renac
renewables academy

Renewables Academy Online

Certified Flexible Power System Specialist (CFPSS)

Online training on flexible power systems with thermal power generation capacity and increasing shares of grid connected variable renewable energy (wind and solar)







Certified Flexible Power System Specialist (CFPSS)

Impressum

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Renewables Academy (RENAC)

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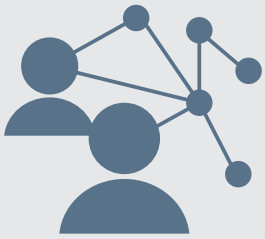
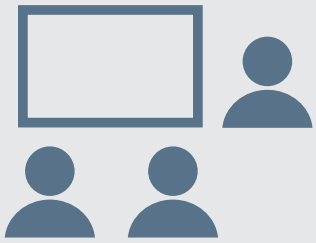
RENAC Online



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 Flexibility Power Systems Specialist (CFPSS)" Online Training?

The online training starts with an introduction to the main RE renewable technologies photovoltaic (PV) and wind. It then focuses on the topic of grid integration of larger shares of wind and PV into the existing electricity grid. Based on this introduction the training focuses explains in detailon the topic of flexibility options in for power systems. Measures to increase the and flexibility of le existing thermal power plants to giveand an introduction of call for tender criteria for new thermal power plants give the participants a comprehensive overview on all relevant technical aspects related to power systems operated with more increasing shares of VRE.

CFPSS courses

- Photovoltaics (PV) application
- PV-diesel hybrid systems
- Wind power
- Wind and PV grid integration
- Flexibility options for power systems
- Flexibility thermal power plants

This training suits you if you:

- Work on medium- and long-term strategies to develop interconnected power supply systems with thermal power plants and high shares of wind power and photovoltaic power stations
- Prepare decisions to invest in new or to retrofit existing thermal power plants generation capacity
- Analyse the development of market shares of thermal power generation capacity
- Develop medium- and long-term power trading strategies
- Avoid stranded investments in thermal power stations

After the online training, participants will be able to:

- Consult energy ministries or working groups that draft energy strategies and propose measures to increase the power system flexibility
- Provide advice to private and public institutions on tender documents for flexible thermal generation capacity

Courses

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.

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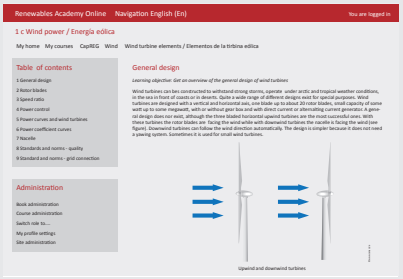
Why choose RENAC Online?

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.

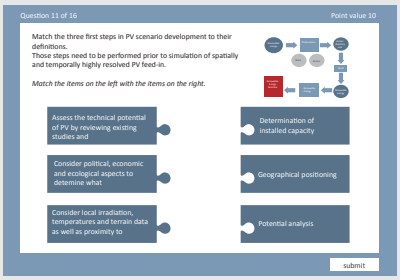


2 Videos

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

3 Tests

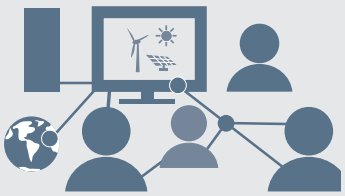
Many self-assessment tests within each course help participants to test their knowledge.



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. 180 hours in total

Duration:

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

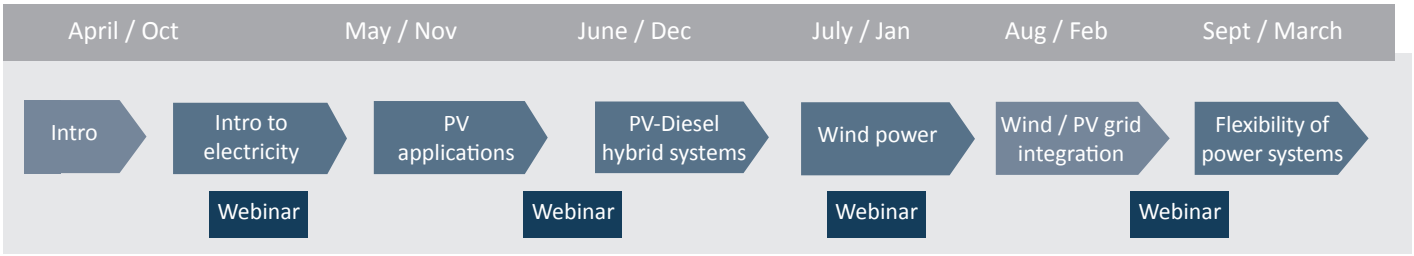
Assignments:

