The discovery of electricity

Renewable energy: <Solar Power>

<Track the energy flow>

The rays emitted by the sun sustain life itself, and provide not only sunlight, warmth and allow plants to grow, but is already widely used for heating water, heating and cooling buildings, some low temperature industrial applications and solar thermal power systems.

Various means are used to convert sunlight into electricity. In California, 'Solar One' has been in operation since the mid 1970s. Sited in the Mojave Desert, several acres of mirrors, computer controlled to follow the sun during the day focus its rays on a large stainless steel sphere mounted on a high tower. This generates steam used to drive generators. Other plants of similar designs have successfully operated in Europe.

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Solar ponds

Other applications for using the sun are solar ponds, which collect and store heat by preventing natural convection in the water. The most common method is to maintain a varying level of salinity. The saltiest layer of water remains at the bottom with less salty water near the top. Water temperature near the bottom of the pond can exceed 85 degrees Celsius, which can drive a turbine or provide industrial process heat. These systems are potentially attractive for Australia's arid areas where accompanying salinity is high.

<Solar pond activity>

<Teachers notes>

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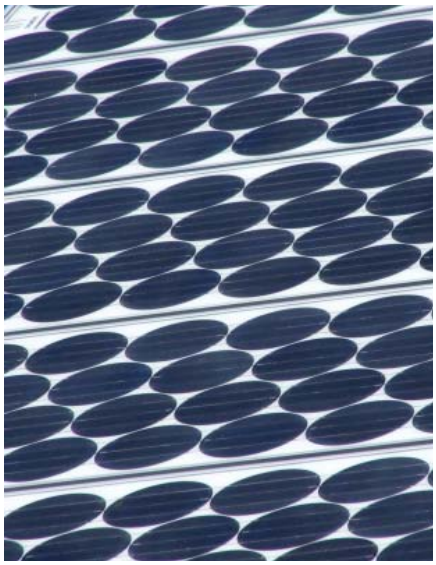


Photovoltaic (PV) solar cells

Another source of electricity from the sun is solar cells. Photovoltaic or PVs convert sunlight directly into electricity. The word photovoltaic comes from the Greek word photos meaning light and the word voltaic meaning electricity.

The original PVs were developed in the 1880's but were only one per cent efficient which severely limited their practical application. In 1953 a breakthrough was achieved when silicon was used to make PVs increasing their efficiency to 15 per cent. Australian made PVs are producing over 20 per cent efficiency and continuing improvements are being made.

Silicon is the most commonly used material in making these cells. Silicon is the second most abundant element on earth and makes up over 25 per cent of the earth's crust. It is extracted from sand and quartz rock and can be melted to make different types of solar cells.

Currently PVs are being used to supply electric power for sale to energy authorities for remote area power supplies, and for small items such as watches and calculators. In Australia telephones and signalling equipment in outback areas are powered by solar energy. Illuminated signs on our freeways use this technology and streetlights are often installed without connection to a central supply source because they use their own solar cell.

The Worldwatch Institute in the US has predicted that by 2050, 30 per cent of the world's energy will be supplied by solar cells. Australia, with its climate, and large open, flat land is ideally situated to expand this technology using this free, non-polluting form of energy.

