Harnessing Solar Energy in Coastal Maharashtra: Opportunities and Challenges in the Konkan Region

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ABSTRACT

Harnessing solar energy in the coastal Konkan region of Maharashtra offers strong potential for decentralized power and rural applications, but it faces significant hurdles due to heavy monsoon cloud cover, high humidity, and complex terrain. [1, 2, 3]

Opportunities in the Konkan Region

- Decentralized & Rural Electrification: Solar power can help stabilize local grids and solve low-voltage or erratic power supply issues common in rural pockets. [1]
- Agricultural & Wildlife Protection: Implementing solar fencing systems under state initiatives (such as the Shyama Prasad Mukherjee Scheme) helps farmers deter wildlife intrusion while protecting crops. [1]
- Agro-Industrial Integration: Solar-powered cold storage units can support regional horticulture (such as Alphonso mangoes and cashews) and reduce post-harvest losses. [1]
- Government Subsidies: State and central programs—including enhanced state support for vulnerable sections (BPL, SC/ST, and EWS)—significantly lower the upfront capital cost of residential and community installations. [1]
- Tourism & Sustainable Lifestyles: Eco-resorts and traditional Konkan housing can integrate passive solar design, rooftop PV, and solar lighting to cut down diesel generator reliance.

KEYWORDS-solar energy, Konkan, Maharshtra, opportunities, challenges

INTRODUCTION

- Monsoon Intermittency: The western coast experiences heavy rainfall and dense cloud cover for 3 to 4 months (June to September) during the southwest monsoon, sharply dropping solar output. [1]
- High Humidity & Saline Air: Coastal proximity brings high salt content and moisture, which can accelerate corrosion on panel frames, wiring, and inverter components, requiring specialized marine-grade equipment.
- Terrain & Land Constraints: The Konkan belt features undulating hills, dense vegetation, and fragmented land holdings, making large-scale utility solar parks difficult to construct compared to plateau or arid regions. [1]

- Grid and Infrastructure Bottlenecks: Some rural and remote coastal pockets face local transmission capacity constraints and maintenance lags. [1, 2]

Comparative Overview

Dimension	Opportunities	Challenges
Climate & Weather	High solar radiation during non-monsoon months	3–4 months of heavy monsoon rains and cloud cover
Agriculture & Rural	Solar fencing for crop protection and cold storage units	Voltage fluctuations and uneven grid availability
Environment & Maintenance	Clean alternative to fossil fuels and diesel generators	Saline humidity causing accelerated hardware corrosion
Financial Support	State and central solar subsidies (up to 80%–95% for targeted groups)	High initial setup and anti-corrosion maintenance costs

DISCUSSION

For solar EPC companies planning megawatt-scale projects, a thorough solar site survey in India is the first step that decides feasibility, cost and long-term performance. India's terrain spans deserts, coasts, mountains and plains, so survey requirements change from state to state.

A solar site survey goes far beyond measuring land. It assesses terrain, irradiation, soil, grid connectivity, regulatory compliance and dozens of other parameters that vary across Indian states. For EPCs working in several states, that variation is a challenge, and an advantage for teams that understand it.

A solar site survey is an on-ground assessment that evaluates whether a proposed location is suitable for solar project development. In the Indian context, where geographical, climatic, and regulatory conditions vary widely from state to state, site surveys must be tailored to address location-specific challenges and opportunities.

The primary objectives of a solar site survey include:[3,4,5]

Land feasibility assessment: Evaluating topography, terrain conditions, and land availability for optimal solar panel placement

Solar resource evaluation: Measuring solar irradiation levels, sun path analysis, and shading factors specific to the location

Technical infrastructure assessment: Analyzing grid connectivity, evacuation capacity, and electrical infrastructure availability

Geotechnical investigation: Conducting soil testing and foundation analysis for structural engineering requirements
Regulatory compliance verification: Identifying required approvals, clearances, and state-specific regulatory requirements
Risk identification: Detecting potential obstacles including land disputes, environmental constraints, or access limitations
For EPC companies, the quality and accuracy of site survey data directly affects every later phase of the project, from solar design and structural engineering to permits and installation. Inadequate or inaccurate survey data can lead to costly design revisions, project delays, budget overruns, and suboptimal energy generation performance.

