INTERNATIONAL SOLAR ALLIANCE

Module Outline

TECHNO-COMMERCIAL APPRAISAL OF PV PROJECTS

Disclaimer

Relevance and Background

Investors carry out techno-commercial appraisals to understand the financial viability of any project. The appraisal process is carried out by investors using their own resources or engage an external party. A thorough appraisal helps investors make good investment decisions and supports beneficiaries to find investments at an attractive financing cost.

For a new project, an appraisal is generally carried out during the project preparation phase with the intent to raise debt and equity. For an operational project, an appraisal is carried out for the expansion of the project or to replace the investors.

Theme – Financing
Competency – Feasibility Assessment
Code of the Module – T04C10M28

Learning Outcomes

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

- Major aspects of the appraisal
- Methodology for the Appraisal Process

Method of Delivery

Duration	Resource Code	Resource Delivery
60 min.	M28 L01	Lecture on Techno-Commercial Appraisal of PV Projects

M28 L01: Lecture Presentation

The MS PowerPoint presentation will present the objective of the techno-commercial appraisal and the end beneficiaries of appraisal activity. The lecture will discuss the various aspects and methodologies of technical assessment & feasibility study. Subsequently, financial viability is discussed.

The presentation will then cover other important aspects of the appraisal process like management capabilities and risks.

The presentation concludes with the investor-specific requirements.

Key Topics to be Covered

1. Technical Feasibility
2. O&M Plan

3. Financial Viability
4. Permits and Clearances
5. Management Capabilities
6. Risk Assessment and Mitigation
7. Investor Specific Requirements

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1 Introduction

Techno-commercial appraisals are carried out to understand the feasibility of projects with the objective of arriving at an investment decision. These appraisals are also known as techno-economic viability (TEV) studies and are most commonly used by lenders to make lending decisions, including debt restructuring. Equity investors also use these appraisals for investment decisions. The project areas appraised are given below:

- **Technical Feasibility**
- **Operations & Maintenance (O&M) Plan**
- **Financial Viability**
- **Permits and Clearances**
- **Management Capabilities**
- **Risk Assessment and Mitigation**
- **Investor Specific Requirements**

The appraiser collects the required information from the project developer and carries out an independent review of the proposal submitted by the developer. The review also involves a study and comments on the reasonableness of the information and its source. The information available can vary with the stage of the project - at the inception stage, the information available is mostly tentative. The completeness of the information improves as the project progresses.

2 Technical Feasibility

Technical feasibility assesses the suitability of the proposed site, technical configuration, and execution plan for the proposed project.

2.1 Site Location and Condition

The site is assessed to understand the following:

- **Ownership -** The project developer should own the land or have the right to use the land for the proposed project for longer than the full tenure of the project in case of a lease.
- **Site Conditions -** The site (soil and rooftop) should be able to support the solar modules and other equipment, whether ground-mounted or solar rooftop (SRT) plants. Enough proof should be available that the report findings are used in designing all civil work like structure foundations, drainage, and roads, etc. Water quality, water level, tides and waves, wind, aquatic life, waterbed, bank of the water body etc are assessed for floating solar projects.
- **Topography -** The array layout changes according to the topography, so the topography survey results are used to develop the layouts.
- **Transport Connectivity -** The site should have connectivity for easy movement of material and manpower.

- **Power Evacuation -**
    - The capacity of the identified power evacuation sub-station to evacuate from the proposed project, and the viability of constructing the evacuation line need to be assessed.
    - Local grid codes contain the requirements for evacuation and the process for application and sanction. These codes, along with the calculations and application documentation, can be referred to, to understand the status of the evacuation.
    - In case the evacuation line has to pass through land owned by others, approvals for right-of-way would be needed.
- **Local Climate -** Temperature, wind, rainfall and humidity are usually considered for the study of local climate.
- **Site Preparation Requirements -** These requirements include removal of obstacles like large boulders, levelling, soil treatment and water draining.
- Security arrangements for theft and other intrusions, and safety.
- Other conditions include but are not limited to the history of natural calamities (like cyclones, flooding, and earthquake) and the local environment (like dust, pollution and salinity).

2.2 Solar Resource Assessment

The assessment is carried out to estimate the energy generation from the project. Local site conditions are used to estimate the generation, which includes solar irradiance, local climate, and other conditions. Considering energy generation estimates at p(90) data is a prudent approach. Other aspects of the assessment are knowing and indicating the accuracy levels, and understanding the uncertainty and risks arising thereon.

2.3 Plant Specifications and Layout

The assessment includes a description of technology and specifications of the major components of the plant, along with rationale for the selection and sizing. Major components include PV modules, array mounting structure, inverters or power conditioning units (PCU), and monitoring, evacuation and safety equipment, etc.

2.4 Plant Performance Simulation

Energy generation from the proposed project is simulated using simulation software. Monthly generation for the first year and annual generation for the life of the project are estimated using the simulation. The following are considered for the simulation:

- Solar Irradiance
- Weather and Local Conditions
- Orientation and Inclination of Solar Arrays
- System Losses

2.5 Construction Schedule

The schedule should identify the critical path, milestones and factors affecting the schedule. Permits and licenses with reasonable timelines should also be considered in the schedule.