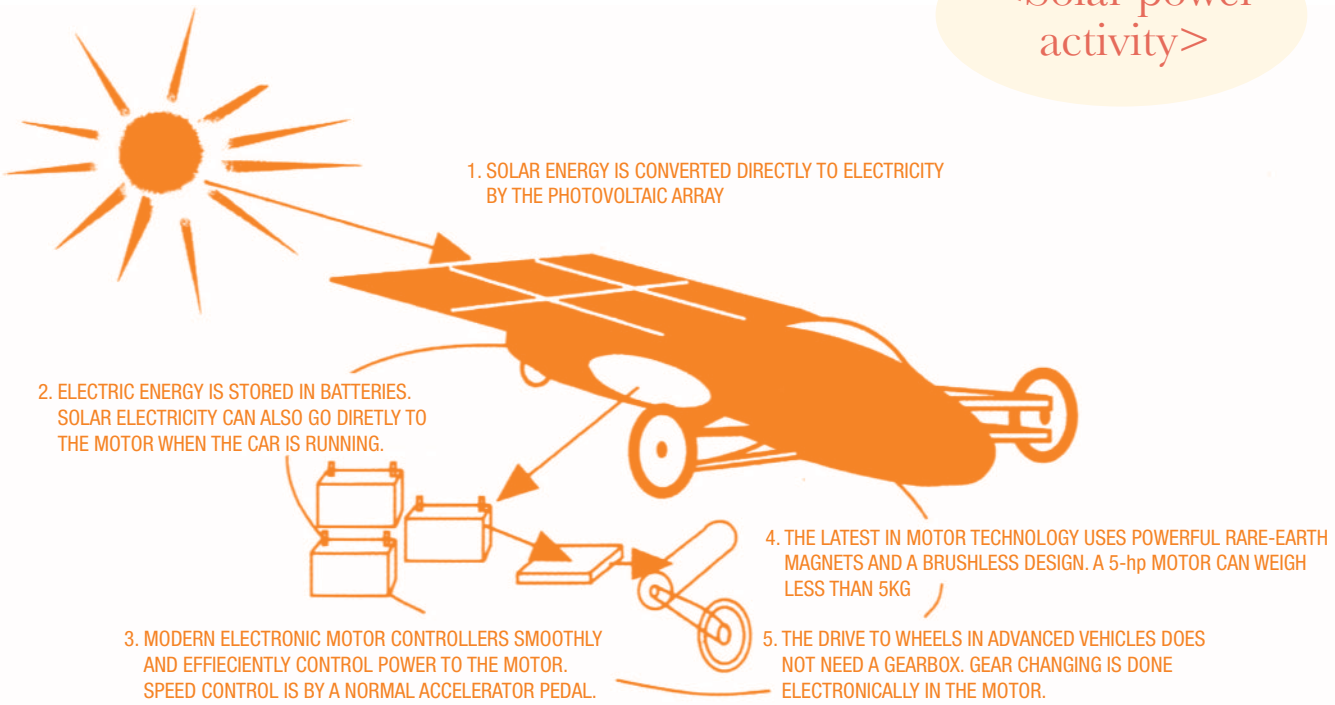
Activity

Investigate the advantages and disadvantages of installing a solar hot water system in your home.

Electric cars

Another application of solar cells is to provide power for <electric cars> , and while this also is still basically experimental, the <Solar Challenge car races> held on several occasions in Australia over the last decade, provide a glimpse of the future of motoring using non-polluting sources of power.

<Solar power activity>



More information

Alternative energy sources

<http://www.greenpeace.org.au/climate/solutions/index.html
<http://www.darvill.clara.net/altenerg/index.htm

<Wind power>
<Solar power>
<Hydro power>

Nuclear power

<http://www.energyquest.ca.gov/story/chapter13.html>
<http://www.greenpeace.org.au/climate/solutions/nuclear.html >

Solar power

<http://www.energyquest.ca.gov/story/chapter15.html>
<http://www.darvill.clara.net/altenerg/solar.htm>
<http://www.jatsgreenpower.com/solar-basics.html>

Activity

Uses of solar power

Make up a game which presents scientific ideas or principles based on the theme **"Various uses of solar power: now and the future".**

Work in small groups and research the topic. You could look at solar cars, solar heating, solar powered signs and calculators, amongst other uses. Make sure you include advantages and disadvantages of using solar power.

Your game can be a board game, card game, acting out of events or any other type of game.

Play your game with other members of your class.

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Track the energy flow and complete the cycle

Activity

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The discovery of electricity

1. Most of the energy we use is derived from the sun.

   Choose one of the power sources from the list below and describe (draw, write, or map) how the sun is involved in generating this power source.

   - Hydro power
   - Wind power
   - Fossil fuels (coal, oil, gas)
   - Wave power
   - Solar power
   - Geothermal power

2. Present your findings to your class.

3. Based on the class presentations, decide which of the energy sources listed above are renewable on a human time-scale, and which are not.

4. Write an essay on the topic: Only renewable energy sources can provide long-term energy security for the human race. Discuss.

The following websites may be useful for your research:

The Alternative Technology Association
<http://www.ata.org.au/>

Sustainable Energy Authority Victoria
<http://www.seav.vic.gov.au>

Solar Matters
<http://www.fsec.ucf.edu/solar/>

Geothermal energy
<http://www.eren.doe.gov/geothermal/>

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Investigate a solar pond Activity 7

Solar ponds have considerable potential in Australia, where we have plenty of hot, dry, salty regions. **In this class activity you will investigate how a solar pond works.**

You will need:

- A tank large enough to hold 20-30 litres of water
- A plastic lid from an ice-cream or yoghurt container.
- 1 kg of sodium chloride
- A small funnel which fits the tubing
- 50 cm of thin plastic tubing
- 3 thermometers
- Red and blue food colouring
- A lamp with a 100w bulb

Further research

Find out how solar ponds are already being used in India and the US to generate power. The following websites might help:
<http://www.azsolarcenter.com/>
<http://www.solarpond.utep.edu/>

1. Place the salt and about 8 L of warm water into the tank and stir until all the salt is dissolved. Add 10-20 drops of red food colouring, until you can see the colour.
2. Let this solution cool.
3. Attach the plastic tubing to the funnel, and place the end of the tubing about half way into the red salt solution. Slowly pour 8 L of cold water into the funnel, gradually lifting the tubing up in the salt solution as you pour.
   Don't let the end of the tubing come out of the solution.
4. Carefully float the plastic lid on top of the solution.
5. Very slowly and gently, without splashing, pour the last 4 L of cold water on to the plastic lid so it gradually over flows the lid, and spreads over the surface of the tank. Add 10-20 drops of food colouring to the water on the lid.
6. Place the three thermometers in the tank so that one thermometer bulb reaches the bottom, one bulb measures half-way up the tank, and the third bulb measures the top layer of water.
7. Place the lamp over the tank and turn it on. Record the temperature of the water in the tank at all three positions over the next 2 days (if possible).

Results:

- What did you observe happening to the temperature and colour of the solution during this experiment?
- How can you explain your observations? (Hint: It's got something to do with density and convection currents)

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Teachers notes

Solar Pond activity

This activity is adapted from one found at the University of Texas, where they have a large solar pond used for research and public awareness-raising activities. The principles of operation of a solar pond are described on the website <http://www.solarpond.utep.edu/>. Essentially, the salty water at the bottom of the pond has a greater density than the non-salty water at the top. Between the two layers is a gradient zone that becomes progressively less salty from the bottom to the top. Generally convection currents operate in liquids and gases, where warmer regions move towards cooler zones. Due to the density difference between the zones, such convection currents do not operate as normal in a solar pond. The gradient zone provides a insulating layer, trapping the solar energy absorbed by the solution, resulting in the lower layer becoming much hotter than the upper layer.

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