Tasmanian Energy Security Taskforce

Consultation paper

Submission Form

This document provides a form which respondents may find helpful in providing answers to the questions presented in the Taskforce's consultation paper. The Taskforce recommends that you read the consultation paper to understand the context in which the Taskforce has posed the questions. The Taskforce will also welcome submissions in other formats should respondents prefer not to use this form.

Should you wish to claim confidentiality in relation to all or part of your submission, please clearly indicate the reasons for your claim. If only parts of your submission are requested to be confidential, please attach the confidential parts separately to the remainder of your submission that is suitable for publication.

Submission details	
Name:	Dr John Bishop
Organisation (if applicable):	
Contact (optional and not to be published):	

1. What are the specific risks to Tasmanian energy security that you think the Taskforce should consider?

Tasmania faces a series of energy security risks which the Taskforce should consider:

- The reliability of the National Electricity Market and the ability of the NEM to provide supplementary electricity to Tasmania when necessary. The supply and demand balance within the NEM is expected to be increasingly volatile the NEM's ability to dispatch electricity to Tasmania may be limited;
- The reliability on the Basslink interconnector to transfer NEM sourced electricity;
- Tasmania's hydro resource and the impact of prolonged weather events (e.g. drought) on this resource;
- The impact of each of the aforementioned on the price stability of electricity within Tasmania. Price certainty is one of the competitive advantages of Tasmania industry and compromising Tasmania's ability to offer predictable power supply and pricing would materially impact Tasmania's economic prosects.

Each of the risks outlined above could be materially mitigated by Tasmania's Inferred Geothermal Resource, which has the potential to supply the State with a significant amount of low cost base load renewable energy. However there is a risk that this untested potential is not adequately understood or evaluated before commitments are made for potentially more costly alternatives. Fortunately this geothermal potential could be determined relatively cost effectively, by drill testing the target that was defined in 2009 by Tasmania's only geothermal specific exploration program to date. This target is arguably better than those on mainland Australia (see accompanying statement). Unfortunately there is very limited private capital available to fund such exploration after the Industry faltered in 2009 due to largely external factors[1]. The Taskforce should consider whether it is in the State's interest to directly fund or provide sufficient incentives for Tasmania's geothermal potential to be adequately tested.

[1] Budd and Gerner, *Externalities are the Dominant Cause of Faltering in Australian Geothermal Energy Development*, Geoscience Australia, 2015

2. What risks are acceptable to you or your business in terms of energy security and the risk/cost trade off? How well are you or your business able to manage energy supply disruptions?

Our business is principally focussed on generation of stable, low carbon base load energy rather than being an energy consumer. Geothermal Energy has the potential to generate very cost competitive base load renewable energy in Tasmania. This opportunity should justify the exploration uncertainty but private risk capital is not available in the current environment.

3. What level of reliable electricity supply is required by customers? Do customers

consider reliability should be as close as possible to 100 per cent at all times, or would, for example, reliable supply closer to 99 per cent of the time be acceptable if the cost is significantly less?
If the geothermal resource is developed, Tasmania has sufficient natural resources to ultimately provide 100% availability of renewable energy and to provide industry with stable, predictable energy supply.

4. How well are Tasmania's energy security risks understood and communicated to the community?

Tasmania's energy security, or lack of it, appears to be well understood by the community. However there is a poor level of understanding regarding:

- the importance of table base load supply (rather than more volatile energy resources such as wind);
- the significance of stable, long term power prices to the Tasmanian economy;
- value of ancillary services that can be provided by technologies like geothermal; and
- lastly, geothermal energy and its potential to reduce risk and promote Tasmania economic development[2].

[2] Budd and Gerner, *Externalities are the Dominant Cause of Faltering in Australian Geothermal Energy Development*, Geoscience Australia, 2015

5. What existing frameworks for assessing and monitoring energy security might the Taskforce wish to consider?

N/A

6. Which potential energy security solutions should the Taskforce consider?

See attached statement on geothermal energy.

7. What international examples of water storage management practices should be considered by the Taskforce when reviewing Hydro Tasmania's approach?

N/A

8. What governance arrangements might be useful to consider in strengthening water storage management in Tasmania?

N/A

9. What economic opportunities and risks are there for Tasmania associated with a second Bass Strait interconnector, and how would it improve Tasmania's energy security?

