RES4Africa Foundation
Knowledge Platform
Framework for PV site study development
EDPR
The RES4Africa Knowledge Platform offers a set of content-driven, technical-functional training

The aim of the RES4Africa Knowledge Platform is to establish a public platform of technical training content, usable by third parties in accordance with the Foundation’s core principles of a think tank and open hub for knowledge sharing.

The purpose of the Platform is to offer a set of technical-functional content, organized in sharp modules covering renewable energy and more in general the key topics part of the energy transition.

The modules will be also delivered to on-request professionals of the energy sector (e.g., Energy Ministries, Regulatory Authority, vertically integrated incumbents, Associations, other relevant parties).
The Platform covers all the key areas of energy transition, with a comprehensive perspective across the value chain.

The Platform covers the following thematic areas:

- **Technologies**: a comprehensive understanding of different technological options and features/potential is a pre-requisite for a successful planning and implementation of fully functioning energy systems.

- **Policies and regulations**: must go hand in hand with measures ensuring that industrial and other economic capabilities are aligned with sustainable development and climate priorities.

- **Access to market**: Successful deployment of RES and flexibility technologies depends on how effectively MWh produced can be sold on the market and to what extent risk is properly hedged.

- **Permitting**: one of the key hurdles that developers face, especially for utility-scale RES projects. Key common issues can be identified, and proper management principles can be set up.

- **Financing**: bankability is one of the highest impact factors to ensure that utility-scale RES projects are successfully deployed. Compliance with requirements from international funding entities is fundamental.

- **Operation**: considering the level of maturity reached by RES technologies, a significant share of the value that can be extracted by RES projects stems from an advanced asset management approach.

- **Sustainability**: is progressively becoming a top priority for investors and energy industry stakeholders in assessing investment opportunities. A more comprehensive evaluation approach must be adopted.
The Framework provides an enabling tool for the successful deployment of PV technologies

The Platform covers the following thematic areas:

- Technologies
- Policies and regulations
- Access to market
- Permitting
- Financing
- Operation
- Sustainability

Framework for PV site study development

**What is the context:** successful deployment of RES technologies and systems depends strongly on choosing an appropriate site for their installation. Such an assessment must consider a variety of factors capable of impacting the performance and operation of RE systems.

**Why is this relevant:** a framework for site study development provides an enabling tool in order to conduct a comprehensive and multi-layered evaluation of the various factors and elements that affect the performance of RE technologies and systems.

**What are the key questions:**

- Which are the typical principles criteria and metrics to be factored-in when developing a utility scale RES study?
- How do they need to be considered?
# Framework for PV site study development

Overview of the typical principles criteria and metrics to be factored-in when developing a utility scale RES study

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1. Introduction & Site Selection

- The first consideration in all the developing process is to analyse the proposed site.

- The process of site selection must consider the constraints of each site and the impact they could have on the Project’s overall cost (CAPEX, OPEX, etc.) and feasibility.

- A developer conducting a site visit is part of the pre-screening activity. Much relevant information can be easily obtained through a visual inspection to aid with site design.

- The developer must know the land-use permits, limits of the plot, setbacks and easements to other properties or roads, and the restricted areas in the plot.

Site Image

- A Geographical Information System (GIS) mapping tool shall be used to include all constraints and determine the available area for the solar PV project development.

- Developers shall use Google site map KMZ file as a basis for preliminary analysis of the site, to identify main constraints and other aspects that can impact in development and/or designing. It is beneficial to identify picture locations/angles and geo-locate them on the overall site map as it is created.
2. Solar Resource

- A higher irradiation offers a greater level of electrical output for solar PV and therefore greater potential revenues.

- A complete meteorological database is necessary to evaluate the potential yield of the plant. Other meteorological factors such as wind, rain, snow, hail and lightning risk are also necessary to consider when evaluating the design requirements.

- At initial development phase, high annual Global Horizontal Irradiance (GHI) is one of the most basic considerations for site selection. The higher the resource, the greater would be the energy yield (kWh/kWp).

- The idea here is to have a quick estimate on solar resource availability.

- This can help developers pick or drive towards one site or the other and identify if a site with low irradiance can be considered for fixed tilt systems.
3. Altitude

- There is no restriction to the altitude of the plant.
- In fact, areas at higher altitudes show higher global radiation levels.
- However, over 2000 meter above sea level, some inverters can have a derating.
- Also, the rest of the main electrical equipment, as transformers and switchgears will be impacted (insulation distance increase) by high locations over 1000 m which could increase project cost.
4. Climate

- A weather incident could significantly impact project operations and lead to unwanted downtime.
- Also, risks of extreme weather could render the project unviable as the cost of construction or insurance would be too high.
- Developers should check local newspapers, media or similar to find information related to this unusual weather events in the Project area.

International Building Code (IBC) defines loads that pertain to structural designs. It is helpful to check preliminary information regarding wind, snow, hail and potential seismic zones.

- Weather events that shall be collected by Developers to evaluate the impact are:
  - Temperature
  - Flooding
  - High wind speeds
  - Snow
  - Hail Storm
  - Seismic
  - Atmospheric Corrosivity
5. Near Shadows and Horizon

- The developer shall consider not only the existing shadowing elements, but also the possible future shadowing elements. For example:
  - Trees growth with time
  - The maximum permissible height for future construction projects (buildings, etc.)

