Machine Learning for Energy Forecasting 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

Machine Learning for Energy Forecasting Training Course is designed to equip professionals with the skills required to apply Artificial Intelligence (AI), Machine Learning (ML), Deep Learning, and advanced time-series analytics to modern energy forecasting challenges. As renewable generation, distributed energy resources, smart grids, energy storage, and demand-response systems expand, accurate forecasting is increasingly important for balancing supply and demand, improving grid reliability, optimizing asset utilization, and reducing operational costs. Recent research highlights the growing use of LSTM, CNN, Transformer, ensemble, hybrid, physics-informed, and explainable AI approaches for solar, wind, hydropower, and electricity-demand forecasting.

The course combines hands-on data science, predictive analytics, forecasting model development, model evaluation, uncertainty quantification, and real-world energy case studies. Participants learn how to transform historical energy and weather datasets into production-oriented forecasting solutions while addressing data quality, intermittency, model interpretability, scalability, and deployment challenges. Emerging themes such as Explainable AI (XAI), Physics-Informed Machine Learning (PIML), Digital Twins, Edge AI, Federated Learning, smart grids, and renewable-energy optimization are incorporated to reflect current industry and research directions.

Programme Curriculum

Machine Learning for Energy Forecasting Training Course

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Course Objectives

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

1. Understand AI-driven energy forecasting concepts, architectures, workflows, and industry applications.
2. Develop robust time-series forecasting pipelines for energy demand and generation.
3. Apply supervised machine learning algorithms to electricity forecasting problems.
4. Build and optimize Deep Learning models including LSTM, GRU, CNN, and Transformer architectures.
5. Perform advanced feature engineering using historical, weather, operational, and calendar data.
6. Forecast solar, wind, hydropower, and electricity demand using real-world datasets.
7. Apply ensemble learning and hybrid ML models to improve forecasting robustness.
8. Implement probabilistic forecasting and uncertainty quantification for risk-aware energy decisions.
9. Use Explainable AI (XAI), SHAP, and interpretable analytics to improve model transparency.
10. Explore Physics-Informed Machine Learning (PIML) for constraint-aware energy forecasting.
11. Integrate forecasting models with smart grids, microgrids, energy storage, and demand-response applications.
12. Understand Digital Twins, Edge AI, real-time analytics, and scalable forecasting deployment.
13. Evaluate forecasting systems using MAE, RMSE, MAPE, R^2, backtesting, model monitoring, and MLOps practices.

Target Audience

1. Energy analysts and **energy data scientists**
2. Electrical and power-system engineers
3. Renewable-energy engineers and project specialists
4. Smart-grid and **microgrid professionals**
5. Data scientists and machine-learning practitioners
6. Energy consultants and sustainability professionals
7. Utility, grid-operation, and energy-management professionals
8. Researchers, academics, and postgraduate students working in **AI and energy systems**

Course Modules

Module 1: Energy Forecasting, AI & Data Foundations

- Energy forecasting fundamentals
- Energy time-series characteristics
- Data sources
- Data preparation, missing-value treatment, outlier detection, normalization, and temporal alignment
- **Case Study:** Building an electricity-demand forecasting dataset from historical consumption and weather variables

Module 2: Statistical & Machine Learning Forecasting

- Regression, decision trees, **Random Forest, Gradient Boosting, and XGBoost**
- Support Vector Regression and conventional machine-learning baselines
- Feature selection, dimensionality reduction, and automated feature engineering
- Hyperparameter optimization and cross-validation for time-series datasets
- **Case Study:** Short-term commercial-building electricity-demand forecasting using **XGBoost**

Module 3: Deep Learning for Energy Forecasting

- Neural-network foundations for nonlinear energy forecasting
- **LSTM and GRU** architectures for sequential energy data
- CNN-based approaches for temporal and spatial pattern extraction
- Transformer-based forecasting and attention mechanisms
- **Case Study:** Multi-step solar-power forecasting using an **LSTM/Transformer comparison**

Module 4: Renewable Energy Forecasting

- **Solar PV forecasting** using irradiance, temperature, cloud, and historical generation data
- **Wind-power forecasting** using wind speed, direction, turbine, and weather features
- Hydropower forecasting using rainfall, river-flow, reservoir, and historical-generation data
- Multi-source forecasting and **spatiotemporal learning**
- **Case Study:** Renewable-generation forecasting for a hybrid solar–wind microgrid

Module 5: Advanced Forecasting, Uncertainty & Explainable AI

- **Probabilistic forecasting** and prediction intervals
- Quantile regression and uncertainty quantification
- Ensemble forecasting and hybrid ML architectures
- **Explainable AI (XAI), SHAP, feature importance, and model interpretation**
- **Case Study:** Explaining electricity-demand forecasts to support transparent building-energy decisions

Module 6: Physics-Informed ML & Digital Twins

- Fundamentals of **Physics-Informed Machine Learning (PIML)**
- Combining physical constraints with data-driven forecasting
- **Digital Twin** architectures for energy assets and systems
- AI-enabled simulation, monitoring, optimization, and predictive analytics
- **Case Study:** Climate-aware digital-twin forecasting for a decentralized renewable-energy microgrid

Module 7: Smart Grids, Storage & Real-Time Forecasting

- Forecasting for **smart grids and distributed energy resources (DERs)**

- Battery energy-storage forecasting and state-aware energy management
- Demand response, peak-load prediction, and load balancing
- **Edge AI, IoT, real-time analytics, and streaming data**
- **Case Study:** Forecast-driven battery dispatch for a renewable-powered microgrid

Module 8: Deployment, MLOps & Capstone Energy Forecasting

- Model validation using **MAE, RMSE, MAPE, R^2, backtesting, and forecast error analysis**
- Model deployment, monitoring, drift detection, retraining, and **MLOps**
- Scalable cloud and edge deployment architectures
- Cybersecurity, data governance, interoperability, and responsible AI considerations
- **Capstone Case Study:** Design an end-to-end **AI-powered energy forecasting platform** for a smart-grid or renewable-energy operation

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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