



## 2010 STAV VCE PHYSICS CONFERENCE ALTERNATIVE ENERGY AT ECOLINC

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**Accreditation period:** 2009-2012

### Further information

- VCAA website [www.vcaa.vic.edu.au/vce/studies/physics/physicsindex.html](http://www.vcaa.vic.edu.au/vce/studies/physics/physicsindex.html)
- VCAA Bulletins [www.vcaa.vic.edu.au/correspondence/index.html](http://www.vcaa.vic.edu.au/correspondence/index.html)
- VicPhysics website [www.vicphysics.org/](http://www.vicphysics.org/)
  - Resources for Physics teachers in Victoria, website operated by the Education Committee of the Victorian Branch of the AIP

### UNIT 1 or 2

#### Assessment at Ecolinc

A SAC assessment sheet is prepared to accompany the field work ensuring that all assessment criteria are met.

Outcome	Key knowledge	Assessment tasks
<b>Unit 1 or 2</b> <b>Area of Study 3.5:</b> <b>Detailed study</b> <b>Investigations:</b> <b>Sustainable energy sources</b> <b>Outcome 3.5</b> Use concepts of energy transfer and transformations to design and report on an experimental investigation into an aspect of a renewable energy supply system	Explain the terms sustainable and renewable in terms of energy use  Compare different renewable energy sources  Analyse the benefits and limitations of renewable energy sources  Analyse energy transfer and transformation process of renewable energy sources	<b>Students:</b> <ul style="list-style-type: none"> <li>▪ Are introduced to ecological sustainable design principles;</li> <li>▪ Undertake a number of practical investigations to explore and compare a variety of renewable energy sources;</li> <li>▪ Evaluate renewable energy sources based on information provided and practical activities.</li> <li>▪ Explore the concepts and principles of energy, including conservation of energy, energy efficiency, energy transformations and different forms of energy.</li> </ul>

### USEFUL RESOURCES

- Ecolinc website – virtual tour highlighting the ecological sustainable design features of the centre and the Building Maintenance System including logs of electricity usage and generation. Logon and password are both 'display'. [www.ecolinc.vic.edu.au](http://www.ecolinc.vic.edu.au)
- Australian Government, Your Home Design Guide – description of ESD features. [www.yourhome.gov.au/](http://www.yourhome.gov.au/)
- Modwood decking. [www.modwood.com.au](http://www.modwood.com.au)
- Sustainability Victoria – renewable energy resources in Victoria. [www.sustainability.vic.gov.au/www/html/2109-renewable-energy-resources.asp](http://www.sustainability.vic.gov.au/www/html/2109-renewable-energy-resources.asp)
- Alternative Technology Association. [www.ata.org.au/](http://www.ata.org.au/)
- Magazines such as New Scientist [www.newscientist.com/section/science-news](http://www.newscientist.com/section/science-news), Nature Geosciences [www.nature.com/ngeo/index.html](http://www.nature.com/ngeo/index.html), Physics World <http://physicsworld.com/cws/home>

- Pittock, A. Barrie. (2009) *Climate Change – The Science, Impacts and Solutions*. CSIRO Publishing, AUST
- EPA – Climate change and greenhouse effect. [www.epa.vic.gov.au/climate-change/](http://www.epa.vic.gov.au/climate-change/)
- Australian Academy of Science, Nova – the natural and enhanced greenhouse effect. [www.science.org.au/nova/016/016key.htm](http://www.science.org.au/nova/016/016key.htm)
- Greenhouse effect animation. <http://earthguide.ucsd.edu/earthguide/diagrams/greenhouse/>
- Australian Government, Bureau of Metrology – climate change data and information. [www.bom.gov.au/](http://www.bom.gov.au/)
- Australian Government, Department of Climate Change – Australian greenhouse gas emission data. [www.climatechange.gov.au/en/climate-change/emissions.aspx](http://www.climatechange.gov.au/en/climate-change/emissions.aspx)
- DSE – Victoria’s greenhouse gas emissions. [www.climatechange.vic.gov.au/Greenhouse/wcmn302.nsf/childdocs/-BA39AAA009DEED19CA25702D00154534?open](http://www.climatechange.vic.gov.au/Greenhouse/wcmn302.nsf/childdocs/-BA39AAA009DEED19CA25702D00154534?open)
- How stuff works – relevant animations and videos. Topics include: Renewable energy, such as wind power, hydrogen powered cars, solar cars and global warming. [www.howstuffworks.com/](http://www.howstuffworks.com/)
- How **hydrogen fuel cells** work, includes video. [www.pbs.org/wgbh/nova/sciencenow/3210/01.html](http://www.pbs.org/wgbh/nova/sciencenow/3210/01.html)
- How **wind turbines** work. [www1.eere.energy.gov/windandhydro/wind\\_how.html](http://www1.eere.energy.gov/windandhydro/wind_how.html)
- Catalyst – ABC TV. Topics: CO<sub>2</sub> tree capture, coal gas, dye solar cell, methane – the forgotten gas, solar future and wave power. [www.abc.net.au/catalyst/default.htm](http://www.abc.net.au/catalyst/default.htm)
- United Nations Framework Convention on Climate Change – including Kyoto protocol. <http://unfccc.int/2860.php>

## ECOLINC PROGRAM

### Ecolinc Sustainability Trail

Students are introduced to sustainable energy sources by completing the Ecolinc Sustainability Trail. This trail explores the Ecological Sustainable Design (ESD) features of the building, such as passive heating and cooling, high thermal mass, ‘hot box’ heating technology, high and low louvers, vents, T5 lighting, large double glazed windows, sky lights, solar hot water, photovoltaic panels and the use of recycled materials. Log onto the Ecolinc website [www.ecolinc.vic.edu.au](http://www.ecolinc.vic.edu.au) to preview the virtual Sustainability Trail.



