Committee Secretary

Senate Standing Committees on Environment and Communications

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My name is Grant Gartrell. I am an Honorary Life Member of both the Australasian Cave and Karst Management Association Inc. (ACKMA), and the Cave Exploration Group (South Australia) Inc. (CEGSA). The word "karst" is used to denote geographical landscape features in which solutional rather than simply erosional processes play a significant role. Certain types of rocks, such as limestones, tend to be prime candidates for karst development.

I am a senior member of both organisations with a life-long passion for the science, conservation, and appreciation of caves throughout the world, and especially those within Australia. I am now 80 years of age. I have a Ph.D. in Physics from the University of Adelaide.

I had an active interest 60 years ago in the discovery and scientific investigation of some of the vast network of caves under the Nullarbor Plain, and have maintained that interest to the present day. While karst only occupies a small percentage of our planet's land surface area, the Nullarbor karst is the largest such region in the World and is considered, particularly amongst the scientific community, to encompass a broad range of karst related exceptional values that make it a strong candidate for inclusion on the UNESCO World Heritage Register.

To some less karst aware people the Nullarbor may seem to be a featureless plain with no particular landscape values. In reality, the almost total absence of significant surface erosional features is because in their place there is instead an elaborate and largely integrated solutional drainage network, which appears to support an extensive and complex, but as yet not comprehensively described biota.

In 1969 I made a contribution to the discovery of megafauna assemblages at Naracoorte in South Australia which led eventually to what is to date the listing of South Australia's only entry on that same UNESCO World Heritage Register. Both sites engender considerable interest right around the world, and with or without World Heritage listing, Australia will be judged internationally by the way we look after these local, national, and whether we like it or not, international treasures, on behalf of enlightened and concerned citizens all around our planet.

I am greatly disturbed by a proposal of which I have recently become aware, dubbed the Western Green Energy Hub (WGEH), to cover large swathes of the Nullarbor Plain with an intensive "farm" of wind turbines and solar panels, water reticulation systems, channels, grids, townships and associated sewage treatment plants, structures and tracks to generate electrical power for the purpose of creating so-called "green hydrogen" and "green ammonia". The proponents of this scheme seem to be blissfully unaware of the properties of karst, or even that the presence of

numerous substantial underground cavities makes it a most unsuitable place for siting massive wind-turbine towers. What makes their proposal even more concerning, is their apparently naïve faith that the "Green Hydrogen" that they are proposing to produce will actually benefit the planet, when a more considered analysis suggests that the opposite is actually the case.

My analysis of the WGEH proposal has led me to the realisation that others across Australia may be considering similar schemes. Where applicable, my comments are relevant to those schemes as well.

In response to an invitation to do so, I wish to make a submission to the Senate Standing Committees on Environment and Communications, concerning the subject of Greenwashing, with particular reference to the first two terms of reference, as per headings 1 and 2 below:

1. The environmental and sustainability claims made by companies in industries including energy, vehicles, household products and appliances, food and drink packaging, cosmetics, clothing and footwear.

I have very serious concerns about the commonly used term " Green Hydrogen ". In the narrow sense this term is used to describe hydrogen gas which has been generated by the use of electrical power derived solely from sources of renewable energy. Implicit in this definition is that, provided that no CO_2 generating fossil fuels are consumed in the production of this hydrogen, and subsequently released into the atmosphere, then all parts of the energy consumption process "down stream " of that mode of generation cannot, will not, and do not, have any negative connotations for global warming or for other adverse atmospheric impacts for our precious planet.

This is simply not true. It suggests that hydrogen, once contained under pressure, or fed through a pipe network such as is currently used for the domestic distribution of natural gas, is incontrovertibly an innocuous fuel for the production of clean, green energy. This inference is terribly misleading.

Where hydrogen gas is burned in air, or even where it is converted via the Haber-Bosch process into ammonia (NH_3), to create an alternate energy source which is subsequently burned, then commercial scale use of such an energy source simply replaces one set of problems with another which is potentially even worse. Instead of clean combustion, because nitrogen is an integral part of the atmospheric air providing the necessary oxidising agent for the combustion process, sundry oxides of nitrogen are also formed in parallel with the more publicised exhaust product, water vapour. These nitrogen oxides are an extremely serious problem, the impacts of which are discussed in more detail below under the second term of reference.

Instead of enjoying the term "Green Hydrogen ", it has been suggested in at least one recent report, that the alternative name "Ghastly Hydrogen ", would be more appropriate.

2. The impact of misleading environmental and sustainability claims on consumers.

Various forms of fossil fuel have been developed and refined over several centuries to date, so successfully that they are now making an unacceptably high contribution to global warming, as a consequence of their continuing impact on atmospheric levels of the greenhouse gas carbon dioxide (CO_2).

Hydrogen and ammonia have also been known for a very long time, and their use as an energy source has had ample time for development. Because of significant problems pursuing such a path, these potential alternate energy sources have up until now largely been sidelined.

Recently, however, there has been a good deal of publicity promoting the existence of so-called "Green Hydrogen" and its derivatives as a potentially clean alternative for replacement of fossil fuels that must inevitably be phased out.

