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**Hochschule Flensburg Wind Energy Technology Institude**

University of Applied Science Research on wind Energy

**Wind Farm Project in Gujarat, India**

**Wind Farm Project Development, WiSe 2024/25**

Master’s degree in Wind Engineering, Flensburg, Germany

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# Abstract

* Overview of the Project, Key Findings, Recommendations

# Introduction

## 2.1 The Evolution of Wind energy in India

India has made significant wind energy farm over the past few decades, becoming Globally, India ranks fourth in terms of installed wind power capacity. The journey began in the 1980s with small-scale wind energy projects. The first wind farm was established in 1986 in coastal Gujarat. India has developed several large wind farms, particularly in states like Tamil Nadu, Gujarat, and Maharashtra. The growth of the wind industry has created a strong support system, improved project management skills, and built a manufacturing capacity of around 15,000 MW per year. [1] [2]

## 2.2 Importance of Wind Energy in Gujarat

[As of May 2024, Gujarat has an impressive 11,823 MW of installed wind power capacity](https://www.thehindubusinessline.com/economy/gujarat-bags-award-for-highest-wind-power-installed-capacity/article68292944.ece). [This makes it the leading state in India for wind energy, surpassing Tamil Nadu, which has 10,743 MW](https://www.thehindubusinessline.com/economy/gujarat-bags-award-for-highest-wind-power-installed-capacity/article68292944.ece). [3] Its growth has been significantly influenced by a dedicated wind and land policy, which is further explored in a later section of this report.

|  |  |  |  |
| --- | --- | --- | --- |
| No | State | Wind Potential at 120 m (GW) | Wind Potential at 150 m (GW) |
| 1 | Andhra Pradesh | 70.90 | 123.3 |
| 2 | Gujarat | 142.56 | 180.8 |
| 3 | Karnataka | 124.15 | 169.3 |
| 4 | Madhya Pradesh | 15.40 | 55.4 |
| 5 | Maharashtra | 98.21 | 173.9 |
| 6 | Rajasthan | 127.75 | 284.2 |
| 7 | Tamil Nadu | 68.75 | 95.1 |
| 8 | Telangana | 24.83 | 54.7 |
| 9 | Other | 18.95 | 27.1 |
|  |  |  |  |

(Table 2 1: **Potential of Wind Energy in Gujarat, India)** [1]

## 2.3 Objectives of the Report

* To analyse the growth and current status of wind energy installations in Gujarat, India.
* Design and analyse of Wind Farm using GIS and Wind Pro software
* To examine the policies and regulations that have supported the development of wind energy in Gujarat
* To identify the key drivers and barriers to the expansion of wind energy in Gujarat, India, including infrastructure, financing, and policy support.
* Making schedule and timetable for wind Farm development project in Gujarat, India.

## 2.4 Scope and Limitations

### 2.4.1 Scope:

* **Geographic Advantage**: Gujarat’s long coastline and favorable wind conditions make it an ideal location for both onshore and offshore wind projects. [4]
* **Government Support**: The state government offers various incentives, including subsidies, tax benefits, and streamlined approval processes, to encourage investment in wind energy.
* **Economic Impact**: Wind energy projects create jobs, boost local economies, and contribute to sustainable development goals.

### 2.4.2 Limitations:

* **High Initial Costs**: The setup and installation of wind turbines and related infrastructure require significant upfront investment.
* **Land Use Conflicts**: Large-scale wind farms can lead to land acquisition issues and conflicts with local communities.
* **Environmental Concerns**: Wind turbines can impact local wildlife, particularly birds and bats, and may cause noise pollution.
* **Grid Integration**: Integrating wind energy into the existing power grid can be challenging due to the need for stable and reliable energy supply. [5]

# Literature Review

## 3.1 Wind Resource Assessment of Gujarat

The wind resource estimates in this study highlight regions with average annual wind speeds above 8 m/s, mainly in the Gulf of Kutch and the southern coast. Similar to past research, our 2011 analysis confirms the highest wind potential in the northwestern Gulf of Kutch, with comparable potential found along the southern coastline. While the International Renewable Energy Agency agrees on high wind speeds in these areas, they report higher speeds of 9 m/s in the Gulf of Khambhat, exceeding our estimates. [4]

Wind speeds in Gujarat peak from May to August, reaching over 10 m/s, particularly along the coast, and are lowest in October and November, averaging below 7 m/s. Gujarat has a tropical and subtropical steppe climate, with occasional cyclones, droughts, and floods. The state experiences three main seasons: winter (November-March), summer (March-June), and monsoon (June-September). The northern region is dry, while the southern part is humid, with coastal winds influenced by sea breezes. [4]