Tasmania has the potential to become an energy exporter to the NEM generating significant investment and economic development for the state. The NEM is currently lacking low carbon base load with limited resources available to meet this requirement in future. The lack of clean base load power will limit the ability to deploy intermittent renewables (egg wind and solar) within the NEM.

Tasmanian hydro and Geothermal Energy resources could be exported through a second Bass Strait interconnector and would provide both base load supply and ancillary services to the NEM. Other states ought to pay a premium for stable, clean power supply from Tasmania where it is lower cost than alterative sources.

By supporting the expansion of Tasmania's energy generation capacity Tasmania's own energy security issues would be addressed. There would be excess generation capacity within Tasmania irrespective of short term issues with the interconnectors.

10. How might the Taskforce consider the role for gas generation in Tasmania relative to other options to maintain energy security and the associated costs and risks?
Tasmania's competitive advantage in energy production is in its geothermal, hydro and wind resources. Every effort should be made to ensure that Tasmania employs renewable energy, thereby enhancing its valuable 'green' image and support the broader decarbonisation objectives of the NEM.

11. What can be done to strengthen the Tasmanian gas market without significant subsidy from Government and costs on taxpayers or consumers?
N/A

12. How could the potential expansion of renewable energy generation in Tasmania help long term energy security without creating increased costs for consumers?
Given the long-established and fully amortized nature of Tasmania's present power generation, any new capacity (renewable or otherwise) would almost certainly mean an increased cost for consumers. However, renewable energy (including geothermal energy) now has the potential to be highly competitive with alternative forms of new capacity whether fossil fuel or renewable.

13. Which renewable energy technologies and products present the best opportunity for Tasmania and why?
Geothermal Energy. See attached statement.

14. Is there a limit on the level of intermittent renewable generation that Tasmania can sustain without affecting the reliability of the network, or requiring significant cost to strengthen the network?
N/A

15. Are there material barriers to the take up of emerging energy products and services in Tasmania?
Private capital is not adequately incentivized to invest in the early stage development of geothermal energy.

16. Is there a timeframe where renewable energy developments could be more favoured in Tasmania than elsewhere?
Yes, see attached statement.

17. What impact will the national commitment to reduce carbon emissions have on renewable energy development in Tasmania and in the wider NEM?
SEE ATTACHED STATEMENT.

18. Are there other climate change related implications for energy security in Tasmania?
Climate change is likely to have relatively minor implications for Tasmania's energy balance, such as the amount of rainfall that can be harnessed, and the negative perception towards burning fossil fuel for electricity generation. Note: Climate change will have a near-zero impact on the performance of a geothermal power plant. (The only expected impact would be a negligible decrease in the efficiency of the cooling process in a warmer climate.)

19. Are there other scenarios with energy security implications in Tasmania that the Taskforce should be considering?
Significantly increased energy demand in Tasmania. Increasing cost of diesel fuel

Are there any other comments or input that you would like to provide to the Taskforce?
This submission (see accompanying separate document) is primarily concerned with informing the taskforce of the several advantages to be gained by including geothermal power in any program for increasing Tasmania's power capacity.

Do you wish to claim confidentiality for all or part of your submission? Please explain your reasons for seeking confidentiality.
N/A

Accompanying Statement to the Tasmanian Energy Security Taskforce

The Case for Geothermal Electricity Generation in Tasmania

Summary

Following Tasmania's recent energy crisis, an Energy Security Taskforce has been established to report on how Tasmania's future energy security can be strengthened, and at what cost. In this context, it is important for the Taskforce to consider the State's inferred geothermal resources that were defined by KUTh Energy Ltd's shallow drilling program in 2009.

Geothermal energy has a proven track record of delivering long term base load renewable electricity in more than eighteen countries across the globe, including the original and still active Larderallo plant where geothermally generated electricity was first produced in 1903.

The energy potential of a geothermal system is determined by the size, depth and temperature of the heat source and the ability to extract sufficient heated water. Thus Tasmania's recently defined geothermal resources are likely to be of high quality, because KUTh's exploration results indicate that the resource is already fractured, saturated and sufficiently hot. If such a naturally saturated geothermal resource does exist then it would have considerable advantages over the Enhanced Geothermal Systems (EGS) that have been the focus on mainland Australia, which require artificial fracturing and the injection of additional water.

The next phase of KUTh's evaluation was a deeper drilling program to confirm the presence of a naturally saturated geothermal resource, and thus the geothermal potential, but this was constrained by a lack of capital and other external factors. Fortunately this work can still be done with an exploration hole that would be relatively inexpensive compared to the overall capacity potential. If the inferred target is proved through deeper drilling then Tasmania would have a geothermal resource that is highly amenable to power generation at a lower Levelized Cost of Electricity than other geothermal projects in Australia.

