KONDLE VENTURES Ltd.
EDUCATIONAL SYSTEMS

LHP 801
RENEWABLE ENERGY

The LHP 801 laboratory introduces the student to the practical and theoretical area of Renewable energies that are generated from sources that regenerate themselves or are inexhaustible. The laboratory consists of a set of simulators, trainers and equipment listed on the right of this page.

The laboratory explains the operating principles of **Solar energy**, **Wind energy**, **Biofuel** and **Hydropower**. It includes:

- Products for the introduction to renewable energies.
- Trainers for the photovoltaic solar energy.
- Trainers and simulations for the passive solar thermal energy.
- Trainers for the wind energy.
- Trainers for the hybrid solar and wind energy.

All trainers and simulators are dealing with the theoretical parameters of energy production from alterative sources, power and efficiency, installation and technical specifications of components, system performance under various conditions, faults in various configurations of performance.
The laboratory's equipment is accompanied by the appropriate software to run interactively with PC workstations, wherever this is applicable.
The software is organized in subjects corresponding to simulations or experimental exercises relevant to the scope of each topic.
The simulators, are accompanied by relevant software to enable the student to follow step-by-step the theory and the exercise.
The systems are accompanied by installation, technical manuals, theory and exercises. Each one of the lab equipment is described hereinafter.

RENEWABLE ENERGY SOURCES

GE100S Trainer
Solar, Wind, Fuel cells energy trainer

SOLAR POWER

PT GE SV12 Trainer
Photovoltaic energy basic trainer

PT GE SV22 Trainer
Photovoltaic energy electrical installations

PT ST A Trainer
Solar thermal energy trainer

PTH-350S Thermal System Simulator Application
Solar thermal home plant simulator

WIND POWER

PT GE W22 Trainer
Wind energy modular trainer

COMBINED POWER SOURCES

PT GE HSW22 Trainer
Hybrid/solar-wind energy electrical installations

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RENEWABLE ENERGY SOURCES

GE100S Trainer
SOLAR, WIND, FUEL CELL ENERGY TRAINER

Renewable Sources of energy are provided to us inexhaustibly by nature. This laboratory explores the operating principles of **Solar**, **Wind** and **Hydrogen Fuel energy.**

The GE100S is a trainer on Renewable Energy Sources and includes practical training devices and build-in instruments which enable the students to carry out a wide range of experiments in the area of Solar, Wind and Hydrogen Fuel Cell applications. The aim is to implement a **complete program of experiences** which enable students to learn the main characteristics of these 3 types of Renewable Energy. Also, to **practice on processes and methods** such as solar radiation to photovoltaic conversion process, wind power and factors of performance, electrolysis and Hydrogen fuel cell, renewable methods of energy usage, power and coefficient measurements for each case, while doing real practical experiments.

THE GE100S TRAINER

The console of the trainer includes:
- All connecting terminals for the input devices and output power measurements.
- A built-in interface for measuring voltages and currents.
- A data logging controller.
- A variable load 0-100 Ohm, 0-450 Ohm motor.
- A data display LCD 3.5 inch.
- A motor with couplings to drive the wind generator (if no fan is used) and a variable speed to simulate wind speed.

The trainer connects to the following input sets:
- Fuel Cell set
- Photovoltaic panel
- Wind turbine set

GE 100S POWER PARAMETERS
- Power Input 220V
- Maximum Output 12V/2A
- Power measurements build-in circuit (VI) up to 24 V/ 5A

Using the GE100S the students will be able to interconnect and perform the tasks in the three categories of Renewable Sources of energy as well as for Hybrid systems combining:
- The **Wind Energy** training tasks using the GE100S trainer and the Wind turbine kit.
- The **Hydrogen Fuel** training tasks using the GE100S trainer and the H2 fuel kit.
- The **Solar energy** training tasks using the GE100S trainer and the photovoltaic cells.

DIDACTIC TOPICS

A. Fuel cells
- Fuel cell structure and specifications.
- Operational principles of fuel cells, water solution electrolysis - charging a fuel cell, storing hydrogen in a cell.
- Hydrogen/oxygen and hydrogen/air cell.
- Electrolyzer: performance characteristics and efficiency.
- Fuel cell: performance characteristics and efficiency.
- Model hydrogen car.

