TOWARDS AN INDUSTRY GUIDELINE FOR
GEOTHERMAL RESERVES DETERMINATION

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SUMMARY – The recent trend for financing of geothermal development companies through stock market listings presents a welcome market-driven mechanism for funding the exploration and development of geothermal prospects. However, this process depends heavily upon being able to demonstrate the value added at successive stages within the long development path from exploration to power generation, and in particular for investors to have confidence in the claims made by developers about the energy resources and reserves available within each project. Similar requirements apply, in fact, to all forms of capital market financing. A standardised and trusted approach to geothermal energy resources and reserves classification and estimation is required for the stability of our industry.

We offer here a starting point for the development of such a methodology broadly based upon mining industry principles and work recently finalised by the SPE, but with regard to the specific characteristics of geothermal resources and considering current trends for development of EGS, HDR and lower temperature systems. We suggest that any useful methodology must include a categorisation such as "Proven-Probable-Inferred" categories that indicate to the investor how reliably various parts of any geothermal resource are defined rather than primarily relying on probabilistic methods using parameter distributions applied to the entire resource. However, probabilistic methods can be usefully applied to each category.

The other key categorisation is based upon the commercial viability of extracting energy from the resource. Adopting the SPE approach would mean having "Reserves" defined as the part of the resource that is commercially extractable and "Resource" as the sub-commercial component. Commercial viability depends on a range of technical and economic factors making this a potentially complex issue. We suggest that it is probably not practical to have an economic model as part of the reserves assessment, so this could best be achieved through some industry guidelines for what is commercial in the context of the conversion technology that is expected to be applied to the resource.

1. INTRODUCTION

In addition to traditional project financing, increasingly a wide range of capital market mechanisms are being employed in the financing of geothermal projects. In countries such as Canada and Australia where several geothermal companies are listed, the regulatory bodies will very soon be forced to consider how to protect the investing public against misleading statements that could potentially be made by project promoters. Both countries have a strong tradition of raising finance for mining projects through the stock market.

Consequently there are now strong drivers for our industry to establish an improved methodology for providing a standardised assessment of geothermal energy reserves and defining the levels of uncertainty in that assessment so that :

1) Lenders and stockmarket investors can transparently evaluate their exposure when investing in geothermal projects, and be able to compare risks across different projects
2) Projects have a method that effectively books increased value as exploration progresses.

The first issue has been manifest for a long time as commercial lenders have had to evaluate the resource potential and project risk. However with increasing numbers of smaller investors who are individually unable to undertake an in-depth due diligence of a project, it is important for the industry to have an agreed and transparent methodology that is understood by the markets.

The second driver will be increasingly important for our industry in getting projects through the barriers of exploration cost and risk. Several smaller geothermal companies are now successfully utilising stock market listing and share issues as a mechanism for funding geothermal projects through the high risk phase of exploration without dependence on government intervention. This presents a model that is likely to have wide application, particularly as market awareness of geothermal energy as a renewable resource grows.

Smaller developers, or new entrants without the advantage of experience or substantial resources, often find there are two key barriers particular to geothermal development:

- Funding through the high-risk and high-cost phases of exploration and drilling to prove the resource, and
- The typically long period between up-front exploration drilling expenditure and any return on investment at financial close of the development stage, or eventual returns from generation revenue.

Overcoming these barriers through enabling progressive success in each exploration stage to be realised in the total value of the project will help to add diversity to the pool of developers and stimulate increased activity in the sector.

Developers are increasingly utilising stock market listing as a mechanism to register the increased value of their project in a tradable form for the benefit of investors and to raise capital through share offers at each stage. Investors don't need to wait several years (until a project generates revenue or secures development funding) before they can realise value growth from their investment. Doing geophysics, or well drilling can increase real project value in a shorter timeframe, and deliver gain on that investment.

An exciting corollary of having a sound methodology is that the processes for increasing reserves will be more explicitly recognised and so developers should be incentivised to have a balanced strategy for exploration along with proving production. For example, an exploration well that proves reserves but which is too far away to be connected in the next production stage may have greater value than it is traditionally accorded.

