

Project Design Phase

Problem – Solution Fit Template

Date	15 February 2026
Team ID	LTVIP2026TMIDS62246
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 Template: Wind Turbine Energy

Energy companies, wind farm operators, and grid managers face significant challenges due to the unpredictable nature of wind energy production.

- **Energy Companies** struggle to forecast energy output accurately, making distribution and pricing inefficient.
- **Wind Farm Operators** cannot plan maintenance effectively, risking downtime during high wind activity.
- **Grid Operators** find it difficult to balance renewable energy with traditional sources, leading to instability in the grid.

Define CS, fit into CC	1. CUSTOMER SEGMENT(S) Primary Customers (B2B): - Energy Grid Managers Secondary Customers: - Renewable Energy Asset Owners - Utility Companies - Power Traders	CS	6. CUSTOMER CONSTRAINTS Need for high-accuracy, real-time predictions. Complex variables like wind direction/power curves are hard to model. Regulatory reliability requirements. Financial costs of balancing and backups.	CC	5. AVAILABLE SOLUTIONS - Legacy forecasting systems lacking advanced models. - Raw weather forecast data. - Simple rule-based or historical average models. - Expensive fossil-fuel backup generators.	AS	Explore AS, differentiate
	2. JOBS-TO-BE-DONE / PROBLEMS Accurately predict wind turbine energy output. Optimize dispatch schedules and manage energy storage. Problem: Wind energy output is inherently intermittent and volatile. Difficulty relying on raw weather forecasts. Inaccurate forecasting leads to grid instability and financial penalties.	J&P	9. PROBLEM ROOT CAUSE Current legacy systems lack advanced predictive modeling capabilities. Inability to effectively translate multi-dimensional weather data into precise power generation estimates in real-time.	RC	7. BEHAVIOUR Constantly monitoring weather forecasts and grid status charts. Relying on expensive fossil-fuel backups for stability. Manually adjusting dispatch schedules. Experiencing stress and pressure from inaccurate forecasts.	BE	
Focus on J&P, tap into BE, understand RC	3. TRIGGERS Sudden and unexpected changes in wind speed or direction. Significant discrepancies between forecast and actual generation. Regulatory pressure for grid stability compliance. Financial penalties for grid imbalances.	TR	10. YOUR SOLUTION A Random Forest regression model that accurately predicts wind turbine energy output based on wind speed, wind direction, and theoretical power curve. Deployed as a user-friendly Flask web application for real-time insights.	SL	8. CHANNELS OF BEHAVIOUR ONLINE Legacy software dashboards Meteorological websites Digital communication platforms	CH	Focus on J&P, tap into BE, understand RC
	4. EMOTIONS: BEFORE / AFTER Before: Apprehensive, pressured, anxious about grid stability and costs. After: Confident, in control, relieved, empowered to make data-driven decisions.	EM			OFFLINE Control room operations Stakeholder meetings Phone calls for emergency balancing		