B. Photovoltaic
- Electromagnetism laws - radiation.
- Power output performance of the solar cell based on surface area, light intensity, angle of incidence of solar rays.
- Angle of incidence of solar radiation.
- Solar panel power output (VI) in serial and parallel circuit.
- Characteristics of performance in photovoltaic panels.
- Power output - VI of photovoltaic panels.

C. Wind energy
- Wind energy transformation to electrical energy principles.
- Effects of the wind energy output based in: wind speeds and directions, number, position and type of wind turbine blades, blade pitch angle and structure of blade.
- Power characteristics (VI) of wind turbine under no load and under different loads.
- Green power grid: transformation and storage of electrical energy produced by wind turbine and solar photovoltaic panels into fuel cells. Principles of Energy balance, load balance and sufficiency in a green energy integrated system.

The trainer operates:
- As stand alone
- With the use of the tablet running Kondle 's **GE100S** trainer software application (*optional feature*).

RECOMMENDED ACCESSORIES

1. Light source for solar cells with halogen lamp min100W (if it is not used with Sun light directly).
2. Three speed domestic air fan. This can be used to create air stream for the wind generator. Without this appliance the user can rotate the wind generator using the motor driver. **The trainer offers a scale of motor RPM's /air speed to facilitate wind simulation.**

The **GE100S application** in combination with the console hardware offers immediate and graphical ways to the user by recording data directly from energy sources, analyzing data and record all data for all viewable or implemented experiments. Makes power efficiency calculation and performance reports for any input/ output from the various alternative energy setups. Tablet is included in this optional add-on.

SOLAR POWER

PT GE SV12 Trainer
PHOTOVOLTAIC ENERGY BASIC TRAINER

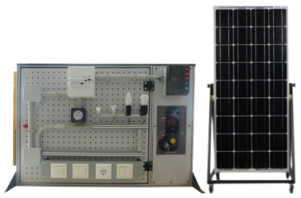
The PT GE SV12 trainer is a complete didactic system for the theoretical and practical study of **photovoltaic solar energy facilities**. It is mounted on a mobile structure that allows it to be moved to the open space for practical sessions and allowing the photovoltaic panel to receive solar radiation. The photovoltaic panel can be inclined through a range of 0° to 90° angle detected by a sensor. Another sensor in the panel is used to measure solar irradiation. The front is connected to the back of the movable frame and includes all the components of a basic photovoltaic facility used to provide **12V of direct current** and equivalent load facilities.

OPTIONAL – RECOMMENDED

PT GE SU4
Indoors light source
The PT GE SU4 is an **optional indoors light source** to provide suitable lighting to the photovoltaic solar module that is used in the laboratories using either Photovoltaic panels or Solar heating panels.
The light intensity of the source can be manually adjusted through a potentiometer or automatically controlled to allow performing experiments with different light intensities, day, night, shade cloudy etc.
The PT GE SU4 includes the following **main components**:
- 4 off halogen lamps, 300 W each
- Dimmer for controlling the light intensity
- Magneto-thermal switch, differential 10 A
- Potentiometer, 10k
- Adjustable stand with base and lamp side tilted joint

PT GDQ SW
This module allows the connection of the power controller of the system to a windows PC workstation. It is a data acquisition interface and SW which allows the students to store data, do analysis and graphs and verify results using modern acquisition tools.

PT GE SV22 Trainer
PHOTOVOLTAIC ENERGY ELECTRICAL INSTALLATIONS



The PT GE SV22 trainer is a complete didactic system for the theoretical and practical study of **photovoltaic solar energy** facilities and the electrical installations related to them. Students train with real components.

OPTIONAL – RECOMMENDED

PT GDQ SW
This module allows the connection of the power controller of the system to a Windows 10 PC workstation. It is a data acquisition interface and SW which allows the students to store data, make analysis and graphs and verify results using modern acquisition tools.