- Additionally, PV plants may be constrained due to shading from prominent terrain features:
  - Mountains,
  - Hills
  - Buildings on the far horizon

- So, one of the key inputs selecting the project location is, to a large extent, the absence of shadowing elements.
6. Site Land Use

- The cost of the land could have a significant impact on the feasibility of the project; either as an initial acquisition cost or as an annual, quarterly or monthly leasing cost.
- Solar PV plants are ideally built on low-cost land.
- It is important to have an understanding of regulatory bodies conditions posed on the site under review.
- If the land is currently classified as an agricultural land, then cost and time implications or re-classifying land for industrial use must be taken into consideration.
- Locating the plant in an environmentally sensitive area can require additional studies and remedies that could delay the project and increase cost.
7. Site Access

- It is helpful to make note of the following features of available existing roads:
  - Availability of different access options
  - Road numbers/names
  - Type of road (Gravel or Paved)
  - Width of road and any loading restrictions
  - Road conditions (poor/medium/good) as this can impact improvement works cost to avoid damage of equipment during transportation to site.
  - Road permits required

- For new access roads it would be helpful to note:
  - Potential constrains
  - Availability of different access options

- Other important aspects:
  - Distance to the nearest town from site location to quantify how quickly O&M personnel can respond
  - Distance to nearest fire station
8. Affected Services

- All available information on the following services must be collected:
  - Roads
  - Gas and oil ducts: pipes, deposits
  - Water: pipes, deposits
  - Electricity: buried and aerial lines
  - Telephone lines
  - Sewerage
  - Other

- For each of these services, it is necessary to know the location and the minimum allowable distance to them. This information could be obtained from the local authorities.

- Obtaining the necessary permits to remove, or divert existing services, may be a long process and can jeopardize the plant construction; therefore, it should be addressed as soon as possible.
9. Distance to Special Sources: Soiling

- The efficiency of the solar plant could be significantly reduced and maintenance cost increased (regular module cleaning) if the modules are soiled (covered) by particulates/dust.

- Typical things to watch out for would be:
  - Nature reserves or bird breeding areas as for example lakes...
  - Agricultural activity such as farming...
  - Industrial activities...
  - Traffic activity on neighboring access road and future road expansions...
  - Distance to the sea (coastline)...

- Additionally, desert (sand) and dust conditions shall be analyzed as dust on the modules can seriously affect production and requires regular cleaning.
10. Distance to Special Sources: Other

INHABITED AREAS
To avoid problems in obtaining permits, PV Plant area should not be too close to urban settings.

AIRPORTS
Restrictions may be applicable in areas surrounding airports due to the risk of glint and glare.
In some cases, a detailed glare study might be required increasing permitting time and project cost.

ARCHEOLOGY SITES
Existing archaeological sites can reduce the overall usable acreage or even make the project unfeasible or require additional investigation to avoid unforeseen archeological discovering during construction.
11. Available PV Plant Area

The size required for a PV project varies due to many factors. The most important are:

- **Latitude**: The row pitch required to avoid significant inter-row shading varies with the site latitude: the lower the latitude the less extension is needed.

- **Slope**: plots with a south facing slope (in the northern hemisphere) or facing north (in the southern hemisphere) require less land.

- **Shape**: Regular plots require less land.

- **Technology**: Higher module efficiency requires less land.

- **Support structure**: Fixed tilt systems require less land than tracker systems, but trackers can increase production.

Project economics will be partially driven by overall system size, but is impacted by many other factors. The larger the PV system, the lower is typically the unit cost per Watt ($/W).
12. Topography & Geotechnical Information

- Shall be obtained a topographical map, as detailed as possible, showing the limits of the plot, setbacks and easements to roads, and other plots, proposed accesses and restricted areas.

- Ideally, the site should be flat or on a slight slope facing south in the Northern Hemisphere or facing north in the South Hemisphere. This would allow keeping site grading and cut/fill costs low or negligible.

- During the site screening process, some preliminary geotechnical information about the site shall be captured by the Developer.

- Main factors that can impact project cost are:
  - Vegetation
  - Top soil layer
  - Caliche/Hard soils
  - Corrosion
  - Ground water level

Geotechnical site survey by a third part is recommended if the PV plant passes the first screening.
13. Utility Services

Availability of water, fuel, electricity and any other relevant services and potential taxes to be paid should be registered

- Water availability
- Fuel availability
- Electricity availability
- Communication, GSM Coverage
14. Local Regulations

Developers should determine all the local codes and regulations which must be applied to the project design, construction and O&M.

When no local or national codes are applicable, international codes can be used.

Some local requirements that could impact the Project cost:

- Electrical, mechanical and civil codes for construction
- Firefighting
- Noise regulation
- Requirement on the visual impact
- Environmental Restrictions
15. Grid Interconnection

The technical requirements for the interconnection to the grid are a relevant part of the cost assessment:

- Transmission Lines
- Utility Substation (POI)
- Capacity
- Proximity
- Voltage Level for Interconnection
- Required Works at POI
- Interconnection Requirements
16. Power Evacuation Infrastructure

Depending on the POI voltage level the required power evacuation infrastructure can be:

- **Connection to MV system**: typical solution could be a MV switchgear control center in the PV Plant area and an interconnection line to the POI plus the additional works in the POI.

- **Connection to HV system**: typical solution could be a MV/HV substation in the PV Plant area and an interconnection line to the POI plus the additional works in the POI.

The cost of power evacuation infrastructures and other potential interconnection fees could be a large part of the total cost of the PV plant.
17. Construction Requirements

- The Developer shall provide an estimated Start Of Construction (SOC) for the Project considering all the permitting phase.

- This data will allow the selection of the best available technology for the Project and the expected costs for the main equipment.

- The Developer shall address if there is any specific requirement related to construction requirements that could impact in the Project cost (work stoppage due to environmental restrictions, specific equipment requirements (local ones), etc.)