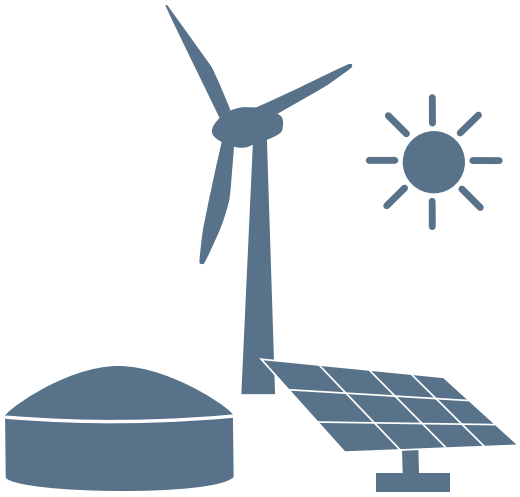
renac
renewables academy

Renewables Academy Online

Certified PV Professional

Online training on photovoltaic and PV-diesel hybrid systems

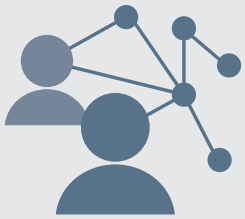
Certified PV Professional



RENAC Online

RENAC Online helps you:

- Boost your professional career
- Study with flexibility following your own schedule
- Learn at any time and from any location



RENAC Online offers extensive support & interactive learning:

- Videos
- Graphics
- Exercises for self-evaluation
- Discussion forum
- Virtual classrooms

RENAC Online staff are:

- Certified e-learning trainers
- Experienced professionals
- In direct contact with the industry

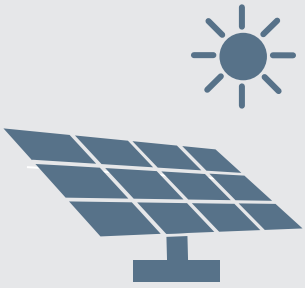
CERTIFIED EUROPEAN E-LEARNING MANAGER

What is the „Certified PV Professional“ online training?

This online training focuses on different applications of photovoltaic (PV) technology.

The first three courses provide basic knowledge on components, configuration and sizing as well as on economics of various types of PV systems.

The following three courses further explain these topics, and show how to plan and operate exemplary PV power plants and PV-diesel systems. These courses give technology-specific details as well as tips for the planning and operation process.



Introductory courses

Each participant will have access to short introductory courses on energy and electricity topics to learn or revise the basics. These courses are not mandatory, and will not be covered in the exam.

PV professional courses

- Photovoltaic - application
- Technology
- PV-diesel hybrid systems
- Off-grid systems
- Planning of large-scale grid-connected PV
- Planning of PV-diesel hybrid power stations

More than 850 participants have joined RENAC Online!

This training suits you if you

- require detailed knowledge on the technical characteristics of various PV systems
- will be involved in planning or supervising the implementation of a PV plant

Learning objectives

After the online training, participants will be able to

- determine the optimal PV system size and estimate the corresponding energy yield
- categorize PV-diesel hybrid systems and evaluate their economic viability
- identify the system type (off-grid, grid-connected or hybrid) suited to an application
- define the planning and implementation steps to ensure the success of a PV project

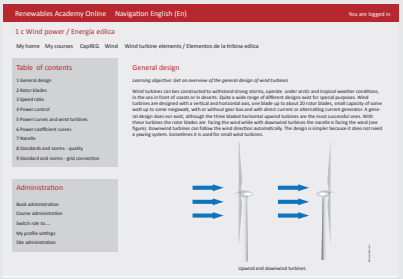
Certified PV Professional

Why choose RENAC Online?

Self-study material

1 Text and Images

Courses are structured in small, illustrated units of instruction; learners are guided through the material step-by-step.

