Now Alcohol Fuel Cells are here.

I have long argued that the future of Hydrogen Power is in Alcohol fuel cells.

Sorry for the long post but this looks very interesting. Picked this one up from Physics World. (This atrticle is not on general view hence not just a URL)

As fuel-cell buses take to the streets in Iceland, the idea of an economy based on hydrogen rather than fossil fuels is being taken more seriously, as Tim Chapman discovers.

Iceland might seem an unlikely place to lead a technological revolution that could radically change the structure of the global economy. But as the country takes its initial steps towards becoming the world's first hydrogen society, Iceland is aiming to prove that the 21st century can be powered without the environmental and political pitfalls of fossil fuels.

With no fossil-fuel reserves, Iceland has long exploited its other geological assets to develop alternative energy sources. It meets virtually all its electricity and heating requirements from hydroelectric power and geothermal water reserves. But the sparsely populated nation of 280 000 still relies on $150m worth of imported fossil fuels every year for transport, including meeting the demands of the country's fishing fleet, which provides 70% of the national income.

The Icelandic government is now backing an ambitious programme to remove all fossil-fuel requirements from Icelandic society within a generation. The key is to use hydrogen or hydrogen-rich compounds in vehicles powered by fuel cells. The first hydrogen buses will hit the streets of Reykjavík early next year, filling up with hydrogen-rich methanol at a new filling station built by Shell, one of the major corporate backers of the project along with Norsk Hydro and DaimlerChrysler.

Over the next few years, the capital's entire fleet of 80 buses will be replaced with vehicles powered by polymer electrolyte membrane (PEM) fuel cells, accompanied by the introduction of PEM fuel-cell cars for private transportation (see Fuel cells eye up the mainstream market, pages 30-31 print version only). A demonstration project for a fuel-cell-powered ocean vessel is planned for 2006, with the intention of replacing the entire national fishing fleet beginning in 2015.

Bragi Árnason, a chemist at the University of Iceland and an advocate of hydrogen power since the 1970s, says the transition to a hydrogen economy could be complete by 2030-2040.

Production and storage

The production of hydrogen is well established in Iceland for use in fertilizers. Each year 2000 tonnes of the gas is generated by electrolysing water. But this capacity would have to be increased by almost a factor of 30 to produce enough hydrogen to meet the expected demand.

Electrolysis is an energy-intensive process. According to Árnason, hydrogen produced this way is up to three times as expensive by energy content as imported petrol. Conveniently, PEM fuel cells are up to three times as efficient as internal-combustion engines, so hydrogen fuel is competitively priced. And if hydroelectric electricity is used for production, greenhouse-gas emissions are minimized.

Many pundits in the car industry judge methanol to the best medium for storing hydrogen because it has a relatively high proportion of hydrogen by mass. Moreover, methanol is easier to handle than methane because it is a liquid. Pure molecular hydrogen would be the most energy-efficient fuel, but is extremely awkward to store in a car in its gaseous state.

Another problem with hydrogen is that liquefying and compressing it requires 20-40% of the energy it produces, and pressurized storage tanks weigh many times more than their contents. Metal hydrides can store hydrogen at close to atmospheric pressure, but are too heavy for many uses.

American power

The hydrogen economy involves more than fuel for transport. Iceland is fortunate that it can meet its national demand for electricity with fully renewable sources, but most countries are dependent on fossil fuels to produce electricity for homes and businesses.

Spurred largely by the desire to reduce its dependence on oil imports from politically sensitive parts of the world, the world's biggest and most energy-hungry economy has also embarked on an ambitious programme to convert to hydrogen.

Late November the US Department of Energy (DOE) published a report that set out a wide-reaching vision of hydrogen as the nation's premier energy carrier. The DOE aims to realize the "meaningful introduction" of fuel cells for energy generation by 2005, replacing 12 trillion kilowatt-hours of conventional energy with hydrogen by 2010. Each year the US consumes 2500 times as much energy, but the plans do not stop there. By 2030 the DOE intends to replace at least one-tenth of its current annual energy consumption with hydrogen power.

A major part of the DOE proposals is the use of hydrogen fuel cells in distributed generation and the move away from massive centralized power stations to much more localized generation. Many offices and industrial buildings around the world already generate on-site heat and power from fuel cells that use hydrogen-rich fuel derived from natural gas. The cost of on-site fuel cells is now approaching parity with buying energy from existing power plants, but prices should fall dramatically once there is sufficient demand to exploit manufacturing economies of scale.

Promoting adoption

The first stages of the transition to a hydrogen economy are something of a catch-22 situation, with consumer demand unlikely to rise until the infrastructure is in place and vice versa. The DOE proposes that national and state government services should be early adopters of hydrogen technology to help stimulate the market.

Some advocates of the hydrogen economy believe that market forces will be enough to drive the transition. Research by the Rocky Mountain Institute, the environmental think-tank in Colorado founded by experimental physicist Amory Lovins, shows that the transition can be profitable at every step. To kick-start the process, Lovins proposes leasing fuel-cell cars to people who work in and around the buildings where fuel cells have been installed. The cars can fill up with hydrogen while parked during the day, and can also use their fuel cells to

generate electricity to sell back to the grid. Eventually, most homes will have a fuel cell in the cellar, Lovins believes.

Hydrogen can also help solve one of the obstacles to the wider adoption of renewable energy sources. If such systems can only provide power when the wind is blowing or the Sun is shining, they will play only a small part in meeting national energy needs. But if that power is used in electrolysis, hydrogen acts as an effective storage medium for renewable energy.

Those first small steps for Iceland could eventually prove to be one giant leap for the rest of the world.

About the author

Tim Chapman is a science writer based in Halifax, UK