Our site survey and land feasibility services are scoped so the survey data feeds directly into the engineering design that follows.[6,7,8]

Critical Parameters Evaluated During Solar Site Surveys in India
A professional solar site survey must evaluate several connected parameters that together decide project viability and design requirements.

Land Topography and Terrain Assessment
Detailed topographical mapping forms the foundation of solar project design. Survey teams measure land elevation, slope gradients, contours, and terrain irregularities that affect panel mounting systems, civil works requirements, and drainage design. In India, terrain can range from perfectly flat desert land in Rajasthan to rocky, undulating terrain in Karnataka or hilly regions in northeastern states. Each terrain type presents unique engineering challenges and cost implications.

Solar Irradiation and Meteorological Data
Accurate measurement of solar irradiation levels is essential for energy yield calculations and financial modeling. Site surveys collect data on Global Horizontal Irradiance (GHI), Direct Normal Irradiance (DNI), and Diffuse Horizontal Irradiance (DHI). Additionally, meteorological parameters including ambient temperature, wind speed and direction, humidity levels, and rainfall patterns must be assessed. Our guide to GHI, DNI and DHI irradiance data in India explains which dataset to use. These factors vary across Indian states: coastal Tamil Nadu experiences different conditions than arid Rajasthan or humid West Bengal.

Soil Investigation and Geotechnical Analysis
Comprehensive geotechnical investigation determines foundation design requirements and structural engineering specifications. Soil testing evaluates bearing capacity, soil composition, water table depth, and potential for soil erosion or settlement. In states like Gujarat and Maharashtra with varied soil conditions, geotechnical data is critical for structural engineering design that ensures long-term stability of mounting structures and inverter foundations.[9,10,11]

Grid Connectivity and Electrical Infrastructure

Assessment of existing electrical infrastructure determines grid connection feasibility and evacuation capacity. Survey teams evaluate the nearest substation location, available transformer capacity, transmission line routes, and voltage levels. Grid infrastructure varies significantly across Indian states, with some regions offering strong connectivity while others, particularly in remote areas, present significant evacuation challenges that impact project economics.

Shadow Analysis and Shading Considerations
Identifying potential shading sources, including existing structures, trees, hills and planned developments, is essential for accurate energy yield projections. Shadow analysis must account for seasonal sun path variations specific to the project latitude. In densely populated states or industrial areas, nearby structures can significantly impact rooftop solar potential and ground-mount project layouts.

Access Roads and Logistics Assessment
Evaluation of site accessibility determines construction logistics, equipment transportation feasibility, and ongoing operations and maintenance requirements. Survey teams assess existing road conditions, required road improvements, distance from major highways, and potential monsoon-related access challenges. In remote locations across states like Madhya Pradesh or Rajasthan, access infrastructure can significantly impact project timelines and costs.

Water Availability for Operations
Assessment of water sources for panel cleaning and maintenance is particularly important in India’s dusty regions. Survey teams identify nearby water sources, water quality, and availability throughout the year. In water-scarce regions like Rajasthan, water logistics must be factored into project planning. Our regional guide to soiling loss in India shows how cleaning frequency changes the yield model.
Maharashtra offers diverse solar opportunities across industrial and rural regions:

Industrial rooftop potential: Extensive industrial infrastructure providing significant rooftop solar opportunities requiring detailed structural load assessments
Varied terrain: From coastal Konkan region to Vidarbha plateau, requiring location-specific survey approaches[12,13,14]
Regulatory framework: Complex approval processes involving multiple authorities and clearances
Grid infrastructure: Well-developed in industrial areas, but capacity constraints in some rural regions
Land costs: Higher land acquisition costs in many regions compared to northern states