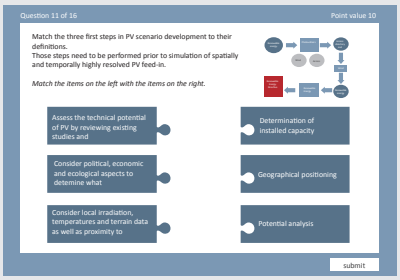


2 Videos

Video lectures explain some of the most important topics in a visual and entertaining way.

3 Tests

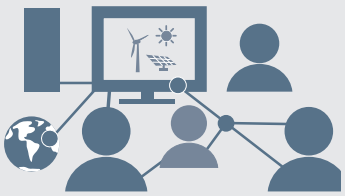
Many self-assessment tests within each course help participants to test their knowledge.



Extensive support

1 Forum

Support and communication take place in a discussion forum. RENAC monitors the forum constantly. RENAC experts are ready to give assistance and discuss the course topics.



2 Assignment

After studying each course, participants are asked to answer an assignment question. RENAC gives individual feedback for these assignments.

3 Virtual classroom

Participants should attend the live virtual classroom sessions (webinars). These are conducted by renewable energy experts. During and after the presentation participants are invited to discuss in the live chat.

Certificate

All participants who score above 70% in the final online exam will receive a printed RENAC certificate. All others will receive a certificate of attendance per e-mail.

For Spanish-speaking participants (upon request):

- Course texts and self-tests in Spanish
- Videos with Spanish subtitles
- Support by a Spanish-speaking tutor

Live virtual classrooms (webinars) for the whole class and exams are held in English language only.

Schedule

The courses will be online:

Spring and fall semester each year
Start date: 1 April / 1 October

Recommended study time:

5 – 10 hours per week
approx. 150 hours in total

Resulting duration:

4 to 6 months for the entire training depending on previous knowledge and study habits.

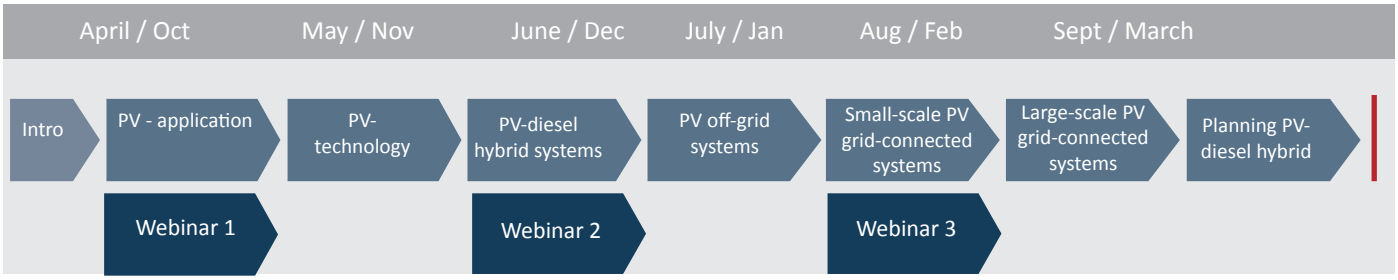
Assignments:

The courses are designed for a continuous participation from the beginning of the semester until the exam. There is an assignment for each course, which counts towards the final grade. Participants are asked to write a short statement regarding an important topic of each course. Assignments need to be handed in by the deadlines.

Scheduled exam dates:

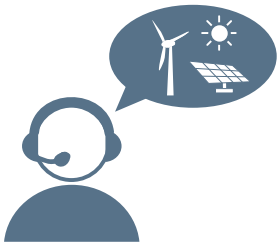
Participants can take the exam after 4, 5 or 6 months

Spring semester / fall semester



Live virtual classrooms (webinars)

Two live virtual classrooms are part of the Applying Renewable Energy online training. These live events are not mandatory, but participation is strongly recommended.



