Solar PV Performance Analysis and Optimization 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

Solar PV Performance Analysis and Optimization Training Course is designed to build professional capability in solar photovoltaic performance assessment, energy yield analysis, system optimization, operational analytics, and asset performance management. As PV projects increasingly rely on data-driven operations, participants will learn how to evaluate plant performance using key indicators such as Performance Ratio (PR), specific yield, energy performance index, availability, losses, degradation, irradiance, and temperature effects. The course integrates PVsyst simulation, SCADA analytics, IoT-enabled monitoring, digital twins, AI/ML, predictive maintenance, fault detection, and performance benchmarking to support technically sound decisions across the PV asset lifecycle. Current industry work is increasingly connecting PV performance assessment with digitalisation, digital twins, and AI-based fault detection.

Through hands-on exercises and real-world case studies, participants will develop the ability to identify underperformance, quantify technical losses, investigate root causes, optimize plant configuration, and develop actionable improvement strategies. The programme reflects current professional training trends that emphasize PVsyst modelling, shading and loss analysis, bifacial PV, trackers, energy storage, bankable yield assessments, and practical software-based exercises. Participants will work with realistic operational datasets and simulated plant scenarios to transform performance data into actionable insights, predictive maintenance strategies, higher energy yield, improved availability, reduced losses, and stronger renewable-energy asset returns.

Programme Curriculum

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Course Objectives

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

1. Master Solar PV Performance Analysis and modern performance-management principles.
2. Calculate and interpret Performance Ratio (PR), Specific Yield, Availability, Capacity Factor, and Energy Performance Index.
3. Analyze irradiance, temperature, weather, and environmental datasets for PV performance assessment.
4. Use PVsyst for energy-yield modelling, loss analysis, simulation, and optimization.
5. Identify and quantify soiling, shading, mismatch, thermal, inverter, clipping, degradation, and electrical losses.
6. Conduct SCADA analytics and identify abnormal plant operating conditions.
7. Apply AI/ML and anomaly detection concepts to PV fault identification and performance forecasting.
8. Develop predictive maintenance strategies for modules, inverters, trackers, transformers, and balance-of-system assets.
9. Apply digital twin and IoT-enabled monitoring concepts to solar PV asset management.
10. Optimize PV module/inverter sizing, DC/AC ratio, orientation, tilt, tracking, and system configuration.
11. Perform root-cause analysis and corrective-action planning for underperforming PV plants.
12. Develop performance dashboards, KPIs, benchmarks, and management reports for operational decision-making.
13. Evaluate optimization opportunities based on energy yield, reliability, lifecycle cost, ROI, and sustainable asset performance.

Target Audience

1. Solar PV Design and Performance Engineers
2. Renewable Energy Engineers and Project Developers
3. Solar Plant Operations & Maintenance Professionals

4. Electrical and Energy Engineers
5. Asset and Portfolio Managers
6. SCADA, IoT and Energy Data Analysts
7. Energy Consultants and Technical Advisors
8. Utilities, EPC Contractors, Investors and Renewable-Energy Project Managers

Course Modules

Module 1: Solar PV Performance Fundamentals & Industry KPIs

- Solar PV operating principles and **performance benchmarking**.
- Understanding **PR, specific yield, capacity factor, availability and energy performance indicators**.
- Irradiance, module temperature, ambient conditions and their influence on PV output.
- Establishing **baseline performance, reference conditions and performance thresholds**.
- **Case Study:** Performance benchmarking of a utility-scale PV plant using monthly energy and irradiance data.

Module 2: Solar Resource, Data Acquisition & Quality Analytics

- **GHI, DNI, POA irradiance** and meteorological data interpretation.
- Weather-station, pyranometer, sensor and **SCADA data acquisition**.
- Data cleaning, validation, missing-data treatment and anomaly identification.
- Time-series analysis and visualization for **PV performance analytics**.
- **Case Study:** Detecting erroneous irradiance and temperature measurements in a commercial PV plant.

Module 3: PVsyst Simulation, Energy Yield & Loss Analysis

- PVsyst project configuration and **energy-yield modelling**.
- PV module and inverter selection with optimized **DC/AC ratio**.
- Horizon, near-shading, thermal, IAM, mismatch, soiling and wiring-loss assessment.
- P50/P90 energy estimates and comparison with operational results.
- **Case Study:** PVsyst optimization of a 1 MW plant to improve annual energy yield and reduce technical losses.

Module 4: Advanced PV Performance Diagnostics & Root-Cause Analysis

- Analysis of **inverter, string and module-level performance**.
- Identifying underperformance through normalized energy and loss indicators.
- **Thermal imaging, I-V characteristics and electrical diagnostics** concepts.
- Root-cause analysis of shading, soiling, degradation, clipping and equipment faults.
- **Case Study:** Investigating a sudden drop in plant PR and developing a corrective-action plan.

Module 5: SCADA, IoT, AI/ML & Digital Twin Analytics

- SCADA architecture and **real-time PV monitoring**.
- IoT sensors, cloud analytics and automated performance dashboards.
- **Machine learning, anomaly detection and predictive analytics** for PV assets.
- Digital twin concepts for performance modelling, diagnostics and operational optimization.
- **Case Study:** AI-assisted detection of abnormal inverter behavior using historical SCADA data.

Module 6: PV System Optimization & Advanced Technologies

- Optimization of **tilt, azimuth, row spacing and DC/AC ratio**.
- Bifacial modules, single-axis trackers and advanced PV configurations.
- **Soiling mitigation, cleaning optimization and thermal-performance improvement**
- PV plus **Battery Energy Storage Systems (BESS)** and grid-interactive optimization.
- **Case Study:** Comparing fixed-tilt, bifacial and tracking configurations for annual energy yield and lifecycle performance.

Module 7: Predictive Maintenance, Reliability & Asset Optimization

- Developing **condition-based and predictive maintenance** programmes.
- Failure-mode identification for inverters, modules, trackers and electrical equipment.
- Remaining Useful Life (**RUL**) and degradation assessment concepts.
- Maintenance prioritization using risk, criticality and performance data.
- **Case Study:** Building a predictive maintenance strategy for recurring inverter faults using operational data.

Module 8: Performance Improvement, Reporting & Capstone Case Study

- Developing **PV performance improvement plans** and optimization roadmaps.
- Financial and operational evaluation of proposed corrective actions.
- Building management dashboards and **executive-level performance reports**.
- Integrating technical KPIs with **asset management, ROI and sustainability objectives**.
- **Case Study:** Complete analysis of a 10 MW solar PV plant—from data validation and PR assessment to loss diagnosis, optimization recommendations and final performance report.

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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