Renewable Forecasting for Grid Operators Training Course

Professional Development Training Course Outline

Category	Renewable Energy	**Duration**	5 Days
Base Fee	$1,500 USD	**Delivery Mode**	Online / On-site Hybrid

Course Introduction

Renewable Forecasting for Grid Operators Training Course equips power-system professionals with practical knowledge to manage the increasing variability and uncertainty associated with solar PV, wind power, hybrid renewable systems, and changing electricity demand. As renewable penetration rises, accurate forecasting becomes increasingly important for grid stability, dispatch planning, reserve allocation, congestion management, energy markets, storage optimization, and renewable curtailment reduction. Current research is moving beyond traditional statistical approaches toward machine learning, deep learning, ensemble forecasting, probabilistic forecasting, explainable AI, physics-informed ML, and edge intelligence.

The course focuses on the complete forecasting-to-operations pathway: weather and SCADA data acquisition, data quality, feature engineering, forecasting horizons, model selection, uncertainty quantification, forecast validation, operational decision-making, and real-time deployment. Participants examine practical case studies involving solar ramp events, wind variability, day-ahead renewable forecasting, net-load prediction, battery storage coordination, and grid-reserve planning. Recent system-level research demonstrates that probabilistic forecasts can improve reserve allocation and grid decision-making, while current studies highlight the growing role of hybrid AI and ensemble models in renewable forecasting.

Programme Curriculum

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Course Objectives

By the end of the course, participants will be able to:

1. Apply AI-powered renewable forecasting concepts to grid operations.
2. Analyze solar PV and wind power variability using operational datasets.
3. Build effective short-term, intraday, and day-ahead forecasting workflows.
4. Apply machine learning and deep learning models to renewable generation data.
5. Compare LSTM, CNN, Transformer, ensemble, and hybrid AI forecasting approaches.
6. Perform time-series feature engineering using weather, SCADA, and historical-generation data.
7. Develop probabilistic forecasts and uncertainty quantification for operational decisions.
8. Interpret forecast performance using MAE, RMSE, MAPE, R^2, prediction intervals, and skill scores.
9. Integrate renewable forecasts into dispatch, reserve, balancing, and grid reliability processes.
10. Apply forecasting insights to battery energy storage, demand response, and flexibility optimization.
11. Identify and manage forecast errors, ramp events, data quality problems, and model drift.
12. Evaluate explainable AI, physics-informed ML, edge intelligence, and real-time forecasting applications.
13. Design an operational renewable forecasting framework suitable for a modern grid control environment.

Target Audience

1. Transmission System Operators (TSOs)
2. Distribution System Operators (DSOs)
3. Grid Control-Room Engineers
4. Power-System Planners and Analysts
5. Renewable Energy Forecasting Specialists
6. SCADA, EMS and Energy Management Professionals
7. Renewable Plant and Asset Managers
8. Energy Market, Dispatch and Operations Professionals

Course Modules

Module 1: Renewable Forecasting & Modern Grid Operations

- Fundamentals of **variable renewable energy (VRE)** and intermittency.

- Forecasting horizons.
- Impact of forecast uncertainty on **grid balancing and reliability**.
- Renewable forecasting requirements for **TSOs, DSOs, and control rooms**.
- **Case Study:** Managing solar variability and reserve requirements during a high-renewable operating day.

Module 2: Data Acquisition, SCADA & Weather Intelligence

- Working with **SCADA, smart-meter, satellite, and numerical weather prediction (NWP)** data.
- Data cleaning, missing-value treatment, anomaly detection, and normalization.
- **Feature engineering** from temperature, irradiance, wind speed, cloud cover, and historical generation.
- Data pipelines for **real-time and near-real-time forecasting**.
- **Case Study:** Improving solar forecasts by combining historical plant output with meteorological variables.

Module 3: Statistical & Machine Learning Forecasting

- Baseline models including **persistence, regression, ARIMA, and statistical time-series methods**.
- **Random Forest, XGBoost, LightGBM, and ensemble learning**.
- Model training, validation, hyperparameter tuning, and cross-validation.
- Selecting models according to **accuracy, interpretability, computational cost, and deployment requirements**.
- **Case Study:** Comparing persistence, ARIMA, and ensemble ML models for wind-power forecasting.

