In association with
The School of Engineering Systems
Queensland University of Technology (QUT)
and
The Australian Power Institute (API)

Power & Sustainability Project

Mission Brief

THE SITUATION

Natural disasters occur with regularity but lately these unpredictable events seem to be increasing in frequency. Earthquakes, tsumanis, tornedos, volcanic eruptions, hurricanes, severe storms and bush fires destroy electricity supplies and displace people.

One of the major problems associated with disaster relief is the provision of fresh water when there is no power supply to pump water from the source to the people. Engineers provide solutions to problems of this type.

In engineering, a realistic approach to problem solving is the **PIST** method.

Problem

Impact

Solution

Timing

The Problem

After a natural disaster, often millions of people are left without electricity. In many countries electricity is required to pump water from wells

The Impact

People die very quickly without water. Without sanitation, diseases spread very quickly.

The Solution

- Submersible pumps to pump water out of wells.
- Solar electricity panels to provide the electrical power to do the work in raising water to the surface.
- Solar panels have an electronic voltage regulator to preset the best operating voltage to operate pumps so as to give the maximum volume of water per day

The Timing

Immediately and urgently, water is a vital resource for sustaining life.

THE TASK

To determine the **best operating voltage** to operate a solar water pump so as **to give the maximum flow rate** of water in a day from sunrise to sunset.

1. Assemble the solar pump under the guidance of your group's supervising engineer.
2. Test a range of variables to determine which conditions provide provision of the maximum volume of water in a day.

THE INVESTIGATION

What is the optimum voltage to produce the best flow rate of water and how can this be produced?

Independent variables:

1. angle of the solar panel to the sun
2. light intensity falling on the solar panel
3. light frequency (colour of light) falling on the solar panel

Dependent variable:

1. voltage
2. flow rate of water

Results:

Independent variable	**Conditions**	**Voltage**	**Volume of water moved in 2 minutes**
Angle of the solar panel above the horizontal	15^o		
	30^o		
	45^o		
Light intensity (Shade cloth filter)	Light (green) 50%		
	Medium (blue) 70%		
	Heavy (cream) 90%		
Light frequency (colour of light determine by coloured cellophane)	White		
	Red		
	blue		

Conclusion:

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Light Intensity

One way to increase the intensity of sunlight is to tilt the solar panel to face the sun so that the sun's rays hit the panel at 90°. Another is to concentrate the sun's energy by use of mirrors.

You have two 'mirrors' about the same size as the solar cell. Can you think of another way to increase the sun's intensity falling on the solar panel?

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Do not reflect the sun directly into the face of other students as this can cause eye damage

TEST THIS

With the back of the panel facing the sun, use one mirror to reflect the sun onto the solar panel. Record the panel voltage __________________v.

Now using the two mirrors, reflect the sun onto the solar panel. Record the voltage ________v.

Is this the result you expected? ____

Can you explain the result? ____

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With the front of the panel facing the sun, record the panel voltage _________ v .

In order to reflect sun onto the panel, you will have to work out how to use the two mirrors, being careful not to cast a shadow over the panel.

Record the panel voltage ____ v

Mirrors are used in real world situations to increase the intensity of sunlight falling on solar panels. Mirrors are permanently set up so as to reflect some extra sunlight. Check out YouTube, Solar PV mirror concentrators.