

# GEOTHERMAL ENERGY AS A PRESENT VIABLE OPTION FOR CLEAN LARGE SCALE BASE LOAD POWER GENERATION.

## A SUBMISSION TO THE GARNAUT CLIMATE CHANGE REVIEW

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Summary: The possible effects of climate change are wide ranging, act indiscriminately w.r.t. class and biological species, and may be irreversible if not addressed with some speed and persistence.

In this submission it is suggested how emissions from the foremost contributor, electric power generation, can be reduced very significantly in a medium time scale with present technology, although some incentive provisions may need to be made by government.

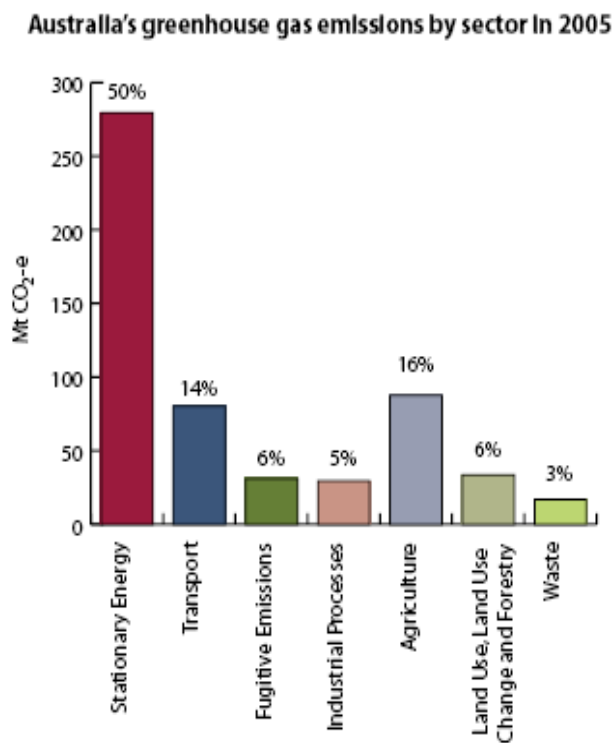
### THE LARGEST CONTRIBUTOR OF EMISSIONS

Solutions to finding reductions greenhouse emissions are subject to some key constraints,

- a. Urgency. Measurable increasing temperature effects can lead to tipping points in parameters. Some effects may therefore be irreversible. The habitats of some rarer species are already considerably affected. 2020 or even 2050 on both evolutionary and geological time scales are very short.
- b. The lead times required to scientifically discern any appreciable change in some parameters.
- c. The large scale of human activity and the determination required to exercise some meaningful control.

Consideration therefore needs to be given to seeking those sources that make the greatest contribution to CO<sub>2</sub>-e emissions and for which a viable commercial alternative could exist. The National Greenhouse Gas Inventory (2005) has assessed Australia's emissions by sectors and has shown that 50% comes from the Stationary Energy category. (See histogram next page.) Furthermore, 69.5% of this derives from the generation of electricity, i.e. 34.7% (194.3 Mt equivalent CO<sub>2</sub>) of the national total in 2005. This is the single largest contributor to emissions in Australia. It thus becomes clear that any replacement of coal fired generating plant by a zero

emission supply, whether by direct phasing out or by gradual retirement, will have an immediate and significant effect in decreasing the figure of 34.7%. ABARE estimates that Australian demand will require 8500 MW of new capacity by 2020.



## GEOHERMAL PROSPECTS

As a zero emission base load power candidate geothermal energy has the excellent prospects for reasons that,

1. There are no emissions. Hot brines flow in closed loops to the surface, the heat is extracted, and the fluid is returned to the hot rocks below.
2. No new technology is required. A vast array of techniques is presently available from the oil and gas industry.

3. The technology is basically simple, reliable and available. The principles could easily be exported to less developed countries to aid reduction of their emissions.
4. Australia is well endowed with appropriate geological conditions and locations for high temperature radiogenic granites.
5. Geoscience Australia (Geothermal Roundtable, March 2007) has produced preliminary maps and figures to indicate that Australia has heat resources between 5km depth and 150 C isotherm amounting to 120 M PJ of energy, theoretically sufficient to meet Australia's electrical energy needs for many centuries. (This figure is actually 20 000 times Australia's 2004/5 consumption. Ibid p.14. However this energy is not all extractable economically.) For purposes of comparison with coal reserves Australia has 1.3 MPJ of black and brown coal, while hot rock resources are, 2.5 MPJ inferred plus 0.4 MPJ delineated (extractable).
6. When emissions penalties of \$30/tCO<sub>2</sub> are added to the cost of coal fired production its cost rises to \$68 /MWh. The cost of clean geothermal power stays at \$55 /MWh which on that basis become more than competitive with coal.
7. Several geothermal companies have developed their projects to advanced levels being in different stages of exploration, drilling and testing (Petratherm and Green Rock), and full circulation testing on completion of both insertion and production wells (Geodynamics). Approximately 30 companies are in process of acquiring Geothermal Exploration Licenses.

