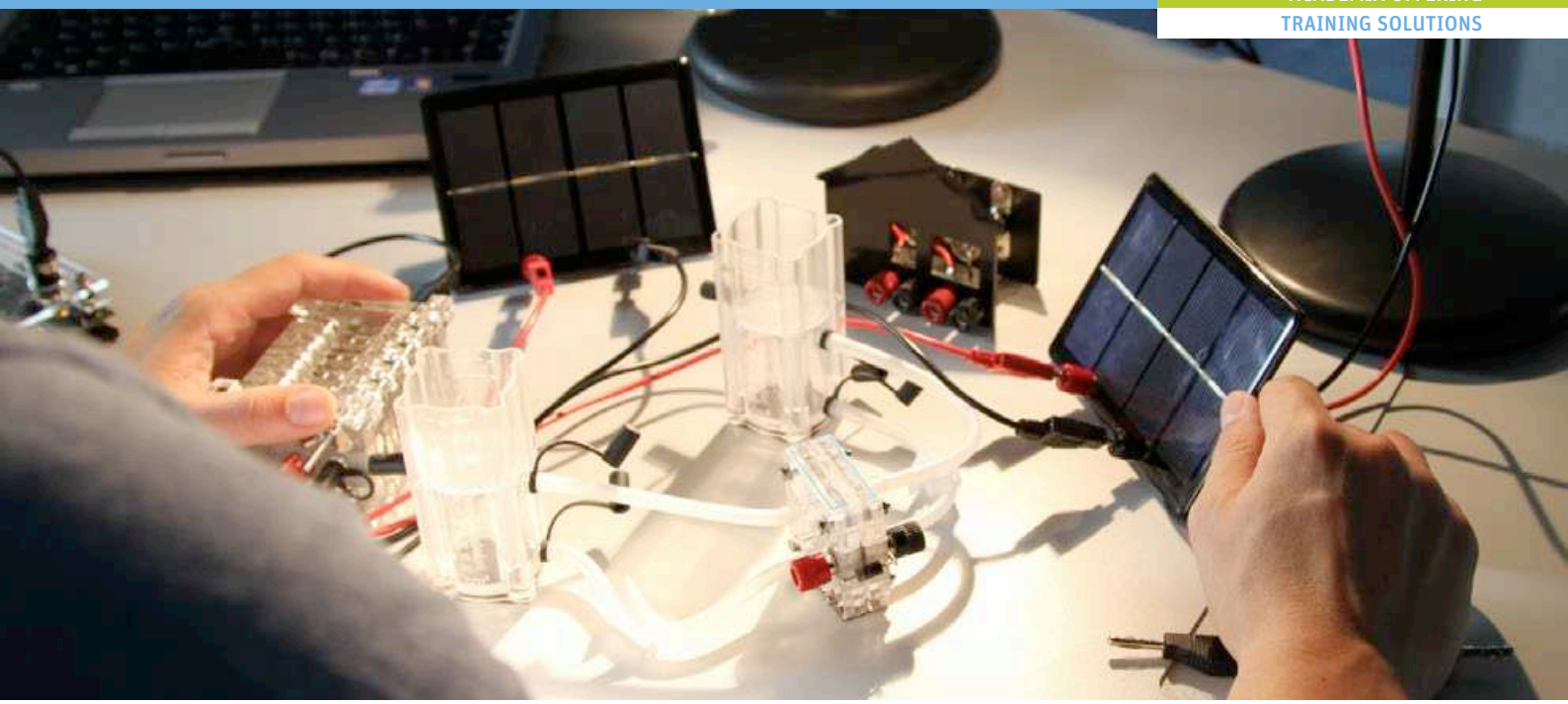
Heliocentris

NEW AND IMPROVED Software and Teaching Material

Clean Energy Trainer

Experiment Set for Renewable Energy Generation, Storage and Supply

ACADEMIA OFFERING
TRAINING SOLUTIONS



The Clean Energy Trainer examines renewable energy generation through solar and wind and introduces students to the methodology of efficient energy conversion, storage and supply by means of hydrogen fuel cell technology. Students gain a sound understanding of the complete energy conversion chain, the practical application and principles behind the technologies.

