

The development, launch and implementation of the Australian Geothermal Reporting Code and current developments

Malcolm Ward^{1*}, Graeme Beardsmore², Anthony Budd³, Barry Goldstein⁴, Fiona Holgate⁵
Graham Jeffress⁶, Adrian Larking⁷, Jim Lawless⁸, Peter Reid⁹ and Adrian Williams¹⁰

¹ Geothermal Advisory Pty Ltd, ²Hot Dry Rocks Pty Ltd, ³Geoscience Australia, ⁴Primary Industry and Resources, South Australia, ⁵KUTh Energy Limited, ⁶Australian Institute of Geoscientists, ⁷Green Rock Energy Limited, ⁸Sinclair Knight Merz, ⁹Petratherm Limited, ¹⁰Geodynamics Limited

*Corresponding author: PO Box 275, Orford, Tas, 7190, mward@geothermaladvisory.com

A joint committee of the Australian geothermal Energy Group (AGEG) and the Australian Geothermal Energy Association (AGEA) developed the world's first reporting code for geothermal resources, reserves and exploration results in 2007-2008. This paper, by the Geothermal Code Committee, outlines the development of the code, its basic structure and principles, implementation since August 2008 and developments since its launch.

Keywords: Geothermal reporting code, resources, reserves, exploration results, AGEA, AGEG, geothermal lexicon, ASX

History and Background

The Australian geothermal sector has expanded rapidly in the past decade, consisting now of some 11 stock exchange listed and 30 unlisted companies with geothermal exploration or development tenements. These companies are targeting Engineered Geothermal Systems (EGS), Hot Sedimentary Aquifer (HSA) and/or 'Direct Use' type geothermal plays within Australia and some are also looking at these and 'conventional' geothermal plays outside of Australia.

Australia has long had an active capital market supporting the mining and energy sectors and resources companies account for a significant proportion of the market capitalisation of companies listed on the Australian Securities Exchange (ASX). The Listing Rules of the ASX have developed alongside these traditional resources sectors to bring about a Public Reporting regime in which investors have confidence in the consistency of terminologies and mechanisms of accountability. This has greatly facilitated the raising of both debt and equity by the companies concerned.

Specifically, the Listing Rules of the ASX incorporate aspects of the Society of Petroleum Engineers (SPE) regime and, for the mining sector, the entire indigenous Joint Ore Reserves Committee (JORC) Code, which governs how Australian publicly listed mining and exploration companies may make Public Reports concerning their Mineral Resources, Ore Reserves and Exploration Results.

In 2007 a group was formed comprising stakeholders from companies, regulators and

technical agencies to produce a Code to regulate Public Reporting by geothermal companies in Australia. This group is now constituted as a committee under the technical umbrella group the Australian Geothermal Energy Group and the company organisation, the Australian Geothermal Energy Association.

Development of the Geothermal Reporting Code and the Geothermal Lexicon

After considering a number of models, the 'Geothermal Code Committee' chose to base the new Australian Geothermal Reporting Code on the JORC mineral code model (Joint Ore Reserves Committee, 2004), for four main reasons:

- It had been developed and revised for more than 20 years and found to be very robust;
- Australian regulators were accepting of it;
- Mineral sector investors around the world were familiar with it and it has been formally accepted for use in some overseas jurisdictions; and
- It was desirable to minimise the introduction of new terminologies and concepts.

The scope of the new Code was designed to accommodate all forms of geothermal energy (excluding heat pumps), including 'conventional' geothermal plays.

During 2008 the Geothermal Code Committee met to resolve many issues arising in the adaptation of a minerals reporting code to the geothermal environment, whilst preserving the key terms and principles. One of the key determinations was in respect of reportable energy units, as follows:

- Thermal energy in place in Petajoules for Inferred Resources;
- The same for Indicated and Measured Resources, optionally also as recoverable thermal energy in Petajoules. These categories may also be reported as assumed electricity generation and rates

as MW_e for a defined period or GWh in total;

- Probable and Proven Reserves are reported as thermal energy in place and recoverable thermal energy (Petajoules). Electricity generation should be presented as net electricity output (MW_e) for a defined period or GWh in total.

In all cases all key assumptions should be stated alongside the energy totals and in the case of electricity generation figures, a statement on the technological pathway proposed for the energy extraction/conversion.

