Unit I
Viability
LCoE and
Financial
Model
Dimensioning and design of Off-Grid single user facilities. Detailed financial model.

All projects shall be financially viable, both on the initial cost and during the whole lifetime. If a project is not financially viable, there is no project, just a waist of time and effort.
Solar PV Dimensioning and design. Financial Model SAM.

### Summary

<table>
<thead>
<tr>
<th>Metric</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual energy (year 1)</td>
<td>301,450 kWh</td>
</tr>
<tr>
<td>Capacity factor (year 1)</td>
<td>17.5%</td>
</tr>
<tr>
<td>Energy yield (year 1)</td>
<td>1,536 kWh/kW</td>
</tr>
<tr>
<td>Performance ratio (year 1)</td>
<td>0.82</td>
</tr>
<tr>
<td>Battery efficiency</td>
<td>0.00%</td>
</tr>
<tr>
<td>Levelized COE (nominal)</td>
<td>18.77 €/kWh</td>
</tr>
<tr>
<td>Levelized COE (real)</td>
<td>15.22 €/kWh</td>
</tr>
<tr>
<td>Electricity bill without system (year 1)</td>
<td>$2,440</td>
</tr>
<tr>
<td>Electricity bill with system (year 1)</td>
<td>$892</td>
</tr>
<tr>
<td>Net savings with system (year 1)</td>
<td>$1,547</td>
</tr>
<tr>
<td>Net present value</td>
<td>$453,980</td>
</tr>
<tr>
<td>Payback period</td>
<td>NaN</td>
</tr>
<tr>
<td>Discounted payback period</td>
<td>NaN</td>
</tr>
<tr>
<td>Net capital cost</td>
<td>$621,853</td>
</tr>
<tr>
<td>Equity</td>
<td>$186,556</td>
</tr>
<tr>
<td>Debt</td>
<td>$435,297</td>
</tr>
</tbody>
</table>

### Energy Loss

- POA shading loss
- POA soiling loss
- DC module model
- DC inverter MPPT
- DC mismatch loss
- DC diodes and cor
- DC wiring loss
- DC tracking loss
- DC nameplate loss
- DC power optimizer loss
- DC performance adjustment loss
- AC inverter power clipping loss
- AC inverter power consumption loss
Wind. Dimensioning and design. Financial Model SAM.

Summary:

- **Metric**: Annual energy (year 1)
  - **Value**: 162,633 kWh

- **Metric**: Capacity factor (year 1)
  - **Value**: 18.6%

- **Metric**: PPA price (year 1)
  - **Value**: 18.43 c/kWh

- **Metric**: PPA price escalation
  - **Value**: 1.00 %/year

- **Metric**: Levelized PPA price (nominal)
  - **Value**: 20.03 c/kWh

- **Metric**: Levelized PPA price (real)
  - **Value**: 15.76 c/kWh

- **Metric**: Levelized COE (nominal)
  - **Value**: 22.27 c/kWh

- **Metric**: Levelized COE (real)
  - **Value**: 17.52 c/kWh

- **Metric**: Net present value
  - **Value**: $-38,487

- **Metric**: Internal rate of return (IRR)
  - **Value**: 5.00 %

- **Metric**: Year IRR is achieved
  - **Value**: 25

- **Metric**: IRR at end of project
  - **Value**: 5.00 %

- **Metric**: Net capital cost
  - **Value**: $269,784

- **Metric**: Equity
  - **Value**: $80,935

- **Metric**: Size of debt
  - **Value**: $188,849

- **Metric**: Minimum DSCR
  - **Value**: 0.64
Dimensioning and design. Financial Model SAM.

System Minimum Selling Price: 621,853 USD

Electricity Minimum Selling Price: 0.24 USD kWh

Only 10 mins Wasted

Client / Offtaker Accepts and signs contract ?

E P C Starts
Unit I
EPC
Design
EPC. Design, Engineering, Procurement and Construction.
EPC. Site Design.
EPC. Site Design.
EPC. Site Design.
Solar PV. EPC. Design.

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 |

| 1 |
| 2 |
| 3 |
| 4 |

Diagram:
- Length: 2 mt
- Height: 1 mt
EPC. Procurement.

- Sourcing
- Construction Program
- Payment Schedule
- Contract for goods or services

Suppliers & Quotes
EPC. Simultaneous Engineering.
EPC. Health & Safety.

- Personal protection gear is mandatory inside the works area for ALL people. You and visitors included.
- HiVis vests are mandatory for ALL people while on-site, either in works area or not.

Mandatory H&S gear for works area:
- Hi Vis vest.
- Safety boots or shoes.
- Helmet.
- Safety Glasses or Googles.
- Work gloves.

Additionally,
- Ear covers or earbuds when close to noisy areas.
- Electric insulation Gloves when works near life wires.
- Electric insulating footwear when near life equipment.
- Back & waist protection band when lifting weights.
- Safety Knee pads when working involves kneeing.

WEARING THE H&S GEAR IS MANDATORY FOR EVERYONE.
IMMEDIATE FIRE ANYONE FAILING TO DO SO.
EPC. Health & Safety.

- DAILY SAFETY BRIEFING BEFORE WORK START IS MANDATORY FOR ALL PERSONNEL.

- SAFETY BRIEFING IS MANDATORY FOR ALL VISITORS PRIOR ENTERING THE SITE AND THE WORKS AREAS.

