Sustainable Energy Development Office
Government of Western Australia

FACT SHEETS

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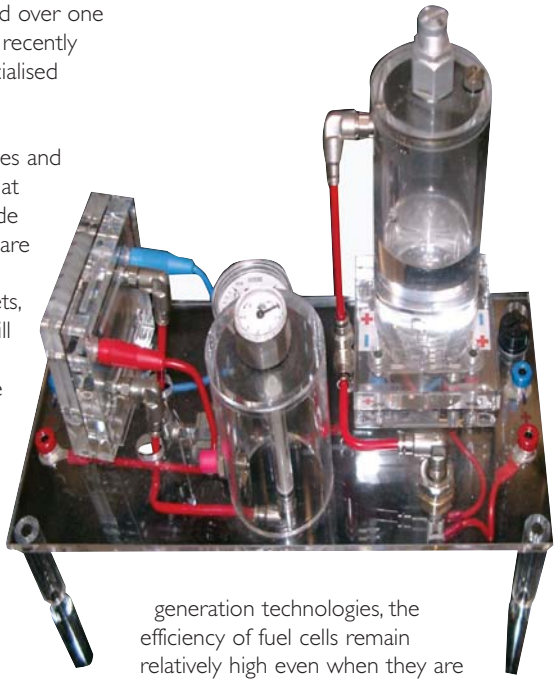
Fuel cells

Fuel cells were first developed over one hundred years ago but until recently have only been used in specialised applications such as in powering spacecraft and submarines. The development of new fuel cell types and associated technologies means that they may soon be suited to a wide variety of applications. The signs are that these technologies could be destined not just for niche markets, but for major applications that will increase the efficiency of our use of fossil fuels, and extend our use of renewable energy.



Why the Excitement?

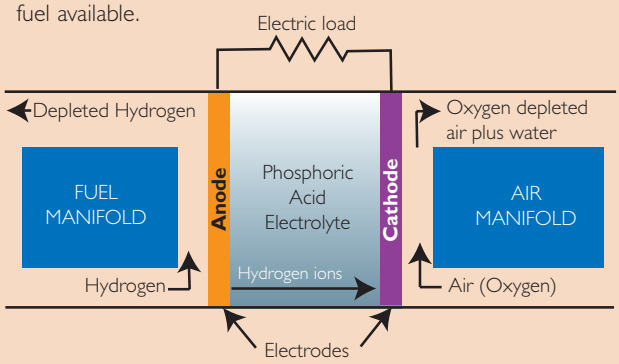
A fuel cell uses an electrochemical process to produce electricity from gas or liquid fuel, providing a continuous supply of power with a number of inherent advantages.

Fuel cells are potentially smaller, quieter, more efficient and reliable than conventional fossil power systems, and because there are few moving parts they require less maintenance. Unlike conventional power generation technologies, the efficiency of fuel cells remain relatively high even when they are operated at less than full capacity. In addition, waste heat from the fuel cell opens opportunities for domestic, industrial and commercial cogeneration of electricity and heat. Efficiencies can be as high as 50–60% — almost double that of traditional generators, and more than 80% for cogeneration systems.

Fuel cells can be manufactured with a power capacity from a few watts up to hundreds of kilowatts. They are compact and their clean and quiet operation should enable them to be located in cities where the energy is needed, reducing losses associated with long transmission lines.

How A Fuel Cell Works

A fuel cell is similar to a battery, providing direct current through an electrochemical process. However, a battery converts the material stored at the electrodes, whereas a fuel cell is sustained by chemical fuel fed to the electrodes on demand. A battery is an energy storage device, whereas a fuel cell is an energy conversion device which can be operated for as long as there is fuel available.



Comparative Efficiency of Power Generation Methods

The high efficiencies are achieved from the direct conversion of fuel to electrical energy within the unit. Being more efficient than traditional fossil-fuelled electromechanical generators, fuel cells produce less carbon dioxide emissions, as less fuel is required to give the same power output. As there is no combustion reaction, there are negligible emissions of other pollutants such as oxides of nitrogen that normally result when a fuel is burnt.

Most fuel cells operate using hydrogen as the fuel but almost any clean liquid or gaseous hydrocarbon fuel, including natural gas, methanol and biogas can be used after processing. Fuel can be obtained from both fossil fuel and renewable energy sources. For example, electricity generated by wind turbines can be used to electrolyse water to produce hydrogen. Fuel cells output low voltage direct current (DC) electricity that needs power conditioning to produce higher voltages for use in vehicles or to produce standard alternating current (AC) electricity.

Fuel cell technologies still have some disadvantages to overcome. They have a very high initial capital cost due to the difficult manufacturing processes involved in the production of the cells.

High temperature fuel take a few hours for start up and most types use expensive platinum metal as a catalyst.

Cost, weight and fuel storage problems appear to make fuel cells unsuitable for many applications at present, including cars, but they can be used to power large electric vehicles, such as trucks or buses. Other major potential fuel cell applications may include:

- Small portable power units
- Residential sized units
- On site power generation for large buildings or remote locations
- Industrial cogeneration in one to 10 MW modules
- Over 100 MW centralised power station generation.

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