This document describes how a geothermal resource with a number of very desirable, and relatively favourable characteristics has been (independently) interpreted for Tasmania, and argues that at the very least a drill hole should be completed to confirm its potential. If so, then Tasmania will have the means to not only ensure its own energy security but should also be able to export low cost base load renewable electricity. Further, the goal would be achievable via a series of incremental steps, with each step supplying several more Megawatts.

Tasmania's Geothermal Resource

Two inferred geothermal resources have been defined in Tasmania under the Australian Code for Reporting Geothermal Resources and Reserves[2].

An inferred resource of recoverable energy of 11,000 PJ_{th} was estimated for the *Lamont Geothermal Resource* in central-eastern Tasmania. This resource would be capable of meeting all of Tasmania's current power demand of around 1500MW for more than 30 years.

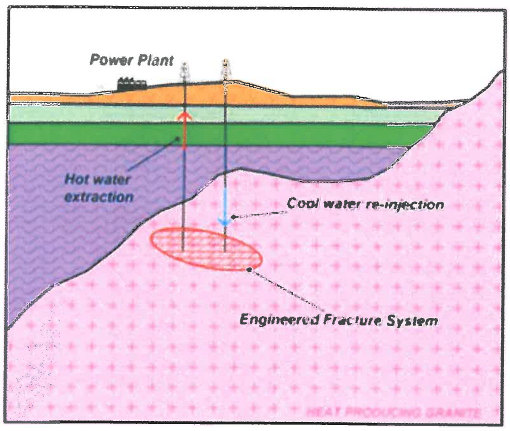
A second separate resource of 3,900 PJ_{th} of recoverable energy was defined at the *Fingal Geothermal Resource* in north-eastern Tasmania, which would be capable of running a 500MW power station for more than 30 years.

At both locations, confirmatory drilling and a feasibility study is required to advance the resource status from 'inferred' to 'proven'.

It is envisaged that binary heat exchangers (producing zero-emissions) would be used, with an incremental approach whereby the installed capacity (and therefore capital expenditure) would increase over time along with the number of holes drilled.

The Tasmanian geothermal resource developed by KUTh Energy is materially different to the Enhanced Geothermal System (EGS) targets being pursued on mainland Australia. EGSs are usually more expensive to develop due to a reduced water flow and harder rocks resulting in tougher drilling. However, analysis of the existing data suggests that these constraints will not apply to Tasmania's resources. In Tasmania's case, high flow rates of steam and water should be obtainable from a naturally fractured area within or close to the heat source. Figure 1 compares the interpreted geothermal situation for Tasmania with that of a typical EGS project.

The economics of Tasmania's geothermal resources are similar to those of Tasmania's (now mature) hydro-electric industry. The resources are of roughly comparable size (~2000MW), and in both cases a relatively high capital cost was/would be incurred, followed by relatively low operating costs. The Tasmanian Government was the driving force behind Tas Hydro and similar leadership would be needed to develop Geothermal.



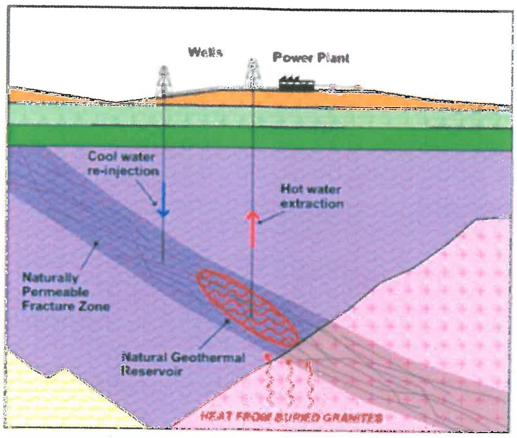


Figure 1. *A cross-section of a typical EGS (an Enhanced or Engineered, Geothermal System) on the left, compared with the interpreted setting for Tasmania on the right. Assuming a similar reservoir temperature in both cases, the electricity generated by typical EGS will be constrained by the flow rate between the two holes (even when enhanced), whereas the Tasmanian case should have no such limitation. The Tasmanian case should also have cheaper, faster drilling, with no requirement to place the return water well adjacent to the production hole (from Holgate, 2009)[3].*

Additional Benefits

As well as producing electricity, geothermal power can be used for a number of other commercial activities and something similar to Iceland's geothermal plant at Svartsengi is envisaged. As well as producing $75MW_e$ (plus $190MW_{th}$ for direct heating), Svartsengi has several associated enterprises including a thermal pool, wellness clinic, methane production unit and a carbon recycling centre, with a total employment of around 700 people (see www.resourcepark.is). A Tasmanian project could replicate most if not all of these activities.

