Solar for Education

Capacity Building of Education Institutions, Banks and other Stakeholders on Sample Project Design
September 14, 2018 | Jaipur

Report

CUTS International along with Bask Research Foundation organized the Capacity Building Workshop on Sample Project Design, in continuation of the Capacity Building Workshop on Techno-Commercial aspects of Solar Rooftop Systems for schools, civil society organisations and banks from three districts of Rajasthan, namely Jaipur, Chittorgarh and Sawai Madhopur. The training was conducted on September 14, 2018 in Jaipur.

The capacity building workshop on sample project design comprised of both 'on-site' as well as 'off-site' trainings. The On-site training was based on the '**Site Assessment and Feasibility Studies**' conducted in schools in **Chittorgarh** and **Sawai Madhopur**. The objective of the site assessment training was to apprise the stakeholders/beneficiaries about the entire process of installation of rooftop solar at their respective facilities. The case study of the schools was then presented to a larger group of beneficiaries in the 'off-site training'.

The workshop focussed on the following aspects with respect to sample project design:

- To present the key elements of a site assessment and feasibility study
- To apprise the participants about the pre-contractual process
- To highlight the significant components of a fair contract between a customer and the project developer
- To analyse the financial viability of the project

I. On-Site Training:

1. Objectives

The purpose of the on-site training was to provide site-specific information on how a solar PV system could be adopted by the schools to meet the gap in electricity demand and supply. The site assessment and feasibility study was hence carried out in order to assess the electricity requirement and hence carry out load assessment;

✓ To further carry out a detailed roof assessment and shadow analysis for the installation for solar system; to assess the system size requirement.

The site and feasibility assessment comprised of the following studies:

- Structural assessment which comprises of analysis of rooftop layout and construction of the facility

- Shadow analysis
- Electrical assessment, where the electrical equipment are assessed thoroughly to understand the energy efficiency requirements
- Risk assessment which includes an analysis of potential risks at the site pertaining to installation of solar solutions

2. **Key observations from the site assessment and feasibility studies:**

a) **School Infrastructure**: The school buildings had nearly 10-15 rooms based on the size of the rooms, which could accommodate around 250 to 350 students. The number of rooms in the buildings depended on the strength of students as well as the location of the school. Further, the schools also comprised of large playgrounds and lobby areas.
The critical load of the buildings largely comprised of tube lights, fans, photocopiers, Refrigerators and the non-critical loads included the water pumps and water coolers. Further, the schools also had computer systems or ICT labs which would require electricity. It was observed that the appliances and equipment installed in the schools were also old.

b) **Status of power supply**: The schools experience power cuts for only 3-4 hours a day. In order to meet its energy requirements, the schools used inverters that range from 0.85 KVAs to 6 KVAs based on the energy requirement. However, unreliability of electricity supply disallows the schools to utilise several appliances and gadgets including the computers.

c) **Viability of installation of solar solutions**:

- Energy requirement, reliability of energy supply, availability of battery backup and availability of alternative sources of fuel like diesel, amongst other things could be crucial factors in order to determine the feasibility of installation of off-grid solar solution at a facility. It was observed that the schools suffered from power cuts for only 3-4 hours a day and the energy requirement of the schools could be easily met by enhancing the capacity of the inverters and by replacing old appliances with energy efficient ones. Hence, it may not be feasible for all the schools to install an off-grid solar system.
- However, remoteness of the schools could also be crucial in determining the feasibility of installation of an off-grid solar solution. Further, unreliability of power supply during bad weather conditions could also call for installation of an **off-grid system**. The **Government Senior Secondary School of Sadi, Chittorgarh** is located in an extremely remote location and also has poor network and road connectivity. The school also faces power cuts for 4-5 hours during the day, which could hamper the day-to-day activities of the school and also restricts the charging of the storage systems or inverters. The site was found to be ideal for installation of an off-grid system. After conducting a detailed site assessment and feasibility study at the school, it was observed that the capacity of the off-grid solar solution was low and ranged between 2KW to 5KW.