Information	Review Methodology
Data - Local climate, Other climate conditions	• Review of the reasonableness of the source and authenticity of the data • Comparison with multiple reliable sources
Ownership, Construction schedule	• Documentary review
Power evacuation,	• Documentary review of application/approval • Documentary review of assumptions, specifications and calculations
Plant specifications and layout	• Documentary review of assumptions, specifications and calculations
Plant performance simulation	• Review of assumptions, specifications and calculations • Comparison with similar projects
Site preparation, Security	• Documentary review • Site inspection
Site conditions	• Review of the soil testing report, roof bearing capacity report and bathymetric reports for ground mount, rooftop and floating solar projects respectively

3 O&M Plan

An O&M plan is used for identifying the key system operating parameters, maintenance procedures and schedules, and processes to meet the same. O&M plans and their execution are crucial in plant performance and financial viability. The appraisal of the following aspects of the O&M plan includes:

- Resource planning, including manpower and water
- System monitoring methods
- Preventive maintenance schedule
- Breakdown maintenance strategy
- Strategy to minimize downtime
- Insurance plan
- Security
- Spare parts strategy
- Manpower and skill development plan

Information	Review Methodology
O&M Plan	• Documentary review • Comparison with similar plants

4 Financial Viability

Financial parameters used for assessing a project viability vary with the investor. Equity investors use equity internal rate of return (EIRR) and payback period. Lenders use debt service coverage ratio (DSCR). Government agencies use levelized cost of energy (LCOE). The financial viability should be carried out as per the requirement of the investor. The inputs used for financial viability are:

- **Project Cost -** The project cost should be estimated from the firm and valid commercial quotations from vendors, and then compared with similar projects. Project cost includes:
  - Cost of plant and equipment
  - Manpower costs
  - Soft costs
    - Interest during construction
    - Costs of licenses, permits and approvals.
    - Insurance premiums during transport and construction
- **Revenue -** Revenue is estimated from generation (along with annual duration) and tariffs from different sources. For projects with no power purchase agreements (PPAs) like mini-

grids, solar pumps, etc., revenue estimation needs to consider the load survey, energy consumption pattern, competition from the grid and other sources, and revenue realization.

- **Depreciation**
- **Replacement costs**
- **O&M cost**
- **Financial Parameters**
  - Debt equity ratio
  - Cost of equity/Required return on equity.
  - Interest rate, interest payment and repayment schedule for the term loans
  - Working capital requirement
  - Taxes
  - Incentives like capital subsidy, interest rate subvention, tax holiday, accelerated depreciation.

Information	Review Methodology
Project cost	• Documentary review of the quotations/purchase orders • Comparison with similar projects
Revenue	• Review of PPA for the project life, tariff, penalties and supply conditions • Review the revenue estimates • Review of load survey and consumption pattern reports for projects with no long-term PPAs
Depreciation and taxes	• Review the calculations in reference with the local accounting and taxation laws
Other costs including O&M cost	• Review the calculations • Comparison with similar projects
Financial parameters	• Interview with the investors and project developer
Returns on the project	• Review the financial model • Carry out sensitivity analysis

5 Permits and Clearances

The appraisal should identify all the permits and clearances required from the respective departments involved, and the tentative timelines for acquiring the same.

Information	Review Methodology
Permits and clearances	• Refer to policies and regulations and local relevant laws to identify the requirement and process • Documentary evidence of application/approval

6 Management Capabilities

The appraisal should highlight the capabilities of the developers to execute the plant and operate the same to achieve the projected returns. This will involve assessment of the:

- Legal status of the developer
- Organization performance - technical and financial
- Track record of the management team
- Qualification and experience of the project team

Information	Review Methodology
Management capabilities	• Documentary review • Interview with the project developer

7 Risk Assessment and Mitigation

Associated risks, their impact and criticality need to be identified. The project needs to be assessed if appropriate mitigation strategies are being adopted. Major risks generally covered in the appraisal are pertaining to:

- Project execution risk
- Design of the plant
- Implementation planning
- Quality of implementation
- Acquisition of permits and clearances
- Cost overruns especially with the imported plant and machinery
- Operational risk
- Technology performance
- Offtake of energy including the availability of evacuation and grid stability
- Energy generation forecasting
- Regulatory constraints
- Financial risk
- Revenue realization
- Generation of returns from the project
- Competition for projects with no long-term PPAs
- Offtake of power in case of grid extension for off-grid projects

Information	Review Methodology
Risk assessment and mitigation	• Documentary review • Review the warranties and guarantees of the equipment, especially solar PV modules, inverters and other equipment

8 Investor Specific Requirements

The above-listed topics are the regular content of a techno-commercial appraisal. Investors have additional requirements that may need to be addressed in the appraisal. The most common of these requirements are environmental and social assessment, and resettlement and rehabilitation assessment.

Reading Material

1. *Feasibility Study on the Use of Solar Energy at Piarco International Airport by The International Civil Aviation Organization (https://www.icao.int/environmental-protection/Documents/SolarFeasabilityStudies_PiarcoTrinidadTobago_Report-July9-web.pdf)*

2. *Pre-Feasibility Study Report for 10 MW Solar Power Generation Project Konsa City, Kajiado by Ecoplan Kenya Limited (https://nebula.wsimg.com/6b030a717d48189ba53956bc8d7f6a41?AccessKeyId=82A41D5164BB3AE47300&disposition=0&alloworigin=1)*

3. *Feasibility Study for Application of Photovoltaic Power on Male And Hulhumale Islands in the Republic of Maldives by Japan International Cooperation Agency (https://openjicareport.jica.go.jp/pdf/11972536_01.pdf)*