Advancing Geothermal Energy — Opportunities, Options and Strategies

A PRELIMINARY DISCUSSION ON MAXIMISING SUCCESS IN AN ENVIRONMENT OF HIGH UNCERTAINTY AND RAPID CHANGE

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ABSTRACT

With energy security and climate change as the backdrop, there is an urgent need to diversify national and international energy portfolios to include renewable and near-zero emission generating energy sources and technologies. This paper provides a preliminary concept and discussion on a current project, "Advancing Geothermal Energy – Opportunities, Options and Strategies". The project is due for completion in June 2008.

In this paper we attempt to provide a clear description of the project. This includes key theoretical frameworks and concepts being used within the project and commentary on preliminary project findings. These findings include the emerging major factors and uncertainties facing the geothermal industry.

We propose that the combined use of new theoretical frameworks and leading-edge concepts that incorporate uncertainty and dynamism can yield significant insight for parties interested in geothermal energy, in particular energy players and geothermal players. This insight holds the potential for players to make significantly enhanced strategic decisions, undertake an enlightened management of options and understand the relevant uncertainties and shaping factors within which the options are contextualised. In summary, by moving beyond technical focus and traditional strategic approaches, geothermal companies can advance their commercial interests and maximise the likelihood of success in an environment of high uncertainty and rapid change.

About the Project

NEGOTIACTION is undertaking this research and analysis project through our cross-disciplinary, innovative NEGOTIACTION Challenge project model (see Appendix 1.0). With energy security and climate change as the backdrop, there is an urgent need to diversify national and international energy portfolios to include renewable and near-zero emission generating energy sources and technologies.

Different challenges and opportunities for deployment and diffusion are associated with each technology, and these influences may vary significantly across and within different states [1], different time horizons and in light of different plausible scenarios and environmental outcomes. Some key issues for consideration include:

- Poorly defined economic costs, market share and technology improvements in the emerging carbon economy;
- Some remaining uncertainty about technological feasibility;
- The rate at which alternative energy sources can be diffused; and

- Community perceptions about each technology (that may or may not be soundly or objectively based) [5].

In Australia, geothermal energy is one such potential energy source and there are a number of drivers and uncertainties that are informing the decision making agenda and shaping the risks and opportunities for different types of energy players. To date a variety of perspectives and expectations have been posited about geothermal energy in Australia, in particular pertaining to hot dry rocks.

This initiative is focused on two commercial perspectives. One perspective covers energy players seeking to understand potential plays[1], shaping factors, uncertainties and the design of options in taking an interest within the geothermal industry. The other perspective covers the perspective of geothermal energy companies seeking to understand potential plays, shaping factors, uncertainties and options in enhancing the likelihood of their success through better managing uncertainty and the design and implementation of market strategy.

We intend to generate insight and provide enhancements in the use of critical futures, strategy and energy frameworks in advancing emerging geothermal technologies under significant uncertainty. This project will have a number of potential avenues through which the geothermal industry and those interested in participating in it could stand to benefit. The four outcomes that we are seeking to generate through this project are:

- An outlook on the extent to which geothermal energy could shape Australia's energy future.
- Identification of plays available to be advanced by energy players either today or in the near future.
- Evaluation of the attractiveness of these plays using qualitative and quantitative criteria, assessed over several time-horizons.
- An appreciation of the significant factors driving the value of these plays and the extent to which these factors may be controllable, influenceable, or predictable by business, community or government.

As a result of this project we hope to make a significant contribution to the advancement of the geothermal industry.

This initiative will be contextualised within existing and developing policy frameworks and major national and international studies such as *The Heat is On – The Future of Energy in Australia* undertaken by CSIRO, the upcoming Geothermal Industry Development Framework commissioned by DRET and ABARE's Energy in Australia 2008.

UNDERPINNING THEORETICAL FRAMEWORKS AND KEY CONCEPTS

In the geothermal industry advances will not come easily. Accordingly, all players will need to work hard simply to stay in the game. But unlike their losing cousins the winners will be those companies that work hard and think smart. At the core of smart thinking is the confidence to view options from a strategic perspective and the ability to consider prospective futures, to execute enlightened strategy and plays, and to apply futures thinking, uncertainty concepts and real options logic.

