Submission to Productivity Commission re Barriers to Effective Climatic Change Adaptation

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and Author of:

Climate Change: An Australian Guide to the Science and Potential Impacts, ed. Barrie Pittock (2003) (1.4Mb), Australian Greenhouse Office, and
Climate Change: The Science, Impacts and Solutions (2nd. edition), Barrie Pittock, March 2009: see http://www.publish.csiro.au/nid/20/pid/6010.htm.

This is a personal submission. I write as a climate change scientist and contributor to four major reports by the Intergovernmental Panel on Climate Change, several books and over 250 scientific papers. I also have some long extra-curricular experience in relation to Aboriginal affairs.

There are five key points that I think are important to climate change adaptation in remote parts of Australia:

1. *Action requires both an understanding of the climate change problem and an acceptance of the need for a risk management framework in developing appropriate policies in the face of a degree of scientific uncertainty.* On this point please see my article, attached, which is about to appear on the website *The Conversation*, which is sponsored by CSIRO and the universities.

2. *This question of risk is very important for remote parts of Australia where increased heat, sea-level rise, and other extreme events such as floods, drought and fire will make adaptation especially difficult.* Added to that is the likely rise in the price of oil-based fuels, notably diesel, on which many remote communities rely for power generation, transport fuel and especially aircraft fuel. I have reviewed some of these problems with extensive references to the recent literature, in a paper recently published in *The Rangelands Journal*, a copy of which is attached and with open access. In that paper I argue that a key adaptive strategy in remote areas is to develop large-scale renewable energy resources which they are blessed with, namely solar, wind, geothermal, tidal and current power. The most plentiful of these is solar power. Recent developments in the building and commercial applications of concentrated solar power in Spain and increasingly in the United States suggest that this is a potentially economic way to go.

Several key problems confront this form of adaptation and they are outlined in my RJ paper. These include particularly access to energy markets. This presently means that solar power has only been developed in remote Australia on a localised small scale for local use, notably through the efforts of *Bushlight*, a subsidiary of the *Centre for Appropriate Technology* (CAT), which has by now installed mostly small photovoltaic systems in some 150+ remote communities.

Large-scale renewable energy generation requires either that the generators are connected to the national electricity grid, or that the power can be used locally or exported by other means. The first option requires substantial investment, although probably no more than for the National Broadband Network, and with the possibility of making Australia self-sufficient in renewable electricity, thus substantially meeting Australia's goals for reducing its greenhouse gas emissions.

3. *The use of renewable electricity on site to generate hydrogen, or perhaps better, still ammonia, which can be transported readily by road or rail tanker or pipeline or used to manufacture fertiliser.* This can be done by using the electricity generated to electrolyse water, thus generating hydrogen. Hydrogen can be used directly in fuel cells or otherwise as a fuel in internal combustion engines, but it has low energy density and is difficult to transport. On the other hand, ammonia can be produced from hydrogen by combining it with nitrogen from the air at high temperatures (the so-called Haber-Bosch process), which can be generated with large solar power installations, especially concentrated solar power.

$$3\ H_2 + N_2 \rightarrow 2\ NH_3$$

Ammonia is often seen by renewable energy advocates as a means of energy storage, where the ammonia is generated when there is sunlight and later decomposed in a highly heat-generating process to make electricity via turbines. This latter use is cyclic, but what is proposed here is a one-way process, where the ammonia generated is used off-site as a fuel or fertiliser. On a suitable scale, and with the best available technology, this may well prove economic compared with extending the electricity grid. I attach several papers that touch on this subject from different points of view. The Solar Thermal Group at ANU may well be the best Australian authorities on this, although their emphasis is on using ammonia as an energy storage medium for baseline power applications, rather than to use energy generated off the grid. Key contacts are rebecca.dunn@anu.edu.au or keith.lovegrove@anu.edu.au.

Access to sharing existing gas pipelines may also be an issue.

4. *A key problem with my suggestions is the availability of water on site in remote areas.* Water for the operation of large-scale solar energy installations may well be less of a problem with modern low-water-use technologies, but water would be needed for electrolysis to generate hydrogen. This may prove difficult in some locations.

5. *Other key issues are the clear social advantages or co-benefits of large-scale generation of renewable energy in remote areas, as argued in my Rangelands Journal paper, provided development is done with the express support and involvement of the communities involved, and that jobs for locals are a key part of the strategy.* I have talked with representatives of Bushlight, the Centre for Appropriate Technology and the Central Land Council in Alice Springs last September re these ideas. They seemed keen on the idea in principle and as a piece of strategic thinking, but they are all very heavily committed to more immediate projects. My view is that with the federal government's moves towards reducing greenhouse gas emissions, and the rising price of diesel fuel,

now might well be the time to move on these ideas. It will require local support and a comprehensive program to involve locals via preferential employment and training. Bushlight already does this where appropriate in regard to their smaller-scale installations, but a more comprehensive training programme may be needed, perhaps in collaboration with such bodies as the Batchelor Institute.

The economics will of course be affected by economies of scale, the cost of any supporting infrastructure, and rapidly developing technologies. Ammonia production for fertiliser is already a large industry, as is pipeline technology, so some elements of the necessary technology are already well-developed and commercially available. And in case there is any doubt, liquid ammonia transport is already well proven and has a good safety record (better than gasoline) as is well documented on several websites.

I hope you find these comments relevant to your deliberations. I would be happy to respond to questions, although I am not an engineer, chemist or economist, so other expertise is needed.