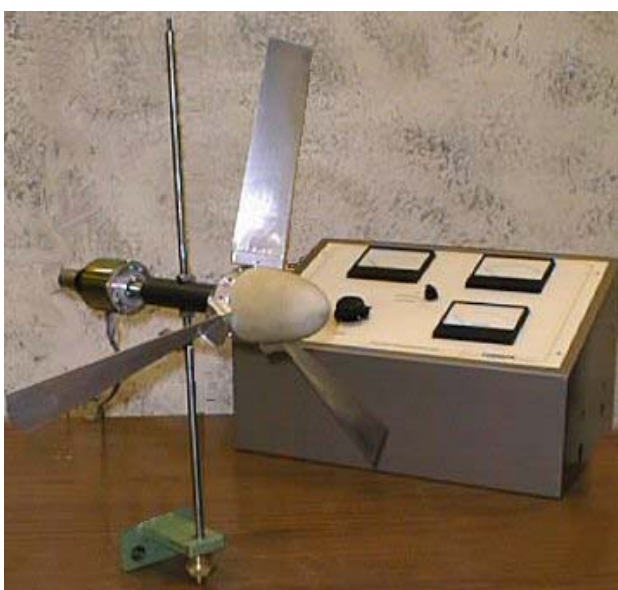




## INTRODUCTION

World attention has been focused on the use of the world's consumable resources by the Kyoto Agreement and by the mounting evidence of climate change. Students tend to be very aware of environmental issues and have a high motivation to study renewable energy. The engineering disciplines that are spread across renewable energy are applicable as part of a broader mechanical or aeronautical course.



Cussons Technology's range of renewable energy laboratory experiments and demonstrations are designed to teach students the principles of each discipline of renewable energy. Each manual lays out the engineering theory behind the experiment in a way that allows the experiment to be part of a dedicated renewable energy module, or an interesting part of other modules.

The range includes:

## WIND ENERGY

Cussons offers a horizontal axis wind generator module P3100, able to measure torque and thrust generated from a 600mm diameter wind turbine. A range of variable pitch wind turbine blades is available as options, including

- P3102 aerofoil blades suitable for low Reynolds number airflows,
- P3103 twisted momentum blades and
- P3104 straight momentum blades.

## Cussons Renewable Energy Range

The hub is designed to accept blades of a student's design. A vertical axis wind turbine P3120 is also available supplied with a single set of aerofoil blades. The wind generator module can be used in the open wind with a support frame, but is intended for lab use with Cussons P3015 wind channel and associated P3106 Wind Fan and Bench drawing up to 3m<sup>3</sup>/s. The manual includes theory on windmill and aerofoil performance.

Wind products are available with data acquisition.

## WAVE ENERGY

A very wide range of commercial wave generators (absorbers) are working or planned. Cussons range of products allows experiments to be conducted on different types of wave absorbers.

- P6330 Floating buoy devices, suitable for fitting students designs of buoy,
- P6335 A flexible pitching wave absorber,



- P6340 Oscillating air column within a fixed structure
- P6345 Surge devices such as the TAPCHAN scheme

The power output in each experiment is measured as water lift. A number of commercial wave generators use air to drive a Well's Turbine and Cussons P3110 provides a working Well's Turbine, for use with Cussons P3100 wind generator.

The Wave Energy products can be used with most wave making devices but we recommend the P6275 5m water channel and P6285 wave generator. This makes a competitive and flexible wave tank that also works as a flow channel.

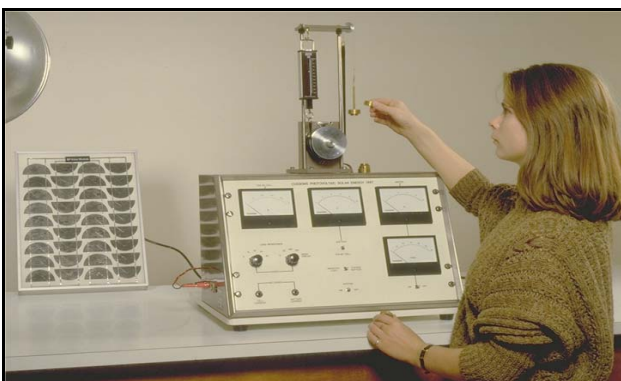
### TIDAL ENERGY

Tidal energy has traditionally been captured by the use of barrage systems and bulb type turbines. Cussons tidal range includes a P6267 bulb turbine test set and a variety of models of barrage casements. A software simulation package allows students to relate model tests to full size schemes. More recently run of water turbines have been introduced both in horizontal axis and vertical axis formats. Cussons P6390 product provides a demonstration run of flow horizontal axis turbine, usable from a boat, pier or a large flow channel such as Cussons P6410. P6385 is a smaller vertical axis run of flow tidal turbine for use in P6275.

Some tidal products can have data acquisition.

### SOLAR ENERGY

Solar energy can be used in a number of ways, either through direct conversion to electrical energy or for heating a process. Cussons P9060 provides a



useful experiment in the use and efficiency of photovoltaic energy panels whilst P7140 provides a solar heating panel experiment, heating water. The P7135 solar distillation apparatus provides a range of experiments distilling brine using solar energy.

Solar products are available with data acquisition.

### FUEL CELLS



Many renewable energy sources are not dependable as wind, waves and sun are not constant power forms. Fuel cells provide one method of efficient energy storage, as well as potentially revolutionising automotive power. Most engineers have never seen a fuel cell yet alone conducted tests on them. It is essential that every student should use a representative fuel cell as part of his or her education.

Cussons P9040 provides a 10W membrane fuel cell, supplied with a variable load capability to allow performance under different operating conditions to be determined. P9041 is a compatible metal hydride hydrogen storage system also configured for performance measurement.

To demonstrate load management using fuel cells to balance renewable energy supplies Cussons load control device P9045/46 allows the Cussons fuel cell range to be used with the P9060 photovoltaic experiment and the P3100 wind generator to make a constant power output system, switching between low pressure hydrogen storage or use to maintain constant output as wind or light levels are altered.

Fuel cell products can have data acquisition.

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