

Module Outline

PROCUREMENT OF SYSTEMS





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Relevance and Background

After securing the financial closure of a large-scale solar project, the emphasis shifts towards procuring the necessary equipment, construction, and commissioning of the power plant within the specified timeline and budget. Ensuring timely completion of the project and maintaining the budget is a top priority for developers. The goal is to construct an efficient and reliable power plant that generates the expected amount of energy and revenue. Key aspects of project implementation include obtaining permits and licenses, selecting and contracting the engineering, procurement and construction (EPC) company, constructing the power plant, and providing operations and maintenance (O&M).

Theme – Project Management

Competency – Procurement

Code of the Module – To3Co8M21

Learning Outcomes

At the end of the presentation, participants will be conversant with the following:

- Various types of business models for different solar based solutions
- Procurement of EPC and O&M services, including selection of suitable systems
- Key aspects of EPC and O&M contracts

An understanding of the above would enable the participants to understand how systems are procured for solar projects and how to develop appropriate EPC and O&M contracts. This understanding is expected to support them in developing quality solar projects in a cost-effective and time-bound manner in their respective countries.

Method of Delivery

Duration	Resource Code	Resource Delivery
60 min.	M21 L01	Procurement of Systems

M21 L01: Lecture Presentation

The MS PowerPoint presentation details out the process through which project owners can procure systems for a large-scale solar project. It highlights the key differences between a capital expenditure (CAPEX) and a renewable energy services company (RESCO) model, with reference to the engineering, procurement and construction (EPC) process. The presentation focuses on the need to spell out the responsibilities of all parties in a transparent manner. The final section covers the importance of operation and maintenance (O&M), along with the selection process of an O&M agency.

Key Topics to be Covered

1. Key Differences between CAPEX and RESCO Models
2. Scope of EPC Contracts
3. Procurement of O&M Services



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1 Introduction

In terms of the ownership of solar projects, there exist two potential business models: CAPEX and RESCO, each accompanied by its distinct advantages and disadvantages. Consumers make their choice of model based on various factors, such as their intended use of solar energy, the availability of financing, the scale of the project, the evolution of the renewable energy market, and more.

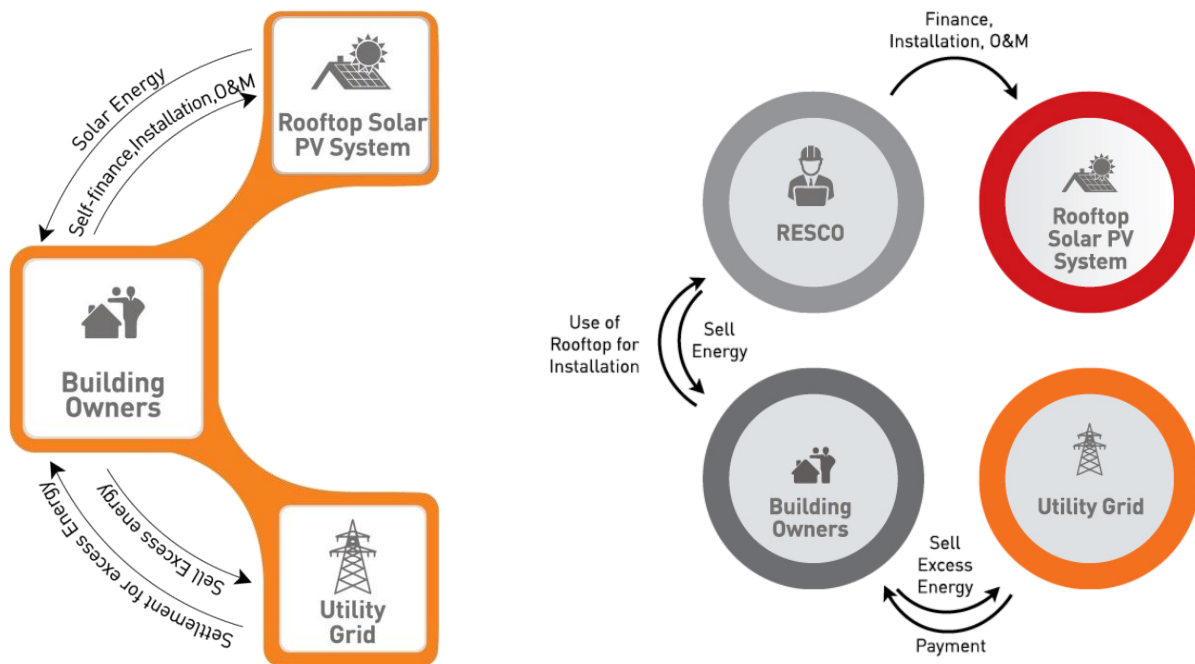


Figure 1: CAPEX and RESCO based business models

2 Key Differences Between CAPEX and RESCO Models

- **CAPEX Model:** This is the most common model for solar power projects in power and renewable energy markets that are yet to completely mature. In this model, the customer or the project company generally hires a solar EPC company that is responsible for the installation of the entire solar power project and then hands it over to the consumer upon its successful commissioning. One of the major advantages of this model is that the customer is eligible to claim accelerated depreciation to obtain tax savings from the government.
- **RESCO Model:** In this model, a RESCO sets up and owns the solar project and sells the project's electricity to the customer or project company through a power purchase agreement (PPA). In addition to other clauses, the PPA mentions the capacity and duration of the contract.