Other parallels can be drawn with Iceland whose population of around 323,000 enjoys a similar high standard of living to Tasmania's. Like Tasmania, Iceland has a number of energy-intensive companies as well as with a growing number of visitors attracted by beautiful landscapes and untouched scenery. Iceland currently derives around 70% of its power from hydroelectricity but now relies on geothermal to increase capacity.

Geothermal Facts and Perceptions

Geothermal power is widely admired and (rightly) regarded by the public as a renewable, low-emission (near-zero emission for binary systems) and smart way to produce power. Global installed capacity increased steadily over the last sixty-five years (Figure 2). However, Australia has been a notable exception with only one very small plant producing electricity (at Birdsville, in Central Australia). This is in contrast to Germany, for example, which also has no recent volcanism but has nevertheless successfully installed more than twenty direct heating and/or electricity generation geothermal plants in the last decade[4].

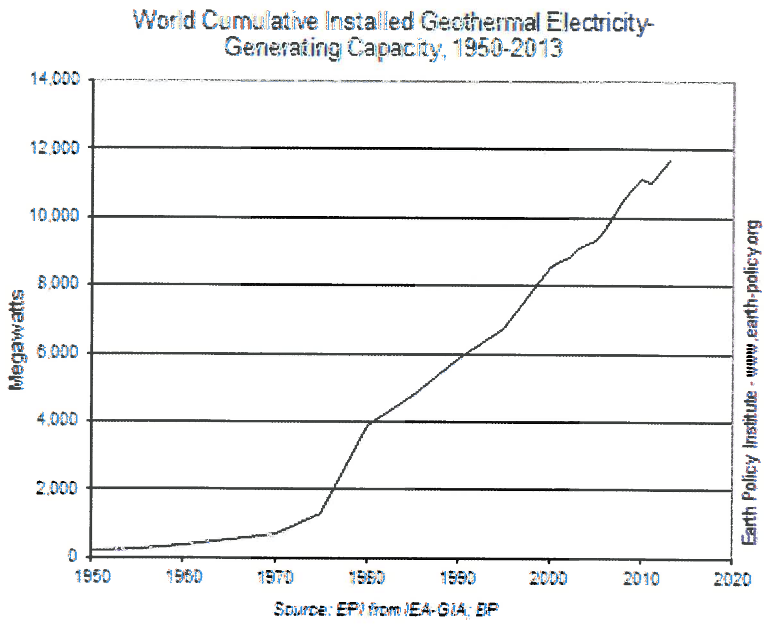


Figure 2. *Global installed geothermal electricity generation has shown good growth over the last sixty years, with Australia a notable exception: see text for detail.*

A number of factors have been identified as contributing to the lack of geothermal energy in Australia[4]. Although these are almost entirely non resource-related, the lack of success has led to a widespread scepticism towards geothermal in Australia. This misconception has been reinforced by Geodynamics, the previous leading geothermal company in Australia, exiting the sector after several major setbacks at their main project in Central Australia. Geodynamics also suffered from a 'chicken and egg' situation, whereby the resource development could not be financed without connection to the grid (a 'billion dollar' additional expense), and no grid connection could be financed without first proving beyond doubt the existence of a large, viable resource.

Thus any attempts to privately finance geothermal energy in Australia has the challenge of overcoming the legacy of previous stalled projects. However, Tasmania has a number of exceptional and possibly unique advantages[2]. These include:

- Tasmania's geothermal resources although rural (and removed from any population centres), are 'under the wires'. Thus a very low cost to connect to the grid.
- The main *Lemont* resource appears to be intersected by a large fracture zone. In which case, the expected high permeability could dramatically reduce the cost of power production.
- Tasmania's mild climate would increase the plant's working temperature contrast (c.f. the Australian mainland) and thus add to the overall efficiency.

