FUTURE SPARKS

CSIRO

FACT SHEET

Solar energy

What is solar energy?

Solar energy is energy from the sun as a result of nuclear fusion on the Sun's surface. This fusion typically involves two hydrogen atoms being compressed together by the enormous pressure and temperature of the sun to form one helium atom. During the conversion some of the mass of the two hydrogen atoms disappears as it is converted into a large amount of energy that appears as sunlight. The heat and light we experience everyday are obvious examples of solar energy. A solar cell converts sunlight into electrical or thermal energy. A solar battery contains solar cells, usually mounted in panels.

How is it used?

Solar thermal energy

It lights up our days. It heats the earth, our bodies and our homes. It dries our clothes and gives us produce like sun-dried tomatoes. All for free! It's also used to heat water for domestic use and swimming pools. With more advanced technology it can even be used for cooling. When concentrated using mirrors, solar thermal energy can replace burning fossil fuels as a source of heat for power stations. This is called "concentrating solar thermal" (CST) generation and several large power

stations of this kind have been in service since the global oil crisis of the 1970s. More advanced CST technologies are now being developed and tested, such as "power towers" surrounded by fields of tilting mirrors that reflect the Sun's rays to a single collector, producing temperatures as high as 1000 °C.

Solar electrical energy

Solar energy also produces electricity directly through solar cells, more formally known as photovoltaic (PV) cells, which are assembled into PV arrays of any size from rooftops to solar farms. Solar photovoltaic energy can be used in stand-alone and grid-connected situations.

Stand-alone solar power systems have no interconnection to the major Australian networks, and are found in remote homes and towns, islands, mine sites and villages, and tourist resorts. It is often cheaper to install a solar energy system than to lay electricity cables to these remote sites. To provide a reliable power supply, for example during times where there is no sunshine, an alternative energy source is needed. This can be a fossil-fuel generator such as a diesel engine or a gas turbine, or it can be an energy storage system that is charged when the sun is shining.

In grid-connected circumstances, where utility-supplied electricity is available, clean, free energy from the Sun can be harvested to add to the existing grid supply. Homes and businesses can install solar PV arrays and receive payment for the electricity they generate. Large generating companies can create solar farms and operate as a major supplier. Where the electricity grid is unreliable, and perhaps too expensive to upgrade, solar energy can be part of a backup power supply which

would also include energy storage or a fossil-fuel generator to ensure a continuous supply. When used for backup power solar energy may be conserved by providing power only to the most important electrical appliances.

Challenge

An obvious limitation of solar systems is that the sun only shines during the day and may be intermittent even then due to cloud cover. Some means of providing power when the sun is not shining is therefore essential when using solar energy.

Although the energy generated is free, because no fuel is required, the cost of solar photovoltaic cells is high and their useful lifetime of 15-20 years is less than half the typical lifetime of a coal-fired or gas-fired power station. Presently, government subsidies are helping to increase the amount of solar energy, and large-scale manufacturing has led to dramatic decreases in costs in recent years.

Solar thermal power stations and solar photovoltaic arrays have different costs and benefits, so in the near future there is likely to be strong growth of both technologies.

Source: CSIRO CarbonKids Curriculum Unit, Sustainable Energy for All, pages 25-32

Acknowledgements

The Future Sparks educational materials project is being undertaken by CSIRO Education for Green Cross Australia.

These educational resources are designed to introduce teachers and students to Australia's use of 'clean energy' as one of the carbon dioxide mitigation options available for achieving significant reductions in atmospheric carbon dioxide emissions. Whilst not an exhaustive educational resource, it is intended to raise the awareness of school-aged students about our changing climate, clean energy practices and applications and the other alternative energy technologies that reduce greenhouse gas emissions.

The materials in this educational resource have been developed by Angela Colliver from CSIRO Education.

For more CSIRO school resources visit csiro.au/carbonkids