Project Design Phase

Problem – Solution Fit

Date	13 February 2026
Team ID	LTVIP2026TMIDS83348
Project Name	Weather Based Prediction Of Wind Turbine Energy Output - A Next Generation Approach To Renewable Energy Management
Maximum Marks	2 Marks

Problem – Solution Fit Overview:

The Problem–Solution Fit validates that a real industry challenge exists and that the proposed system effectively addresses it. For this project, the fit is evaluated across wind farm operators, grid managers, and renewable energy policymakers who face challenges due to unpredictable weather conditions affecting wind turbine energy generation.

Target Customers

• Wind farm operators and renewable energy plant managers
• Grid managers and electricity distribution authorities
• Renewable energy analysts and policymakers

Customer Problems (Key Pains)

• Fluctuating wind speeds causing unstable energy output
• Difficulty in accurate short-term and seasonal energy forecasting
• Grid imbalance due to unpredictable renewable generation

Proposed Solution

An **Exploratory Data Analysis (EDA) and Machine Learning–based Weather-Driven Wind Energy Prediction System** that provides:

• Historical weather and energy output trend analysis
• Visual dashboards showing seasonal and performance variability
• Accurate ML-based energy generation predictions
• A simple Flask-based web interface for operational forecasting

Problem–Solution Fit Mapping

Customer Problem	Solution Feature	Expected Impact
Unpredictable wind conditions affecting generation	Historical trend analysis + ML prediction model	Improved generation forecasting accuracy

Grid instability due to fluctuating supply	Daily/weekly forecast summaries	Better load balancing and grid stability
Lack of actionable operational insights	Web-based dashboard with clear visualization	Faster and data-driven operational decisions
Financial risk from inaccurate commitments	Confidence-based prediction outputs	Reduced penalties and optimized energy trading

Channels & Adoption

• Web application accessible to wind farm operators and grid managers
• Deployment within renewable energy control rooms
• Integration with smart grid management systems (future scope)
• Demonstrations to renewable energy companies and utilities

Success Metrics

• High prediction accuracy (target R^2 score above defined benchmark)
• Reduction in energy forecasting errors
• Improved grid stability metrics
• Adoption by wind farm operators and energy planners

Future Improvements

• Real-time weather API integration for live prediction
• Integration with IoT-based turbine sensor data
• Multi-day and seasonal forecasting models
• Cloud-based deployment with scalable infrastructure