Levelized Cost of Electricity

There are various ways of measuring the cost of electricity as well as different types of geothermal systems, but geothermal energy plants tend to have a high capital cost and low operating cost relative to other forms of energy[6]. Figures 3 and 4 are taken from The Australian Academy of Technological Sciences and Engineering 2011 Report into Levelised Cost of Electricity for a Range of New Power Generating Technologies. The expected capital cost for a naturally fractured system is expected to be lower than the cost estimates shown here, which are based on Enhanced Geothermal Systems which have more difficult drilling and additional fracturing. Operating costs of naturally fractured systems tend to be lower than EGS because of better fluid flow and heat transfer characteristics.

Figure 3. Comparison of capital costs ($/kW) for 2015[6]

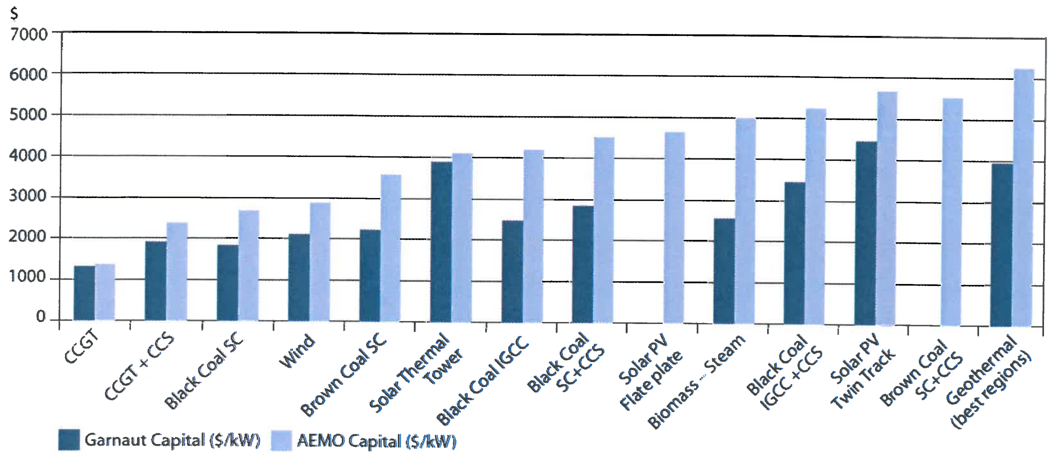
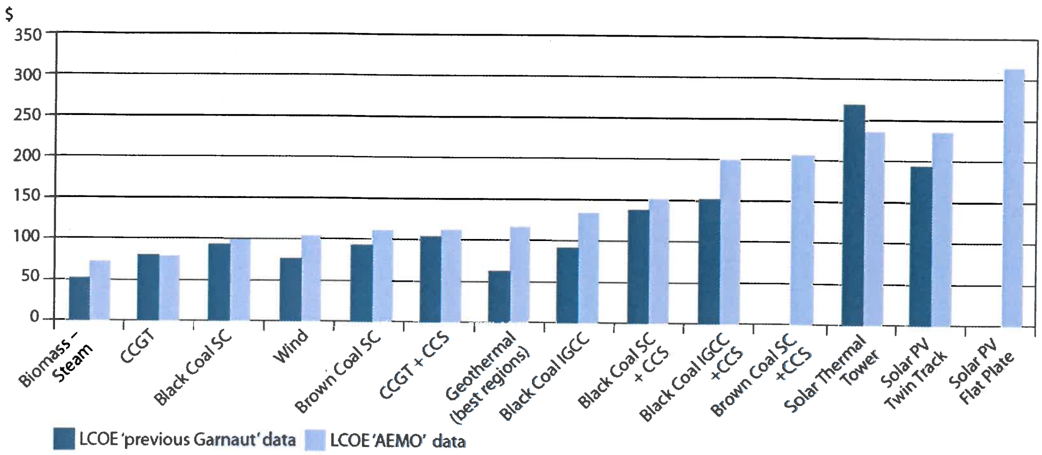


Figure 4. LCOEs ($/MWh) for different technologies in 2020[6]



A study by the USA Energy Information Administration (EIA) predicts that by 2020, geothermal energy will be the cheapest option for the USA (Figure 5). Geothermal is already the lowest cost form of generation in the EIA's Annual Energy Outlook for 2016. (http://www.eia.gov/forecasts/aeo/pdf/electricity_generation.pdf)