By assuming this approach the geothermal winners will be able to identify with increasing confidence the pathways that could lead to attractive prospective futures. Smart thinking also enables the winners to act with agility. In this way they will be able to shape the game and respond to events as they unfold. It is of concern to us that many geothermal companies are unlikely to be equipped to take this approach. They could be wedded to reactive tactics rather than proactive

[1] Plays are courses of action involving one or more entities and can be identified and exercised now or in the near future.

strategies. Or they could be grounded in basing their decisions on past experiences and their current situation. Or worse yet, they could suffer from both limitations.

Futures Thinking and Uncertainty

Success in the competitive and dynamically changing business environment is often measured by management's flexibility and ability to adapt to changes [9]. Incorporating futures thinking enables us to reframe our analysis, move away from narrow or familiar perspectives and to consider the many futures that could unfold: what is possible, what is plausible and what is preferable. By looking at these alternatives and thinking in broader perspectives we can gain multiple benefits including better identifying the relative attractiveness of strategies.

Uncertainty

Uncertainty could be a source of value creation [6] and could also be a source of value deterioration. To make better strategy choices under uncertainty, the uncertainty must be understood.

Traditional approaches to decision-making assume a static, relatively linear processes with fixed outcomes [9]. The typical strategic-planning and decision-making process is built around describing the strategic action in great detail and a fact-based case to estimate expected economic return. In generating point-forecast assumptions, managers are encouraged to ignore whatever uncertainties they may find. This business case approach assumes that a deep analytical understanding of today is the key to developing foresight about the future [2].

The use of traditional strategy processes in the context of non-traditional environments characterised by significant uncertainty lead to strategies that fail to either manage risks or take advantage of opportunities [2]. Futures thinking and concepts are non-traditional tools that assist in dealing with different types of uncertainty and complexity. Concepts that are of particular significance are drivers and indicators.

Drivers

Drivers are the key factors that underpin and effect change. Defining the drivers of major trends enables us to understand change dynamics, anticipate discontinuities and gain a stronger appreciation for alternative futures.

Indicators

Indicators come in two types – events and variables. It is through identifying relevant, significant indicators that geothermal players can undertake effective monitoring and therefore more effectively execute strategies and plays within highly uncertain and complex environments.

Events are discrete occurrences that either happen or don't. Examples of events include securing a geothermal tenement, gaining project finance, accessing a drilling rig and executing a contract with complementary geothermal companies within a formal consortium.

Variables are continuous quantities that vary over time and can be a part of trends and long-term changes. Demand for electricity, economic growth, interest rates, price of carbon, geothermal source temperature and steam flow rates are examples of variables. Variables can act in a number of ways. They can be constant or change, and can change at varying rates or in varying directions. Any one of those movements could be an indicator that one or another scenario is developing [7].

The time horizons that are relevant, the time horizons that are considered and the role that time plays in changing industry landscapes is a critical factor of consideration.

IN FOCUS: REAL OPTIONS AND OPTIONS LOGIC

One particularly compelling play logic is the integration of real options reasoning and analysis in the design and execution of strategic and operational commitments. This is applicable in several ways in the energy industry.

Real options are defined as "investments in real capital, relationships, capabilities, and other tangible or intangible assets that offer the asymmetric payoff profiles associated with financial options"[2]. Such investments are option-like, because they create or potentially create a decision right available to be exercised in the future, importantly allowing for further learning about the potential payoff before the future decision is made.

Flexibility to change direction can reduce investment risk and expand potential value creation in environments of significant uncertainty, unpredictability or rapid change. This is the key benefit to a staged, option-like resource commitment as opposed to an irreversible commitment.

On a business strategy level, real options reasoning involves framing decisions in such a way that major opportunities and choices for learning and commitment are rigorously identified and evaluated in light of their potential contribution to achieving a strategic objective such as future growth or hedged risk.

It is important to note that not every option created is destined to be exercised and thus some resources committed may be seen in hindsight as yielding little payoff. Thus, a key insight of real options reasoning is to structure both highly leveraged options, where the payoff is significant relative to its cost and following through with the larger commitment that is usually required to realise the option value created.

