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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

**Submitted by**

Karan Soni (760153)

Mozafary Mostafa (750247)

Patil Rahul (750532)

**Supervising Professors:**

Dr. Marina Blohm

(Europa-Universität Flensburg)

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Table of Contents

[1. Abstract 3](#_Toc179993787)

[2. Introduction 3](#_Toc179993788)

[2.1 The Evolution of Wind energy in India 3](#_Toc179993789)

[2.2 Importance of Wind Energy in Gujarat 3](#_Toc179993790)

[2.3 Objectives of the Report 4](#_Toc179993791)

[2.4 Scope and Limitations 4](#_Toc179993792)

[2.4.1 Scope: 4](#_Toc179993793)

[2.4.2 Limitations: 4](#_Toc179993794)

[3. Literature Review 5](#_Toc179993795)

[3.1 Wind Resource Assessment of Gujarat 5](#_Toc179993796)

[3.2 Review of existing wind energy projects. 5](#_Toc179993797)

[3.2.1 Scaling challenges in Gujarat 5](#_Toc179993798)

[3.2.2 Suzlon secures a repeat order of 193.2 MW in Gujarat 5](#_Toc179993799)

[4. Methodology 7](#_Toc179993800)

[5. Pre-Processing 8](#_Toc179993801)

[5.1 Site Selection and Mapping 8](#_Toc179993802)

[5.2 Law & Regulation as well as Park Layout 8](#_Toc179993803)

[5.3 Land Leasing 8](#_Toc179993804)

[5.3.1 Lease Duration and Terms 8](#_Toc179993805)

[5.3.2 Eligibility and Allocation 8](#_Toc179993806)

[5.3.3 Application and Approval Process 8](#_Toc179993807)

[5.3.4 Usage and Compliance 9](#_Toc179993808)

[5.3.5 Financial and Operational Responsibilities 9](#_Toc179993809)

[5.3.6 Governance and Oversight 9](#_Toc179993810)

[5.4 Informal Permission of Community 9](#_Toc179993811)

[6. Processing 10](#_Toc179993812)

[6.1 Commissioning all necessary studies 10](#_Toc179993813)

[6.1.1 Environmental Impact Assessment (EIA) 10](#_Toc179993814)

[6.1.2 Social Impact Assessment (SIA) 10](#_Toc179993815)

[6.1.3 Wildlife and Habitat Studies 10](#_Toc179993816)

[6.1.4 Regulatory Compliance 10](#_Toc179993817)

[6.2 Wind Measurement 11](#_Toc179993818)

[6.3 Grid Connection 11](#_Toc179993819)

[6.4 Profitability and Financing 11](#_Toc179993820)

[6.5 Wind Area 11](#_Toc179993821)

[7. Post-processing 11](#_Toc179993822)

[7.1 Permit Approval Process 11](#_Toc179993823)

[7.2 Financial Support, Finding Investors and Find O&M company 11](#_Toc179993824)

[7.3 Apply for Auction 11](#_Toc179993825)

[7.4 Construction 11](#_Toc179993826)

[7.5 Commissioning 11](#_Toc179993827)

[7.6 Official Opening 11](#_Toc179993828)

[8. Schedule and Timetable 11](#_Toc179993829)

[9. Conclusion 11](#_Toc179993830)

[10. References 11](#_Toc179993831)

[11. Appendices 13](#_Toc179993832)

# 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 [14]

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

Policy 2023 aims to facilitate the leasing of government fallow land in Gujarat for the establishment of green hydrogen production facilities. These facilities will utilize non-conventional renewable energy sources such as solar, wind, and hybrid wind-solar energy. [8]

### 5.3.1 Lease Duration and Terms

Lease Period: 40 years.

Annual Rent: ₹15,000 (€ 150 – €170) per area, subject to a 15% increase every three years.

Advance Payment: Annual rent and applicable taxes must be paid in advance. Late payments integrate 12% simple interest after 90 days.

Security Deposit: Applicants must provide a deposit equivalent to one year’s rent, a 1% service charge, and necessary stamp duty upon land possession. [8]

### 5.3.2 Eligibility and Allocation

Criteria: Includes financial stability (minimum net worth of ₹1200 crore (€130.44 million)), experience in renewable energy generation (minimum 500 MW).