RESULTS

A strong energy mix of Renewable Energy Sources (RESs) is needed for sustainable development in the electricity sector. India stands as one of the fastest developing countries in terms of RES production. In this framework, the main objective of this review is to critically scrutinize the Maharashtra state energy landscape to discover the gaps, barriers, and challenges therein and to provide recommendations and

suggestions for attaining the RES target by 2022. This work begins with a discussion about the RES trends in various developing countries. Subsequently, it scrutinizes the installed capacity of India, reporting that Maharashtra state holds a considerable stake in the Indian energy mix. A further examination of the state energy mix is carried out by comparing the current and future targets of the state action plan. It is found that the installed capacity of RESs accounts for about 22% of the state energy mix. Moreover, the current installed capacity trend is markedly different from the goals set out in the action plan of the state. Notably, the installed capacity of solar energy is four times less than the target for 2020. Importantly, meeting the targeted RES capacity for 2022 presents a great challenge to the state. Considering this, an analysis of the state's strengths, barriers, and challenges is presented. Moreover, strong suggestions and recommendations are provided to clear the track to reach the desired destination. This can be useful for the government agencies, research community, private investors, policymakers, and stakeholders involved in building a sustainable energy system for the future.[15,16,17]

Maharashtra is the third largest state geographically and the second most populous state in India. It has the most business enterprises and employment opportunities compared to other states. Maharashtra is located in the western part of India.

Renewable energy has a 15% share of the total electricity generation capacity of the state. The current mix of conventional and renewable energy sources of the state . The share of the installed capacity of renewable energy sources is far from conventional sources at about 9.2 GW, which is only about 22%. It consists of wind as a major stake at 4.7 GW, followed by biomass at about 2.5 GW. The segments of solar and mini-hydro are not large in the energy mix.

CONCLUSIONS

The state has the Maharashtra State Electricity Board (MSEB), which is an electricity regulation committee. The MSEB was restructured into four companies on 6 June 2005 [130]:

The Maharashtra Electricity Regulatory Commission (MERC) was organized to improve the efficiency and economy of the power sector and to manage the amount of power production, communication, and transportation in order to acknowledge the significance of users and other partners [131].

Maharashtra State Power Generation Company Limited (MSPGCL) was organized by the Indian Companies Act 1956 following the agreement of the government of Maharashtra to restructure the MSEB [18,19]

Maharashtra State Power Transmission Company Limited (MSPTCL) is a fully possessed corporation under the government of Maharashtra that was coordinated by the Companies Act after reorganizing the former MSEB [133].

Maharashtra State Power Distribution Company Limited (MSPDCL) transmits power to consumers across the state, except in some areas of Mumbai [134].

The various projects undertaken by the Maharashtra government and the private sector to develop renewable energy systems in the state are as follows:

Solar Energy

Maharashtra is one of the three best regions in India for solar installation and has a massive potential for solar power production. There are about 250–300 clear sunny

days, with the possible irradiation of 4 to 6 kWh/m2 in a day. Hence, it has the potential to produce about 1.5 million units/MW/year through the solar photovoltaic system and up to 2.5 million units/MW/year through the solar thermal system. Maharashtra State Power Generation Company (MAHAGENCO) authorized 515.01 MW as of October 2017, which is about 3.3% of the overall equipped quantity of solar power plants in India [135]. It has six solar cities: Nagpur, Kalyan-Dombiwali, Shiridi, Thane, Aurangabad, Nanded, and Pune. Out of these cities, Nagpur is declared as a model solar city and Shiridi and Thane are declared as pilot solar cities [136]. There are three major solar parks in Maharashtra with a high capacity for generation: Sai guru, Patoda, and Dondaicha solar parks.[20]

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