Another issue that called for additional consideration was the definition of the lowest confidence category, Inferred Resources. Given the high cost of drilling test wells into a reservoir, it was decided that, to allow junior companies to report early stage reservoir definition in a controlled manner, an Inferred Resource could be estimated and reported without any direct well penetration into the reservoir.

The Code governs how geothermal resources, reserves and exploration results are publically reported, but not the method of computation or estimation. However as the sector is new in Australia, the committee decided also to compile a Geothermal Lexicon which would describe good practice in estimation methodology. The Lexicon is not required to be used under the Code, but if the methodologies outlined in it are not broadly followed, then this must be stated in the Public Report.

Implementation of the Code

The Geothermal Reporting Code 2008 Edition was launched in August 2008 and was adopted as mandatory for AGEA members for a six month trial. The Geothermal Code Committee established a Compliance sub-committee which periodically reviewed Public Reports made by AGEA members and then offered confidential feedback to those companies. A number of Practice Notes were also compiled and circulated by the Geothermal Code Committee to inform AGEA members on 'best reporting practice' in respect of particular aspects of the Code.

The main issues that have been identified in the early application of the Geothermal Code include the following.

- Generation and reporting of large Inferred Resource figures which have the potential to mislead if the confidence level of the estimation is not understood by the reader. This issue comes about through the definition not requiring a direct penetration of the reservoir, allowing the energy in place of large volumes of reservoir to be reported and also because

recovery factors and conversion efficiencies are not required to be made. This issue will likely be mitigated by the eventual requirement to apply a plausible recovery and conversion factors to the raw Inferred Resource figure(s). In combination, these could reduce the reportable figure to as little as 1% of the energy in place.

- Lack of understanding by companies of the role of the Competent Person in the drafting and sign-off of various types of Public Reports, such as derivative summaries of reserves and resources as might appear in Annual or Quarterly Reports. The answer here found in the Code is that each and every report of data involving a Competent Person's estimation of Resources, Reserves or exploration results must be agreed to in writing by the Competent Person.
- The amount of technical detail required in Public Reports; some reports have been very brief whilst some companies released the entire original internal technical report on the resource estimation. Ultimately it is up to the Competent Person to agree to the content of any Public Report based on their work. A very brief report will likely not contain enough information to allow the confidence on the 'bottom line' figure to be assessed, while a full report is unlikely to be comprehended by the target audience of investors. In early reports, as an education exercise, the Geothermal Code Committee has suggested more information is better than less, and a resources or reserve report of between 10 and 20 pages would be adequate, with the length of report probably decreasing over time.

The Geothermal Code has been disseminated to organisations and experts around the world and feedback has been constructive and positive. A number of comments or queries have come from technical persons concerned with the possibility of their technical freedom being restricted or bringing up particular circumstances where there is ambiguity with data or interpretation, for instance which temperature(s) in and around a reservoir should be used. In nearly all cases it can be shown that the Geothermal Reporting Code in no way limits any estimation methodology or choice of data, as long as those choices are clearly stated in the Public Report and can be justified by the Competent Person, if called upon to do so.

The Competent Person must also make judgments as to the classification of the resources and/or reserves. Again, there are no 'rules' laid out but check-lists and prompts are given in the

guidelines and at the end of the day, the experience of the Competent Person is relied upon, as is their preparedness to defend their choices.

In discussing and reporting geothermal reserves and resources, the term 'estimation' is preferred over terms such as 'measurement' to emphasise that the computation is not exact.

With use, a number of possible improvements were identified and a Second Edition of the Code will be launched in November 2009. Following the successful trial, AGEA has begun the process of having the Second Edition formally incorporated into the ASX Listing Rules.

International application

It is hoped that in co-operation with other national geothermal organisations, this Code might form the basis of a uniform, or at least a harmonised international geothermal reporting code, which will greatly assist cross-border investment and understanding based on recognised heat flow provinces.

Over-view of the Geothermal Reporting Code

The Code seeks to govern how Public Reports of Listed Companies are worded and presented. It does not govern how resources and reserves are estimated, although if methodologies deviate significantly from the conventional techniques outlined in the Geothermal Lexicon, then that must be stated.

