

# Fact Sheet: Hydrogen

## Hydrogen

- is the simplest, most abundant element in the universe;
- is the lightest known element;
- is a colourless, odourless gas;
- is non-toxic;
- burns readily with oxygen, releasing considerable energy as heat and producing only water as exhaust;
- produces no carbon dioxide or carbon monoxide emission when burnt in air, and therefore does not contribute to global warming as does the burning of fossil fuels;
- produces small amounts of nitrogen oxides when burnt in air at very high temperatures, which can contribute to smog and acid rain (however, these pollutants are at much lower levels than those produced by hydrocarbon fuels when burnt);
- produces a heat of combustion that is two to three times higher than that of other fuels;
- can be used in fuel cells to provide electrical energy without emitting any harmful by-products;
- holds the potential to be the backbone of a clean and sustainable energy system for the future.



## Hydrogen uses

Hydrogen is currently used in many different industry processes, such as the production of plastics, fertilizers and petroleum products. Hydrogen may be used to power steam turbines or as fuel in a vehicle internal combustion engine. Hydrogen may also be used to power fuel cells. The Hydrogen Fuel Cell is an electrochemical energy conversion device that converts chemical energy in the form of hydrogen and oxygen into an electric current and the by-products of water and heat.

Hydrogen fuel cells are being developed for automobiles, portable power systems, and electric power generation. Hydrogen fuel cells have been used for many years on-board space shuttles, providing electricity and drinking water for the astronauts. Hydrogen is also used as the rocket launch fuel.

## Hydrogen Production

Hydrogen is not found in nature in its pure (elemental) form on earth and must be produced or reformed from a primary source. Steam reforming of natural gas is currently the most widely used and economical method of producing hydrogen. Close to 98% of hydrogen is presently generated from fossil fuels such as natural gas.

Hydrogen can also be produced by electrolysis through entirely renewable means. Electrolysis involves passing an electric current through water to produce hydrogen and oxygen. If the electricity used in this process is produced from renewable energies such as solar, tidal or wind, then greenhouse gases emitted in the process are negligible.

Other forms of production, such as photoelectrolysis (using the sun's energy and water to produce hydrogen and oxygen) and photobiological (using bacteria/algae to produce hydrogen) hydrogen production hold some promise for efficient and cost effective production in the future. However, technologies such as this are still in their developmental phase and need more time and research to become viable. Biomass or municipal waste gasification may also be used for hydrogen production

in the future.

## **Infrastructure**

Very little hydrogen infrastructure is in place throughout the world. Hydrogen is currently transported predominantly by ship as a liquid or by truck as a gas. As use increases, it may be viable to create a hydrogen gas pipe network system similar to the present natural gas pipeline system.

## **Storage**

Small amounts of hydrogen may be stored as a compressed gas in pressure tanks or as a liquid in cryogenic containers or dewars.

Depending on the geology of an area, underground storage of gaseous hydrogen may be possible. Old oil and gas fields, underground aquifers, and salt and rock caverns hold potential for bulk storage of hydrogen.

## **On-board vehicle storage**

Currently, compressed gaseous hydrogen is the most cost-effective method of on-board vehicle storage. Some automobile manufacturers are also using liquefied hydrogen in prototype vehicles. Other methods of storage such as metal hydride, alkali hydride, and carbon nanotube storage are currently under research and development.

## **Safety**

Millions of kilograms of hydrogen are used in industry every day around the world. The technology to produce, transport and use hydrogen safely is well known.

Hydrogen is non-toxic and therefore does not create an environmental hazard in the event of a spill. Hydrogen is also lighter than air; and therefore will rapidly dissipate if leaked.

Fears of risk associated with the use of hydrogen as a fuel are perpetuated by its unfamiliarity. Highly vivid and widely publicised accidents, such as the Hindenburg and Challenger disasters, have promoted concern over hydrogen use, even though hydrogen was not responsible for either tragedy. Hydrogen can be handled safely, if its unique properties - sometimes better, sometimes worse, and sometimes just different from other fuels - are respected.