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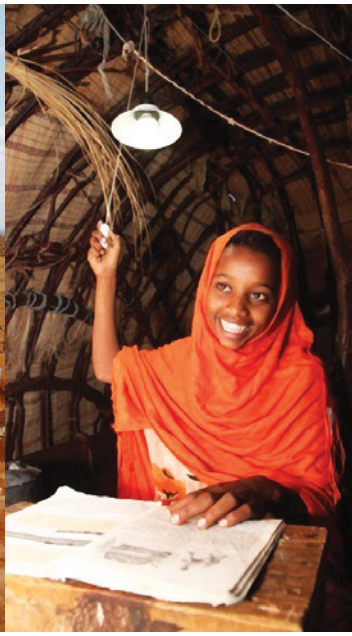

Where shall we put it?

Solar mini-grid site selection handbook

The German Climate and Technology Initiative
Promotion of Solar-Hybrid Mini-Grids in Kenya

Published by
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Promotion of Solar-Hybrid Mini-Grids in Kenya

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GIZ ProSolar
Promotion of Solar Hybrid Mini-Grids Programme

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Ministry of Energy and Petroleum

Rural Electrification Authority

Kenya Power

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Solar power has the capacity to transform the lives of remote communities.

1 Introduction

A mini-grid is an integrated local electricity generation, transmission and distribution system serving numerous customers. Electrification is projected to boost and diversify the economic potential of a given area, by spurring other key enablers of development in the short and/or long term. All selection factors being equal, the most suitable site for installing a solar-hybrid mini-grid is the site that offers the biggest potential to transform the lives of intended beneficiaries.

Solar-hybrid mini-grids produce electrical energy through a mix of solar and any other resource — it could be a renewable resource like wind, or a fossil fuel like diesel used as a back-up. The combination makes solar-hybrids extremely versatile and adaptable to a wide range of uses and climatic conditions.

This site selection criteria handbook was developed with flexibility in mind, and can be used as a guideline by all actors in the energy sector to perform a site selection analysis for any mini-grid project, by carefully selecting the appropriate parameters that apply to their own areas of implementation.

The site selected for mini-grid implementation has a heavy impact, among other factors, on attracting both public and private investments and the overall sustainability of the system. In response to these factors, there is need for a careful and thorough evaluation of potential sites for implementation in order to deliver both social and economic benefits to potential power consumers, as well as boost investment from the public and private sectors.

The guidelines incorporated in this handbook have been developed to assist all players in the energy sector, private sector actors, government institutions, academic institutions and development partners in site assessment and selection. The guiding principles are based upon the findings of the assessment of 14 sites, carried out by GIZ, REA, MoEP and Kenya Power between June and October 2013 in Marsabit, Samburu and Turkana counties, in the framework of the Scaling-Up Renewable Energy Programme (SREP) for Mini-Grids.

This handbook is divided into 4 chapters: Chapter 1 gives a basic introduction. Chapter 2 describes the procedures for site selection, Chapter 3 outlines in detail the ranking criteria parameters, while Chapter 4 gives a summary of what should constitute the final evaluation report. Some illustrations from the GIZ site selection process have been incorporated in this handbook, as a practical guide to how the process can be conducted with ease. It thus establishes, but is not limited to, the basic considerations for an adequate site selection process. Other parameters can be incorporated in addition to the ones discussed here.

2 Basic procedures for site selection

A. Site selection parameters

This handbook documents the five basic categories of site selection parameters, and offers suggested evaluation criteria for ranking them. The parameters are applicable to every site. In addition, a weighting factor ranks the relative importance of each of the parameters in selecting the sites. Constant or varying weighting factors can also be applied. Thus, detail and precision in selecting the parameters is important for an effective and successful evaluation (see a more detailed discussion under Chapter 3).

The five suggested categories of site selection parameters

Category		Parameters
1.	Exact location of installation	a) Distance to existing power source (proximity to grid or off-grid power sources) b) Transmission distance based on population distribution (dense or sparse) c) Accessibility and topography (terrain)
2.	Productivity	a) Water pumping b) Irrigation c) Cottage industries d) Commercial activities
3.	Payment for services	a) Ability to pay b) Willingness to pay
4.	Magnitude of potential power consumers	a) Households b) Businesses c) Social institutions d) Administrative units e) Development organisations
5.	Security	a) Cattle rustling b) Clashes c) Highway banditry d) Petty theft

The five site selection parameters tabled on the previous page form the basis for (i) setting the selection criteria, (ii) evaluating the sites, and (iii) selecting the sites.