Webinar 1
Introduction to RENAC Online
First week of the semester
(1 hour)

Webinar 2
Energy yield of renewables
Middle of the semester
(1 hour)

Webinar 2
PV planning aspects
End of the semester
(1 hour)

Certified PV Professional

Registration and discounts

Registration:

You can register for the Certified PV Professional online training via the registration form at:

www.renac.de/trainings-services/trainings/open-trainings/produkt/certified-pv-professional/

Deadlines:

Early bird deadline: 20 August / 20 February

Registration deadline: 22 March / 22 September

Participants who are not able to finish the online training in one semester can book an extension of 6 months (following semester) at a 80% reduced course fee

Fee: 1380 Euro

Discount:

Early bird 10%; group (2 or more) 5%; combination of both 15%

Payment:

VISA, MasterCard, American Express, invoice

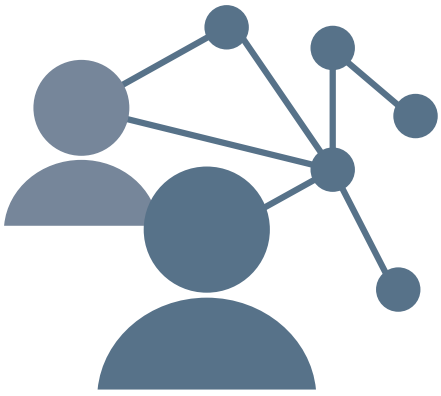
Technical information

You need to provide an e-mail address, which you check regularly. Furthermore you need a computer with a stable internet connection (at least 2 Mbit/s). For webinars, the AdobeConnect add-in or app should be installed, and a headset or speakers are required to listen to the presentation.

Demo course

For a first impression of our online platform, have a look at:

http://renewables-online.de/blocks/demologin/logindemo.php?course=Demo



Learning objectives and content of the courses

Introduction to energy

Learning objectives

- Describe the global situation of energy supply and demand
- Differentiate forms of energy as well as energy and power
- Name fundamental parameters, units and conversion factors related to energy topics.

Content

Development of energy demand

- Energy supply and demand, fossil fuels
- Renewable energy resources
- Outlook of energy supply

Physical basics

- Energy and supply chain
- Forms of energy, energy and power
- Performance indicators for energy conversion
- Capacity factor and full load hours

Units and conversions

- Introduction
- International System of Units
- Energy content in different fuels

Introduction to electricity

After completion of this course, participants will be able to:

- Describe the basic technological terms and principles governing the operation of electrical power systems,
- Give reasons for keeping grid frequency stable,
- Explain why power systems are typically built as three-phase AC systems and
- Distinguish between electric energy and electric power.

Content

Basics of electricity

- Current, voltage, resistance, frequency
- Balance and imbalance in the grid, reasons for keeping grid frequency stability
- Peak voltage and phase angle, different phase angles
- Three phase systems
- Active, reactive and apparent power
- Relationship between voltage, current and power, power factors

Introduction to the solar resource

After completion of this course, participants will be able to:

- Describe the variability of the solar resource around the world and influencing factors,
- Explain the difference between irradiation and irradiance and explain components of solar radiation,
- Define important solar terms and the position of the sun in the sky and
- Discover the importance of orientation and tilt of a solar array for optimising energy yield.

Content

Introduction

- What is solar energy used for?

Physical basics of solar energy

- What is the difference between solar irradiation and irradiance?
- What is solar irradiance physically: waves or particles?
- How is solar irradiance composed?

Sun positioning

- How does the sun position affect solar irradiance?

PV - application

After completion of this course, participants will be able to:

- Name the different applications for PV systems and corresponding categories,
- Decide which system types and components are to be used for which purpose,
- Explain the basic parameters impacting power output of a PV system and
- Paraphrase the economic aspects of PV systems incl. energy yield, metering options and costs.

Content

Application

- PV system categories/application
- Grid-connected and off-grid configuration

Components of a PV system

- Overview of PV cell types, PV modules
- Introduction to inverters and mounting structures

Physical aspects

- PV cell energy output
- Electrical characteristics and the I-V curve
- Factors affecting power output

Energy yield and Performance Ratio

- Definition, calculation and Example
- Economics of PV systems

PV technology

After completion of this course, participants will be able to:

- Explain the principles of the photovoltaic effect,
- Describe the characteristics of the different types of PV cells and modules,
- Paraphrase the impact of efficiency and shading on PV modules and
- Select the appropriate PV array configuration for each purpose.