Land Allocation Limits: One applicant or their partners can only lease enough land to produce 30 lakh metric tonnes () of green hydrogen each year. This means they can't lease more land than what is necessary for that amount of production. [8]

### 5.3.3 Application and Approval Process

Pre-Feasibility Report: Applicants must submit a preliminary report demonstrating their capability to produce green hydrogen.

Review Committees: A Committee of Experts evaluates the applications, followed by the High-Power Committee for final recommendations. [8]

Tripartite Agreement: Upon approval, a tripartite agreement is signed between the Collector, the nodal agency (GPCL), and the applicant. [8]

### 5.3.4 Usage and Compliance

Dedicated Use: Leased land must be exclusively used for green hydrogen production.

Development Timeline: Projects must develop infrastructure and achieve 50% capacity within 3 years and full capacity within 8 years.

No Subleasing: The leased land cannot be subleased to third parties. [8]

### 5.3.5 Financial and Operational Responsibilities

Infrastructure Development: Applicants are responsible for all infrastructure, including power transmission, roads, water supply, and security.

Energy Usage: Generated renewable energy must primarily be used for green hydrogen production within Gujarat. Excess energy sales are subject to government discretion.

Charges and Taxes: All applicable taxes, licensing fees, and GST must be borne by the lease agreement. [8]

### 5.3.6 Governance and Oversight

Nodal Agency (GPCL): Manages land allocation, application processing, and project monitoring.

High Power Committee (HPC): Sets parameters for equipment and production standards, and prioritizes applications based on predefined criteria.

Revenue Department: Ensures land allocation aligns with state requirements and oversees final approvals. [8]

## 5.4 Informal Permission of Community

**Community Meetings**: Organize meetings with community members to explain the benefits of the project, such as job creation, infrastructure development, and clean energy. Address any concerns and answer questions.

**Engage Local Leaders**: Work with local leaders and influential community members to gain their support. Their endorsement can help in building trust and acceptance within the community.

**Transparency**: Maintain transparency throughout the process by sharing project details, timelines, and potential impacts. This can help in building trust and reducing resistance.

**Benefit Sharing**: Propose benefit-sharing, such as community development funds, scholarships, or infrastructure improvements, to ensure that the community also gains from the project.

**Regular Updates**: Keep the community informed about the progress of the project through regular updates and open communication channels.

# Processing

## 6.1 Commissioning all necessary studies

### 6.1.1 Environmental Impact Assessment (EIA)

While wind energy is a greener choice compared to fossil fuels, it has some environmental challenges. One major issue is that birds, especially predators like raptors, can accidentally fly into the spinning turbine blades, leading to injuries or deaths. These impacts interrupt local ecosystems, as seen in reduced raptor populations leading to increased numbers of prey species, such as the fan-throated lizard. Noise from turbines and habitat disruption during construction can further affect wildlife. [9]

In India, even though environmental impact assessments (EIA) are not required for wind farms, the wind energy sector still must follow certain guidelines from the Ministry of Environment and Forests (MoEF). If a wind power project is located in a forest, national park, or wildlife sanctuary, it must get approval from the State Forest Board, the State Pollution Board, and the National Board for Wildlife. Additionally, if the land is home to scheduled tribal communities or traditional forest residents, the project must comply with the Scheduled Tribes and Other Forest Dwellers Act, 2006.6.1.2 Geophysical and Geo-Technical Studies. [9]

### 6.1.2 Social Impact Assessment (SIA)

**Impact on Livelihoods**: Assess how the project might affect local livelihoods, such as agriculture and fishing, while identifying potential benefits like job creation and infrastructure improvements.

**Health and Safety**: Evaluate possible health and safety impacts, including noise pollution and environmental changes that could affect the community.

**Cultural and Heritage Impact**: Examine the impact on cultural heritage sites, traditional practices, and local customs to ensure the project does not harm these aspects.

**Economic Impact**: Analyse economic benefits and costs to the local community, such as changes in property values and opportunities for local businesses. [10]

### 6.1.3 Wildlife and Habitat Studies

### 6.1.4 Regulatory Compliance

Ensure that the project complies with all relevant local, state, and national regulations and standards. [11]

## 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