FIELD VISIT REPORT

ON

DAYALBAGH EDUCATIONAL INSTITUTE

AGRA, INDIA

Submitted by: Group 4

2016 ProSPER.Net Young Researchers' School

'Sustainable Energy for Transforming Lives: Availability, Accessibility, Affordability'

Report on field trip to Dayalbagh Educational Institute

Introduction

The Dayalbagh Educational Institute is a premier educational institution located at Dayalbagh in city of Taj Mahal, Agra. Participants of 2016 ProSPER.Net Young Researchers' School visited the Dayalbagh Educational Institute (DEI) during February 2016 to learn about their experience in research and implementation of renewable energy technologies to improve energy availability, accessibility and affordability for the campus and wider community. This report summarises some of the key strategies and technologies that have been implemented at the site to respond to these key challenges of energy availability, accessibility, and affordability.

In order to realize the vision of Eco-Village, the Dayalbagh Educational Institute has ventured into 'total' solar electrification of its campus. Some key sustainability initiatives implemented at the site including the following:

- Roof-Top Solar Photovoltaic (PV) systems with battery bank
- Solar thermal systems
- Tracking PV system, designed by DEI student
- Energy efficient architecture

Energy technologies

Roof-Top Solar Photovoltaic system with battery bank

This decentralised model uses seven roof-top solar photovoltaic (PV) power plants together supplying 518.2 kW at present. This, when combined with two more plants under erection and the existing residential units will amount to about 1 MW capacity. The whole decentralized PV power system is composed with sub-systems, including the photo-translating system, inverter system, storage system (battery), monitoring system and other related supporting facilities. This project was designed that "power generated for local use and if any left access to grid".

Under the policy promotion, pressure of carbon emission reduction and relatively mature development of PV technology, Institute like DEI with suitable conditions using decentralized energy system are working together with the decentralized PV power generators to install this kind of new power producing system in their spare space. Depends on the installed capacity of the project, it can reduce the power usage in varying degrees from the national grid. If there are any left electricity generated from PV, it can be sold to national grid. In DEI's case, there is still no subsidy from the electricity grid owner. Battery system was installed also to store the electricity generated from the solar PV system.

This project is one typical demonstration decentralized solar power project in India, which is a replicable energy efficiency model can be referenced by other areas in the country. Following the definition of decentralized energy system, this project is one typical project with a certain size (installed capacity and technical operation) can be a reference for other areas. There is also some need to promote such as implementation of policy, subsidy incentives and cooperation between

different stakeholders to make it more profitable, affordable and sustainable.

In addition to the abovementioned energy initiatives at the Agra campus, approximately 30 kW PV has been installed at various Distance Education Centers of DEI in different regions of the country. A 5kW Solar-Wind integrated system has been installed at its Melathiruvenkatanathapuram (MTV Puram), Tirunelveli campus as a training test bed for the pioneering vocational stream on solar–wind electrification being launched in January 2014. The renewable energy initiatives of Dayalbagh Educational Institute have demonstrated that universities are ideal venues for trialing and implementing renewable energy technologies.

In addition to sustainable development through clean energy technologies and self-sufficiency in energy, a university micro grid is an ideal test bed for conducting indigenous research and development through UG and PG projects and Ph.D. theses. This would ensure quality research with relevance as well as development of skills and intellectual property in the area. Universities can design and implement model curriculum for vocational diploma and certificate and higher courses in solar energy technologies, provide earn-while-you-learn schemes to the students and encourage entrepreneurial start-ups through incubation cells.

Solar-thermal

Solar energy is abundant throughout India. Technologies developed on the use of this energy can help save fossil fuels for various applications, thereby, making modern sources of energy more accessible to rural people. Concentrating solar systems have been found to be quite suitable for cooking food for hundreds and thousands of people in community. To save energy and make efficient cooking, community cooking is the best way.

The Institute uses a solar thermal system for generating steam and for direct application for cooking food. The direct solar cooker utilises solar thermal energy for cooking of rice, pulses, vegetables, meat, fish and preparation of snacks, soups, cakes etc. either directly or by producing process steam. In this system, no additional fuel is required no smoke is produced. In the community kitchen, the thermal solar cooking, electric induction heating and gasifier system is the non-polluting way for community cooking. There is fixed focus E-W automatically tracked elliptical dishes (Scheffler) for direct outdoor cooking for about 50-100 people and for steam generation for the purpose of community cooking, laundry, space cooling etc. of any capacity.

Solar Tracking System

Dayalbagh Educational Institute has also developed a solar tracking PV system. A simple (patented) device is used for orienting a solar panel towards the sun as it moves across the sky. The tracking installation was developed from a student research pilot project on the application of dual-axis tracking systems in India. The research found that there was limited benefit in adding a second axis of tracking for this area, and so the final installation relied only on single-axis tracking.

Precise tracking of the sun is achieved through systems with single axis tracking. It will have a fixed vertical axis and an adjustable horizontal motor controlled axis. The tracker will actively track the sun and change its position accordingly to maximise the energy output.

Energy availability, accessibility, and affordability

Energy availability

Energy availability at the Institute is secured by using multiple renewable energy technologies, discussed above: solar thermal, solar PV, and backup battery systems. The solar PV system with battery bank supplies 100% of the Institute's electricity demand. Solar thermal is used to produce steam for heat, and also direct solar thermal for cooking needs. The addition of the battery bank to the PV system means power is available during periods of low solar activity and at night, ensuring sufficient energy availability. The Institute is also grid-connected, and feeds excess energy into the grid during periods of low demand, such as during winter and when the university is closed. Additionally, by relying on renewable energies the Institute reduces its reliance on grid energy, which reduces demand and leaves more capacity available for other users.

Energy accessibility

The battery system overcomes electricity grid reliability issues. Prior to installing the system, the Institute would regularly experience grid outages of up to 8 hours due to factors such as high demand and power theft. This had significant impacts the Institute, including the loss of lighting and power during classes and experiments. The Solar PV and battery bank provide a more reliable system, ensuring uninterrupted energy access.

Energy affordability

The battery bank added significant additional cost to the system, increasing the system cost by 40%. Under normal circumstances this may have been prohibitive, however due to the importance of reliable power supply and the educational benefits to the Institute of having such a system available for students to explore and learn from.

Sustainable energy for transforming lives

The renewable energy technologies showcased at the Dayalbagh Institute have significant potential for transforming lives. The solar photovoltaic system with battery bank provides a reliable energy supply so the Institute can provide a quality educational experience to students. Additionally, students are exposed to these systems first-hand, so they may learn about renewable energy technologies and sustainable development concepts. The system reduces the Institute's dependence on the grid, reducing demand and freeing up capacity for other users, which helps improve energy reliability and availability for the rest of the community.

The Dayalbagh Educational Institute is a great example of sustainable development principles in action. The initiatives undertaken at DEI are helping to develop solutions for local energy availability and accessibility issues, while also serving as a place provide education on renewable technologies to the students who will one day become decision-makers in their communities. They are actively engaged in disseminating research findings and communicating their sustainable development journey and in this way the Institute provides an outstanding example to other institutions and the wider community.