Hybrid Renewable Energy Systems with Solar, Wind & Biomass Training Course



14 - 18 Dec 2026

Cape town

4600 € (Per Person)

Ref: #ERE4275_265380

Course Introduction / Overview:

The future of sustainable energy lies in the intelligent combination of different renewable sources to overcome the inherent limitations of each. This training course, offered by BIG BEN Training Center, provides a comprehensive look at the design, optimization, and management of hybrid renewable energy systems. The curriculum focuses on integrating solar, wind, and biomass energy to create stable and reliable power networks. Drawing on the foundational work of global academic authors like Djamila Rekioua, a leading expert in the field, and key insights from her book "Hybrid Renewable Energy Systems," this course is grounded in both rigorous theory and practical application. Participants will learn how to analyze resource availability, model system performance, and select the optimal mix of technologies to meet a given energy demand. The program covers the technical aspects of energy conversion, storage solutions, and network integration, ensuring participants can design systems that are not only efficient but also economically viable. BIG BEN Training Center is committed to equipping professionals with the advanced skills to develop, implement, and operate these complex systems, which are essential for powering remote communities and building resilient energy infrastructure.

Target Audience / This training course is suitable for:

- Renewable energy system designers and engineers.
- Project managers in the energy sector.
- Utility company planners and operators.
- Government officials and energy policy analysts.
- Academics and researchers in sustainable energy.
- Consultants in hybrid power systems.
- Technicians involved in system installation and maintenance.

Target Sectors and Industries:

- Renewable energy and clean tech.
- Power generation and utility companies.
- Rural electrification and development.
- Engineering and consulting firms.
- Government agencies and regulatory bodies.
- Agriculture and waste management.

Target Organizations Departments:

- Renewable energy projects.
- Electrical engineering.
- System planning and design.
- Operations and maintenance.
- Rural development and sustainability.
- Biomass and waste-to-energy.

Course Offerings:

By the end of this course, the participants will have able to:

- Design and size hybrid renewable energy systems.
- Understand the principles of solar, wind, and biomass energy conversion.
- Analyze the technical and economic feasibility of a hybrid system.
- Develop control strategies for optimal energy management.
- Integrate energy storage technologies into hybrid networks.
- Evaluate system performance and troubleshoot common issues.
- Assess the environmental benefits and impacts of hybrid systems.
- Plan for the grid-connected or off-grid operation of a hybrid system.
- Utilize software tools for system modeling and optimization.

Course Methodology:

This training course is delivered through a highly practical and immersive methodology. Participants will engage in hands-on design and modeling exercises where they will apply their knowledge to create and optimize their own hybrid renewable energy systems. The curriculum is structured around a series of detailed case studies that simulate real-world project challenges, from resource assessment to financial analysis. This approach moves beyond theoretical concepts, giving participants the opportunity to make critical design decisions and see the results in a simulated environment. We will utilize interactive sessions and group projects to encourage collaborative problem-solving and the exchange of best practices. Instructors will provide personalized feedback and guidance throughout the process, ensuring that every participant gains a comprehensive understanding. By simulating the full project lifecycle, BIG BEN Training Center ensures that participants leave with the practical skills and confidence needed to design, implement, and manage complex hybrid energy systems in their professional roles.

Course Agenda (Course Units):

Unit One: Introduction to Hybrid Renewable Energy Systems

- Fundamentals of solar, wind, and biomass energy sources.
- Advantages and challenges of combining multiple sources.
- Key components of a hybrid system: sources, storage, and converters.
- Off-grid vs. grid-connected hybrid systems.
- Resource assessment and site selection for hybrid systems.
- Global trends and case studies of successful hybrid projects.
- Sizing and load profile analysis.

Unit Two: Solar and Wind Energy Integration

- Principles of photovoltaic (PV) systems and their modeling.
- Wind turbine types and power curve analysis.
- Optimizing the solar-wind energy mix.
- Maximum power point tracking (MPPT) for solar and wind.
- Technical challenges of integrating solar and wind.
- Energy yield assessment for solar and wind.
- Simulating a solar-wind hybrid system.

Unit Three: Biomass Energy Systems and Co-Generation

- Introduction to biomass resources and their classification.
- Biomass conversion technologies: combustion, gasification, and anaerobic digestion.
- Design and operation of a biomass power plant.
- Integrating biomass with solar and wind for continuous power.
- Waste-to-energy concepts and applications.
- The role of biomass in a circular economy.
- Modeling a hybrid system with a biomass component.

Unit Four: Energy Storage and System Control

- Types of energy storage technologies: batteries, hydro, and thermal.
- Sizing and selecting the right energy storage system.
- Battery management systems (BMS) and their role.
- Control strategies for hybrid energy management.
- Load sharing and power flow control.
- Grid stability and ancillary services from hybrid systems.
- Advanced control algorithms for system optimization.

Unit Five: Financial, Environmental, and Operational Planning

- Financial modeling for hybrid energy projects.
- Economic feasibility analysis and LCOE calculation.
- Risk assessment and mitigation strategies.
- Environmental impacts and life cycle assessment.
- Operation and maintenance planning for hybrid systems.
- Future trends and emerging technologies in hybrid systems.
- Final project: a comprehensive plan for a hybrid energy system.

FAQ:

Qualifications required for registering to this course?

There are no requirements.

How long is each daily session, and what is the total number of training hours for the course?

This training course spans five days, with daily sessions ranging between 4 to 5 hours, including breaks and interactive activities, bringing the total duration to 20 - 25 training hours.

Something to think about:

Considering the intermittent nature of solar and wind energy and the dispatchable but slower response of biomass, how can advanced energy management systems dynamically optimize this mix in real-time to meet a fluctuating load while maximizing economic returns?

What unique qualities does this course offer compared to other courses?

This training course provides a unique and holistic perspective on hybrid renewable energy systems by combining three major sources—solar, wind, and biomass—into a single, integrated curriculum. While many programs focus on one or two of these technologies, our approach teaches participants how to design and manage complex systems that leverage the strengths of each source to overcome their individual weaknesses. We move beyond simple theory by providing hands-on case studies and modeling exercises, allowing participants to gain practical experience in system sizing, control, and financial analysis. The inclusion of biomass as a dispatchable power source provides a distinct advantage, as it offers a solution for the intermittent challenges of solar and wind. This program is not just about technology; it is about strategic energy planning and project development. By the end, participants will have a comprehensive understanding of how to create resilient, efficient, and economically viable hybrid energy solutions, making them invaluable assets in the renewable energy sector.