A brief comparison between the two are given below.

CAPEX Model	RESCO Model
Allows consumer to own the system, and risks associated with it	Ownership rests with counterparty; reduced risks of consumer
Ideal for DRE (distributed renewable energy) projects that are behind the meter	Ideal for large-scale projects, front of the meter
Users can benefit by selling surplus power generated to the DISCOM (distribution company)	Fixed amount of electricity procured provides predictability of electricity costs
Better utilization of available space	No space required at the consumer's end
Potential tax savings through accelerated depreciation	Can get cheaper solar electricity due to economies of scale
EPC company directly recruited by the project company	Solar developer recruits an EPC company for execution or has in-house EPC capabilities

The typical stages in a solar project are project development, project finance and investment, project design and engineering, procurement of EPC and O&M services, construction management, and O&M phase. Systems or equipment are procured in the EPC procurement stage. As the equipment is procured by the EPC player, O&M is generally its responsibility, and a separate agreement is entered into with them. However, O&M can be with any other specialized party too, with clear ring-fencing of roles and responsibilities of repair and maintenance of equipment and the project between parties. As ownership of the equipment rests with the user in the CAPEX model, procurement of the same is of paramount importance. This module highlights the key issues that the user should consider while making procurements of EPC and O&M services, and for the systems.

3 Scope of EPC Contracts

For many large-scale solar projects, the project developer or the customer often hires an EPC firm to handle tasks beyond those related to permits, financing, and legalities. Some companies are vertically integrated, with control over manufacturing, development, and EPC (e.g., First Solar). There are a variety of arrangements between project developers and EPC contractors, ranging from in-house EPC services to specialty firms or generic EPC firms. The decision to use an in-house or generic EPC contractor, or a specialty firm, typically depends on the level of risk associated with the technology. The responsibilities of a typical EPC company in the process of commissioning an energy project can be broadly classified into three categories:



- **Engineering:** The engineering phase, which can last up to several years for large plants, starts with a site survey and feasibility analysis, followed by a complete design of the PV project, including the placement and number of PV modules and inverters, as well as any buildings and roads required for operations and maintenance. This design serves as the basis for procurement and guides the construction process.
- **Procurement:** Procurement involves acquiring all physical assets and securing the services of all necessary personnel to carry out the PV project. These assets and personnel include, but are not limited to, construction vehicles, modules, inverters, and other infrastructure necessary for setting up PV projects and generating electricity. The timing for procurement of different assets and services can affect the overall installed project cost, as early deliveries may result in additional storage fees, while late deliveries can result in costly delays in construction.
- **Construction:** During the construction phase, installations of modules and inverters take place, along with the development of all necessary infrastructure. For PV projects, the term

"balance of system" refers to all components of a solar project excluding the modules, such as cables, racking systems, wiring, road graders, and inverters. Often, multiple firms are involved in the construction process, with specific tasks, like electrical or road work, subcontracted from a general contractor to experts.

3.1 Procurement of EPC Services

EPC is a type of comprehensive solar power project execution that involves a company assuming responsibility for the design, construction and commissioning of a solar power plant. During the course of the project, the EPC contractor oversees every aspect of the undertaking, from start to finish, because of which the importance of selecting the right contractor is crucial. Procurement of EPC services involves the following steps:



- **Developing tender documents:** The call for a tender includes a request for proposal (RFP) and a copy of the EPC contract. Core sections of an RFP for procuring EPC services include (Pratt et al. 2021):
 - Background and context for the procurement
 - Definitions of terms used in the RFP and the EPC contract is an important component as it helps avoid future litigation between the signing parties.
 - Interpretations of terms and conditions, and eligibility and evaluation criteria are also part of the RFP.

- The most important component is the scope of work of the EPC contract.
- Finally, the RFP contains timelines for various actions of both parties like the date for pre-bid meetings, bid submission deadline, bid opening date, etc.
 - **Evaluation of bids received:** EPC bids are generally evaluated on two accounts - technical and financial. First a technical assessment of eligibility is carried out based on the criteria mentioned in the RFP. The bids that qualify are then technically evaluated, again according to the criteria mentioned in the RFP. After this a financial evaluation is undertaken. In some government procurement processes, the least cost or L1 system is followed, in which financial bids of three bidders that have obtained the highest marks are opened and the one quoting the least is awarded the contract. In some cases, a quality and cost-based selection (QCBS) is followed, in which evaluation is carried out giving weight to technical and financial aspects, and a winner is selected.
 - **Contract negotiation and signing:** Negotiations with the selected bidder are then undertaken on the terms and conditions of the contract, timelines and penalties, and recourse for both parties upon non-compliance of the contract terms and conditions. Internationally two broad frameworks for contracts are followed for large-scale construction projects as described briefly in the next section.


