

75 years of Climate Change, & Renewable Research Unchanged

By Leigh Sheppard

When I wrote this article, Australia was experiencing one of its longest serving governments, and so a very substantial track record on approaching energy and climate change issues existed which could be thoroughly considered in the context of Australia's future.

Of course, times have changed and we now have a different government, with a different approach towards these issues. It is arguably too soon to judge how well the current government is addressing climate change and developing renewable energy technologies, but the need for bold and decisive leadership clearly remains.

Hopefully it will come soon, and Australia will enjoy its time in the sun. *Leigh Sheppard*

1932 was an eventful year. The depression was in full swing, maintaining a vice-like grip on everyone's purse strings, and America was dry (at least according to the law). Amelia Earhart became the first woman to cross the Atlantic Ocean solo, and the 20 month old son of fellow aviator, Charles Lindbergh, had been kidnapped. The notorious criminal mastermind, Al Capone, had been sent to Atlanta Prison, while the infamous Adolf Hitler was getting comfortable with his surroundings as a new citizen of Germany. Donald Bradman made several big centuries, and Babe Ruth, despite being on two strikes, made his famous gesture with his bat before knocking a home run into the centre field stands. The Harbour Bridge was opened, linking the two sides of Sydney Harbour, and the Australian

Dr Leigh Sheppard is the co-leader of the Solar Energy Technologies group at the University of Western Sydney.



Institute of Political Science (now known as the Australian Institute of Policy and Science) was established to link the general public to the major issues that affected them.

Many things have changed since that time, especially with respect to our concern for the environment. In the 1930s, any discussion over the emission of carbon dioxide and the problems posed by global warming and climate change would have been met with bemused expressions. Of course, no alternatives existed back then, and it must always be respected that it was the use of fossil fuels in the first place that gave birth to the industrial revolution, and the explosive technological development that followed; development that today's people take for granted. However, in modern times, it can no longer be justified to simply live in ignorance to the damage fossil fuels are causing to our planet.

At present there exists a wealth of scientific evidence that links carbon dioxide emission to global warming. This evidence closely supports models which are used to predict the future consequences of global warming. Of course, this is a case of scientists supporting other scientists who are playing for the same team. Sceptics, and those interested in maintaining the status quo, can easily find ways to dispute this evidence, essentially by questioning its validity. Scientists must continually refine their approaches in order to make their findings more and more objective and representative of behaviour on a global scale. Unfortunately, Mother Nature herself has added fuel to the sceptic's fire by generating a number of strange and extreme weather events over the history of the Earth, such as several ice ages and subsequent thaws.

To a reasonably-minded individual, it should be hard to ignore the extreme weather occurring on a regular basis worldwide. According to the International Strategy for Disaster Reduction, the number of natural disasters that occurred during the period 2000-2005 was 2788, which compares to 294 for the period 1950-1959 and 73 for 1900-1909. Whilst geological (earthquakes, volcanoes etc) and biological (epidemic etc) disasters are contributors to these numbers, hydrometeorological causes (eg. flooding, drought, wind) predominate. Since 1991, weather related natural disasters have accounted for 76% of all



Dr Leigh Sheppard discussing solar-hydrogen with the (then) Australian Attorney-General, the Hon. Philip Ruddock during his visit to the Centre of Materials Research in Energy Conversion in 2006.

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natural disasters. While nature has always produced strange weather events, the question becomes one of frequency, and the frequency is clearly increasing at an alarming rate. This is difficult to dispute and fits well to scientific predictions.

The real underlying issue which is paralyzing our large scale response to climate change is our almost complete dependence on fossil fuels for the supply of energy. This dependence has grown from a desire for convenience, and has resulted in a dramatic improvement to our living standards since the beginning of the industrial revolution. In 2005 (according to BP), Australians consumed 52.2 million tonnes oil equivalent of coal, 21.3 million tonnes oil equivalent of natural gas and 39.7 million tonnes of oil. This has led to the emission of 354 million tonnes of carbon dioxide into the atmosphere (2004 - International Energy Agency). On a per capita basis, Australians are amongst the top 5 consumers of fossil fuel and emitters of carbon dioxide. However, we should consider ourselves as no longer just the “lucky” country, but also the “smart” country.