II. Capacity Building Workshop (Off-Site Training):

1. Pre-Contractual Process:

Even before the parties enter into a contract, following pre-contractual processes must be undertaken:

a) **Site Assessment and Feasibility Study**: Site assessment and feasibility study is one of the most crucial steps in order to estimate the size of the system. The study is conducted at the site of the facility or establishment where solar rooftop must be installed and comprises of not only technical analysis of the site and electrical equipments but also detailed interaction with the owners of the establishment on aspects like operations and maintenance. The depth of technical assessment conducted by the project developer also determines the technical capabilities of the project developer.

Based on the site assessment exercise conducted, following key points were discussed with respect to site assessment:

1. **Determination of Capacity based on energy assessment**: In order to estimate the capacity required for an off-grid system, a complete estimation of the power load of all connected equipment must be conducted. The critical loads of the schools largely comprised of tube lights, fans and projectors and the non-critical loads comprised of water coolers and water pumps. In case of a grid-connected system, the capacity of the system is estimated on the basis of the Net Metering Policy of the state[1].

2. **Load optimisation and Energy Efficiency are critical to estimating the capacity of the system:** Installation of a solar rooftop project cannot be done in isolation. Estimation of capacity of the solar installation also involves customisation of services in order to suit the energy requirements of the facility. Hence, load optimisation exercise is crucial in order to estimate the capacity of the off-grid system.

   Optimisation could comprise of several components:

- Replacement of old appliances which comprise of the critical load (like fans, tube lights, printers) with energy efficient appliances,
- Enhancement of capacity of the exisiting equipments which comprise of the non-critical load (like water coolers and water pumps) and reschedule their usage time.
- Energy efficiency exercise could lead to reduction in the size of the system and cost of the off-grid system could be reduced substantially.
- As the equipment and appliances installed in the schools were also old, it made a strong case for replacement of appliances with energy efficient equipments.

3. As a result of site assessment and feasibility study, **multiple case scenarios** of different system capacities could be offered to the customers.

4. **Accessibility of Rooftop**: The school buildings are spread horizontally and do not have permanent access to the rooftops. Lack of permanent access to the roof could act as an advantage as well as a disadvantage to the facility. It could act as a challenge during installation of the modules and also during the operation and maintenance of the modules. However, lack of easy accessibility to the rooftop of the building could reduce the probability of damage caused to the solar panels on the roof.

[1] In Rajasthan, the Net Metering regulations allow the capacity of a solar installation to be maximum upto 80% of the total connected load of the establishment or facility.

Recommendation:
Focus on energy efficiency before installation of solar: For smaller establishments, where the supply of power is not highly unreliable, it is suggested that the customers invest in enhancing their energy storage capacity and installation of energy efficient appliances. This would cater to the energy requirements of the establishment.

b) **Terms of Agreement**:

Before a contract is signed, the following Terms of Agreement could be pre-defined:

1. **Parties to a contract:** Project Developer and Consumer are two important parties to a contract. However, the other parties to a contract could depend on the mode of financing of the project. In an OPEX model, an EPC contractor and Operations and Maintenance Agency could also be the parties, to whom the project developer outsources the work.
2. **Scope of Work:** Based on the number of parties to a contract, the scope of every party is defined. The roles and responsibilities of the parties must be determined in advance. **Engineering details like** roof layout, capacity deployed, string designs showing equipment layout and type of module, amongst other things could be pre-defined.
3. **Performance Guaranty and responsibility of project developers**: In the absence of adequate grievance redressal mechanism for disputes in solar, a Contract could be an efficient tool for clearly defining roles and responsibilities of the project developers and determining their accountability for deviations in delivery of services and tools for mitigation of risks.
   In case of off-grid systems for education institutions, where the installation of solar is done through the respective government authorities at a large scale, a Rental System could be adopted, where the project developer would receive money on a monthly rental basis. Rental system ensures that the project developer is accountable towards the functioning and maintenance of the system as well.

4. **Extension of agreement and Exit Clause**: In case of an OPEX model, it is essential to determine the clauses that govern the extension of the agreement at the end of the term of contract. Further, the parties of the contract could also per-define the terms of exit in case of disputes. The exit rate could be predefined based on the return of the developer, degradation rate of the system and legal cost of the developer.

c) **Best practises for a fair contract**:

1. **Approvals and Permissions**: In case of grid connected systems, approval from Municipal authorities, fire safety, urban or industrial development, building / factory inspectors, lenders and approval from Distribution Utility for Net Metering become essential.
   However, in case of off-grid systems, the schools and project developers need to take only '**No-Objection Certificate**' from the schools or Gram Panchayats for installation of solar systems. In case of utilisation of CSR funds, the NOC becomes an important document. It is advisable that the approvals must be taken before installation of the system.
   It is also essential to pre-define responsibilities of the parties towards the permissions.

