

Renewable Energy Demonstration Models

A. Plastic kits – suitable for children 8 -12

1. Solar Powered Car
2. Solar Powered Rowing Boat
3. Solar House
4. Fuel Cell Powered Car – Solar generator of H₂ and Oxygen.
5. Wind Turbine

B. Exergia kits – suitable for assembly by high school students under teacher supervision

1. Wind Turbine
2. Fuel Cell Kit – Solar generator of H₂ and Oxygen
3. Candle Powered Sterling Engine
4. Low temperature Sterling Engine
5. Thermogenerator
6. Solar Pump

Operating Guidelines.

Plastic Kits.

Solar Car.

The model will operate in strong direct sunlight. If demonstrating inside, a 100 Watt light source should be held about 50cm away from the solar collector unit.

Please note the switch should be moved to one extreme or the other for operation of the wheels. It is a bit touchy and may need to be juggled.



The unit can be operated under battery power too, but if so, make sure the solar collector electric leads are removed from the spring connector before connecting the battery leads in the same springs. Take care to keep the red leads together on the same side and the black leads on the opposite side.

There is also a hand cranked generator available which can power the unit.

Solar Boat.

Ideally the boat would be best demonstrated in a small water tank or child's wading pool in bright sunlight.



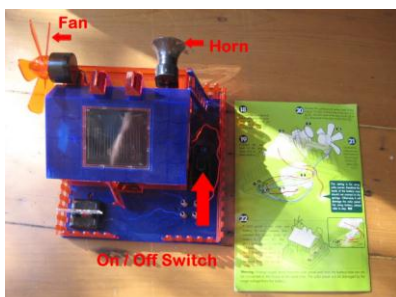
However, if demonstrating indoors, the same comments as for the car apply. It might be an idea to raise the model on some block so the oars can rotate freely.

It will also operate with a battery pack, making sure to follow the same instructions for removing the solar collector leads first before connecting the battery pack, or the hand cranked generator to the unit.

Solar House.

The house has several functioning units which can be demonstrated as directly coming from the solar source, a fan, a siren and a flashing light. However, it appears that only one of these units can be operated at any one time.

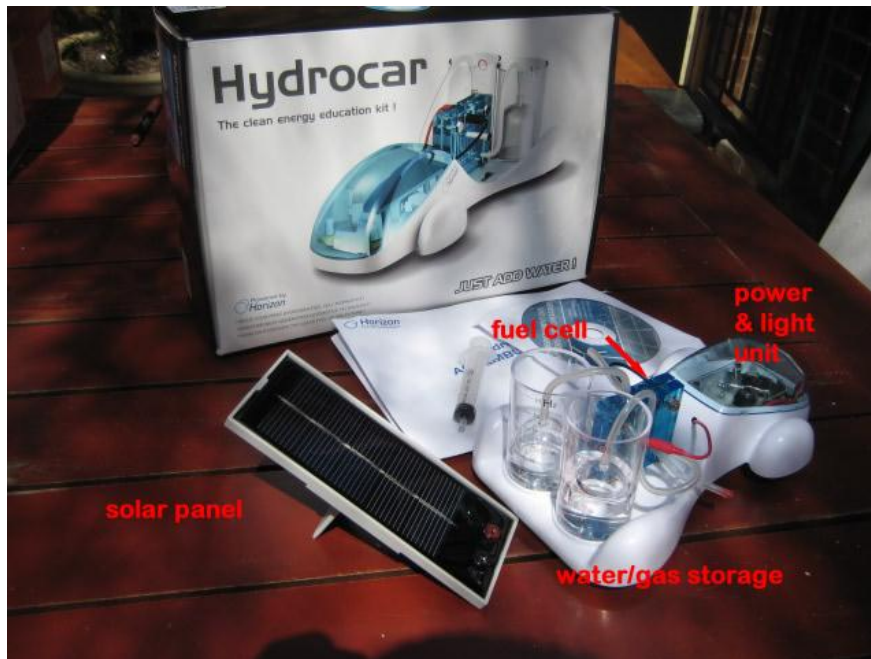
As with the car and the boat, for indoors demonstration the choice of hand held lamp, battery pack or hand cranked generator are available.



Hydrogen Powered Car (DVD available as side demonstration if required)

The principle behind the operation of this model is that hydrogen and oxygen are separately fed into a fuel cell unit, which allows them to chemically combine via a catalyst, producing water and the energy liberated as electrical energy can be applied to the small motor and the flashing lights of the vehicle.

Firstly however, the hydrogen and oxygen need to be produced. This is done electrically by another fuel cell which works in the reverse means as the power fuel cell in that it catalytically breaks water up into its constituent elements of oxygen and hydrogen.



To achieve this the two plastic vessels at the rear of the vehicle (marked as Hydrogen or as Oxygen) are filled about half full with distilled water. They must cover the inner upturned vessels which will capture the hydrogen and oxygen when they are produced.

The power required for the catalytic production of the gases is provided by the solar panel provided, but if there is insufficient sunlight or operating indoors, a battery pack may be used. Take care to remove the power leads from the solar panel, before connecting the power leads from the battery. Also remember the black leads always plug in to the Hydrogen side of the fuel cell and the red leads to the oxygen side.

After about 15 minutes of gas production, the power leads from the car motor, may be connected to the power fuel cell – black to Hydrogen and red to Oxygen.

When the demonstration is finished, or at the end of the day, take care to leave the rear fuel cell (the gas producer), about half full of water, otherwise the membrane will dry out and the cell will not work.

Remove all power leads from both cells and plug water and gas tubing where necessary.

Empty water from the water containers at the rear of the model.

