

## **SOLAR ELECTRICITY INSTALLATION COURSE - OFF-GRID APPLICATIONS**

**8 – 12 November 2010, Berlin (to be confirmed)**

*Learn how to design and install stand-alone / off-grid solar electric systems*

This five-day intensive course on the design and installation stand-alone / off-grid solar electric systems (not grid-tied) is run by RENAC, the Renewables Academy in Berlin.

The course is ideal for anyone who wants to install their own solar electric system, start a solar business or seek employment in the solar industry.

**Includes practical sessions and visits to systems.**

**The course is aimed at an international audience and will be in English.**

(Courses are also available on grid-tied / grid-connected systems.)



**COURSE CONTENTS** Introduction to renewable and solar energy • The solar resource  
System configurations • Solar system design • Solar modules • Solar module mounting structures & arrays  
Electrical wiring • Solar modules • Lights & appliances • Charge controllers • Batteries • Fuses • Inverters •  
Solar water pumping • Electrical safety • Practical sessions • Sizing solar systems  
System testing & commissioning • Solar hybrid systems – diesel / wind • Case studies

**THE VENUE** RENAC is located in Berlin, a city in the forefront of renewable energy technology. RENAC can be found at <http://www.renewables-academy.com> or <http://www.renac.de>

**ACCOMMODATION** Berlin has an excellent selection of reasonably priced hotels. Participants will be provided with a list and contact details.

**HOW TO GET THERE** The venue is about an hour from Berlin's two airports.

**FEES** The course costs €1,575 plus 19% VAT (includes lunch each day)

**To register receive further information for this and other courses, contact**

Frank Jackson (Main Course Tutor) Green Dragon Energy

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*Early booking recommended*

*Course tutor Frank Jackson has taught solar electrical installation courses in the UK, Kenya, Tanzania, Somalia and France. He worked at the KARADEA Solar Training Facility in East Africa and has also run courses on renewable energy for the University of Wales*

*The course is aimed at engineers, technicians and business developers*

*We recommend that participants consult with the main course tutor, Frank Jackson, before enrolling*

# COURSE CONTENTS

**Introduction to renewable energy** - range of renewable energy sources, energy use, energy conversion, power & energy.

**The solar resource** - peak sun hours, solar insolation maps, using solar insolation data.

**Solar modules** - photovoltaic cells & modules, open circuit voltage, short circuit current, module power outputs, IV curves, diodes, monocrystalline modules, polycrystalline modules, multi-junction modules, amorphous silicon modules.

**Module mounting structures & arrays** - orientation, tilt angles, effects of shade, effects of temperature, solar array mounting systems.

**Solar module & array wiring** - configurations, modules in series, modules in parallel, modules in series-parallel, measuring module voltages & currents, modules in parallel, modules in series.

**Solar electric systems** - solar system configurations, examples of solar systems.

**Electricity & energy** – circuits in stand-alone systems, electrical safety, instruments, DC & AC, energy and power.



*Off-grid solar system, France*



*Off-grid solar training in Tanzania*

**Lights in solar systems** – lumens / watts, luminaire efficacy, incandescents, halogens, fluorescents, LEDs, DC lights, AC lights, estimating lighting requirements.

**Appliances in solar systems** - computers, TV/video, radio/sound, other household appliances, use of DC appliances, use of AC appliances.

**Solar water pumping**- pumping system types, solar pump sizing.

**Charge controllers** - charge controller characteristics, range of available charge controllers, amp-hour meters.

**Batteries** - types of batteries, battery capacity, battery characteristics, battery cycle life, battery configurations, main battery fuse, battery specification sheets.

**Batteries installation & wiring** - batteries in series, batteries in parallel, batteries in series-parallel, individual battery cells, battery safety, state of charge measurement.

**Electrical wiring** - cable sizes, thermal requirements / voltage drop, cable plans, wiring diagrams, fuses & circuit breakers, RCDs, DC wiring - lighting circuits, AC wiring - lighting circuits, socket circuits, hard-wired circuits, earthing.

**Inverters & inverter chargers** - inverter characteristics, choosing & sizing an inverter, inverter installation, inverter-chargers in solar-diesel hybrid systems, remote monitoring of systems.

**Solar system design** - choosing the most cost-effective and performance-effective options.

**Sizing solar systems** - solar array sizing, using solar insolation and determining tilt angles, battery bank sizing, charge controller sizing, including using computer sizing systems.

**Case studies** - examples of different types of solar electric systems.

**Practical sessions** – assembly, testing and commissioning of stand-alone solar systems, and trouble shooting.

**System commissioning** - system testing procedures, completion certificates.

**Solar hybrid systems** – overview of solar-wind systems, solar-diesel systems.

**Projects** - participants will have the opportunity to discuss and develop their own projects during the course.

*The course will be delivered by several RENAC tutors*



*Off-grid solar system in Spain  
Photo: www-solonet.net*