BASIC PRINCIPLES

Any approach must deliver clarity for investors through defining the basis for the reserves statement. Reserves estimates inherently include assumptions about the ability to commercially extract the energy resource so these assumptions need to be clearly stated, particularly as potential development technologies now range from low temperature pumped developments through HDR, EGS to conventional high temperature developments. In addition, resources undergo progressive exploration with different parts of the resource being explored using a variety of exploration and proving technologies, so not all parts of a resource are equally well defined. This contextual information of assumed commercial development technology and the quality of reservoir-defining information should be explicitly integrated within the assessment so that the reserve numbers can be confidently evaluated by investors. Unfortunately, in the past such assumptions have often not been explicit.

Mineral and Petroleum Industry Practice

Methodologies for classifying reserves are well established in the petroleum and mineral industries and can provide useful principles to form the basis for application to geothermal classifications. Aligning geothermal with those industries provides a measure of familiarity to potential investors. As mobile resources petroleum reservoirs have many similar characteristics to their geothermal equivalents but geothermal resources often have less continuity and more complex structures and are subject to a variety of thermodynamic processes under extraction. Mineral resources generally have greater variability and less continuity and so require greater sampling density to assure the magnitude of contained resource. Geothermal further differs from both by being renewable through recharge, albeit usually at a slower rate than it is extracted.

The Society of Petroleum Engineers (SPE) and the World Petroleum Congress (WPC) have jointly proposed definitions of standard terms for booking petroleum reserves. Their Guidelines for the Evaluation of Petroleum Reserves and Resources (SPE/WPC, 2001) are drawn upon significantly here.

The minerals industry has converged on a methodology that is consistent across the main mining jurisdictions and is manifested in codes applied by the Canadian Institute of Mining, Metallurgy and Petroleum (CIM) and the Australasian Institute of Mining and Metallurgy, Joint Ore Reserves Committee (JORC). The CIM code is referenced by National Instrument 43-101 which must be followed for all mineral resource/reserve reporting on the Toronto Stock Exchange (TSX) where several geothermal companies are now listed.

The mineral and petroleum approaches both broadly include a two-dimensional classification based on:

1) reliably of the information defining the physical resource, and
2) commercial extractability of the resource

The first dimension is typically provided for by classification into progressive categories of reliability such as Possible < Probable < Proven or Inferred < Indicated < Measured, which are often inversely related in terms of size.

For the second dimension (commercial extractability), the SPE provides a division based on whether the oil/gas resource is commercial or sub-commercial. The mineral industry, however, places more emphasis on whether or not the project-specific commercial viability has been assessed, normally through the completion of a financially robust pre-feasibility study or better. In this dimension, both industries have a two-part division between Resources and Reserves.

This inter-relationship between resource stored in the reservoir and the viability for extracting that resource is embodied in the definitions of the various classifications. For example the SPE defines Proven Reserves as

"those quantities which, by analysis of geological and engineering data, can be estimated with reasonable certainty to be commercially recoverable, from known reservoirs and under current economic conditions, operating methods, and government regulations." (SPE, 2005)

The important aspects of this highest category are having a high confidence in the ability to practically and economically recover the required quantities of energy from the reservoir. The SPE asserts that for a reservoir to be regarded as Proven requires actual production tests to have demonstrated commercial levels of productivity. The minerals codes go further, to requiring that Proven means that the resource is so well defined by physical sampling methods that there can be no material "surprises" in terms of resource quantity or quality.

Application to Geothermal

We suggest that categories of reserve are important to provide explicit understanding of the certainty (quality and reliability) of the information that is used to define the resource magnitude. Each category should provide a real sense of meaning to an investor, especially with regard to how well the energy potential is defined and whether that energy can be realistically extracted under present conditions or requires improved technology or market conditions to be realised.

Following the previous example, Proven geothermal reserve should be strongly related to an area or volume of reservoir where the productivity of any new wells should be predictable to a confidence level equivalent to any typical in-fill production drilling activity. Proven resource should not be solely based on the high confidence limits of a probabilistic estimate based on a larger area of resource that is not so reliably defined.

The Probable category should similarly have real meaning in terms of the present knowledge about real areas of the resource that have been delineated by some exploration work. Inferred resource would be less reliably constrained by physical location criteria.

A second main categorisation based on whether the energy resource is commercially extractable or not is a little more problematical.

