

Renewable Energy Education Lab Package for Classrooms:

Are you ready to teach green energy technologies and help your students develop their environmental awareness?

This classroom package can be used as a key part of your science, engineering, design or technology courses. The included hardware, software, and curriculum material take a blended learning approach to teaching Green Technologies with applied **STEM** (Science, Technology, Engineering and Mathematics) activities throughout.

Demand for energy is rising all over the world, while fossil fuel resources are dwindling and the climate is being adversely affected. Meanwhile the specter of climate change is looming. Science and technology can provide innovative solutions that will be needed to tackle these issues. Today's students will need a firm grounding in the scientific and engineering principles that underpin these technologies, if they are to contribute to the future of sustainable energy.

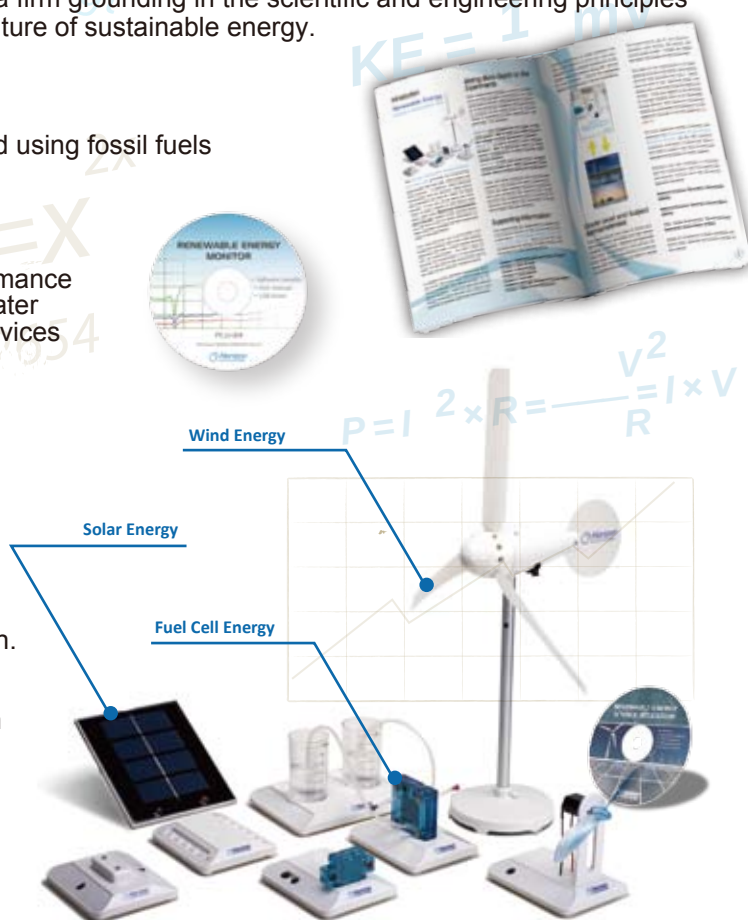
Activities include:

- Identify how the majority of global power generation is produced using fossil fuels
- Recognize the need for sustainable energy resources
- Investigate the science and impact of climate change
- Use solar panels to generate electricity
- Use a wind turbine to generate electricity
- Build a model wind farm or solar farm and evaluate their performance
- Fuel Cells: Use fuel cell technology to extract hydrogen from water
- Fuel cells: Use a hydrogen fuel cell system to power various devices
- Plus many more.....

Renewable Energy Education Set

The Renewable Energy Science Education Set is a modular experiment set designed to demonstrate the workings of a complete clean energy technology system on a miniature scale. With this very complete kit, an entire miniature renewable energy system can be constructed for experimentation and demonstration.

This set includes a real working miniature wind turbine kit, a solar photovoltaic panel, an electrolyzer, a PEM fuel cell, and hydrogen storage system encouraging users to learn the system step by step, configure the system in different ways, and visualize the workings of clean energy principles from start to finish.



Horizon Renewable Energy Monitor (Power measurement device)

The Renewable Energy Monitor is an educational evaluation and monitoring device with measurement software for graphical display of performance characteristics on your PC screen. It offers a two line LCD screen for viewing measurements that you cycle through at the push of a button, avoiding the confusing setup of multi-meters. The Renewable Energy Monitor is battery operated so it can also be used with or without a computer – indoors or outdoors – where you can make direct solar and wind measurements.

Horizon developed the Renewable Energy Monitor to allow you to provide an immediate, graphical approach to recording data directly, with no formulas. With this monitor system, the impact on of live experiments on the kits in the classroom can be seen real-time on a large screen or wall using a projector. Numerous experiments and evaluation activities for hydrogen fuel cells, miniature wind turbine kits, and solar panels will now be quantifiable in real time for voltage, current, power, joules, resistance, and even RPM speed. Compatible with any of Horizon's clean energy educational kits!



Renewable Energy Technologies Curriculum

The content includes a variety of informative and relevant experiments using Horizon's kits as hardware. Also introduces students to basic electronics, data logging software, theory behind renewable energy sciences, and activities to sponsor new ideas and encourage a next generation of green engineers and designers.