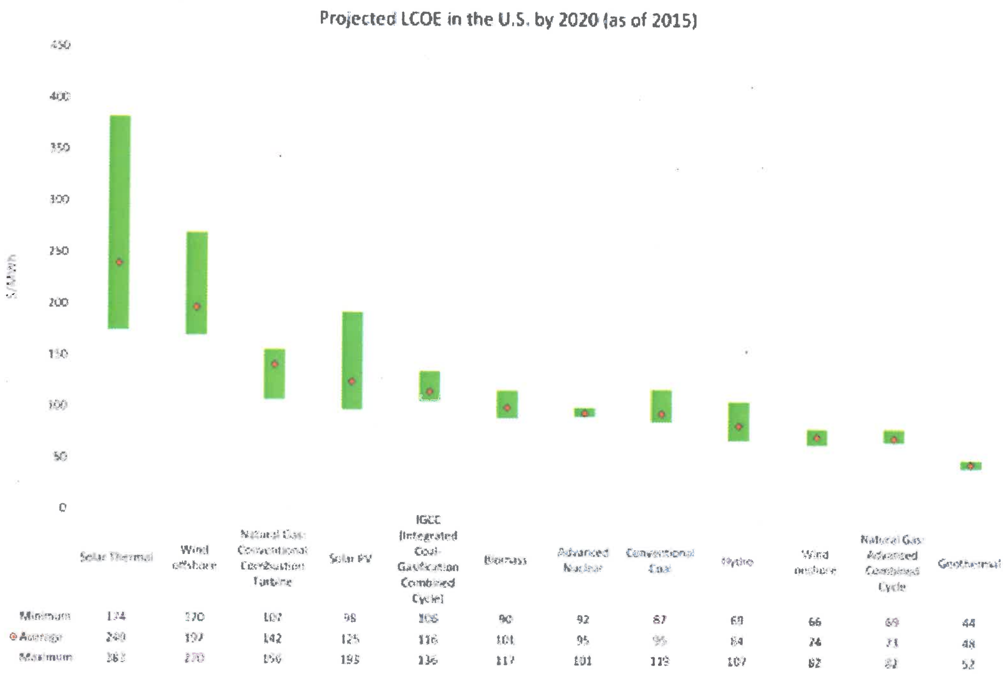


Figure 5. *Geothermal Energy is predicted to have the lowest levelized cost of electricity in the USA by 2020 (from https://en.wikipedia.org/wiki/Cost_of_electricity_by_source)*

One attribute shared by all geothermal systems, but possibly not widely appreciated or adequately factored into the LCOE, is that although geothermal is generally used for base-load supply, it can also be used for peak-load and load-following purposes[7]. This feature would be important if geothermal were to be used in tandem with non base-load generators such as wind and solar.

Conclusion

Given the high potential of Tasmania's recently defined inferred geothermal resource, and the relatively low cost of proving this potential, a confirmatory drill hole is recommended. If the geothermal resource is sufficiently hot, fractured and saturated (as is expected) then a geothermal power plant should be a viable means of securing Tasmania's energy security – and be a potential exporter of electricity – well into the future.

Disclosure

The author was the founding chairman of KUTH Energy Ltd which held a special exploration licence in eastern Tasmania from 2005 until the takeover by Geodynamics Ltd in 2014, and defined the two geothermal resources. He is also a signatory to a recent new application for an exploration licence covering these two resources.

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9th September, 2016

References

[2] See KUTh Energy Ltd ASX releases; eg, 17 November, 2011: http://www.asx.com.au/asxpdf/20111117/pdf/422lcl4p8hnqmn.pdf

[3] Holgate, F.L. et al, 2009. *Exploring Eastern Tasmania: a novel Geothermal Province*. Australian Geothermal Energy Conference, November, 2009.

[4] Weber, J. et al, 2015. *Geothermal Energy Use In Germany*. Proceedings WGC, 2015. https://pangea.stanford.edu/ERE/db/WGC/papers/WGC/2015/01045.pdf

[5] Budd, A. and Gerner, E., 2015. *Externalities are the Dominant Cause of Faltering in Australian Geothermal Energy Development.* Proceedings WGC, 2015. https://pangea.stanford.edu/ERE/db/WGC/papers/WGC/2015/04015.pdf

[6] The Australian Academy of Technological Sciences and Engineering, March 2011. *The Levelised Cost of Electricity for a Range of New Power Generating Technologies.* http://www.garnautreview.org.au/update-2011/commissioned-work/new-power-cost-comparisons.pdf

[7] http://geo-energy.org/reports/2015/Firm%20and%20Flexible%20Power%20Services%20from%20Geothermal.pdf