It is clear that the immediate abandonment of fossil fuels for energy supply would have devastating economic consequences. These are consequences

that no Australian would be immune from. However, climate change is also posing devastating economic consequences. Over the last 5 years, meat and grocery prices have substantially increased in price as a result of the drought. Whether or not the drought is due to climate change can be debated, however it is representative of what Australians can expect from climate change. In the same vein is the case of cyclone Larry, and the effect on banana prices in 2006. Consider also the increase in the price of insurance premiums, and the requirement for government spending in order to sustain primary producers during their times of hardship. For example, in 2005 Hurricane Katrina hit New Orleans with a cost of at least US\$75 billion, or about US\$250 per American. Hence there is an urgent need for an alternative, environmentally friendly fuel source. At \$1.30 to \$1.40 per litre, petrol may feel like a hit to the wallet. But in overall terms, the price at the pump is but a mozzie bite.

While a fossil fuel in the ground is widely considered a valuable energy resource, few people would consider the sun in the same context. Annually, 1.3×10^{16} kWh of energy falls on Australia in the form of sunshine. In less than 1 hour of sunshine, Australia receives enough energy to satisfy Australian energy



Cartoon by Bill Leak from *The Australian*. newsphotos@news1td.com.au

demand for a year, and about 4 days of Australian sunshine could power the world for a year. The sun represents a vast energy resource that cannot be depleted or overused, and Australia has this resource in abundance.

Photovoltaics, or solar panels, as many people know them, are the first technology that springs to mind when one considers a technology that can collect solar energy. Yet, several other technologies exist, which convert energy from the sun into useable energy through various means. However, as sunlight is only available during daylight hours, such solar based technologies suffer from an inability to deliver energy during times of peak demand, which usually occurs during the night. Consequently, considerable effort has been undertaken to find ways to effectively store electricity, which is the product of most solar technologies. However, this has proven difficult. Storage of energy is much simpler if the energy is in the form of a fuel, but this fuel must be clean, and environmentally friendly.

Instead of producing electricity, solar energy could be converted into hydrogen fuel through solar water-splitting. Hydrogen generated in this fashion is called solar-hydrogen, and is particularly attractive as an

alternative to fossil fuels due to its failure to generate CO₂ during utilization and production. Instead, the combustion of hydrogen results in the formation of water, which is a scarce and precious commodity in Australia. In principle, solar-hydrogen is produced using a photo-electrode which is made from a light-sensitive material like those used in photovoltaics, but which has the additional capability to react with water. At the Centre for Materials Research in Energy Conversion at the University of New South Wales, such materials are currently being developed based on titanium dioxide semiconductors. Using unique facilities which enable the study of oxides during processing, the UNSW researchers are able to engineer specific material properties, enabling the development of a photo-electrode with enhanced performance.

With the capacity to replace the current demand for fossil fuels, the scope for solar-hydrogen is enormous. By combining this approach to energy supply, with Australia's abundant solar energy, and access to seawater, the mind boggles at the possibility for Australia to become a leading clean and sustainable energy exporter of the future. In addition, water demand could be relieved by collecting the water

generated through the use of hydrogen as a fuel. For Australia, this technology offers the rare win-win situation.

Instead of recognizing Australia's potential for sunlight harvesting, nuclear power is being seriously considered as a candidate for energy supply. As well as servicing increased energy demand, this is also an attempt to combat global warming and climate change. In terms of carbon dioxide emissions, nuclear power may be considered environmentally friendly. However this label can never truly apply to nuclear energy due to the hazardous nature of the nuclear waste generated. Furthermore, due to the huge amount of energy required to generate nuclear fuel (which is also a finite resource like fossil fuels) it is unlikely that nuclear energy could ever become the principle supplier of electricity in Australia without the need to import nuclear fuel. Nuclear power also fails to address the use of fossil fuels for transportation, which is a major contributor to global warming. If it is made, the decision to use nuclear power in Australia will not be one of political leadership, but one of political follow the leader. If political leaders had pursued renewable technologies 30-40 years ago, as they pursued nuclear power, then today's options for sustainable and environmentally friendly technologies would be vastly improved. The time has come for today's political leaders to demonstrate a vision that their predecessors lacked.

So, since 1932, when the Australian Institute for Political Science was established, many important changes have occurred, such as the community

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awareness of the impact of global warming and climate change. However, this change has not been reflected in the attitude towards the support of renewable and environmentally friendly technologies such as solar-hydrogen. Perhaps, if appropriate research support is provided, especially from the government, Australia may genuinely reaffirm its status as a "smart country". Considering the historical trend towards new Australian technologies and inventions over the last 75 years, this change of attitude may be the single biggest change of all. ➦