Smart Grid Data Analytics 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

Smart Grid Data Analytics Training Course is designed to equip energy professionals with practical capabilities for transforming complex grid data into actionable intelligence. Modern power systems are rapidly evolving through Artificial Intelligence (AI), Machine Learning (ML), Internet of Things (IoT), Advanced Metering Infrastructure (AMI), Distributed Energy Resources (DERs), renewable energy integration, edge computing, cloud analytics, and digital twins. Recent research highlights the growing role of AI-driven analytics and digital twins in forecasting, fault detection, real-time optimization, resilience, cybersecurity, and intelligent energy management. The course therefore focuses on the complete smart-grid data lifecycle from data acquisition and cleansing to predictive analytics, visualization, anomaly detection, forecasting, optimization, and data-driven decision-making.

Participants will explore how advanced analytics can support grid reliability, demand forecasting, renewable generation forecasting, asset performance management, predictive maintenance, demand response, energy storage optimization, DER coordination, and resilient grid operations. Practical case studies will connect analytical concepts to realistic utility and power-system scenarios, including AI-enabled digital twins, renewable-heavy grids, microgrids, and intelligent asset management. Emerging approaches such as physics-informed machine learning, explainable AI, reinforcement learning, real-time analytics, and climate-aware digital twins are increasingly relevant to future-ready energy systems.

Programme Curriculum

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Course Objectives

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

1. Understand Smart Grid Architecture, Data Ecosystems, and Digital Transformation.
2. Apply Data Engineering and Data Quality Management techniques to grid datasets.
3. Analyze AMI, SCADA, IoT, PMU, sensor, and operational data.
4. Build AI/ML-based load and renewable energy forecasting models.
5. Apply Predictive Analytics and Anomaly Detection for grid operations.
6. Develop Predictive Maintenance approaches for critical power assets.
7. Use Time-Series Analytics and Deep Learning for energy-demand analysis.
8. Apply DER, battery storage, microgrid, and demand-response analytics.
9. Explore Digital Twin and real-time grid analytics architectures.
10. Apply Explainable AI (XAI), responsible AI, and interpretable analytics.
11. Understand Edge, Cloud, and Hybrid Computing for smart-grid analytics.
12. Strengthen Grid Resilience, Cybersecurity Analytics, and Risk Intelligence.
13. Translate analytical outputs into data-driven operational and strategic decisions.

Target Audience

1. Power Systems Engineers and Electrical Engineers
2. Smart Grid and Utility Professionals
3. Energy Data Scientists and Data Analysts
4. Grid Operations and Control-Room Professionals
5. Renewable Energy and DER Specialists
6. Asset Management and Predictive Maintenance Teams
7. Energy Consultants, Researchers, and Academics
8. Digital Transformation, AI, and IT Professionals in Energy

Course Modules

Module 1: Smart Grid Data Foundations & Architecture

- Smart Grid architecture, **AMI, SCADA, PMU, IoT, GIS, and sensor data**.
- Understanding structured, unstructured, streaming, and time-series energy data.
- **Data governance, interoperability, metadata, data quality, and data security**.
- Building an end-to-end **smart-grid data pipeline**.
- **Case Study:** Designing a data architecture for a utility integrating smart meters, SCADA, DERs, and renewable-energy assets.

Module 2: Energy Data Analytics & Visualization

- Data preparation, cleansing, transformation, integration, and feature engineering.
- Exploratory Data Analysis (EDA) for electricity consumption and network performance.
- Time-series analysis, correlation, trend analysis, and anomaly identification.
- Interactive **energy dashboards and data visualization** for operational intelligence.
- **Case Study:** Developing an analytics dashboard to identify peak-demand patterns and abnormal feeder behavior.

Module 3: AI & Machine Learning for Smart Grids

- Foundations of **supervised, unsupervised, and reinforcement learning**.
- Regression, classification, clustering, ensemble models, and neural networks.
- **Deep Learning, LSTM/RNN models, transformers, and hybrid AI approaches**.
- Model evaluation, validation, feature importance, and **Explainable AI (XAI)**.
- **Case Study:** Building an ML model for short-term electricity-load forecasting; recent research identifies ML and deep-learning approaches as important tools for smart-grid optimization and forecasting.

Module 4: Forecasting, Demand Analytics & Renewable Integration

- Short-, medium-, and long-term **load forecasting**.
- Solar and wind **renewable generation forecasting**.
- Weather, demand, market, and operational data integration.
- Forecast uncertainty, probabilistic forecasting, and renewable variability.
- **Case Study:** AI-based forecasting for a renewable-dominated microgrid to improve supply-demand balancing and reduce curtailment.

Module 5: Predictive Maintenance, Fault Detection & Asset Analytics

- Asset health indicators and **condition-based monitoring**.
- AI-driven **fault detection, anomaly detection, and failure prediction**.
- Transformer, transformer-substation, feeder, switchgear, and renewable-asset analytics.
- Remaining Useful Life (**RUL**) concepts and predictive maintenance workflows.
- **Case Study:** Using sensor and operational data to identify abnormal asset behavior and prioritize maintenance interventions.

Module 6: Digital Twins, DERs, Storage & Real-Time Analytics

- **Digital Twin architecture** for modern power and energy systems.
- Real-time synchronization of physical assets with virtual models.
- DER orchestration, battery energy storage, microgrid, and demand-response analytics.
- Edge-cloud architectures and real-time decision-support systems.
- **Case Study:** Developing an AI-enabled digital twin for optimizing renewable generation and multi-energy storage; current research emphasizes digital twins for forecasting, optimization, resilience, and real-time

grid management.

Module 7: Grid Optimization, Resilience & Cybersecurity Analytics

- Data-driven **power-flow optimization and operational decision support**
- Demand response, congestion management, voltage optimization, and energy efficiency.
- **Grid resilience analytics** for extreme weather and operational disruptions.
- Cybersecurity monitoring, anomaly detection, and intelligent threat analytics.
- **Case Study:** Designing an analytics framework for a resilient distribution grid facing renewable variability, cyber risks, and extreme-event disruptions.

Module 8: Advanced Smart Grid Analytics & Capstone

- **Physics-Informed Machine Learning (PIML)** and hybrid AI models.
- Reinforcement learning for adaptive energy management.
- **Generative AI, LLM-assisted analytics, and AI-enabled decision support**
- Building an end-to-end smart-grid analytics solution with measurable KPIs.
- **Case Study:** Create a data-driven smart-grid solution covering data ingestion, forecasting, anomaly detection, digital-twin analytics, optimization, visualization, and executive decision support.

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
23 Nov 2026	27 Nov 2026	Online	$1,000
23 Nov 2026	27 Nov 2026	Physical	$1,500
23 Nov 2026	27 Nov 2026	Physical	$3,000
23 Nov 2026	27 Nov 2026	Physical	$3,000
23 Nov 2026	27 Nov 2026	Physical	$6,000
23 Nov 2026	27 Nov 2026	Physical	$4,500
23 Nov 2026	27 Nov 2026	Physical	$6,000
23 Nov 2026	27 Nov 2026	Physical	$6,000

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