3.2 Basic features of EPC contracts

It is customary to employ a standardized contract format, sometimes referred to as a 'boilerplate contract,' as a template and foundation for the EPC contract. The following standard contract formats are commonly utilized for the delivery of solar PV power plants on a turnkey basis:

- The Conditions of Contract for EPC/Turnkey Projects, First Edition, 1999, published by the Federation Internationale des Ingenieurs-Conseils (FIDIC)
- The Institution of Engineering and Technology's Model Form of General Conditions of Contract (MF/1 Rev. 4)

The crucial clauses for a project owner in any construction contract are those pertaining to time, cost and quality. In the instance of solar PV power plant construction, a solid EPC contract should cover the following areas ("Utility-Scale Solar Photovoltaic Power Plants - A Project Developer's Guide" 2015):

- "Turnkey" scope of work
- Fixed completion price
- Fixed completion date
- Restrictions on the contractor to claim extensions of time and additional costs
- Milestone payment profile that is suitably protective to the owner and based upon the completion of pre-defined sub-tasks.
- Plant performance ratio (PR) guarantees
- Liquidation damages (LDs) for both delay and performance

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- Financial security from the contractor and/or its parent organization
 - Defects warranty

4 Procurement of O&M Services

Solar PV power plants have low maintenance and servicing requirements compared to other power generating technologies. Nonetheless, it is crucial to provide proper maintenance to maximize both the energy yield and the plant's lifespan. Operations must be optimized to balance maximum production and minimum cost. The O&M of a solar PV plant is typically carried out by expert contractors who are responsible for overseeing the overall operation of power plant, its components, and any subcontractors. In addition to operating the plant and maintaining all equipment, the O&M contractor may also be responsible for security and grounds-keeping.



The presence of an O&M contract is crucial in defining the parameters for the O&M of a project during its life. If an O&M contractor is hired to perform certain tasks, it is essential that all requirements related to preventative and corrective maintenance, performance monitoring, and reporting are clearly stipulated in the contract, along with the frequency at which these activities need to be conducted. This helps to measure and evaluate contractor performance, and provides a basis for challenging it, if necessary. Maintenance can be categorized into:

Scheduled Maintenance: This is planned and aimed at fault prevention, as well as ensuring that the plant operates optimally. This is sometimes called preventive maintenance.

Unscheduled Maintenance: This is carried out in response to failures and is sometimes called breakdown maintenance.

Regular and comprehensive maintenance schedules should minimize the need for unplanned repairs, thereby making both scheduled and unscheduled maintenance crucial.

4.1 Basic features of O&M contracts

The O&M contractor is accountable for the O&M of the entire plant, including all of its components and any work performed by subcontractors. The duration of O&M contracts varies and is unique to each project. Some plant owners, typically investment funds, prefer longer contract terms for cost surety and predictability. As a result, contracts of over 20 years, covering the entire project lifetime, are common. However, other owners may prefer shorter durations, such as one to five years, to take advantage of falling market costs and negotiate more favourable terms. Regardless of duration, termination events should be clearly defined to allow the owner to end the contract in case of contractor default, underperformance, or insolvency. An ideal O&M contract should cover the following aspects:

- Services to be carried out by, and obligations of, the contractor
- Frequency of services
- Obligations of the owner
- Standards, legislation and guidelines with which the contractor must comply
- Payment structure
- Performance guarantees and operational targets
- Methodologies for calculating plant availability and/or performance ratio
- Methodologies for calculating liquidated damages/bonus payments in the event of plant under- or over-performance
- Terms and conditions
- Legal aspects
- Insurance requirements and responsibilities.

4.2 Selection of O&M Contractors

When selecting an O&M contractor, it is crucial to thoroughly evaluate the company's capabilities. Specifically, the following factors should be taken into account:

- Familiarity of the contractor with the site and technology
- Location of the contractor
- Number and competency of staff and experience in O&M services for solar PV plants
- Experience and track record
- Financial strength and ability to honor warranties

Based on the above parameters, the consumer/developer prepares a tender and requests bids from O&M service providers. The goal should be to choose a contractor with the necessary experience to fulfil the obligations of the contract throughout the project's duration.





Further Reading

Participants can read the referenced material given below for further learning.

References

Pratt, Lawrence, Manjunath Basappa Ayanna, Ruan Fourie, and Jarrad Wright. 2021. "A Guideline for Cost-Efficient Procurement of Photovoltaic Assets for Municipalities." Issue 2. Pretoria: GIZ-SAGEN.

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