Wind Generator (small plastic model).

This model will probably only operate in high wind conditions. At this stage it is unsure how to best demonstrate it, indoors without a suitable source of rotation for the blades. Spinning by hand does not seem to get good results, but more testing might sort this out and these notes can be amended.



It should be noted that this model was fairly complex to assemble and could not be recommended for young children.

It has also yet to be determined what power source would be best to demonstrate the model actually does produce electricity.

Exergia models.

Wind Turbine

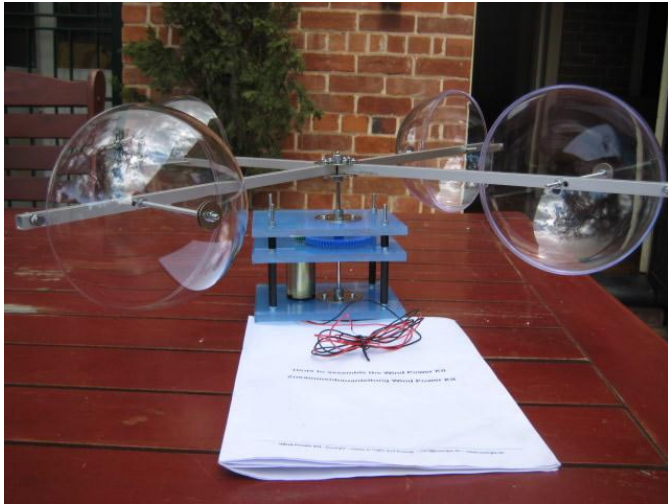
This is a far more complex model and took many hours to assemble and required considerable drilling of components and careful fitting. Not recommended without skilled supervision.

The model is assembled with three distinct levels.

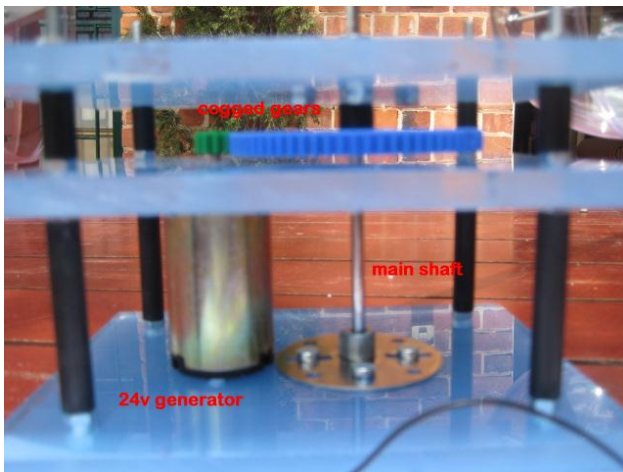
The bottom level houses the 24 Volt generator and the wires from the generator protrude through the bottom and are led to the source requiring the power.

The middle level houses the gearing, with a large gear wheel powered by the rotating “blades”, turning a small wheel driving the generator itself.

The upper level contains the rotating “blades”. These only require a light breeze to begin turning.



For demonstration purposes, an outside location with a steady breeze is ideal, but the unit can still be demonstrated by manually rotating the “blades”.



At this point in time, we do not have suitable unit to power with the 24 volt output of the generator, which at the same time will be seen to be operating even at low speed rotation.

Fuel Cell Kit – Solar generator of H₂ and Oxygen

This model is almost identical to the fuel cell car kit described above. The main difference is that the motor force driven by the electricity produced is a small motor connected to a propeller blade. The model, as with other Exergia models, is of higher quality and is somewhat easier to operate. The car however may appeal more to young people.

Ensure no electrical connections are made before beginning preparation of the model for demonstration.

Distilled water is used to fill the marked containers to the 0 mark in each case.



If the tubing is not connected to the fuel cells from the water/gas generators, then do so at this point. Some dexterity and force might be needed to ensure the tubing is properly fitted on to the spigots on the fuel cells.

When the tubing is securely connected, the power leads from the solar panel (or battery pack) may be connected to the fuel cell so that gas production can begin.

After about 5 minutes of energising of the gas production phase, the electrical connection to the motor may be made and the propeller should begin rotation immediately.

The propeller draws a lot less power than the car and can operate for a very long time on a single charge of gas.

Candle Powered Stirling Engine.

The Stirling engine is commonly called a heat engine and operates via applying heat to one side of a piston causing expansion and pushing the piston away, as the piston travels it encounters a cooler side and the gas contracts pulling the piston back again.



This particular model is set to use a candle underneath to provide a heat source and the ambient air temperature provides the cooler temperature so that the piston will oscillate in its cylinder.

For demonstration purposes, the linkages on the working mechanism may need a “help” every now and again as they can stick and cause the motion to “stick”.

Low Temperature Powered Stirling Engine.



Theoretically, this unit is meant to operate from the heat supplied by the human hand. However, the demonstrator may need some patience for this.

Instead, I would recommend that the unit be placed over a mug of hot water. Within a very short time the unit will begin operation and will continue for many minutes.

Thermogenerator

The principal of this unit is that a conducting unit between two baths of water. One bath is maintained at a high temperature and the other at a lower temperature. The conducting unit is able to produce electricity out of this temperature differential and this can be conveyed to an appropriate motor or light source – in this case a small motor, which drives a propeller.



The mechanism will operate best if near boiling water is in one bath and ice cooled water in the other.

Solar Pump

This is probably the easiest model to operate of them all. The solar panel merely needs to be positioned facing the sun or artificial light source and the pump will begin to operate. Some care needs to be conducted to ensure the water returns to the tank.

Adding food colouring to the water will enhance the visual appeal.