Contingent road maps or option management frameworks are examples of practical strategy tools that can be created – linking indicators (events and shifts in variables) with implications on strategic decisions [2].

A simple example of a strategic real option play in the energy industry could be a player's staged entry into the geothermal market, in which the energy player, perhaps through joint venture, locks in a future contractual right but not an obligation with a smaller geothermal player, to provide full production phase investment should technical uncertainties (e.g. temperature and flow rates) and environmental uncertainties (e.g. the emission trading scheme's indirect effect on energy prices), both affecting the variability in future cumulative revenue from the production lifetime, be resolved. Given the scarce nature of geothermal projects underway, an energy player securing this kind of option, in a single instance, or with several projects, may necessarily lock out their competitors from similar option-like or irreversible commitment opportunities.

Real options analysis can also play a valuable role in many operational investment decisions, as seen in the oil industry. This industry is characterised by large investments in time, money and technology. Decisions are based on imperfect information and under typically significant uncertainty. In order to manage a project under a scenario of future uncertainty, coupled with investment irreversibility, the manager needs managerial flexibilities (real options) to adapt the project to new market conditions [10].

While qualitative and quantitative modelling of decisions using real options techniques can be highly complex it can be used to model serious decisions and overcome the shortcomings of traditional net present value (NPV) project valuation. This does not factor in the flexibility of decision-making and inherent option value.

Examples of decisions which could be analysed in the geothermal area using real options techniques during exploration and appraisal phases include the level of investment that should be spent in acquiring geological data, and how much risk should be ideally shared with a collaborator; as well as the number and location of wells to be drilled, and the size of the power plant in the development and production phases.

Using real options reasoning and analysis in certain strategic and operational decisions allows organisations to enhance their management of risk and uncertainty. For organisations with interests or prospective interests within the geothermal industry, incorporating qualitative and quantitative elements serves to position and monitor for new value creation and capture opportunities.

COMMENTARY ON PRELIMINARY PROJECT FINDINGS

In the geothermal industry there will be winners and there will be losers. One thing is clear from the official releases of publicly listed geothermal companies and the comments made through reputable media channels by privately held geothermal companies. This thing, simply put, is obsession. These companies are obsessed with their energy sources, their geology, their tenements, their drilling technologies, their power generation technologies, their drilling programs and their ability to connect via existing or planned infrastructure to the all-important power grid. But the obsession with these hard-core technical factors is simply not enough.

In fact, we argue that this obsession is counterproductive and will probably lead to the demise of many geothermal companies. In our view some geothermal companies are going to succeed in attracting the relatively large tranches of capital they so desperately require and transform vision into reality to become big winners in the emerging clean energy game. These companies understand things that the others do not.

They understand that their success depends on moving beyond technical models and purely technical considerations to adopting advanced commercial thinking and doing.

One such element of advanced commercial thinking is the understanding that success depends on a handful of critical relationships within and beyond the geothermal industry. By working collaboratively with well-chosen organisations geothermal companies can create greater value. Furthermore, fair shares of value can be captured by designing and executing in an environment where uncertainty is managed and futures thinking is built into organisational process and culture.

At this stage of the project we provide preliminary views on a select few drivers and factors for change affecting geothermal energy's diffusion in Australia. These drivers and factors have been identified based on their prospective role in shaping the geothermal industry and in particular the strategic plays – and the attractiveness of these plays – that energy players could pursue.

Selected key factors and drivers will be explored in detail through the next phase of our project, in particular where drivers and indicators will be connected by a vision of the future, enabling the analysis and profiling of key strategic plays. Given the project is still underway and a layered process of verification is not yet complete these are subject to refinement and change.

Selected key drivers for change affecting geothermal energy (in no particular order):

1. Carbon Constrained Future

Refers to the eventual outcomes that systems such as an Emissions Trading Scheme (ETS) will produce around the globe and the consequences for Australia. Geothermal will need to compete with, and provide cost savings over, other technologies to win the market mandate. The strength of a domestic target and international linkages are likely to see an EU-style carbon price emerging. Auction revenues may provide additional support for overcoming first mover disadvantage and

transmission connection [11]. Many uncertainties remain about the design and implementation of Australia's ETS, and how the dynamics will play out to produce intended and unintended consequences in the energy sector broadly and the geothermal industry specifically. This is seen to be a factor that will continue over the long term.