Contents:

Horizon's experiment guide covers the following important science topics:

- Electrical components, circuits, and terminology
- Learning to correctly use a multimeter
- Measuring voltage, current, power, and resistance
- Ohm's Law

Learning Math and Science using renewable energy will inspire students to greater goals and achievements. The Renewable Energy Education Science Manual provides an exceptionally rich amount of data, photos, and illustrations on the following topics:

- Chapter 1: Environment and Climate Change
- Chapter 2: Solar Energy
- Chapter 3: Wind Energy
- Chapter 4: Electrolyzers
- Chapter 5: Fuel Cells
- Chapter 6: Hydrogen Storage & Transportation
- Chapter 7: Basic Power Electronics

The Renewable Energy Experiment Manual provides over 20 in-depth experiments covering the following:

- Solar Energy Experiments
- Wind Energy Experiments
- Energy from Hydrogen (Fuel Cell) Experiments
- Ultra Cool Experiments(wind farms, solar farms, and more...)



Some of the questions addressed by the experiments include the following and more:

- How does heat, shade, and tilt angle affect the solar panels performance?
- Which is the best number of blades on a wind turbine?
- How do the shape of blade and the pitch angle of the blades affect the wind turbines performance and output power?
- How to measure the RPM speed of wind turbines and how does this relate to output power?
- How to track the maximum power point for solar panels, wind turbines, and hydrogen fuel cells?
- How can solar and wind energy be harnessed to produce hydrogen?
- How to determine the minimum voltage required for water decomposition?
- How do fuel cells generate electricity from hydrogen and oxygen?
- What is the result of connecting multiple solar panels, wind turbines, and fuel cells, in parallel and in series, and how does this affect the voltage, current, and output power of the system?
- What would be needed to run your school using solar, wind, or hydrogen?

Classroom package options:

4-5 students:

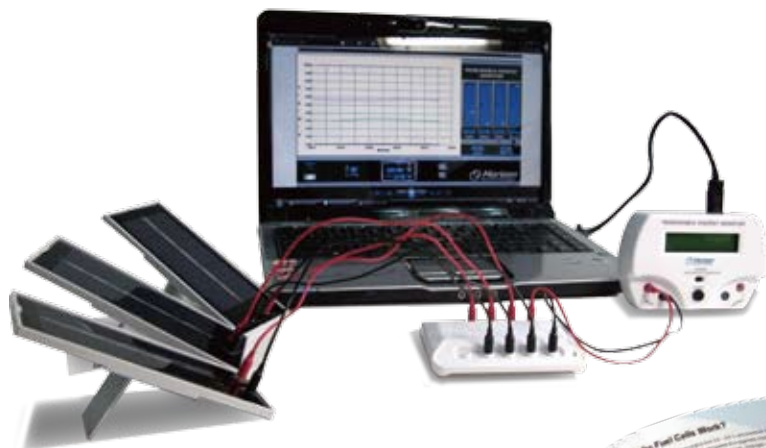
- (1) Renewable Energy Education Sets
- (1) Renewable Energy Monitors
- (5) Renewable Energy Education Curriculum CD's

20 students:

- (5) Renewable Energy Education Sets
- (5) Renewable Energy Monitors
- (20) Renewable Energy Education Curriculum CD's

40 students:

- (10) Renewable Energy Education Sets
- (10) Renewable Energy Monitors
- (40) Renewable Energy Education Curriculum CD's



$$Ra + 40a + 40 \times 2a = 0$$
$$x = \frac{1}{2} \sin(\omega t) - \frac{1}{2} \sin(\omega t)$$

$$v_b' = \frac{1}{4} u (1 - e^{-2})$$
$$v_c' = \frac{1}{4} u (1 + e)^{-2}$$

$$-3.141592654$$

Renewable Energy Kit Contents (FCJJ-27)

- WindPitch turbine body
- Rotor head for profiled blades
- 9 profiled blades for turbine (3 sets of 3 types)
- Rotor head adapter for sheet blades
- 3 polypropylene sheet blades for turbine
- Turbine Support base
- Aluminum wind turbine post
- PEM Electrolyzer
- PEM Electrolyzer base
- PEM Fuel cell
- PEM Fuel cell base
- Hydrogen tank
- Oxygen tank
- Inner Gas containers
- Water/gas tank module base
- Flexible 2mm banana connecting leads
- Transparent silicon tubing
- Plastic plug pins for electrolyzer
- Battery pack with connecting leads
- Syringe
- Motor and fan module base
- Propeller blade
- Small car wheel
- LED module base
- Circuit board module base
- 100 ohm Variable Resistor module (potentiometer)
- 1 Watt Solar panel
- Adaptors, tubing clincher & purging valve
- Assembly instructions
- CD-ROM with renewable energy curriculum manuals



www.horizonfuelcell.com

Renewable Energy Monitor (FCJJ-24)

- Power measurement hardware device
- CD-ROM with Horizon Data Acquisition software
- CD-ROM with renewable energy curriculum manuals
- Flexible 2mm banana connecting leads
- Flexible USB 2.0 cable