The Clean Energy Trainer features:

- Adjustable and scalable solar, wind and hydrogen components on a magnetic baseplate
- USB data monitor for PC-suported data acquisition and analysis
- Highly-advanced didactic software for system control and real-time data plotting
- Extensive teaching materials with over 13 experiments

Clean Energy Trainer

Experiment Set for Renewable Energy Generation, Storage and Supply

Solar Module (2 pieces)

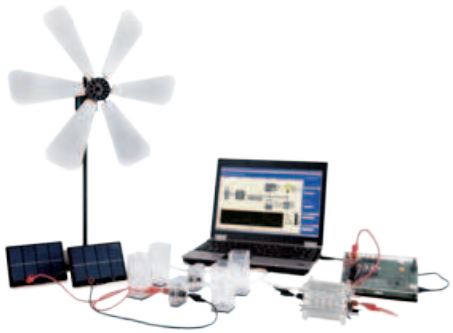
The 4-cell solar module uses solar power to generate electrical energy that can be used to supply the electrolyzer or other loads. The module can be positioned in one of three preset angles.

Wind Generator

The 6-bladed wind generator uses wind power to generate electrical energy. It directly supplies the electrolyzer or other loads. Both, the angle and number of its blades, can be varied to understand their effect on power generation.

Electrolyzer (2 pieces)

The electrolyzer uses electrical energy from the solar module or wind generator to produce hydrogen by separating water into hydrogen and oxygen.



Gas Storage (4 pieces)

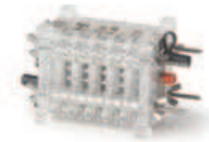
The hydrogen and oxygen produced by the electrolyzer is stored in the gas canisters (à 30 cm³). A scale on the canisters shows how much hydrogen is produced and consumed.

Load

The load simulates an electric consumer load.

USB Data Monitor

The USB Data Monitor is used for data acquisition, as an electronic load or as a power supply for the electrolyzer. It is connected to the computer and software through the USB port.



Fuel Cell Stack

The 5-cell fuel cell stack uses hydrogen and oxygen to generate electrical energy. The number of cells can be varied in order to experiment with different levels of output.

Measurement components

Photometer

The photometer is used to measure light intensity and to conduct detailed experiments with solar energy.

Anemometer

The anemometer is used to measure wind speed. It helps users understand how wind speed affects a wind generator's output.

Accessories

Lamp

The special double spotlight simulates sunlight. It provides the optimal light spectrum the solar module needs to achieve optimal output levels.

Fan

The desktop fan simulates wind. It provides the optimal airflow for operating the wind generator. The fan can be used to simulate three different levels of wind.

Educational Software

"The Clean Energy Trainer is very good for instruction in renewable energies. [...] We plan to expand its use beyond the regular instruction units in the laboratory."

Dr. Octavian Bass, *2013*
School of Engineering, Edith Cowan University, Australia 2013

Software

The educational software is designed to facilitate system control, parameter monitoring, data acquisition and graphical representation of the collected data.

Key features include:

» Guided alignment for optimal positioning of solar and wind components
» Visualization of operating parameters in tables and graphs
» Automatic teacher mode for instant graph plotting to convey fundamental principles
» Manual student mode for extensive data generation and empirical analysis

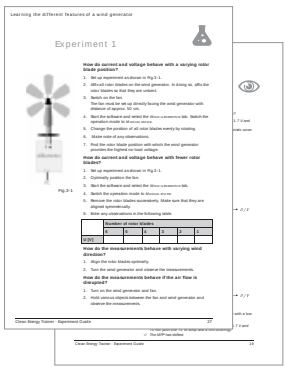
Clean Energy Trainer	
» Wind Generator » 2 x Solar Module » 4 x Gas Storage à 30 cm³ » 2 x Electrolyzer » Take-Apart Fuel Cell Stack » Load » USB Data Monitor	» PC Software » Anemometer » Photometer » Cables and Tubes » Instruction Manual and Experiment Guide » Ferromagnetic Plate » Storage Box
	Art. no. 410

Accessories	
Lamp	**Art. no. 421**
Fan	**Art. no. 422**

Teaching Material

The Clean Energy Trainer is delivered with an experiment guide of over 13 experiments that can be copied and handed out to students, including:

» Operation and principles of solar cells and wind generators
» Influence of illumination intensity and cell shading on the behavior of solar cells
» Temperature dependence of photovoltaic modules
» Connecting solar panels in parallel and series
» Electrolysis: characteristic curve and efficiency
» Fuel Cell: correlation between hydrogen consumption and current
» Power-to-Gas: hydrogen from renewable energy



Experiments

Each of the experiments is accompanied by a question and answer worksheet, facilitating the preparation of lessons. The experiments are designed to fit a 45-minute school lesson.