2. Social Attitudes

Refers to how people are responding to climate change and associated sustainability issues. The speed and coverage of climate change communications by geothermal companies and other stakeholders is relevant. It refers not only to awareness but also acceptance of the issues so as to affect behaviours related to energy demand. This encompasses demand for renewable energy generally and geothermal energy specifically. This is seen to be a factor operating over the long term.

3. Renewables Portfolio

Refers to the mix of existing and potential renewable technologies (wedges) that will be eventually adopted and diffused. While it seems evident that many forms of renewable technologies will have to be implemented in order to have a positive impact on greenhouse gas emissions and global warming, it is the exact mix of technologies chosen that remains uncertain. Early successes in one renewables technology with possible consequent heavier investments may reduce investments in other technologies. Many uncertainties are collectively contributing making commitment decisions difficult at this moment. This factor may have a shorter timeframe than other two.

See Appendix 3.0 for a more detailed snapshot of some factors included within project analysis.

CONCLUSIONS

With energy security and climate change as the backdrop, there is an urgent need to diversify national and international energy portfolios to include renewable and near-zero emission generating energy sources and technologies.

Preliminary project findings propose the major drivers for change affecting geothermal energy (in no particular order) as: carbon constrained future, social attitudes and renewables portfolio.

In the geothermal industry there will be winners and there will be losers.

We propose that the combined use of relatively new theoretical frameworks and leading-edge concepts that incorporate uncertainty and dynamism can yield significant insight for parties interested in geothermal energy, in particular energy players and geothermal players.

This insight holds the potential for players to make significantly enhanced strategic decisions and undertake enlightened strategic management of options and the relevant uncertainties and shaping factors within which the options are contextualised.

In summary, by moving beyond technical focus and traditional strategic approaches, geothermal companies can become more commercially advanced, and maximise the likelihood of success in an environment of high uncertainty and rapid change.

As a result of this project we hope to make a significant contribution to the advancement of the geothermal energy industry.

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Appendix 1.0

About NEGOTIACTION Challenge

To date we have engaged dozens of leading thinkers from major Australian Universities through the vehicle of NEGOTIACTION Challenge and made significant contributions to their growth and development and the field into which Challenge is being applied.

Each round of Challenge is unique, and involves the serious input of one or more teams in "solving" a nominated client project, internally-driven research initiative or opportunity realisation. As a result of our interactions some of our Challenge Alumni have joined our team, some have assumed greater prominence within academia and others are confidently contributing within our business community and government.

This is a unique opportunity for academics and students and an effective vehicle for working on major challenges in a way that drives innovation and forms a successful nexus between academic theory and commercial application. NEGOTIACTION places a high value on disciplined collaborative endeavours.

The transdisciplinary team with academic-commercial crossover creates effective and exciting innovation within projects.

"We have begun to appreciate more fully how the world's dazzling know-how can solve the seemingly unsolvable when we view our problems through the right perspective." – Ban Ki Moon, Secretary-General United Nations on solving Climate Change, TIME Magazine

Appendix 2.0

NEGOTIACTION Challenge Project Team:

NEGOTIACTION Project Team

David La Ferla, Managing Director, Stakeholder Relationship Manager

Wendy Miller, Initiative Project Manager

Jonathan Gomez, Project Lead Architect & Challenge Team Leader

Shiraj De Silva, NEGOTIACTION Research and Project Support

Project Panel

Dr Graham Mitchell AO, Principal, Foursight

Charles Brass, Founder and Chair, The Futures Foundation

Dr Graeme Beardsmore, Senior Research Fellow (Hons), School of Geosciences Monash Univeristy; Technical Director, Hot Dry Rocks

Guest Speakers

Justin Hillford, Director of Corporate Strategy, Telstra

Amir Kordvani, Associate Director, Centre for Resources, Energy and Environmental Law University of Melbourne

Julian Turecek, Investment Manager, Cleantech Ventures

Cate Turner, Consultant, RMCG

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Appendix 3.0

Table 1: A snapshot of some factors included within project analysis

Technical

Geographical Location / site (sources of energy, proximity)

Potential availability of drilling rigs and personnel

Training, skills base, personnel availability

Research base - exploration modelling, tools e.g. remote sensing, techniques, geological understanding

Geological suitability - temperature, flow rates, depth, fluids, hydraulic stimulation behaviour, stress regimes

Project development Timeframes

Transmission (capital cost, infrastructure availability, operating cost, maintenance, efficiency)

Project life-cycles - exploration, appraisal, development, production & divestment, and respective (and relative) certainty of outcomes from each phase.

