

Chapter 2

Solar Energy

Abstract Solar energy mainly depends on insolation intensity and duration of sunlight hours. Both of this varies with location. That is why if suitable location can be identified, optimal utilization of the resources is possible. Solar energy is a popular alternative and renewable form of energy source which can easily be converted to utilizable forms of energy. Although conversion efficiency and cost is not conducive enough to designate this form of energy to substitute the conventional energy sources. But depending on location cost can be reduced and amount of energy can be increased.

Keywords Renewable energy • Conversion cost • Benefits

The solar energy is deemed to be one of the most favourable alternative forms of energy which can replace the conventional energy sources.

The strength, weakness, opportunity and threat or SWAT analysis of solar energy is detailed in Fig. 2.1.

It seems that the major problem of electricity production from solar energy is the availability of sunlight. The amount of electricity that can be produced depends on duration and amount of available sun light. Both of which are location dependent.

Again, the availability of un-shaded area is also an important factor. More the area more panels can be installed to convert solar energy to electricity. The non-shaded area also varies with location.

The cost of installation and maintenance also changes with locations. Another important factor which changes with location is distance from grid or consumers. The wind speed and humidity increases the maintenance requirement of solar panels which are also varies with locations.

That is why it can be seen that most of the factors which influences the efficiency of solar energy production changes with location. The selection of location thus becomes extremely important in the success of a solar power plant.

Fig. 2.1 Figure showing the SWAT analysis of solar energy



2.1 Problems

The previous studies of selection of suitable location for installation of solar power plant are given in Table 2.1.

Although the studies used various tools and techniques to identify optimal location for solar power production, most of the studies have a common disadvantage. It does not selected the factors which influence the selection by using an objective method. Also the selection of factors is based on expert suggestion or views from the stakeholders or experience of the engineers. In most of the cases involving manual interpretations introduce bias and decision changes with decision makers.

The application of both Multi Criteria Decision Making (MCDM) and Artificial Neural Network (ANN) is omnipresent in this type of studies. Although MCDM is used to select location for solar power plant but Group Method of Data Handling, a new variant of ANN, has never been applied in this aspect.

Table 2.1 Table showing the previous studies which identified location for solar power plant with the help of different tools and techniques

Location	Factors considered	Techniques utilized	Type of plant	Authors
India	Radiation, leveled unit cost of electricity	System advisor model	Parabolic trough concentrator (ptc) and linear fresnel reflector (lfr) based solar thermal power plants	Sharma et al. (2016)
Brazil	Location, area and shape	RET screen or homer	Small scale solar and wind power	Ribeiro et al. (2016)
India	Emission reduction constraint	Differential evolution	Solar PV	Rajesh et al. (2016)
Italy	Standard deviation of energy balance and storage requirement		Solar PV and ROR HPP	Francois et al. (2016)
Turkey	Quality of terrain, local weathering factors, proximity to high transmission capacity lines, agricultural facilities and environmental conservation issues	AHP-GIS	Solar farms	Uyan (2013)
India	Techno-economical and environmental factors	RET screen on the basis of viability indicators like internal rate of return (IRR), net present value (NPV), cost of electricity (CoE), benefit-cost (B-C) ratio	Grid connected PV	Jain et al. (2011)
Spain	Social, economic, technological, and environmental factors	AHP-VIKOR	Solar Thermo Electric	San Cristóbal (2011)
Spain	Project execution delay and stoppage risk	Analytical network process	Solar PV	Aragónés-Beltrán et al. (2010)
European Union	Environment, orography, location, and climate factors	Analytical hierarchy process with geographical information system	Grid connected PV	Carrion et al. (2008)
Northern Africa	Direct solar radiation, geographical conditions (land slope, land cover, distance from cooling water resources, etc.), infrastructure (pipelines, electricity grids, streets etc.) and the configuration and performance of a selected solar thermal power plant concept	STEP model, satellite data and GIS	Solar thermal power stations	Bresamle et al. (2001)

References

- Aragónés-Beltrán P, Chaparro-González F, Pastor-Ferrando JP, Rodríguez-Pozo F (2010) An ANP-based approach for the selection of photovoltaic solar power plant investment projects. *Renew Sustain Energy Rev* 14(1):249–264
- Broesamle Hartmut, Mannstein Hermann, Schillings Christoph, Trieb Franz (2001) Assessment of solar electricity potentials in North Africa based on satellite data and a geographic information system. *Sol Energy* 70(1):1–12
- Carrión JA, Estrella AE, Dols FA, Toro MZ, Rodríguez M, Ridao AR (2008) Environmental decision-support systems for evaluating the carrying capacity of land areas: Optimal site selection for grid-connected photovoltaic power plants. *Renew Sustain Energy Rev* 12(9):2358–2380
- Francois Baptiste, Borga Marco, Creutin Jean-Dominique, Hingray Benoit, Raynaud Damien, Sauterleute Julian-Friedrich (2016) Complementarity between solar and hydro power: sensitivity study to climate characteristics in Northern-Italy. *Renew Energy* 86:543–553
- Jain Amit, Mehta Rajeev, Mittal Susheel K (2011) Modeling impact of solar radiation on site selection for solar PV power plants in India. *Int J Green Energy* 8(4):486–498
- Ribeiro AED, Arouca MC, Coelho DM (2016) Electric energy generation from small-scale solar and wind power in Brazil: the influence of location, area and shape. *Renew Energy* 85:554–563
- Rajesh K, Bhuvanesh A, Kannan S, Thangaraj C (2016) Least cost generation expansion planning with solar power plant using differential evolution algorithm. *Renew Energy* 85:677–686
- Sharma Chandan, Sharma Ashish K, Mullick Subhash C, Kandpal Tara C (2016) A study of the effect of design parameters on the performance of linear solar concentrator based thermal power plants in India. *Renew Energy* 87:666–675
- San Cristóbal JR (2011) Multi-criteria decision-making in the selection of a renewable energy project in Spain: the Vikor method.” *Renew Energy* 36(2):498–502
- Uyan Mevlut (2013) GIS-based solar farms site selection using analytic hierarchy process (AHP) in Karapinar region, Konya/Turkey. *Renew Sustain Energy Rev* 28:11–17

Feasibility Model of Solar Energy Plants by ANN and
MCDM Techniques

Majumder, M.; Saha, A.K.

2016, X, 49 p. 14 illus., 13 illus. in color., Softcover

ISBN: 978-981-287-307-1