1. Use the IR thermometer to record the temperature of some external surfaces of the Ecolinc building.

Location	Colour	Material (e.g. wood, metal)	Lighting conditions (e.g. shaded, full sun, etc.)	Light reading (Lux)	Temperature (°C)

## Ecolinc Building Management System (BMS)

Many factors at Ecolinc are continually monitored and recorded by the Building Management System (BMS), such as the building's electricity, water and gas usage, 'hot box', trombe wall and glasshouse temperatures and solar panel output. The BMS is accessible from the Ecolinc website, under activities; the username and password are both "**display**." Past data is accessible by clicking on the Trendlogs items in the menu on the left of the screen. This past data can be accessed in the form of a table or a graph. Students can explore the effectiveness of passive heating and cooling by analysing the **Temperatures – Inside and Outside (°C)** Trendlog. The following are suggested activities:

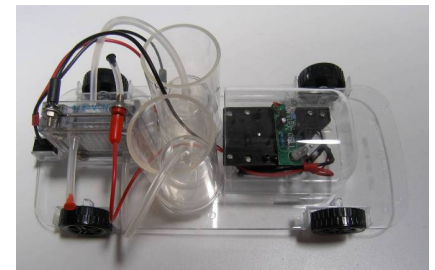
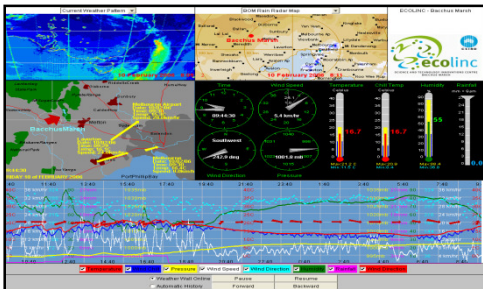


2. Go to the **Graphical and Combined Trendlogs**. Select **Temperatures – Inside, Outside, Hotbox**. Custom, BETWEEN and explore data from winter (10/07/2009 - 16/07/2009) and summer (07/01/2009 - 12/01/2009). Select printable view. Comment on the results and discuss the efficiency of the ESD features.
3. Select **Electricity – Solar Panel Output & Electricity Usage Accumulating**. Custom, ON (dates below), and select printable view. Complete the table below and discuss results.

Date	Solar Panel Output Total (look at the end of day)	Possible weather conditions
06/01/2009		
15/07/2009		

## Ecolinc Weatherwall

Ecolinc records current weather data onsite with our CSIRO weather monitoring station. Current and past data can be accessed onsite from the weatherwall. This data can be used in conjunction with the BMS to draw conclusions. For instance, examine solar panel output and the corresponding humidity percentage and rainfall amount. Humidity and rain suggests clouds which could offer an explanation if a low solar output was observed.



## Renewable energy sources – practical investigations

Students have the opportunity to complete a variety of practical activities which investigate renewable energy sources. The practical investigations focus in particular on the energy transfer and transformation processes involved and the efficiency of each system. Students will also consider the energy sources with regard to their benefits, limitations and environmental impacts.

The practical activities include:

- Alternative energy sources such as wind, hydroelectric, solar and hydrogen fuel cell
- Solar house focusing on passive heating and cooling
- Monitoring light globe and appliance efficiency

### Context of program and assessment

The Ecolinc alternative energy program can be offered as a half or a whole day program. Students usually participate in the structured investigations as an initial starting point from which to base their subsequent further explorations of their chosen energy sources. It is also possible for the investigations to be a conclusion to the learning outcome. Where possible, students could be involved in the design of experiments prior to visiting Ecolinc. Please feel free to discuss your particular situation and how we can best serve your needs.

### Investigation 1: Alternative energy sources – fuel cells

Use the instruction sheet to assist you to operate the fuel cell car kit.

1. Explain the processes involved to operate the car.  

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2. Can you see gases being produced? Are the amounts equal? (Observe that the car has undergone a longer period of electrolysis if you cannot see results).  

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3. What are the benefits and limitations of using fuel cells to generate electricity?  

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### Investigation 2: Alternative energy sources

Operate the models and use the information sheets to complete the table below.

Energy source	Process of energy production (How is the energy obtained from the original source?)	Benefits	Limitations
		Include environmental impact, materials, cost, etc.	
Wind			
Solar			

1. Do you believe the above sources of energy are a viable option for producing a greater proportion of Australia's energy needs? Why or why not?  

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### Investigation 3: Monitoring appliance and light globe efficiency

Use the Energy Meter to measure the amount of energy being used by a variety of appliances and light globes. Calculate the number of black balloons produced if the energy was obtained from burning coal.

Appliance	Power (W)	Light (lux)	Temperature (°C)	Output readings	
				Watts (W)/1000 = kW = Greenhouse gas emissions (kg/hour)	Number of black balloons
Light globe 1					
Light globe 2					
Heater					
Fan					