cent of Indian villages where one solar street light changed the overall village scenario. Installation of solar street lights was never thought for urban or electrified areas. The author of this article has installed more than 5,000 street lights in Northeastern region of the country and the Sundarbans and made a lot of modifications in conventional solar street lights. A number of financial models were also tried in consultation with local Panchayats or Market Committees. It is true that such street lights served a lot to the rural society but finally the programme was not financially sustainable. However, still such street lights can play an important role where grid power has not reached or in case it has reached, is very unstable. Time has come now to gradually adopt battery less solar street lights, particularly in cities where power availability is reliable. A carbon neutral non-battery street light in urban areas has many advantages, such as:

- High power lamps, even up to 200-W LED, could be operated with solar panel, which gives light almost as good as a 400-W sodium vapour lamp.
- High illumination level matching with urban needs
- Much reliable since the street light works with grid power during night time
- No batteries resulting in recurring expenses almost nil
- Totally climate responsive
- No additional infrastructural cost except solar panel and microinverter
- Continuous monitoring possible to ensure carbon neutrality.

**Components of a Battery-less Solar PV Street Light with 200-W LED Lamps**

- 2 x 150-W Solar PV panel (crystalline)
- Pole-top mounting frame of the PV modules
- 300-W grid tied microinverter (Picture 2) to be installed just below the solar panel
- Carbon Neutrality Manager (CNM) for group monitoring of the system about export of solar power and import during night time to keep the street lights carbon neutral. The CNM dims lamp if necessary in the midnight automatically in case there are continuous cloudy days. However, it ensures minimum lux level required for urban areas. Pictures 2 and 4 show the components of a battery-less solar PV street light with 200-W LED lamps.

**Basic Requirements to Install Grid Connected Solar Street Lights**

The basic requirements for the above are as follows: (i) Availability of reliable grid and pole; and (ii) Permission to connect microinverter with grid under the State Electricity Regulatory Commission order.

Picture 3 shows the Deshpriya Park, Kolkata (details of the project have been presented in Table 1) where 50 battery-less street lights are working without any disturbance for the past 10 months (The first experimental project in India).

**Potential**

There is a very high potential of solar street lights planted on flyovers, bridges, etc., in Indian cities, where power availability is more than 95 per cent and, therefore, carbon neutral street lights may be installed. The estimated potential in the city of Kolkata alone is more than 50 MW. The cost of generation varies from ₹ 6.00 – ₹ 7.00/kWh depending on the site conditions. Whereas electricity generation cost from battery-based solar street light works out to be ₹ 20.00/kWh (mainly due to very high cost of
RE Case Study

Table 1: Salient Features of the Deshpriya Park Project

<table>
<thead>
<tr>
<th>No. of Grid Connected Street Lights Installed</th>
<th>Type of Pole</th>
<th>Module Capacity</th>
<th>Microinverter</th>
<th>Date Of Installation and Commissioning</th>
<th>Export/Import Comparison</th>
<th>CNM Manufacturers</th>
</tr>
</thead>
<tbody>
<tr>
<td>50</td>
<td>Steel tubular pole 9 m long</td>
<td>2x150-W Multicrystalline</td>
<td>300-W</td>
<td>January 12, 2015</td>
<td>Exported: 5,400 kWh in 90 days Imported: 5,300 kWh in 90 days</td>
<td>A local Solar Company based on the concept of the author</td>
</tr>
</tbody>
</table>

- Electricity bill of Deshpriya Park with 400-W sodium vapour prior to installation of Solar operated LED (monthly) in grid connect mode for the month of April, 2014: ₹ 31,000.00
- Electricity bill (monthly) after installation of solar PV operated LED in grid connect Mode, April, 2015: ₹ 1,800.00

*Same illumination level has been maintained

Solar street lights

battery). Indian cities where power supply is reliable may opt for carbon neutral solar street light at this stage. Proven technology is available.

Key Recommendations for the Country

Short Term: (2022)

- Conversion of all street lights of flyovers of the country with carbon neutral grid connected solar street lights.
- Conversion of all park lighting with carbon neutral grid connected solar street lights (CNSSL).

Long Term: (2030)

- Installation of CNSSL in all major roads, strategic points of National Highways and State Highways.
- Installation of CNSSL in major wide roads of the metro cities of India (Kolkata, New Delhi, Mumbai, and Chennai) and other major cities.

The estimated cost for installation for one such type of solar streetlight (complete in all respects) works out to be ₹ 50,000 – ₹ 55,000. The programme could be executed through ESCO Model or from CSR Fund of power utilities.

Conclusion

The Government of India has decided to take conventional electricity to all villages and hamlets of the country. In that situation, there will be no off-grid areas. Standalone solar system may not make any sense under that situation. As such, the Solar PV system technology should shift from standalone mode to grid connected mode. Though some transition period will be required to achieve the target, however provision for grid connectivity for any solar system is the need of the hour. There is no reason to go for standalone solar system in any of the Metro cities of India now. According to CEA, the power availability in Metro cities is more than 90 per cent. We must change our mindset and shift from installation of standalone solar system to grid connected system, particularly in urban areas where power supply is very reliable. The solar power cost from a standalone system is always expensive due to the presence of battery.

Moreover, the power output of a battery-based system is generally low and it operates DC devices which are non-standard. Time has come to launch a National Programme on Carbon Neutral Solar Street Light, which could be also a part of National Solar Mission. Kolkata Municipal Corporation has taken a new initiative to solarize 28 more parks of Kolkata Corporation, such initiatives will reduce the electricity bill of the parks by ₹ 25 lakh annually and emission reduction shall also be significant.

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