The governing principles of the Code are:

- a) **Transparency.** This requires that the reader of any Public Report is provided with sufficient information, clearly and unambiguously presented, to understand the report and not be misled;
- b) **Materiality.** This requires that a Public Report contains all the relevant information which investors and their professional advisors would reasonably require, and reasonably expect to find in the report, for the purpose of making a reasoned and balanced judgment regarding the material being reported; and
- c) **Competence.** This requires that the Public Report be based on work that is the responsibility of suitably qualified and experienced persons who are members of recognised, relevant professional organisations and subject to accountability and a professional Code of Ethics.

Under the Code, the writer or compiler of a technical report on either geothermal exploration results, or the estimation of geothermal resources or reserves must be a 'Competent Person' (CP), who is defined as having at least five years of relevant experience in the type of geothermal play under consideration. If a company then wishes to

make a Public Report based on that work, the CP concerned must be satisfied as to the form and content of the Public Report and then must consent in writing to be personally identified as such in the report. This places a dual onus on the reporting company and the CP to produce a Public Report that is transparent, material, competent and defensible.

The categorisation of resources and reserves under the Code is illustrated as follows.

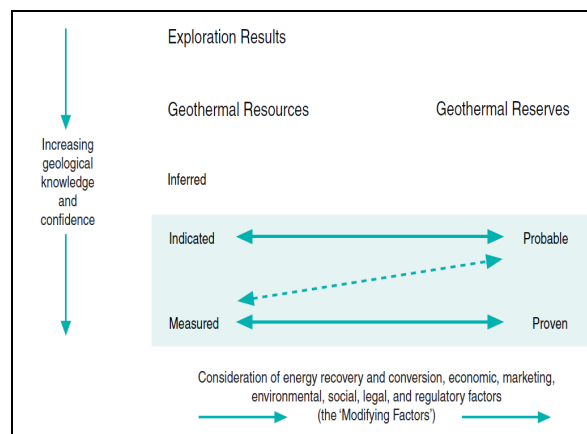


Figure 1 Structure of the Geothermal Reporting Code

With increasing levels of technical knowledge and confidence, geothermal resources progress from Inferred to Indicated to Measured. There is no claim or implication of the ability to economically extract any of the estimated resources at the time of reporting (i.e. for electricity production or 'direct use'), however there should be some expectation that reported resources may be economic under plausible circumstances in the future.

If studies into energy recovery and conversion, economic, marketing, legal and other factors are undertaken, so as to demonstrate energy extraction at a profit, then Indicated Resources may be converted into Probable Reserves and Measured Resources may be converted into Proved Reserves. The level of knowledge regarding Inferred Resources is always such that they may never convert directly into reserves. Reserves may fall back to resource status if the economics of the project decline.

Current developments (late 2009)

The 2008 Edition of the Code was reviewed during 2009 via appraisal of its performance, effectiveness and the technical outcomes resulting from its implementation and via extensive consultation with industry. The major outcome from this review will be enshrined in a Second Edition of the Code, to be launched at the November 2009 Brisbane Conference. The major effect was to change the definition of Resources and Reserves from thermal energy in place to recoverable thermal energy; units remain as PJ_{th} or MW_{th}-years. All estimates must quote a recoverable figure and state assumptions such as

recovery factor(s), base and cut-off temperatures and other key inputs. An estimate of the resource or reserve in terms of total electrical generation (in PJ_e or MW_e-years) or electrical generation over a period (X MW_e for y years) may also be quoted but only in addition to the recoverable thermal energy figure. Again, conversion factors and major assumptions must be stated.

The requirements for Competent Person statements and sign-offs did not change in the Second Edition of the Code, but were made more explicit.

Discussions are continuing with the ASX regarding having the Geothermal Reporting Code incorporated into the ASX listing rules, thereby bringing in mandatory use of the Code for ASX listed geothermal companies via the force of federal law.

The Canadian Geothermal Association, CanGEA have released a draft Geothermal Reporting Code for Canada, which is based on the Australian Reporting Code.

The authors thank the AGEG and AGEA for their encouragement in developing the Australian Geothermal Reporting Code and for permission to present this paper.

Reference

Joint Ore Reserves Committee, 2004, Australasian Code for Reporting of Exploration Results, Mineral Resources and Ore Reserves; The JORC Code 2004 The Australasian Institute of Mining and Metallurgy, the Australian Institute of Geoscientists and the Minerals Council of Australia.