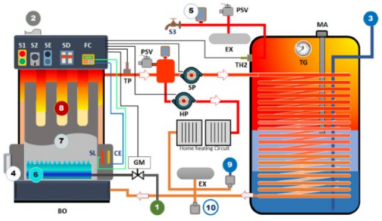
SOLAR POWER

PT ST A Trainer
PASSIVE SOLAR THERMAL ENERGY TRAINER

The PT ST A trainer is a training system for the theoretical and practical study of the **passive solar power facilities used for production of hot sanitary water, air conditioning and other heating services in a household**. The trainer is a real component, fully operational system with a training panel where the operation is monitored.
The PT ST A is a system with a wide range of didactic applications in the above referenced vocational sector. The system is provided with a demonstration panel where the components of such system are interconnected providing testing points, measurement terminals, temperature sensors for the primary and secondary circuit and irritation measurement sensor for calculating the performance and the efficiency of such system under real conditions or simulated solar heating.

PTH-350S Thermal System Simulator Application
Gas, Solar and **Oil** heating system - Software simulation

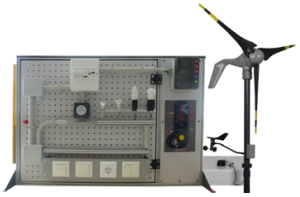
This application offers a **simulation of gas furnace central heating system and oil furnace integrated with a passive solar heating system.** Its aim is to assist the students to comprehend the basic thermal technology, circuits and components, their operation and troubleshooting in the above mentioned types of central heating systems.



The Mechanical components of the Gas Heater

WIND POWER

PT GE W22 Trainer
WIND ENERGY MODULAR TRAINER



The PT GE W22 trainer is a complete didactic system for the theoretical and practical study of **wind energy facilities**.
The Wind generator is mounted on a mobile structure which allows it to be moved to the open space and to be used outdoors for wind access. The Wind generator includes a tripod stand and a wind anemometer measuring wind speed and direction. It connects to the PT GE V22 electrical installation panel. The training panel includes all of the components of a wind generation facility used to provide 12V of direct current and 230V of alternating current and various loads for experimentation on power measurements, efficiency, etc.

OPTIONAL – RECOMMENDED

PT GE SW
This module allows the connection of the power controller of the system to a windows PC workstation. It is a data acquisition interface and SW which allows the students to store data, make analysis and graphs and verify results using modern acquisition tools.

PT GD MW2
This module is a DC motor coupler assembly with PMW control, to facilitate indoor operation of the wind turbine module without physical wind. The control of the motor allows the rotation of the rotor of the turbine in a way that can simulate the rotation of it in various wind speeds. The motor comes with ready mechanical coupling assembly.

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COMBINED POWER SOURCES

PT GE HSW22 Trainer

HYBRID/SOLAR-WIND ENERGY ELECTRICAL INSTALLATIONS

The PT GE HSW22 trainer is a complete didactic system for the theoretical and practical study of a **hybrid system integration of photovoltaic solar energy and wind energy facilities**.
The Photovoltaic panel module is mounted on a mobile structure which allows it to be moved to the open space and the photovoltaic panel to receive solar radiation. The photovoltaic panel can be inclined through a range of 0° to 90° angle detected by a sensor. Another sensor on the panel is used to measure solar irradiation and panel temperature. The Wind generator is mounted on a mobile structure which allows it to be moved to the open space and to be used outdoors for wind access. The Wind generator includes a tripod stand and a wind anemometer measuring wind speed and direction**.** The photovoltaic panel and the wind turbine modules are connected via a provided cabling system to the Training panel PT GE V22**.** The training includes all of the components of a basic photovoltaic and wind turbine facility used to provide 12V of direct current and 230V of alternating current, and various loads for experimentation on power measurements, efficiency etc.

OPTIONAL – RECOMMENDED

- **PT GE SU4** *Indoors light source*
- **PT GDQ SW** *Data Acquisitions module*

This module allows the connection of the power controller of the system to a windows PC workstation. It is a data acquisition interface and SW which allows the students to store data, make analysis and graphs and verify results using modern acquisition tools.

- **PT GD MW2** *Wind generator driver*

This module is a DC motor coupler assembly with PMW control, to facilitate indoor operation of the wind turbine module without physical wind. The control of the motor allows the rotation of the rotor of the turbine in a way that can simulate the rotation of it in various wind speeds. The motor comes with ready mechanical coupling assembly.