

Learning by example: Case study of solar PVs in Bengaluru's schools

In 2015, TERI and Hindustan Aeronautics Limited (HAL) set up Solar Rooftop Photovoltaic (SRTPV) systems connected to the grid under the net metering scheme in 13 government schools and colleges in Bengaluru.

TERI worked on the project, funded by HAL under its Corporate Social Responsibility (CSR), along with the Bangalore Electricity Supply Company (BESCOM). TERI and BESCOM were already working on raising awareness on energy efficiency in around 100 schools in Bangalore Urban and Rural areas through the Vidyut Jagruthi Yojana project. It was during this project that the potential for meeting schools' electricity needs through solar energy based power generation was discovered.



A Memorandum of Agreement (MoA) was signed between HAL and TERI on 15 April, 2015 to undertake the project called 'Sustainable Educational Institutions in Bangalore'. This pilot initiative was introduced in schools and colleges to showcase the least-cost path to net-zero energy and carbon neutrality.

The project aimed to achieve the following:

- Develop sustainable energy systems in the schools and focus on issues of energy conservation
- Facilitate and implement 10 kiloWatt peak (kWp) solar rooftop facilities in educational institutions
- Create awareness amongst students, teachers and the management/committee about renewable energy through value-based education
- Bring about behavioral change among the students on efficient use of energy

The proposed period for completing the installation of the PV systems and connecting them to the grid was five months. As educational institutions were not operational till May 2015 due to summer vacations, the installation was completed during September-October 2015. The first PV system was connected to the grid on 9 October, 2015. The others were soon to follow.

The principal tasks carried out for the project were:

- Selection of schools/colleges and getting their commitment letters
- Selection of solar system supplier through bidding process
- Need assessment reports of individual educational institutions (schools/colleges)
- Engineering report pertaining to individual SRTPV systems for educational institutions
- Obtaining approval from BESCOM for net metering for individual institutions
- Update on installation of PV systems and commissioning progress of work

Once the institutions were selected, a need-assessment study was conducted to identify energy conservation opportunities and estimate the solar PV requirement.

S.No.	Name of the Public Institutions	Monthly Energy Cons. kWh		
		Min	Max	Avg
1	Govt. First Grade College, Krishnarajapuram	722	2415	1411
2	Govt. High School, Doddanekundi	10	617	102
3	Govt. Science College, Nrupathunga Road	5386	8980	7507
4	Smt. V.H.D. Central Institute of Home Science, Seshadri Road	4400	6390	5500
5	Maharani's Science College for Women, Palace Road	3975	5715	4895
6	Maharani's Science College Hostel, Seshadri Road	2057	3062	2575
7	Govt. High School Sanguravanahalli, Basaveshwaranagar	167	448	280
8	Govt. Primary School, Babusapalya, Kalyan Nagar	7	37	16
9	Govt. High School, Chikkabidarakallu	46	101	74
10	Govt. Primary School, Chikkabidarakallu	10	77	55
11	Govt. High School, Agrahara Dasarahalli, Basaveshwaranagar	63	194	116
12	Govt. Primary School, Agrahara Dasarahalli, Basaveshwaranagar	6	86	30
13	Govt. P U College for Boys, Malleshwaram	1109	2730	1708

- Note: 1) Sl.No. 5 & 6 are situated in same campus but with different metering installations
 2) Sl.No. 9 & 10 are situated in same campus but with different metering installations
 3) Sl.No. 11 & 12 are situated in same campus but with different metering installations

During the need assessment study itself, some energy saving measures were identified and conveyed to the respective institutions. These were:

- Providing group control for corridor lights
- Replacing 40W fluorescent tube lights with 28W T5 fluorescent tubelights
- Replacing existing resistance based regulators for the fans with electronic regulators
- Installing IPMPlus Software to reduce the energy consumption of desktops
- Replacing 60W incandescent bulbs with 15W LED bulbs (selected locations)
- Replacing 150W Metal Halide lamps for outdoor lighting with 30/70W induction lamps

According to the Energy Electricity Tariff Order 2015 (dated 12 May, 2014) issued by the Karnataka Electricity Regulatory Commission, all government educational institutions fall under the LT2A tariff category. A few schools were found to be billed with LT2B tariff. The cost savings in billing by changing the tariff structure is around 20 per cent.

The initial selection of public schools and colleges for setting up of the SRTPVs was based on the interest shown by the head of the institutions. In the initial dialogue, principals gave a safety and general maintenance assurance confirmation and respective commitment letters were obtained from them.

The next step now was the actual installation of grid-connected rooftop solar PVs.



After the bidding process, at first the order was placed only for five institutions. This was done to understand the delivery and commissioning period. The first phase of installation was completed in August 2015 and a parallel order was placed for the remaining systems. The commissioning at all institutions was completed in September 2015.

The team closely tracked the applications for net metering with BESCOM's offices. Some institutions had to be asked to change some transformers and install those better suited for net metering. The project also provided an opportunity to BESCOM employees to understand SRTPV system and net metering scheme.

Based on the average power generation and monthly electricity consumption of individual institutions (refer table 2), net monthly reduction in electricity consumption was forecast.

Under the net metering scheme, a bi-directional meter records the electricity (import and export of energy) used by the school and the excess exported to the grid. The meter is monitored remotely in the control room of the power distribution company (in this case BESCOM). The monthly 'electricity bill' under this system is the difference between the exported and imported electricity. Some smaller schools, due to their low demand, were actually expected to earn revenue due to the excess energy they would export to the grid.

Based on the evaluated monthly reduction in power consumption of an individual institution, a sample calculation was worked out to know the monthly benefit from the net meter facility -

Parameters	Case I	Case II	Case III
Installed Capacity SRTPV, kWp	5	10	15
Monthly energy cons. (avg), kWh	74	2575	1708
Monthly generation SRTPV (avg), kWh	600	1200	1800
Net Export of energy to Grid, kWh	526		92
Net Import of energy from Grid, kWh		1375	
Credit bill amount, ₹ (@₹9.56 /kWh)	5029		880
Monthly bill amount, ₹ (@₹5.50 /kWh)		7563	
Monthly bill amount, ₹ (Before SRTPV)	407	14,162	9,394
Net Metering benefit to school, ₹	5,436	6,599	10,274

Apart from generating revenue to the schools, execution of the project resulted in associated benefits of training BESCOM engineers/staff on SRTPV systems operations. Based on this experience, TERI could also make recommendations for simplification of BESCOM procedure for SRTPV scheme penetration. Further, a new insurance policy (from Oriental Insurance) process was developed for SRTPV systems for the first time due to this initiative.

At present, TERI continues to monitor the energy and maintenance of the SRTPV systems, which it is to do for the first three years of the project.