Includes Software

Clean Energy Trainer Laboratory Set

The Clean Energy Trainer Laboratory Set enables more than 24 students to perform experiments in groups of six.

1 x Clean Energy Trainer instruction material with Experiment Guide in ring binder

Clean Energy Trainer Laboratory Set	**Art. no. 960**

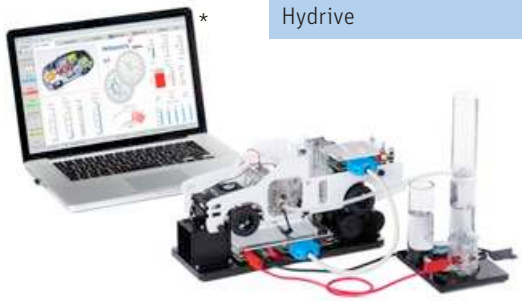
*Notebook not included

Technical Data

Clean Energy Trainer	
The Clean Energy Trainer is delivered with all necessary accessories for conducting experiments, such as tubes, plugs, connection cables as well as a stop watch.	
Packaging dimension (W x H x D)	469 x 157 x 425 mm
Weight	ca. 5 kg
Permissible ambient temperature during operation	+10 ... +40 °C
Wind Generator	
Dimensions (W x H x D)	420 x 670 x 180 mm
Rotor (Ø)	420 mm
Weight	1.6 kg
Power	0.55 W
Voltage max.	6 V
Current max.	0.3 A
Solar Module	
Dimensions (W x H x D)	130 x 95 x 65 mm
Weight	90 g
Power	400 mW
Voltage max.	2.0 V
Current max.	0.5 A
Electrolyzer	
Dimensions (W x H x D)	50 x 55 x 50
Weight	54 g
Power	1.16 W
H_2 production	5 cm^3 / min
O_2 production	2.5 cm^3 / min
Take-apart Fuel Cell Stack	
Dimensions (W x H x D)	125 x 60 x 70 mm
Weight	288 g
Power per cell	0.2 W
Power (5 cells)	1 W
Gas Storage	
Dimensions (W x H x D)	70 x 90 x 40 mm
Weight	48 g
Volume	120 cm^3

Discover the new
HyDrive – Electric Vehicle Trainer

The HyDrive is an experiment set for teaching Fuel Cell Electric Vehicle Technology. The HyDrive is ideally complementing the Clean Energy Trainer, replicating the consumer part of the energy conversion chain.



Hydrive	**Art. no. 1000**

*Notebook not included

USB Data Monitor	
Dimensions (W x H x D)	160 x 35 x 100 mm
Weight	1.4 kg
Power max. (fuel cell mode)	10 W
Power max. (electrolyzer mode)	10 W
Voltage (fuel cell mode)	0...10 V DC
Voltage (electrolyzer mode)	0...4 V DC
Current (fuel cell mode)	0...4 A
Current (electrolyzer mode)	0...3 A
Power supply unit	6.0 V DC / 3.3 A
Anemometer	
Dimensions (W x H x D)	39 x 98 x 17 mm
Accuracy	± 5%
Measuring range	0.2 ... 30 m/s
Photometer	
Dimensions (W x H x D)	64.5 x 188 x 24.5 mm
Accuracy	± 5 %
Measuring range	0.01 ...50000 lux
Load	
Dimensions (W x H x D)	100 x 90 x 45 mm
Illuminant	2 x 2.4 W
Lamp	
Dimensions (W x H x D)	300 x 475 x 180 mm
Illuminant	2 x 75 W

The output of the fuel cell and electrolyzer depends on various influencing factors and decreases over the life of the product. All information on the output applies at the time of delivery.
Parts of the system use hydrogen, a highly flammable gas. This requires compliance with local laws and safety regulations for transport, storage and operation. Read the operating manual carefully before setting up and operating the system.
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Heliocentris

Heliocentris Academia GmbH

Rudower Chaussee 29
12489 Berlin, Germany
Tel. + 49 (0) 30 340 601 500
Fax + 49 (0) 30 340 601 599
academia@heliocentris.com
www.heliocentris.com

Heliocentris Energy Systems Inc.

902 – 610 Granville St.
Vancouver, BC
V6C 3T3 Canada
Tel. + 1 604 684 3546
Fax + 1 604 648 9406
academia@heliocentris.com