Content

Physics of PV cells

- Energy band model, photovoltaic effect, the p-n junction

Types of PV cells

- Crystalline PV cells, thin-film PV cells, new technologiess

PV modules

- PV module examples and data sheets
- PV module configurations, PV array configurations, PV module efficiency
- Effects of shading and types of shading
- Diodes, Shading: crystalline vs. thin-film modules
- International standards

PV-diesel hybrid systems

After completion of this course, participants will be able to:

- Estimate the potential and suitable locations for PV-diesel hybrid systems,
- Decide which components are to be used for which purpose,
- Explain the basic parameters for system sizing and dynamic system behaviour and
- Evaluate PV-diesel hybrid systems from an economic perspective.

Content

Introduction

- Access to electricity, micro and hybrid power systems, grid extension costs
- Classification of PV-diesel hybrid systems

System components

- Structure of small hybrid power systems
- Diesel generators, balance of system, SMA Fuel Save Controller Components

System sizing

- Load profile, peak load, penetration rate, energy share
- Generator minimum loadings

Dynamic system behavior

- Behaviour on a sample day, different set-ups
- Adding storage, energy efficiency and demand side management

Economic evaluation

- Lifetime of components, cost structure of hybrid systems
- Levelized cost of electricity (LCOE) from pure diesel generator systems and hybrid systems
- Mini-grid vs. single household system

PV off-grid systems

After completion of this course, participants will be able to:

- Distinguish different applications and configurations for off-grid PV systems,
- Name and explain the required components for off-grid PV systems,
- Manage the design, sizing, installation and commissioning of an off-grid PV system and
- Analyse the economic viability of off-grid PV systems.

Content

Application

- Typical applications, typical load
- Application example: telecommunications, solar water pumping
- System configurations (Small off-grid PV system and micro/mini- grid configurations, “Fuelsaver concept”ration)

System components

- PV modules and charge controllers: function and types, selection
- Maximum Power Point Trackers (MPPTs)
- DC- DC converters
- Inverters: Battery inverters, inverter-chargers for DC-coupled off-grid system and AC- coupled off-grid systems, grid-connected PV inverters in off-grid systems
- Batteries: Battery capacity, rate of discharge (C-rate), depth of discharge (DoD), cycle life
- Lead- acid battery types and their properties and configurations
- Mounting structure requirements for off-grid systems, mounting system types

System design and sizing

- General steps in system design and sizing
- Load assessment, solar resource assessment
- Orientation, tilt angle, shading
- Design concept and sizing methodology

Installation, commissioning, operation and maintenance

- PV module installation: good practice
- Cable sizing and installation: good practice
- Earthing/grounding: good practice
- Fuses and circuit breakers: good practice
- Battery installation: good practice
- Lightning/surge protection
- Inspection, testing and commissioning
- Operation and maintenance
- Monitoring device

Economics of off-grid PV systems

- System costs
- Example: unit electricity cost of an off-grid PV system
- Viability of off-grid PV and advice to policy maker
- Monitoring device

Small-scale PV grid-connected systems

After completion of this course, participants will be able to:

- Define and explain the required components of the PV power plant,
- Describe the contracts, studies and permissions required for PV project development,
- Present all necessary steps from planning to operation and maintenance and
- Assess and supervise the implementation of a large-scale PV power plant.