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)

Four live virtual classrooms are part of the Certified Flexibility Power Systems Specialist (CFPSS) online training. These live events are not mandatory, but participation is strongly recommended.

Webinar 1
Introduction to RENAC Online
(1 hour)

Webinar 2
Life-Cycle and value chain of PV projects
(1 hour)

Webinar 3
Grid Integration - particular on residual load analysis (1 hour)

Webinar 4
Flexibility options for power systems
(1 hour)

Certified Flexible Power System Specialist (CFPSS)

Registration and discounts

Registration:

You can register for the Certified Flexibility Power Systems Specialist (CFPSS) online training via the registration form at:

https://www.renac.de/trainings-services/trainings/open-trainings/produkt/certified-flexibility-power-systems-specialist-cfpss/

Deadlines:

Early bird deadline: 20 August / 20 February

Registration deadline: 27 March / 27 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:

1850 Euro

Discount:

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

Payment:

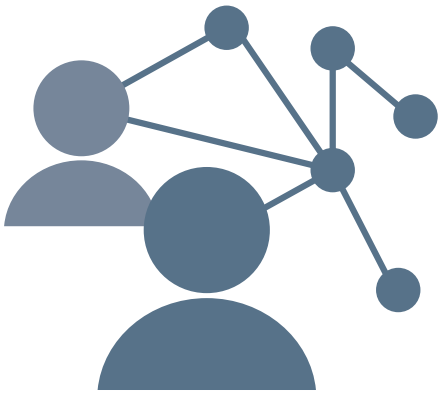
VISA, MasterCard, American Express, invoice

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

Learning objectives

- 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 factorsI

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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-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

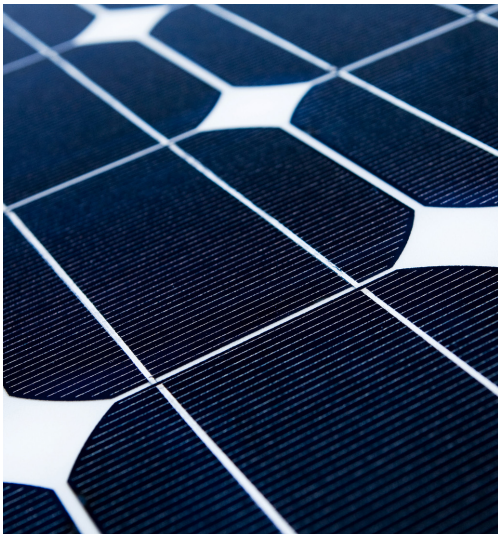
- Load profile, peak load, penetration rate, energy share
- Generator minimum loadings

Dynamic system behaviour

- 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



Wind power

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

- Assess the potential and requirements for wind energy (e.g. resources, site selection),
- Decide which of the most widely used system types and components are to be used for which purpose,
- Employ the basic parameters for system sizing and roughly calculate the energy yield and
- Sketch the planning and implementation steps for a wind power plant.