B. Steps in site selection

1. Reviewing the site selection parameters (SSP)

The first step is to review the parameters and determine if they are applicable to the sites under assessment. Knowledge on applicability of parameters can be gained through site assessments, i.e. through interviews of key area informants, observation, and literature reviews. Some parameters may cut across or may apply to different sites within the region under assessment.

2. Assigning the weighting factors (WF)

After identifying the site selection parameters, weighting factors are assigned to each parameter. In our case, a constant WF of 10 is assigned to all the parameters, because they are considered equally important.

Eng. Gichungi from Kenya Power interviewing a local businessman.

However, the scoring across the appraised sites is different, as discussed below.

3. Assigning criteria ranking scores (RS)

After weighting, scores are assigned to each parameter. A detailed scoring criterion is used and is differentiated upon the parameters in question. Below are two examples of suggested definitions of different ranking scores in reference to two parameters.

CASE 1

Parameter category 1: Analysis of the exact location of installation

In determining the transmission distances, how can the population of the site be described?

- 5 = Very densely populated
- 4 = Densely populated
- 3 = Averagely populated
- 2 = Sparsely populated
- 1 = Very sparsely populated

CASE 2

Parameter category 5: Analysis of security situation

To what level are the occurrences of cattle rustling in the region?

- 5 = High
- 3 = Average
- 1 = Low

Analysis of results across nine potential sites based on parameter category 2: Productivity

PRODUCTIVITY											
	Water pumping (scores)		Irrigation (scores)		Cottage industries (scores)		Commercial activities (scores)		Total	W-Av.	%
Weights	10	W*S	10	W*S	10	W*S	10	W*S	40		
Turkwel	5	50	5	50	3	30	3	30	160	4	12.90
Gold	5	50	1	10	3	30	1	10	100	2.5	8.06
Kaeris	5	50	1	10	3	30	1	10	100	2.5	8.06
Kakuma	5	50	5	50	5	50	5	50	200	5	16.13
Nachukui	5	50	1	10	5	50	1	10	120	3	9.68
Kalokol	5	50	1	10	5	50	5	50	160	4	12.90
Kataboi	5	50	3	30	3	30	1	10	120	3	9.68
Lowarengak	5	50	1	10	5	50	3	30	140	3.5	11.29
Naduat	5	50	1	10	5	50	3	30	140	3.5	11.29
										31	100

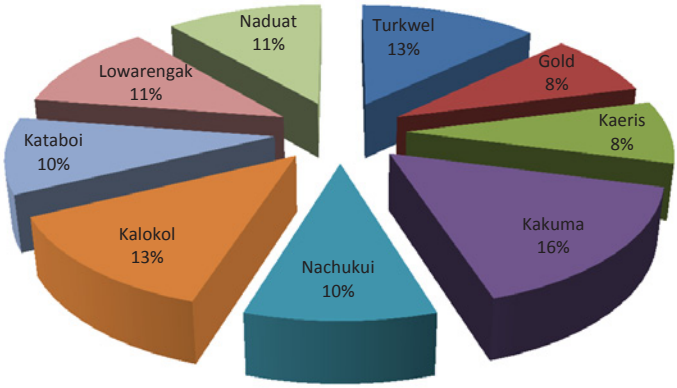
W*S = Weighted score W-Av. = Weighted average

C. Analysis of evaluation results

Using the Excel tabulation method, the scores attained by each site under each of the parameters were multiplied by the weighting factor of each parameter. The weighted average was calculated as a percentage, and the evaluation results represented graphically using pie charts.

On page 10 opposite is an illustration of the analysis and evaluation results across nine potential sites based on parameter category 2: Productivity, with four sub-parameters: a) water pumping b) irrigation c) cottage industries d) commercial activities.

Results of the analysis represented as a pie chart



The analysis of evaluation results and selection process is available at the GIZ ProSolar library as a spreadsheet.

3 Ranking the criteria parameters

1. LOCATION – a) Distance to power source (grid or off-grid)

CRITERIA

The site to be implemented should be more than 50 km from an existing or planned power source. This is because extending a line from a power source within a radius of 50 km is cheaper than establishing a mini-grid.

The following questions also need to be addressed: Does the site offer a long-term opportunity to realise returns on investment and measure impact on communities? Is there a regulation in place clarifying what will happen to the system when the national grid arrives? Sites are rated higher based on their likelihood to lie within a safe distance from a power source. Sites closer to a power source are considered unattractive.

