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HYDROGEN – ENERGY OF THE FUTURE

Ross Blair
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The Commonwealth Government's sudden realisation of how badly Australia is trailing in reducing its greenhouse gas emissions, has lead to a rush for 'off the peg' partial solutions to this problem. Nuclear energy is seen as one of such partial solutions. It has, of course, been available for decades, is widely used in many other countries and was once touted as the 'energy of the future' although that image has become a trifle tarnished. Geosequestration (aka clean coal or carbon capture and storage (ccs)) is potentially another available partial solution. It is being held out as a widely used and well understood technology because gas has, for many years, been pumped into and retained in wells, albeit briefly, for a variety of purposes. The claim is in fact dubious because we have no knowledge of the future problems which are likely to occur when we attempt to retain CO_2, under pressure, for thousands of years. These problems will be accentuated by any acidic solutions resulting from the combination of CO_2 and water under these conditions.

Both solutions have, however, been considered in depth in a number of articles on this website and it is not the purpose of this paper to review them any further at the present time. Sufficient to say, the use of nuclear energy although it is safer now than it has been in the past, continues to be opposed by many people. Geosequestration, on the other hand, is not currently opposed by any significant group but this is likely to change once the public gains an awareness of what is entailed, particularly in its transportation and its storage. This paper believes geosequestration will arouse considerable opposition and its cost will be far greater than the government currently imagines.

The current promotion of these two 'technological solutions' has, unfortunately in the opinion of this paper, led Australians away from the 'technological solution' that is far more likely to have a substantial effect in reducing greenhouse gas emissions than either of those referred to. That is the use of hydrogen energy.

Hydrogen is the most prolific gas in the universe. The sun is a giant mix of hydrogen and helium that emits radiant energy which in turn sustains life on earth and gives us light, makes plants grow, makes the wind blow and the rain fall. Hydrogen, however, is lighter than air and consequently rises in the atmosphere and therefore is not naturally retained on the planet otherwise than as a compound such as in water (H_2O) or methane (CH_4).

Hydrogen possesses the highest energy content of any commonly used fuel by weight but has the lowest energy content by volume.

Hydrogen, like electricity, is a carrier of energy (energy carrier) in that it moves energy in a usable form from one place to another. Its future as an energy carrier looks promising indeed, particularly as, unlike electricity, it is capable of being relatively easily stored in sizable quantities for future use.

Hydrogen is already being used as a portable fuel, although largely on an experimental basis. London buses, for example, have been adjusted to run on hydrogen while in the US hydrogen powered vehicles are becoming available and are being used by organisations like the US postal service as well as by private individuals. Of course we cannot forget to mention that one of the largest present users of hydrogen as a portable energy fuel is NASA which has been using it for years in the space program. The space shuttles are lifted into orbit powered by liquid hydrogen. Their electrical systems are powered by fuel cells (i.e. hydrogen batteries) from which the only by-product is pure water which the crew uses as drinking water. The reality is therefore that in hydrogen, the world has an efficient fuel that is capable of use either as a portable fuel or as the provider of baseload energy.

Currently in the US about 7.8 million tonnes of hydrogen is produced annually. This quantity would

be sufficient to power 20-30 million cars or 5-8 million homes for a year without causing any greenhouse gas emissions at all. It is, in fact, currently being used mainly in industries and by NASA.

As a portable fuel it currently lacks the infrastructure that is available to petroleum and LNG but the likelihood is that over the next 10-15 years, hydrogen powered vehicles will increasingly appear on our roads and hydrogen will, like LNG in the past, become increasingly available at service stations across the country. Like many other portable fuels, the acceptance of hydrogen and its development as the portable fuel of choice, depends very largely on the costs of petroleum. Hydrogen does, however, appear to have an advantage in this regard in that, as appears below, it seems to have a future capability of being produced at a comparable or lower price than petroleum as of now whereas the inevitability is that the cost of petroleum will continue to climb, more likely than not at an even increasing rate.

So what is holding hydrogen back and what should governments be doing to make hydrogen increasingly available at competitive prices?

Hydrogen, as mentioned above, occurs on earth only as a compound with water, fossil fuels (including methane) and biomass. It can be separated from other elements by steam reforming, which is the cheapest method and is used to separate hydrogen from carbon in methane (CH_4) which accounts for most of the hydrogen produced in the US. Alternatively, separation may be effected by electrolysis (water splitting) to separate hydrogen from water (H_2O).

Because methane is a fossil fuel, the process of steam reforming results in the emission of greenhouse gas. Exactly the same would occur if steam reforming was applied to any other fossil fuel for the purpose of separating off the hydrogen.

In consequence the production of hydrogen from fossil fuel sources has no advantage in terms of reducing greenhouse gas emissions although hydrogen could be produced by this means relatively cheaply. .

Electrolysis on the other hand causes no such emission but is comparatively expensive although new technologies are being continually developed which are progressively reducing its cost. As soon as the cost of electrolysis can be reduced to a competitive level the world will have a source of non-polluting energy capable of being produced anywhere on earth by the extraction of hydrogen from water.

Hydrogen therefore has a great future as both a portable and a baseload clean energy fuel. Because it can be produced by splitting water, it can be considered as a renewable energy source as readily available as water itself in massive quantities. One initial use in Victoria might well be in desalination of sea water for human consumption.
The mineral industry says privately that all this will be feasible within 15-20 years but the process could be accelerated if (say) rewards were offered by government for significant advances in electrolysis or any other means of extracting hydrogen from water. Such a result would unquestionably be far more sustainable than either of the present proposals referred to.

Name: Ross Blair
Title: Special Counsel Future Law Team
Area: Future Law Team & Commercial Law
Phone: (61 3) 9670 8822
Fax: (61 3) 9602 5037
Email: ross.blair@mckeanpark.com.au
Web: www.mckeanpark.com.au