## STATUS OF GEOTHERMAL POWER PRODUCTION

The question will be asked, is geothermal power a present realistic option? Is it too soon to be recommending such technology? The answer seems largely one of how quickly can we get the project components together since essentially no new technology is required. The difficult parts, if any, of how to develop underground heat exchangers through artificial stimulation have already been achieved. Leading sector company, Geodynamics, have had major success beyond expectation in engineering good fluid flow rates between adjacent pairs of wells. Drilling wells to 5000m (as in the oil and gas industry) is understood as routine. Building and operating steam turbines has been performed for centuries and is the classic expertise of the present coal fired generating plants in Australia.

Do we actually have significant identified geothermal resource sites? Australia is recognised as having some of the best sites in the world for development of Hot Fractured Rocks. One such in

the Cooper Basin, being developed by Geodynamics, is of a scale that it could easily provide reliable base load power at a capacity of 10 000 MW. (Australia's present total generating capacity is 45 000 MW.)

Petratherm is planning to eventually generate 520 MW from its Paralana location in the northern Flinders Ranges while Green Rock Energy intends to build a 400 MW plant near Olympic Dam. Panax Geothermal hopes to expand to 250 MW in each of three basins on the Limestone Coast of S.A.

Thus every science and engineering step in the process of geothermal power production is already well established and the formal exercise of turning a generator spindle will occur for Geodynamics by end 2008.

#### LIMITATIONS TO PRODUCTION ROLL OUT

For well over a 100 years until relatively recently virtually all generation, transmission, and distribution of electrical power was government controlled and financed. Such infrastructure was regarded as crucial to the progress and building of the country and therefore it was the prerogative and responsibility of government. Now privatization is the trend and new entrant companies are subject to markets as well as to the competition of large scale coal fired plant and infrastructure placed in locations with previous government support. If there is any urgency in establishing zero emission power supplies then the fledgling geothermal companies will need some assistance. This could take the form of special loans or incentives such as infrastructure roads received some years ago. In the neighbourhood of the Cooper Basin of S.A. a number of companies (Green Rock Energy, Petratherm Ltd, Eden Energy, Pacific Hydro, and Geodynamics) have serious renewable energy projects in train which are all remote from the NEM network. The Federal Government should consider options such as providing the transmission lines to the level the playing field.

#### INTERNATIONAL POLICY

As each country changes in stages from being less developed to highly industrialised it is inevitable that the demand for electric power increases by an order of magnitude or more. World gas emissions are thus set to rise even if first world countries could contain theirs.

It therefore behoves us to not only cut our electric power emissions by example but to help provide the means for smaller countries to do the same. Providing free nuclear fuel may not be the best answer. On the other hand making available expertise to discover and develop appropriate geothermal sites will enable poorer countries to access clean power with relatively

simple technology. The World Bank could also be encouraged via our government to make funding assistance of various kinds available for such projects. The international kudos for Australia could be substantial.

Perhaps it should be noted that Australian company, Panax Geothermal is exploring sites in Kyrgyzstan and in India. It is also on the point of deep drilling on the Limestone Coast project in S.A. (See [www.panaxgeothermal.com.au](http://www.panaxgeothermal.com.au))

## RECOMMENDATIONS

Given the will and a sufficient time, most of the 34.7% of Australia's greenhouse emissions from electric power plants can be eliminated by adoption of geothermal generation as the norm.

Recommendations:

- A. That it should be recognised that geothermal power generation is the only economic clean reliable base load power source for Australia's future.
- B. That in view of the urgency of potential climate change effects the Federal Government be encouraged to provide appropriate funding assistance mechanisms to expedite the actual development and construction of geothermal power plants.
- C. That whether for goodwill or for international duty, the Australian Government considers how best to support development of geothermal resources in lesser developed countries in order that harmful atmospheric emissions be reduced on a collective basis.

Personal note. Perhaps I need to add that I am not an employee of any geothermal company nor do I stand to gain from any related enterprise. I recognise the establishment of geothermal power as one ideal commercial solution to emissions for both Australia and the planet. Jaan Boersma