

Weather-Based Prediction of Wind Turbine Energy Output: A Next-Generation Approach to Renewable Energy Management

Chapter 9

Advantages and Disadvantages

9.1 – Advantages:

1. Accurate Power Forecasting:

- Predicts turbine output using weather parameters (wind speed, direction, air density, temperature).
- Reduces uncertainty in renewable energy generation.
- Helps grid operators plan supply in advance.

2. Improved Grid Stability:

- Prevents sudden power fluctuations.
- Supports load balancing and demand–supply matching.
- Enables smoother integration of renewable energy into the power grid.

3. Higher Energy Efficiency:

- Optimizes turbine operation based on upcoming weather conditions.
- Minimizes idle running and inefficient rotations.
- Maximizes energy capture from available wind.

4. Reduced Operational Cost:

- Avoids unnecessary turbine start/stop cycles.
- Lowers maintenance expenses.
- Reduces reliance on backup fossil-fuel generators.

5. Predictive Maintenance:

- Detects abnormal patterns early.
- Prevents equipment damage and breakdowns.
- Extends turbine lifespan.