

Solar Thermal Power Project Development

Phase 1: Project Assessment (PA)

- *Basic Project Information*

As a first step, basic project information must be collected in order to decide if the expected conditions are attractive enough to initiate project development and to make the necessary investments. This first evaluation should provide general information on the electricity market and on the market chances of other possible products of the solar power plant like desalted water or process heat. Further issues are the expected capacity requirement, cost level, revenues, availability of finance, national policies, the level of political risks, the solar irradiation level, possible project implementation structures and the general availability of sites. The scope of this stage is to identify the basic investment opportunities of such a project.

- *Finance of Project Assessment Studies*

The next step is to arrange for partners and for finance of the project assessment studies listed in the following.

- *Solar Energy Resource Assessment*

The first study analyses the available solar energy resource. The analysis is based on satellite remote sensing. The solar beam radiation intensity is mapped for the whole country in a raster of 1x1 km. For every site, annual hourly time series of the solar radiation intensity are obtained.

- *Site Ranking*

Using remote sensing data of the ground, the whole country is scanned in a 1x1 km raster to identify ground coverage, land use, vegetation, soil types, protected areas, natural and other risks, available infrastructure, topography, hydrology etc. With that information, suitable sites for the erection of solar thermal concentrating systems are selected. The last step of this study is a site ranking with respect to the expected technical and economical performance of the solar power plants.

- *Pre-Feasibility Study*

Modelling of several possible solar power plant configurations based on the previously obtained information will specify the basic outline of the project. A sensitivity analysis will reveal the critical parameters for successful economic performance. The following terms will be specified within this study:

- technical concept and preliminary design
- project location and radiation resource
- expected technical and economic performance
- investment, cost of operation and maintenance
- concept of project finance
- concept of risk management
- legal and administrative requirements
- possible project implementation structure (such as utility-owned or IPP)

The Project Assessment Phase serves to compare several project alternatives and yields a recommendation on the most promising. The last stage is a decision on the continuation of project development and investment. The results of this phase will be the basis for further negotiations with potential partners from industry, policy and finance. The duration, including the pre-assessment phase of gathering basic information and finance, is in the order of 9-12 months. If the results are promising, project development will be continued with the following activities.

Phase 2: Project Definition (PD)

- *Foundation of a Project Company*
After the evaluation of the project assessment phase, a project company is founded to organise the further development of the project. The contractual basis for this company is the related shareholders agreement.
- *Negotiation of Project Parameters, Licenses and Contracts*
Negotiations with relevant authorities and potential project partners to define the legal frame, required licenses, fuel-, power- and water supply/purchase agreements, site development agreement and ownership, contractual framework and agreements of potential project partners and contractors, the scheme of finance, the conditions of risk management and the final project implementation structure.
- *Feasibility Study*
Detailed thermodynamic and economic modelling of the most promising solar power plant configuration. Sensitivity analysis of different operation modes and design variants to reveal the critical parameters for successful economic performance. The following terms will be specified within this study:
 - basic design
 - detailed analysis of the expected technical performance
 - detailed economic model (electricity cost, internal rate of return, amortisation period)
 - preparation of a construction bid package
 - investment based on budgetary quotes, cost of operation and maintenance
 - detailed analysis of the expected economic performance
 - detailed structure of project finance
 - detailed structure of risk management
 - legal and administrative frame
 - final project implementation structure
- *Contract for Engineering, Procurement and Construction (EPC)*
 - EPC Contract Award
 - Evaluation of Quotes
 - EPC Contract
- *Definition of the Project Consortium*
 - Project Management
 - Engineering
 - International Construction Company (General Contractor)
 - Power Block and Solar Field Suppliers
- *Definition of other Project Partners*
 - Consultant
 - External Equipment Suppliers and Services
 - Project Finance (Equity, Loan, Grants)
 - Risk Management (Technical, Political, etc.)
 - Operation and Training
 - Scientific Support

The result of this phase is the final conceptual design of the project and the contractual framework between all participating entities which is a major requisite to obtain the construction and project loans and eventually other support for finance. The time frame of this phase is in the order of 9-12 months, if decisions are taken quickly and if most activities are pursued in parallel as far as possible.

Phase 3: Engineering, Procurement and Construction (EPC)

- *Acquisition of the Construction Loan*
- *Engineering*
 - detailed plant design
 - equipment specification
 - system engineering
 - civil engineering
- *Procurement*
 - turbine generator
 - other power block equipment
 - solar field equipment
- *Construction*
 - civil works
 - other construction works
 - solar field
- *Commissioning and Grid Synchronisation*
- *Training of Personnel (parallel to other activities)*






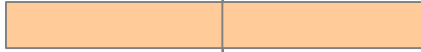
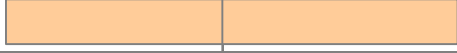



The final step of this phase is the turn-key delivery and commissioning of the plant and the replacement of the construction loan by a long term project loan. The duration of the EPC-phase is in the order of 24 months. The time-critical tasks of this phase are plant design (3 months), power block procurement and construction (18 months) and commissioning (3 months).

Phase 4: Operation (O&M)

- *Operation and Maintenance*
- *Accompanying Measures*
 - performance monitoring
 - training of personnel
 - local infrastructure and industries
 - dissemination and marketing
 - technology transfer

Within a Build-Operate-Transfer (BOT) project, the power plant is transferred to the host country after the repayment of the project loan, which may be after 10 to 15 years after startup. The total operational lifetime of a solar thermal power plant project is expected to be 30 years and higher.

Solar Thermal Power Project development (accelerated PA and PD by quick decision making)

| | Project Assessment Project Definition | | Engineering, Procurement, Construction | | Operation |
|---|---|--|---|---|--|
| | 3 M | first year | second year | third year | 30 - 40 years |
| Project Assessment (basic info + finance) |  | | | | |
| Project Assessment (pre-feasibility) | |  | | | |
| Project Definition (project design, contracts) | |  | | | |
| Purchase of Land | | |  | | |
| Engineering | | |  | | |
| Procurement | | |  | | |
| Civil Works | | |  | | |
| Construction | | | |  | |
| Commissioning | | | |  | |
| Operation and Maintenance | | | | |  |

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