# Designing Hybrid Renewable Energy for Off-Grid Sites Training Course



Ref: #ERE8134

## Course Introduction / Overview:

The global demand for reliable and sustainable energy in remote locations is accelerating, driving the need for advanced off-grid power solutions. This course provides a comprehensive exploration of designing, sizing, and implementing hybrid renewable energy systems for standalone applications. It moves beyond basic concepts to deliver an in-depth understanding of integrating multiple power sources, such as solar photovoltaics and wind turbines, with energy storage and conventional generators to ensure uninterrupted power supply. Drawing on principles outlined by experts like Gilbert M. Masters in his seminal work, "Renewable and Efficient Electric Power Systems," the curriculum focuses on practical application and real-world challenges. Participants will learn to conduct accurate load assessments, select optimal components, and utilize industry-standard design methodologies. BIG BEN Training Center has developed this program to empower professionals with the skills to create resilient, cost-effective, and environmentally responsible power systems for communities and industries operating beyond the reach of the traditional grid. This training is an essential step for anyone looking to master the complexities of off-grid energy independence.

## Target Audience / This training course is suitable for:

- Electrical Engineers and Technicians.
- Renewable Energy Project Managers.
- System Design Consultants.
- Energy Planners and Analysts.
- Technical Staff in Rural Development Agencies.
- Operations and Maintenance Personnel for Remote Facilities.
- Field Engineers working in off-grid locations.
- Entrepreneurs in the sustainable energy sector.

## Target Sectors and Industries:

- Telecommunications for remote tower power.
- Mining, Oil, and Gas for remote operational sites.
- Agriculture and Agribusiness for rural farm power.
- Non-Governmental Organizations (NGOs) focused on rural electrification.
- Healthcare for powering remote clinics and hospitals.
- Tourism and Hospitality for off-grid lodges and resorts.
- Governmental bodies and military for remote installations and disaster relief.

## Target Organizations Departments:

- Engineering and Design Departments.
- Project Management Offices.
- Operations and Maintenance (O&M) Teams.
- Research and Development (R&D) Divisions.
- Sustainability and Corporate Social Responsibility (CSR) Units.
- Technical Services and Field Operations.
- Procurement and Supply Chain Departments.

## Course Offerings:

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

- Conduct comprehensive site assessments and energy load profiling for off-grid applications.
- Analyze the technical specifications of solar PV, wind, battery, and generator components.
- Design robust and efficient hybrid power system architectures.
- Perform system sizing calculations to meet specific energy demands and reliability targets.
- Utilize modeling principles to simulate system performance and optimize component configurations.
- Develop effective control strategies for managing multiple energy sources.
- Evaluate the economic viability and lifecycle cost of off-grid hybrid projects.
- Create detailed plans for system installation, commissioning, and long-term maintenance.

## Course Methodology:

The training methodology at BIG BEN Training Center is designed to be highly interactive and practical, ensuring that participants gain tangible skills they can apply immediately in their work. This course blends foundational lectures with hands-on design exercises, real-world case study analysis, and collaborative group projects. Participants will engage in sessions that simulate the entire lifecycle of an off-grid project, from initial load assessment to final economic analysis. We emphasize a problem-solving approach, where attendees work in teams to design hybrid systems for various scenarios, such as powering a remote clinic or a telecommunications tower. These activities are guided by expert instructors who provide continuous feedback and share insights from their field experience. The curriculum incorporates discussions on the latest industry trends, technological advancements in energy storage, and best practices in system integration. This immersive learning environment fosters deep understanding and prepares participants to confidently tackle complex off-grid power challenges.

## Course Agenda (Course Units):

### Unit One: Fundamentals of Off-Grid Hybrid Power Systems

- Introduction to off-grid energy challenges and opportunities.
- Characteristics of solar photovoltaic (PV) power generation.
- Principles of wind energy conversion systems.
- The role of diesel generators as backup power sources.
- Fundamentals of electrochemical energy storage (battery technologies).
- Understanding energy consumption and load profiling.
- Key metrics for system performance and reliability.

### Unit Two: System Components and Technical Specifications

- Deep dive into solar PV module technologies and selection criteria.
- Analyzing wind turbine power curves and performance.
- Comparing battery technologies (Lead-Acid, Lithium-Ion) for off-grid use.
- Sizing and selecting inverters and charge controllers.
- Understanding the function of a Battery Management System (BMS).
- Specifications for backup generators and automatic transfer switches (ATS).
- Cabling, protection devices, and balance of system (BOS) components.

## Unit Three: Hybrid System Design and Sizing Methodology

- Conducting a detailed site survey and resource assessment.
- Manual calculation methods for sizing PV arrays and battery banks.
- Principles of system architecture (DC-coupled vs. AC-coupled systems).
- Introduction to simulation software for system optimization.
- Step-by-step process for designing a solar-diesel-battery hybrid system.
- Integrating wind turbines into a hybrid power configuration.
- Ensuring system safety and compliance with standards.

## Unit Four: Energy Management and Control Strategies

- Core principles of power flow management in a hybrid system.
- Developing control logic for source prioritization (e.g., renewables-first).
- State of Charge (SOC) management for battery longevity.
- Load shedding and demand-side management techniques.
- Communication protocols between system components.
- Monitoring and data logging for performance analysis.
- Troubleshooting common control and integration issues.

## Unit Five: Project Implementation and Financial Viability

- Best practices for installation and commissioning of off-grid systems.
- Developing a comprehensive operations and maintenance (O&M) plan.
- Calculating the Levelized Cost of Energy (LCOE) for hybrid systems.
- Conducting a lifecycle cost analysis and calculating return on investment (ROI).
- Exploring financing models for off-grid energy projects.
- Case study analysis of successful and failed off-grid projects.
- Final project: Designing a complete hybrid system for a given scenario.

# 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:

As battery technology advances and costs decrease, what is the long-term role of diesel generators in hybrid off-grid systems, and could they be phased out entirely?

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

This course distinguishes itself by focusing intensely on the practical, real-world application of hybrid system design principles. While many programs cover theoretical concepts, this training, curated by BIG BEN Training Center, bridges the gap between theory and practice. Participants engage in a comprehensive design journey, starting from raw load data and culminating in a fully specified, economically viable system plan. The curriculum is uniquely structured to cover not just the individual components but the critical art of their integration and control, which is often the point of failure in real-world projects. We emphasize financial and lifecycle cost analysis, equipping attendees with the skills to justify projects to stakeholders by demonstrating long-term value and return on investment. The course moves beyond just technical sizing to instill a holistic understanding of project viability, reliability, and maintainability, preparing professionals to lead successful off-grid energy projects from conception to completion with confidence and expertise.