Sites further from an existing power source are rated higher.

Evaluation	Score
More than 140 km	5
110 – 140 km	4
81 – 110 km	3
51 – 80 km	2
1 – 50 km	1

1. LOCATION – b) Transmission distances based on population distribution (dense or sparse)

CRITERIA

To cut down on the transmission costs during networking, the units to be connected (households, institutions and/or commercial premises) should be in close proximity to one another.

It is most convenient if the area to be served is within a radius of 600 metres, thus eliminating the need for step-up transformers. This can be measured by how dense or sparse the population in the locality is.

Sites with a dense population can be cost-effectively connected.

Evaluation	Score
Very densely populated	5
Densely populated	4
Averagely populated	3
Sparsely populated	2
Very sparsely populated	1

Potential customers should be located in close proximity to one another.

1. LOCATION – c) Accessibility and topography (terrain)

CRITERIA

This criterion evaluates the local impact of getting materials and staff to site.

The site to be implemented should be accessible throughout the year regardless of weather effects and resulting road conditions. The site must have proximity to transportation routes that can support heavy loads.

Sites closer to transportation routes are easier to implement.

Evaluation	Score
Very good terrain and accessible	5
Good terrain and accessible	4
Fair terrain and fairly accessible	3
Poor terrain and poorly accessible	2
Very poor terrain and totally inaccessible	1

2. PRODUCTIVITY

CRITERIA

The site to be implemented should present productive potential in areas such as

a) water pumping
b) irrigation
c) cottage industries
d) commercial activities etc.

Sites with a higher productive potential are rated higher.

Evaluation	Score
High	5
Average	3
Low	1

The potential for economically-productive activities makes a site attractive.

3. PAYMENT FOR SERVICES

CRITERIA

For the project to be economically viable, the potential power consumers should demonstrate

a) the ability to pay (AtP)
b) the willingness to pay (WtP)

AtP can be measured by assessing

- prevailing economic activities
- disposable income
- percentage of the population engaged in economically productive activities

The WtP relies on a number of factors, including

- current costs of power
- quality of current power sources
- the urge or need to consume quality power

Sites with a higher AtP and WtP are more attractive, thus rated higher.

Evaluation	Score
High	5
Average	3
Low	1

4. MAGNITUDE OF POTENTIAL POWER CONSUMERS

CRITERIA

The generated power must be consumed in order to make a social, environmental and/or economic impact. The categories of potential consumers may include

a) households
b) businesses
c) institutions
d) administrative units
e) development organisations, etc.

A high number of potential power consumers translates to a higher demand for power.

Evaluation	Score
5 categories	5
4 categories	4
3 categories	3
2 categories	2
1 category	1

The higher the number of potential customers, the more attractive the site.

5. SECURITY

CRITERIA

Security is a vital factor in site selection. Security concerns differ across regions, and are also based on the economic activities within the region. Some security concerns include

a) cattle rustling and
b) clashes, more commonly experienced in livestock-rearing communities
c) highway banditry
d) petty theft and vandalism, etc.

Secure areas can be implemented faster and require no special planning on how to counter or prevent insecurity occurrences.

Evaluation	Score
Low risk	5
Average risk	3
High risk	1

A secured mini-grid installation site.

4 Evaluation report

After assessing the potential sites using the criteria given, an evaluation report is produced to help the players in the mini grid sector, e.g. private sector developers, government agencies or development partners, reach an investment decision.

An evaluation report can take a number of formats. These could include basic Excel tabulations, narratives with a few graphics of sites under evaluation, or high-powered multimedia presentations comprising aerial photography, video footage and detailed site plans.

A site evaluation report should include the following components, as shown on the next page.

Include photos and a rationale for your site selection, with the intended beneficiaries.

1. Introduction and summary conclusion

Describe the purpose and scope of assessments, types of systems to be installed, the technology used, and size of planned mini-grids. Include a summary indicating which sites were selected and the rationale behind their selection.

2. Maps and graphics

A site plan with a graphical representation of bearings, distances and GPS coordinates is essential and communicates more effectively. Include the physical features such as water bodies, telecommunication base stations, grid lines and roads as they offer an instant evaluation of the impact of developing a mini-grid in the locality.

It is also helpful to have a graphical representation of each site itself and its immediate surroundings showing roadways, topography, households, business community, social institutions etc., as well as a small scale map of each of the potential sites and their relationship to one another.

3. Evaluation matrix

In addition to graphics, tabulated data are important especially in condensing information and allowing for comparison across categories.

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