- THE DAILY SAFETY BRIEFING MUST INCLUDE UPDATE OF ALL WORKS BEING CARRIED ON THAT DAY IN EVERY AREA AND THE STATUS OF ANY HAZARDOUS ENVIRONMENT IN ANY AREA OF THE SITE.

- ALL PEOPLE MUST SIGN THE ENTRY AND EXIT FROM THE SITE.

- ALL PEOPLE MUST SIGN THE H&S LOG AFTER THE BRIEFING AND BEFORE ENTERING THE SITE AND THE WORKS AREA.

- ALL MACHINERY MUST BE CHECKED FOR FULL SAFETY OPERATION EVERY DAY BEFORE BEING USED.

- INCOMPLIANCE WITH H&S RULES MEANS EXPULSION.
Unit I
EPC
Construction
EPC. Construction.
EPC. Construction.
Unit 1
EPC
Construction
Groundworks
Generation Side. Cable Installation.

- Minimum of 25mm clearance required to consolidate ducts.

- NOTE 33kV arrangement to be used for 400mm² 11kV singlecore.

- May be two trenches or a single wide trench.

Methods of conductor and cable installation.
Solar PV. EPC. Construction.

- Single Pole Static structure
- Double Pole Static structure
- Double Pole Static structure with struts
- Single Pole Seasonal tilling structure (10 to 40 deg)
- Seasonal structure with unique turn buckle mechanism tilling
- Seasonal structure with manual tilling
- Seasonal tilling structure with turn buckle with struts
- Double pole Seasonal tilling structure
- Double Pole Static structure with struts
- Double Pole Static structure without struts
- Double Pole Static structure with beam

<table>
<thead>
<tr>
<th>SFS-PP6-15</th>
<th>SFS Car Park Post Extruded Al6005-T5 Anodize</th>
<th>SFS-SR4-X</th>
<th>SFS-RCCP-01</th>
<th>SunRack Rail 4 (4mm) Extruded Al6005-T5 Anodize</th>
</tr>
</thead>
<tbody>
<tr>
<td>SFS-SCG4</td>
<td>SFS Splice Connector Extruded Al6005-T5</td>
<td>SFS-MCN2-35</td>
<td>SFS-MCN2-35</td>
<td>Carport Rail Clamp Group Extruded Al6005-T5</td>
</tr>
<tr>
<td>SFS-ECN2-35</td>
<td>SFS End Clamp Group (35mm) Extruded Al6005-T5 Anodize</td>
<td>SFS-MCN2-35</td>
<td>SFS-MCN2-35</td>
<td>SFS Mid-Clamp Group (35mm) Extruded Al6005-T5 Anodize</td>
</tr>
<tr>
<td>SFS-FB-24</td>
<td>SFS Foundation Bolt Group Q235 M24x600mm</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Solar PV. EPC. Construction.

- High Strength Metal
- Optional Deflector
- Nestable
- Easy Wire management
- One part + One fastening solution

- Design: Design ensures easy installation and reduces installation time.
- Features: High strength metal, nestable design, easy wire management, and one part + one fastening solution.

Images show solar panels installed on rooftops, with close-up views of the mounting systems.
Solar PV. EPC. Construction.
Unit I
EPC
Construction
Mechanical
Solar PV. EPC. Construction.
Solar PV. EPC. Construction.
Wind. EPC. Construction.
Wind. EPC. Construction.
Unit 1
EPC
Construction
Electro-Mechanical
Solar PV. EPC. Construction.

Panel installation is a critical and delicate process.

Teams of 2 to 4 people are needed.

On 3rd and 4th panel part of the team will have to stand in a small scaffolding structure.

The lower panel always goes first and has to be perfectly fitted and aligned.

The bolting is done ONLY with power tools with torque settable drivers. The panel manufacturer will provide the right number of Nm torque.

Any broken panel must be put aside to avoid stumbling on it and injuries.
Wind. EPC. Construction.
Unit I
EPC
Construction
Weather Station
Solar PV. EPC. Monitoring.
Solar PV. EPC. Electrical works.
EPC. Electrical works. (cont.)
Solar EPC. Testing & Commissioning.
Wind Testing & Commissioning.
Solar O&M. Operation and Management.
Wind O&M. Operation and Management.
Unit 2
Grids
Mini Grids
Clustered
DER
Mini Grids vs Grids. Introduction.

Mini Grid

“Full” Grid
Mini Grids vs Grids. Introduction.

Mesh Interconnected Clustered Mini Grid.

Interconnections are below 66 kV to avoid the cost of substations.

All generation and all consumption is shared over the whole integrated grid providing a self balanced operation.
Mini Grids / Clusters with DER Architecture.

1. Solar PV Plant
2. Inverter Grid Forming
3. Inverter/Charger & Controller
4. Storage
5. Diesel genset as backup.
6. Wind generation and/or others.
Mini Grids / Clusters with DER Architecture.
Unit 2
Metering Collections
Mini Utility
Metering and collections.

Examples of Pre-Pay meters, one with card, the other with code.

They are available in single and 3 phase.

Example of Pre-Pay meters by charged by phone app.

User re-charges by app or sms and receives a code which is dialed into the meter.
Unit 3
Utility Scale Plants
Solar PV. Utility Scale Plants.
Solar PV. Utility Scale Plants. Key differences.
Unit 3
Utility Scale Plants
Wind. Utility Scale Plants.
Wind. Utility Scale Plants. Key differences.
Unit 3
Forms of Contract
Power Plants. Forms of Contracts.