2. **Key Deliverables**: A fair contract must comprise of both **Hard** as well as **Soft deliverables**.

   The hard deliverable could include **Detailed Design and Engineering Plan**, which comprises of information on Energy Assessment, Shadow Analysis, Array Layout, Equipment Layout, Cable Layout, General Assembly Drawing for Structures (all designs), Structural Analysis Report (all designs, approved by authorized Structural Engineer), Performance Ratio and Yield Estimation and Bill of Material, amongst others.

- The soft deliverables could cover aspects like **Quality; Monitoring; Operations and Maintenance and Safety of the System**. The key components that could be mentioned in the contract include Timeline for delivery of materials; Breakdown of activities (civil, mechanical and engineering works); Project team and escalation matric; Monitoring and Reporting; Quality Plan and Safety Plan.

3. Other issues to be covered in the contract:

- **Operational issues** like access of school's infrastructure to the team of the project developer like space for storage of material, use of resources like water and electricity could also be mentioned in the contract. Such clauses would avoid delays in execution of project.
- **Delays in Execution**: The contract document could also accommodate allowance for reasonable delays in execution. However, a realistic timeline for execution could be agreed upon by the project developer and the customer, which is also flexible.
- **Payment structure**: The payment structure should be clearly mentioned in the contract document. The payments could be released against the material delivered by the project developer. The payment structure could also include a break-up of costs incurred in the project and the release of funds could be monitored against this delivery.
- **Responsibility of Contractor for Site Assessment:** It is recommended that the contract also determined the responsibility of the developer in order to conduct the site assessment and feasibility analysis and prepare the project design documents based on the assessment. This would avoid duplication of work if the site assessment is conducted by another developer and the project is executed by another developer. Also, it would allow the installation of the system is as per the site assessment conducted and project design prepared by the developer.

4. **Documents to be handed over by the Project Developer**:
   After the commissioning of the project, the project developer must hand over the **Commissioning Report** and the **Punch list** which will allow the customer to locate any deviations in the project plan, '**As Built Engineering Drawings**' which captures the design of the system, **Performance Reports** and **Warranty documents** of all the components used in the module. It must be clearly defined if the warranty is ensured through a single point contract or the warranty is provided by multiple agencies.

5. **Performance Guarantee**:
   Generation and Performance Ratio ensures that a minimum standard of performance is guaranteed by the project developer, which should also be captured in the contract. This would

help ensure accountability of project developer for minimum performance of the system. However, the performance of the system could be impacted due to several environmental reasons. In order to estimate the performance ratio, real time weather data is extremely crucial. However, due to lack of real time weather data, the performance ratio could not be accurately calculated. Therefore, the performance guarantee of the system could be based the 'average number of units' that should be generated by the system. As performance guarantee could have several financial implications, it is also essential to allow some flexibility in the performance guarantee.

As it is difficult to provide performance guarantee for smaller projects, guarantee could also be provided on the basis of **Generation Ratio**, which could be easily calculated on the basis of historical data.

d) **Financial Analysis of Installation of Solar Systems**:

- In order to analyse the financial viability of a grid-connected solar solution, Break Even Analysis and Analysis of Internal Rate of Return could be conducted. Break Even Analysis would determine the time period when the project would begin to generate surplus revenue and the entire investment is covered. As the size of the system increases, the break-even time period reduces. For a 5KW system, the investment cost breaks-even after 9 years. However, for a 10kw system, the break-even is achieved at 7th year.
- However, grid connected solar systems are long term assets. Internal Rate of Return (IRR) of a project provides a better assessment of financial viability of the system. IRR could determine the profitability potential of the investment in solar systems. As the size of the system increases, the IRR of the investment increases. For a 5KW system, the per Watt cost of the system is nearly INR 60. As the size of the system increases to 50 KW, the per Watt cost reduces to INR 40. For a 5KW system, the IRR is estimated to be nearly 16-17%, whereas, it increases to nearly 27% for a 50KW system.