Position of geothermal on technical and technological innovation curve - Degree of HFR technology development

Importance of success of key geothermal demonstration plants, proof-of-concept

Unknown technical implication resulting from AETS

Political /Government/ Regulatory

Licensing Policy - Exploration, Production & Retention Licenses

Ownership of assets and transmission lines - regulation

Likelihood of tax incentives to invest and the nature of these investments

Geothermal regulations being modelled on natural resource tenements and the variations in these regulations across the states

State policy convergence or divergence

Targets in emissions

Conflict resolution and Management/Reduction of Regulation Complexity and Duplication between and within resource types and elements of industry value chains

Emissions Trading Scheme (e.g carbon prices, caps and the implications for the economic viability of incumbent and emerging industries)

Measures for transitioning to the ETS

Federalism in shaping the relative positions and interests of federal, state and territory governments

Political inertia and/or resistance

Government measures (e.g. grants, rebates and innovation funding)

The calibre and wider acceptance of the Geothermal Industry Development Framework and the associated roadmaps

The parameters of construction codes and standards deployed - residential and commercial

Social

Consumer attitudes - demand for "green" energy

Consumer behaviour - e.g. ETS ethical offset - increasing demand/guilt factor/ cap

Citizenship (e.g. national participation, activism, voting power)

Ramifications of major events such as energy-related events

Role of education - energy management/efficiency

Siting - NIMBY

Social inertia and/or resistance

Shifts in perspectives on timeframes from short-term to long term

Design of global management systems - holistic nature

Native title

Environmental

Surface impact of plant infrastructure and transmission lines - impacts

Potential surface expressions of induced seismic events

Interaction between 'power-up' (renewable) and 'power-down' (efficiency) to reduce CO2

Emissions from stationary energy sector - largest in relative and absolute terms, therefore prime target for mitigation

Catastrophes - susceptibility to weather changes and consequences of catastrophes

Potential loss of water deep underground - effects on farming and communities

Inevitable climate change

Loss of heat at surface negligible

Loss of heat deep underground - leading to thermal contraction

Transient design and construction impacts

Shifting climatic and seasonal conditions - impacts on current land utilisation

Economic

Degree of foreign entity interest - foreign investment

Foreign entity interest - expertise - affecting rates of development, timeframes

Skills availability - Technical and Implementation

Location assets vs Intellectual property

Likelihood of skills transfer from oil industry

Geothermal companies - revenue generation difficulties

Capital constraints

De-stabilisation and shifts from conventional global energy models

Transparency and liquidity provided by ASX Coal Futures market

Relative cost of other renewable energies - shifts in demand and supply

Shifts in competitiveness of energy types

Export/import industry

Rural and urban economic development

Cost of electricity and industry cost structure

Design/construction benefits and operation benefits

Business / Industry / Commercial

Private investment interest and frameworks (ethical investment schemes)

Intra-industry and cross-industry collaboration - research and sharing lessons to reduce critical uncertainties

Business risk management (hedging, strategy, taxation, shifting between subsidiary, fee transfer)

Degree of collaboration with research bodies (research funding directed towards green)

Importing and exporting geothermal expertise (skills)

Entrepreneurial climate

Ease of market entry, competitive forces

Business relocation or takeover possibilities - CO2 mitigation strategies

Early successes and early failures in geothermal may affect the way geothermal energy is used - electricity/direct use

Early successes and early failures in geothermal may affect the way people perceive geothermal (addresses doubt, investment interest)

Revenue challenges

Disciplined investment by players with stakes in the largest geothermal companies

Influence by and involvement of AGEA and AGEG

Industry expectations regarding funding (antagonism in the market and continuing need for investment)

Path dependence (huge funds available for coal mining research and relatively few for geothermal)

Heavy dependence of success of demonstration plants