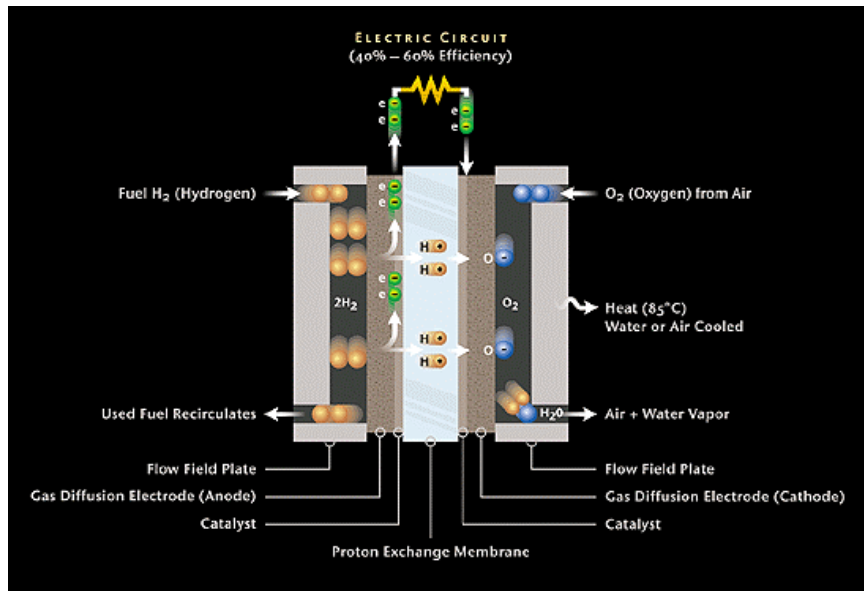


## Fact Sheet      Fuel Cells

Fuel cells are electrochemical energy conversion devices, which convert chemical energy in the form of hydrogen and oxygen into an electric current and the by-product of water ( $H_2 + 1/2O_2 \Rightarrow H_2O$ ).

Fuel cells may be used in both transportation applications and stationary applications to provide electrical energy.



How a Ballard PEM Fuel Cell Works. [www.ballard.com](http://www.ballard.com)

### Hydrogen Fuel Cells:

- produce no greenhouse gases, although the production of the Hydrogen may produce some carbon dioxide;
- produce no smog creating emissions and will therefore help to improve air quality problems;
- are quiet;
- are predicted to be cheap to maintain and operate as they have no moving parts;
- are a very efficient producer of electricity. The fuel cell is two to three times more efficient in converting fuel to power than a combustion engine.

Fuel cells are currently used in hundreds of applications worldwide, but still have barriers to full commercial production.

### Disadvantages of fuel cells include:

- high initial investment costs
- lack of supporting infrastructure

## **Types of fuel cells**

There are a number of different types of fuel cells. Classified by the electrolyte used, each has various advantages and disadvantages relating to cost, temperature, fuel purity, size, and lifetime. Pure hydrogen is the main fuel used in fuel cells; however, hydrogen rich fuels may also be used in some types such as molten carbonate fuel cells and solid oxide fuel cells.

**PEM (proton exchange membrane)** fuel cells are currently being used in prototype fuel cell vehicles. PEM fuel cells could also be used for residential and small commercial distributed power generation, for premium power generation (applications where power supply must either be uninterruptible or particularly clean) and telecommunications. They are low temperature fuel cells with a quick start up time.

**Phosphoric Acid** fuel cells (PAFC) may be used for baseload power and cogeneration. Cogeneration is where waste heat from the fuel cell is also utilised. They may also have applications in transportation. PAFCs have the advantage of being very efficient and the ability to use impure hydrogen as a fuel.

**Alkaline fuel cells** (AFC) are used for power generation during space flights and have potential to be used in utility vehicles (for example military applications) and small watercraft. They are high performance fuel cells, with the reaction time being faster than other types.

**Molten Carbonate fuel cells** (MCFC) and **Solid Oxide fuel cells** (SOFC) are most suited to the production of baseload power, for cogeneration applications and hybrid power. They have advantages of high efficiency, due to high temperature, and the ability to use a range of fuels.

Other types of fuel cells, such as **direct methanol fuel cells** and **metal air fuel cells**, are being developed. Direct methanol fuel cells may be used in electric motor vehicles or as portable power sources in lap top computers or mobile phones. While more research and development time is needed, metal-air fuel cells, may possibly be used in the future as portable power sources or in transportation.