## 3.2 Review of existing wind energy projects.

### 3.2.1 Scaling challenges in Gujarat

Renewable energy development, particularly large-scale wind farms, faces multifaceted challenges (Land Acquisition and local engagement, Logistical Challenges, Grid Integration, Regulatory and Environmental Hurdles, Financial and Contractual Risks, Stakeholder Coordination) that can significantly impact project timelines, costs, and outcomes. The experiences of hypothetical projects like Adani Wind Energy’s 300 MW wind farm in India’s coastal region highlight key obstacles that often arise during such ventures.Successful wind energy projects, such as those proposed by Adani Wind Energy, provide valuable lessons for future initiatives in the renewable energy sector. [6]

### 3.2.2 Suzlon secures a repeat order of 193.2 MW in Gujarat

Suzlon Group, a leading renewable energy solutions provider, has secured a repeat order from The KP Group for a wind energy project in Gujarat. This collaboration underscores the private sector's commitment to sustainable growth, supported by Gujarat's favourable policy environment for renewable energy development. Suzlon's wind turbines, featuring the advanced Doubly Fed Induction Generator (DFIG) technology, efficiently integrate with utility networks to meet grid requirements. The company's R&D focuses on increasing turbine performance, optimizing energy capture from low wind sites, and reducing energy costs. Suzlon’s commitment to **"Aatmanirbhar Bharat"** is evident through its domestically manufactured turbines, contributing to India's self-reliance in the renewable energy sector.

Gujarat's conducive policy environment for renewable energy development, along with Suzlon’s technological expertise and KP Group's commitment, makes the state an ideal location for expanding renewable energy infrastructure. The partnership supports India's net-zero goals while promoting economic progress through clean energy. [7]

# Methodology

Mapping Free Areas (Used GIS Software)

Law & Regulation as well as park layout (Used wind pro Software)

Land Leasing

Informal Permission of Community

Commissioning all necessary studies

Wind Measurement

Grid Connection

Profitability and Financing

Wind Area

Permit Approval Process

Financial Support, Finding Investors and Find O&M company

and Find O&M company

Apply for Auction

and Find O&M company

Construction

and Find O&M company

Commissioning

and Find O&M company

Official Opening [10]

and Find O&M company

# Pre-Processing

## 5.1 Site Selection and Mapping

* Identifying free areas suitable for wind farms.
* GIS and other tools used for mapping and analysis.

5.2 Law & Regulation as well as Park Layout

* Review of laws, regulations, and requirements (wind speed, land, etc.).
* Wind farm planning

## 5.3 Land Leasing

1. **Land Allotment**: The state government has updated its policy on wasteland allotment to support wind, solar, and hybrid energy projects. Under the new rules, developers are required to install 50% of their planned capacity within three years and complete the full 100% within five years. This change aims to boost renewable energy development and make better use of unused land. [8]
2. [**Lease Tenure**: The lease tenure for renewable energy parks is 40 years, with the first five years dedicated to park development and the remaining 35 years for energy generation](https://www.mercomindia.com/gujarat-land-policy-solar-wind-projects). [8]
3. **Rent and Taxes**: Developers must pay an annual rent of $204 per hectare, with a 15% increase every three years. [If rent is not paid within 90 days of the due date, a 12% simple interest is charged](https://www.mercomindia.com/gujarat-land-policy-solar-wind-projects). [8]
4. **Security Deposit**: Developers need to submit a security deposit of $2,717 per MW within one month of land allotment approval. [This deposit is refundable upon project completion](https://www.mercomindia.com/gujarat-land-policy-solar-wind-projects). [8]
5. [**Provisional Registration**: Developers must apply for provisional registration through the Gujarat Energy Development Agency (GEDA) portal, providing necessary documents and paying a registration fee](https://geda.gujarat.gov.in/Gallery/Media_Gallery/Executive_procedure_for_RE_Projects.pdf).

<https://www.saurenergy.com/solar-energy-news/gujarat-frames-land-policy-for-renewable-energy-projects>

<https://www.blueweaveconsulting.com/blog/gujarat-formulate-land-policy-for-renewable-energy-projects>

## 5.4 Informal Permission of Community

# Processing

## 6.1 Commissioning all necessary studies

## 6.2 Wind Measurement

## 6.3 Grid Connection

## 6.4 Profitability and Financing

## 6.5 Wind Area

# Post-processing

## 7.1 Permit Approval Process

## 7.2 Financial Support, Finding Investors and Find O&M company

## 7.3 Apply for Auction

## 7.4 Construction

## 7.5 Commissioning

## 7.6 Official Opening

# Schedule and Timetable

# Conclusion

Summary of Key Points, Final Recommendations, Future Outlook

a. What is the decarbonisation plan of your country (2030/2050) and which role does wind energy play?

b. What are the most important barriers and obstacles for the development of wind farms?

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# Appendices

Technical Data Sheets

Maps and Diagrams

Stakeholder Consultation Records

Additional Supporting Documents