Hydrogen and ammonia have been touted as energy sources providing a "clean" alternative to the burning of fossil fuels. It was quickly, and quite correctly, recognised that hydrogen, if generated as a consequence of a process involving the burning of fossil fuel, became part of the problem, not part of the solution. To distinguish clearly hydrogen gas produced by processes not dependent on the burning of fossil fuel, the name "Green Hydrogen" was coined. Unfortunately the more non-technical members of our community tend to extrapolate the connotations implicit in that name to suggest that hydrogen "can do no wrong". This inference is far from correct. Whether it is a consequence of inadvertent misperception or a wilful misrepresentation, the consequences are indistinguishable, but extremely serious.

Hydrogen generally exists in the environment in molecular form, in combination with other atomic elements. By far the most common form of hydrogen is as part of the water molecule H_2O, from which it is extracted by the process of electrolysis, which requires externally generated electricity. Further energy is required for handling of the resultant hydrogen gas which must be cryogenically cooled and highly compressed for storage with reasonable energy density. When hydrogen is burned in air, the resulting desirable exothermic chemical reaction is the re-combination of that hydrogen with the oxygen component of the air, resulting in the re-formation of the water it originally came from. At that point the energy expended in compression is lost, accounted for in the equations as a significantly less than 100% efficiency factor.

The predominant component of air is the gas nitrogen, and because of the heat generated during the burning of the hydrogen, an unfortunate spin-off of that process is the production at the same time of various oxides of nitrogen.

These oxides occur in three main forms, NO and NO_2, collectively referred to as NOx, which in combination with water form acids such as nitric acid, as well as N_2O, nitrous oxide.

The NOx do not have greenhouse properties anywhere near as significant as CO_2, but they unfortunately feature strongly in the generation of smog, and the destruction of the ozone layer, which is now only slowly being restored after globally phasing out various CFC and HCFC refrigerant gases under the auspices of the Montreal protocol. These modern refrigerants, incidentally were initially developed in part to replace the more difficult to use ammonia as a refrigerant.

While that is bad enough, nitrous oxide, otherwise known as laughing gas, has a global warming potential 300 times greater than CO_2, and thus replacement of CO_2 generating fossil fuel based energy systems with N_2O generating hydrogen based energy systems is hardly improving the situation, and could even rapidly make it worse.

Converting hydrogen into ammonia, NH_3, is not a solution to the problem. In addition to generating oxides of nitrogen directly from air-based nitrogen, the ammonia itself provides another source of nitrogen which simply further adds to the problem.

Of course, the creation of sundry oxides of nitrogen as an unfortunate side effect is not limited to the combustion of hydrogen, or ammonia, but has also been one of the inconvenient consequences of the burning of fossil fuels. To this end there has been considerable development over the last half century of devices known as catalytic converters, the purpose of which is to minimise the environmental impact of releasing such a cocktail of exhaust compounds into the atmosphere.

Unfortunately, treatment of exhaust gas by passing it through catalytic converters is only partially successful. When catalytic converters were first introduced, fuel for high compression engines was augmented with an anti-knock additive, tetra-ethyl lead, to prevent compression-based pre-ignition. With the advent of catalytic converters this additive had to be removed from petroleum fuels as its continued use quickly and completely rendered catalytic converters ineffective. While it is claimed that brand new converters work with about 99% efficiency that figure rapidly falls away with use. It is estimated that catalytic converters on most engines degrade to around 60% or lower efficiency for a vehicle that has travelled 45,000 km. This is only a small fraction of the expected life of modern engines, and unless converters are regularly replaced at considerable expense, the degradation progressively continues. It has even been suggested that a percentage of nitric oxide and nitrogen dioxide gas could be changed to nitrous oxide in catalytic converters, and it is also well accepted that catalytic converters perform best at high temperatures and do not function effectively upon start-up of a cold engine. In some climates, and at some times of the year it is doubtful whether they ever achieve a desirable operating temperature.

Failure to deal adequately with this in future could render the entire planet, or, if we are lucky, only significant portions of it, uninhabitable. This would be an impact we should do our best to avoid, and is hardly an appropriate outcome for an energy cycle predicated on replacing fossil fuel with so-called green hydrogen.

The world population late last year passed 8 billion people. In 1927, approximately 100 years ago it was only 2 billion people, and 100 years before that, in 1810 it passed 1 billion people. This rate of population increase puts enormous pressure on many aspects of our society. We cannot afford to repeat the mistakes of the past and do not have the luxury of sufficient time to indulge in a new set of mistakes. Our own Bureau of Meteorology data shows that for the past 100 years we have been seeing a consistent 20 year doubling of the frequency and intensity of extreme weather events, floods, fires, etc. We have had plenty of warning if we had cared to take notice. It is a bit later now than it needed to be. Insurers and governments are having trouble coping with the rate of change. Is so-called green hydrogen the answer to the mess we now find ourselves in, or just another ill-thought-out knee-jerk reaction with the potential to waste our time and get us into even deeper problems?

Grant Gartrell

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