Next-Generation Solar Technologies 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

Next-Generation Solar Technologies Training Course is designed to equip learners and energy professionals with practical knowledge of the rapidly evolving photovoltaic (PV) landscape. The course explores high-efficiency solar cells, TOPCon, heterojunction (HJT), interdigitated back-contact (IBC/XBC), perovskite photovoltaics, perovskite–silicon tandem cells, bifacial modules, photovoltaic–thermal (PVT) systems, smart solar, and digital energy management. Current research highlights TOPCon, HJT, bifacial architectures, and perovskite-based tandems as important pathways for improving efficiency and energy yield.

Through technology-focused lessons, industry case studies, system-design exercises, performance analysis, and techno-economic evaluation, participants will learn how emerging solar innovations move from laboratory research toward commercial deployment. Recent research has demonstrated certified tandem efficiencies above 32% in several architectures, while ongoing work focuses on stability, scalability, manufacturing economics, degradation, and bankability.

Programme Curriculum

Next-Generation Solar Technologies Training Course

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Course Duration

5 days

Course Objectives

1. Understand the evolution from PERC to TOPCon, HJT, XBC/IBC, and tandem PV.
2. Analyze high-efficiency photovoltaic architectures and their performance characteristics.
3. Evaluate TOPCon technology for commercial and utility-scale applications.
4. Examine HJT solar technology, including its temperature coefficient and bifacial potential.
5. Explore perovskite solar cells and their commercialization pathway.
6. Understand perovskite–silicon tandem technology and multi-junction PV architectures.
7. Assess bifacial PV, advanced module design, and energy-yield optimization.
8. Investigate PV–thermal systems, hybrid solar technologies, and energy integration.
9. Apply AI, IoT, digital twins, predictive analytics, and smart monitoring to solar assets.
10. Evaluate LCOE, CAPEX, OPEX, bankability, ROI, and lifecycle economics.
11. Analyze solar degradation, reliability, durability, and performance warranties.
12. Develop strategies for technology selection, commercialization, scalability, and sustainable deployment.
13. Interpret emerging PV roadmaps, R&D trends, and future energy-market opportunities.

Target Audience

1. Solar PV engineers and technicians
2. Renewable-energy project developers
3. Electrical and energy engineers
4. Solar EPC and O&M professionals
5. Energy consultants and sustainability professionals
6. Researchers, academics, and postgraduate students
7. Utility, grid, and energy-management professionals
8. Clean-tech entrepreneurs, investors, and technology decision-makers

Course Modules

Module 1: Next-Generation PV Landscape and Technology Roadmaps

- Evolution from PERC to n-type and advanced passivated-contact technologies
- Overview of TOPCon, HJT, XBC/IBC, thin-film, perovskite, and tandem PV
- Comparison of efficiency, degradation, temperature performance, cost, and scalability
- Understanding commercial readiness versus laboratory performance
- Case Study: Comparing technology roadmaps for a large-scale solar project

Module 2: TOPCon and Advanced Passivated-Contact Solar Cells

- Fundamentals of Tunnel Oxide Passivated Contact (TOPCon)
- Surface passivation, carrier selectivity, and recombination reduction
- Bifacial TOPCon architectures and energy-yield considerations

- Manufacturing optimization and compatibility with existing PV production
- Case Study: Industrial TOPCon deployment and its pathway toward tandem integration; recent research demonstrates high-performance bifacial TOPCon and perovskite/TOPCon tandems.

Module 3: HJT, IBC/XBC and Back-Contact Technologies

- Principles of heterojunction (HJT) solar cells
- Low-temperature processing and advanced surface passivation
- Bifaciality, temperature coefficients, and high-efficiency applications
- IBC/XBC architecture and back-contact metallization concepts
- Case Study: Selecting HJT versus TOPCon for a premium high-efficiency PV project; current industry analysis emphasizes different cost, performance, and scalability trade-offs.

Module 4: Perovskite Solar Cells and Emerging Materials

- Fundamentals of perovskite photovoltaic materials
- Bandgap engineering and advanced absorber design
- Stability, degradation, encapsulation, and operational lifetime
- Manufacturing scalability and commercialization challenges
- Case Study: Perovskite development from laboratory cells toward industrial-scale PV manufacturing

Module 5: Perovskite–Silicon Tandem Solar Technology

- 2-terminal and 4-terminal tandem architectures
- Perovskite top cells with TOPCon and HJT silicon bottom cells
- Spectral utilization and pathways beyond conventional silicon efficiency limits
- Interface engineering, crystallization, and long-term stability
- Case Study: Recent perovskite/TOPCon research achieved certified efficiencies above 33% at cell scale, illustrating the potential and remaining challenges of tandem commercialization.

Module 6: Advanced Solar Modules, Bifacial PV and Hybrid Systems

- Bifacial module technology and albedo optimization
- Advanced interconnection, metallization, and module architectures
- PV–thermal (PVT) and hybrid renewable-energy systems
- Floating, agrivoltaic, building-integrated, and flexible PV applications
- Case Study: Designing a bifacial solar installation for enhanced annual energy yield

Module 7: Smart Solar, AI, Digitalization and Energy Management

- AI-powered predictive maintenance and fault detection
- IoT sensors and real-time PV performance monitoring
- Digital twins for solar asset optimization
- Machine learning for solar forecasting and predictive analytics
- Case Study: Applying digital monitoring and predictive analytics to reduce downtime in a utility-scale PV plant

Module 8: Techno-Economics, Sustainability and Future PV Deployment

- LCOE, CAPEX, OPEX, ROI, bankability, and lifecycle cost analysis
- Technology selection based on project location and operating conditions
- Circular economy, recycling, low-carbon manufacturing, and responsible materials

- Risk assessment for emerging technologies and commercial scale-up
- Case Study: Multi-criteria selection of a future-ready PV technology portfolio for a utility-scale development

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

Start Date	End Date	Location	Price
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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