Content

Physical basics

- Causes of wind
- Wind speed units and wind power density
- Power coefficient and Betz limit

Wind speed shear

- Wind speed change above ground
- Wind speed extrapolation to a certain height
- Roughness length and wind shear exponent

Wind measurement

- Equipment
- Wind direction and wind rose, wind speed turbulence
- Light detection and ranging (LIDAR) and sound detection and ranging (SONAR)
- The Weibull equation

Wind turbine components

- Wind turbines- range of designs
- Rotor blades and nacelle
- Power control and power limitation methods
- Wind turbine power curves
- Power coefficient curves
- Air density correction of power curves
- Tip-speed ratio
- Standard and norms

Wind farm planning and design: energy yield and wind farm layout

- Energy yield calculation
- Planning step overview
- Wind turbine and wind farm siting

OPEX, CAPEX and LCOE

- Investment costs (CAPEX)
- Operational costs (OPEX)
- Levelised cost of energy (LCOE)

Wind and PV Grid Integration

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

- Explain the use and development of time series for variable renewable energy,
- Present the basics about power system operation, scheduling and forecasting,
- Describe the purpose and types of balancing power and management of grid congestion and
- Discuss capacity planning methodologies, grid codes and the development of grid studies.

Content

Time Series of Variable Renewable Energies

- Development steps for time series
- Time series for wind energy
- Metrological data for wind
- Accounting for wake losses in a wind park
- Time Series for PV
- Data Requirements for PV time series
- Solar Geometry

System Operation: Scheduling and Forecasting

- Residual load and scheduling
- Forecast for: Scheduling, grid operation and trading
- Forecast horizons; forecasting systems
- Wind Forecasting – physical and statistical approach
- PV Forecasting
- Forecast Errors – types & examples

Balancing Power Calculation Methodology

- Purpose and types of Balancing Power
- Quantification of Balancing Power
- Restrictions in Balancing Power Supply

Management of Grid Congestion

- Load Flow Calculation Methods
- Prevention and Adjustment of Congestion
- Dynamic Line Rating

Capacity Planning

- Generation Adequacy (2pp.) and reliability indices
- Analysis with residual load duration curve
- Capacity credit for variable Renewable Energies

Grid Code Development

- Purpose and need for grid codes
- Grid codes for renewables
- Elements of a grid code
- Frequency range of operation considering renewables
- Voltage and reactive power control considering renewables

Grid and System Integration Studies

- Purpose and general considerations
- Questions to ask
- Typical content
- Case definition and selection

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Flexibility options for power systems

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

- Explain the key role of flexibility in successful power system transformation,
- Describe different flexibility options and name important measures,
- Formulate the framework for a cost-effective power system transformation.

Power system transformation

- Impact of VRE
- Value of flexibility
- Optimised management of VRE development

Flexibility options

- Grid – infrastructure and management
- Example: Grid reinforcement and load flow management
- Storage
- Example: Power-to-X
- Demand-side integration
- Example: DSM in industry
- Dispatchable generation – flexible thermal power plants

Cost of flexibility

- Levelised cost of flexibility (LCOF)
- LCOF of transmission grids, distribution grids, storage, small-scale DSI, large-scale DSI, dispatchable generation,
- From LCOF to a flexibility investment plan

Market frameworks

- Role of short-term markets
- Example: System service market

Flexibility of thermal power plants

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

- Explain what flexible operation of thermal power plants means,
- Describe important technical measures facilitating this mode of operation,
- Determine key success factors for operating flexible thermal power plants in an economically viable way.

Content

Dimensions of flexibility

- Overview of thermal power plants
- Dimensions of flexible operation
- Flexibility parameters for different technologies

Operation and maintenance of flexible power plants

- Operation and maintenance of a power plant
- Wear and tear on equipment
- Key role of the instrumentation and control system

Retrofit measures for thermal power plants

- Enhancing the combustion system
- Optimisation of the I&C system
- Flexible turbine operation

Implementation and costs

- Implementation strategy
- System services provided by thermal power plants
- Operational cost of thermal power plants
- Other costs related to flexible operation

Market environments for improved generation flexibility

- Liberalisation of the power sector
- Electricity market options
- Merit order in energy-only markets
- System service markets
- Capacity mechanisms and scarcity pricing
- Long-term investment planning
- Flexibility in a power purchase agreement

Case studies - Flexible power plants

- Case study 1: Minimum load achievements at Heilbronn power plant
- Case study 2: Dried lignite-fired Jaenschwalde power plant
- Case study 3: Integration of battery and thermal storage

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