Content

Introduction to small- and medium-scale grid-connected PV systems

Feed-in tariffs and net metering

Components of grid-tied PV systems

- Photovoltaic modules and mounting systems
- Grid-connected inverters for small- to medium-sized PV systems
- Other components (cables, fuses, meters,…)

Design and sizing of grid-connected PV systems

- Site surveys and shade analysis for grid-connected systems
- Energy yield, performance ratio and energy losses
- Inverter selection and sizing
- Cable sizing
- Design, sizing and simulation software

Installation of grid-connected PV systems

- Installation guidelines, tools, instruments, other equipment
- Installing PV modules on buildings
- Inverter installation, module interconnectors
- DC and AC cable installation, monitoring equipment
- Earthing/grounding requirements

Commissioning grid-connected PV systems

- Commissioning pre-conditions, safety precautions, instruments
- The commissioning process and system inspection
- Electrical testing & performance testing
- System handover, documentation, user training

Operation and maintenance of grid-connected systems

Case Study – 3kWp Grid-connected System, Germany

Summary

Bibliography and sources of further information

Planning of large-scale PV grid-connected systems

After completion of this course, participants will be able to:

- Define and explain the required components of the PV power plant,
- Describe the contracts, studies and permissions required for PV project development,
- Present all necessary steps from planning to operation and maintenance and
- Assess and supervise the implementation of a large-scale PV power plant.

Content

Project mission

- Commercial viability of large PV systems
- Supply options

Main system components

- PV module (standards/certification, limits of module testing standards, mismatching PV modules in PV array strings
- Inverter concepts; transformers (types, cost comparison)
- Switchgear, monitoring and control, irradiation measurements

Project development

- Life cycle of a large PV plant
- Feasibility study (site assessment, yield estimation, cost estimates), contracts

Project planning

- Yield assessment
- Legal and regulatory issues
- Infrastructur

Construction and installation

- Construction and installation planning, construction and installation issues
- System commissioning procedures and documentation
- PV plant decommissioning and dismantling

Plant operation

- Monitoring, power output control
- Operation modes, standards and codes

Planning of PV-diesel hybrid systems

After completion of this course, participants will be able to:

- Distinguish different system designs and their preferable application,
- Lead a feasibility study to integrate PV into an existing diesel power system,
- Explain functioning of system components, operational strategies and optimising potential and
- Assess and supervise the planning and implementation of a PV-diesel power plant.

Content

Introduction

- Diesel power plants – applications and characteristics
- Global distribution of diesel plants
- Off-grid sectors and target groups for hybridisation projects
- PV-diesel hybrid systems – conditions for economical attractiveness
- Project examples from around the world

Introduction to feasibility case study

- Feasibility study overview and importance of accuracy in data collection and processing
- Step 1 (Typical load profiles, monitoring and assessment of load profiles, case study load profile, load profile projections)
- Step 2 (Diesel engines and generators, electric generator, operational limits of diesel gensets (I), operational limits of diesel gensets (II),
- System stability in diesel based mini-grid

Feasibility study – PV integration and conclusions

- The engineer has to realize the PV-hybridization
- PV-diesel hybrid system control; mini-grid internal communication infrastructure
- Sensors and actuators, active and passive control systems
- Comparison of active and passive control systems
- Load-driven control in mini-grids, spinning reserve (definitions, factors, example)
- N+1 criteria, PV-diesel hybrid system limitations
- Electrical protection in mini-grids, operational strategies
- Effects of PV-hybridisation on diesel generator operation and effect of hybridisation on diesel generator working lives
- PV-diesel hybrid system dynamics, fluctuating PV power output
- Frequency deviations, voltage fluctuations and irush currents on mini-grids

Additional options to optimize system

- The chief planning engineer wants to dig deeper
- Impact of diesel generator setup on mini-grid performance
- Overview on storage technologies for mini-grids; lead-acid and lithium-ion batteries
- Battery integration, management and control, system stability and energy storage

Installation, commissioning, operation and maintenance

- The chief planning engineer carries out the financial planning
- Overview of cash-flow structure, LCOE for diesel-only and PV-diesel hybrid systems
- Influence of financing costs on cash-flowss, battery integration, management, control, system stability and energy storage

Final conclusions

- Inauguration ceremony
- References and glossary

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