Module 4: Deep Learning & Advanced AI Forecasting

- **LSTM, GRU, CNN, Transformer, and hybrid deep-learning architectures**.
- Capturing nonlinear relationships and temporal dependencies.
- Multi-variable and multi-site forecasting.
- **Explainable AI (XAI)** for operational confidence and model interpretation.
- **Case Study:** Using recurrent and ensemble models to identify rapid renewable-generation ramps.

Module 5: Probabilistic Forecasting & Uncertainty Quantification

- Deterministic versus **probabilistic renewable forecasts**.
- Prediction intervals, quantiles, scenarios, and probability distributions.
- Forecast uncertainty associated with **weather, ramp events, outages, and data quality**.
- Applying probabilistic information to **operating reserves and balancing decisions**.
- **Case Study:** System-level probabilistic forecasting for renewable supply and electricity demand, demonstrating improved reserve allocation.

Module 6: Forecast Integration into Grid Operations

- Translating forecasts into **unit commitment, economic dispatch, and reserve planning**.
- Renewable forecast integration with **EMS/SCADA and control-room workflows**.
- Managing congestion, balancing, curtailment, and ramping requirements.
- Coordinating forecasts with **battery energy storage and flexible resources**.
- **Case Study:** Using day-ahead renewable forecasts to improve operating-reserve scheduling.

Module 7: Real-Time Forecasting, Edge AI & Grid Resilience

- Architecture for **real-time renewable forecasting**.

- Edge computing and **edge intelligence** for low-latency decisions.
- Monitoring forecast accuracy, **model drift, cybersecurity, and data integrity**.
- Physics-informed and hybrid AI approaches for more robust deployment.
- **Case Study:** Designing an edge-enabled forecasting workflow for a distributed solar fleet.

Module 8: Integrated Forecasting Capstone & Grid Operator Decision-Making

- Building an end-to-end **renewable forecasting and operational decision framework**.
- Combining renewable generation, **load, net-load, weather, and storage forecasts**.
- Forecast performance benchmarking and operational KPI development.
- Scenario analysis for **high-renewable penetration and extreme variability**.
- **Case Study:** Developing a grid-operator dashboard that combines renewable forecasts, uncertainty bands, net load, and reserve requirements.

Training Methodology

- Interactive lectures and presentations.
- Group discussions and brainstorming sessions.
- Hands-on exercises using real-world datasets.
- Role-playing and scenario-based simulations.
- Analysis of case studies to bridge theory and practice.
- Peer-to-peer learning and networking.
- Expert-led Q&A sessions.
- Continuous feedback and personalized guidance.

Register as a group from 3 participants for a Discount

Send us an email: info@fineskilltrainingcenter.org or call *+254769199797*

Certification

Upon successful completion of this training, participants will be issued with a globally- recognized certificate.

Tailor-Made Course

We also offer tailor-made courses based on your needs.

Key Notes

a. The participant must be conversant with English.

b. Upon completion of training the participant will be issued with an Authorized Training Certificate

c. Course duration is flexible and the contents can be modified to fit any number of days.

d. The course fee includes facilitation training materials, 2 coffee breaks, buffet lunch and A Certificate upon successful completion of Training.

e. One-year post-training support Consultation and Coaching provided after the course.

f. Payment should be done at least a week before commence of the training, to Fineskill Training Center account, as indicated in the invoice so as to enable us prepare better for you.

Upcoming Scheduled Sessions

Start Date	End Date	Location	Price
21 Sep 2026	25 Sep 2026	Online	$1,000
21 Sep 2026	25 Sep 2026	Physical	$1,500
21 Sep 2026	25 Sep 2026	Physical	$0
21 Sep 2026	25 Sep 2026	Physical	$0
21 Sep 2026	25 Sep 2026	Physical	$0
21 Sep 2026	25 Sep 2026	Physical	$0
21 Sep 2026	25 Sep 2026	Physical	$0
21 Sep 2026	25 Sep 2026	Physical	$0

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