



Excellence in Wind Farm Operations

Company Profile

The client is a prominent wind farm owner and operator with a significant presence in the renewable energy sector. The company owns and operates a **100 MW** onshore wind farm, strategically situated in Tamil Nadu, a region renowned for its ideal wind conditions. The facility comprises **125** Wind Turbine Generators (WTGs), each contributing to the overall capacity of 100 MW. The wind farm plays a vital role in contributing to the renewable energy landscape of Tamil Nadu.

Case Summary

- In response to the increasing complexity of managing renewable energy assets, the client sought to implement a comprehensive system aimed at enhancing operational stability, improving performance and reducing O&M costs.
- A key requirement was a system capable of providing real-time monitoring and predictive analytics for critical equipment performance. This would empower the site O&M teams with actionable insights and recommendations, aimed at preventing catastrophic failures and optimizing O&M costs.
- The client also needed a system for tracking production deviations, conducting yield analysis, and gaining insights into lost production, alongside a centralized data repository for benchmarking performance across multiple sites. To address these needs, a digital platform was developed that integrates AI/ML analytics, SCADA, and digital twin technology, enabling efficient management of wind energy assets and ensuring optimal performance.





Business Challenges

Prior to the implementation of the system, the plant faced operational inefficiencies that significantly impacted performance, cost-effectiveness, and overall operational stability.

To address these challenges, the client required an integrated solution that would streamline operations, reduce O&M costs, improve asset health management, and enhance overall performance efficiency. The goal was to ensure quicker resolution of issues, minimize downtime, and optimize energy yield, ultimately driving improved operational outcomes.

Our Solution

To address the client's operational challenges, we implemented our Central Control Room for Renewable Assets (CCRA)—a scalable, AI-driven platform for centralized monitoring and management of renewable energy assets. This solution was integrated with 65 solar sites (3100 MW) and 21 wind sites (1050 MW), providing a comprehensive and secure system using open SCADA protocols (OPC UA & MQTT) for reliable data acquisition.

The system offers real-time performance monitoring, predictive analytics, and remote diagnostics, enabling proactive asset management. Key features include:

- Monitoring deviations in power output.
- Tracking critical alarms, tripping, and breakdown events.
- Identifying underperforming assets and providing insights into potential issues.

The key challenges identified were as follows:

Decentralized Monitoring & Data Management

- Lack of a unified platform to manage all critical wind farm asset.
- Consolidating data from various sources proved to be a complex and time-consuming task, leading to delays in decision-making.

Reporting Constraints

- Time-consuming and fragmented reporting processes.
- Lack of a central data repository created significant challenges generating consolidated reports.

Decentralized Monitoring & Data Management

- Delays in identifying underperforming assets.
- Lack of real-time insights to optimize generation efficiency.

Asset Health & Maintenance Challenges

- No predictive analytics for asset health monitoring.
- Increased downtime due to unanticipated failures.

Our Solution

Key Features Include

- Generating custom reports and conducting historical performance benchmarking.
- Analyzing yield loss and production deviations at various asset levels.
- Delivering real-time insights into wind turbine parameters such as real time power output, Yaw & blade pitch angle , temperatures, and wind conditions, rotor speed.
- Depth analysis of Power Curve Analysis, Wind Rose Analysis, Lost Production Analysis.



With this extensive monitoring assisted client with following insights:

Power Curve Deviation:

Through continuous monitoring and behavioral analysis of the power curve, we identified a deviation in the actual WTC power curve which resulted in a reduction in energy yield (MEUs). To address this, corrective measures were taken.

As a result, these improvements led to a **~6 MUs** increase in energy yield.

Blade Erosion Detection:

Through ongoing monitoring, the system identified a deviation in turbine output, while all operational parameters appeared healthy. Upon further inspection, it was discovered that blade erosion had caused a crack that, if left unattended, could have led to a catastrophic failure.

After replacing the damaged blade, a gain of **~5%** in energy yield was achieved, resulting in substantial revenue gains for the client.

Success Recap

The implementation of the Central Control Room for Renewable Assets (CCRA) solution has significantly improved the management of the client's wind farm, setting a new standard for operational efficiency in renewable energy. By leveraging AI-driven analytics, real-time monitoring, and predictive maintenance, the solution optimized asset performance, increased energy yield, and reduced operational costs.

This digital transformation has enhanced energy production and ensured long-term reliability. The project highlights the transformative impact of digital solutions in renewable energy management.



Key Business Impact



Power Curve Improvement

Enhanced energy yield by **~6 MU**, resulting in a revenue gain of **~ \$2,08,429 USD per annum**.



Early Detection of Underperforming Assets

Behavioral analysis identified underperformance, prevented catastrophic failures and generated **~ \$2,43,167 USD** in additional revenue.



Yield Analysis

Enabled identification of production deviations and lost opportunities, optimizing energy output by **~9%**.



Predictive Maintenance & Alerts

Reduced breakdowns and improved operational reliability through predictive maintenance and quick alert systems.



Benchmarking & Data Access

Facilitated continuous performance improvement through historical data and benchmarking.



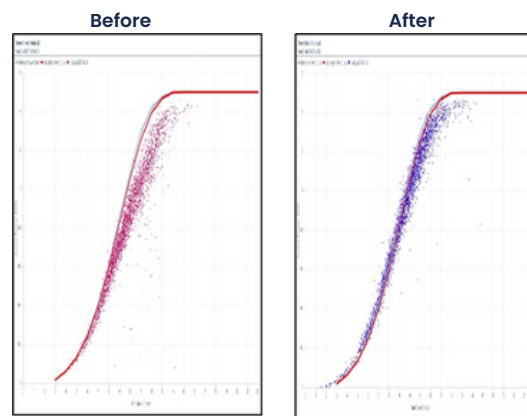
AI & ML Analytics

Improved real-time decision-making, enhancing asset management efficiency.

Trend charts of weather parameters



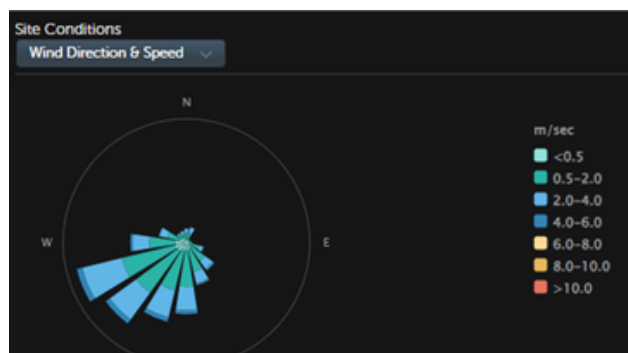
Power Curve Analysis



Comparative analysis of multiple WTGs



Wind Rose Analysis



Real-Time Monitoring of Wind Site