Developers tend to closely guard their commercial information and like to maintain flexibility to develop fluid extraction and energy conversion systems to meet their business needs over the life of the project. That perspective has to be given due regard as important for project viability. However, an investor needs some certainty as to whether or not the energy is likely to be readily extractable under prevailing typical technical and market conditions (or at least those foreseeable in the short term).

A pragmatic approach to defining commercial viability could be through consideration of the resource characteristics required for suitable productivity of wells (or injection-production couplets in stimulated systems) for the type of technology that it is assumed will be applied for energy extraction and conversion, having regard to the probable power price in that particular location. Unlike most minerals and oil which have an internationally defined dollar value, power prices can vary by an order of magnitude from place to place both because of physical alternative sources of supply and regulatory policies. However, this does not tell an investor if this is commercially viable nor deliver a measurable benefit to a developer who adopts a particularly efficient approach to resource extraction or who utilises technology that allows a greater portion of the resource to be utilised.

Typical well deliverability that may be economic for the target method of extraction in the foreseeable future (10 to 20 years) could serves as a guideline for setting the minimum grade of geothermal reservoir to be considered as a Resource. This eliminates from consideration in Resources or Reserves those heat resources that are too deep or low grade to be considered likely to be extracted with existing or reasonably foreseeable technology. The part of the Resource indicated to be suitable to be economically developed now would be regarded as Reserve.

Geothermal reservoirs have other characteristics that need special consideration.

There is typically heat and fluid recharge into most geothermal systems. The rate of this recharge can vary significantly from system to system, and can be stimulated to a varying degree by production. The recharge rate and its affect on reserves is usually poorly defined during the development stages of a project, and so has often been ignored. If it is to be included, then the evidence for quantifying the recharge and the method of inclusion in the reserves must be stated clearly. Such evidence would have to include some production history or at least surface heat flow measurements to be credible.

Geothermal projects are typically sized to utilise a resource over a period of about 20 to 25 years that relates to the life of the wells and energy conversion plant. It is important to state the reserves in terms of the rate of extraction – we suggest a nominal 20 year life.

Except for direct heat use, the geothermal heat energy stored in the reservoir has only an indirect relationship with the magnitude of end-user energy available in the form of electricity. The efficiency of extraction and conversion is highly dependent on many factors, notably resource temperature (more specifically enthalpy) and type of technology. However, if the target end use is electricity production, then it is essential that the Resource or Reserves be expressed in electrical energy equivalent according to some defined guidelines .

SUGGESTED RESERVES CLASSIFICATIONS

A suggested classification regime for geothermal energy resources is illustrated in Figure 1. This is based loosely on the McKelvey diagram used within the SPE definition of proved, probable and possible reserves and contingent resources. The mineral JORC and CIM codes have a similar diagram.

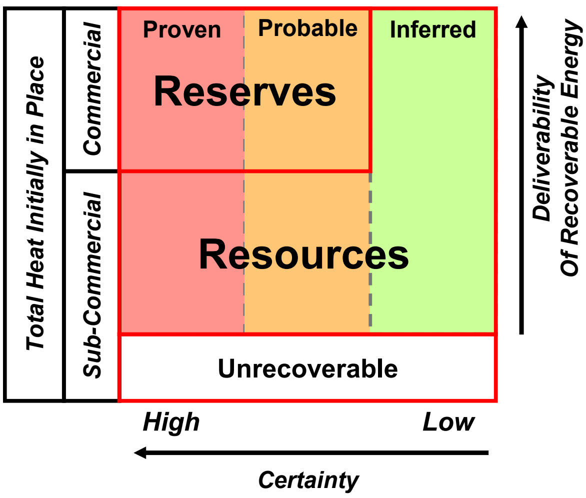

Figure 1. Proposed resource classification system

This classification is only to be applied to geothermal resources that are likely to be technically and commercially extractable now or in the foreseeable future. A three stage classification is suggested to define how reliably the resource is defined:

PROVEN means the portion of the resource that has been sufficiently sampled by wells that demonstrate reservoir conditions and deliverability of fluid over a volume of reservoir such that no substantive surprises can be expected by further drilling within that volume. Supplementary methods such as chemistry, pressure testing and geophysics may be used to demonstrate continuity of resource between and around the drilled area. The results of future drilling should have a very low probability of reducing the energy potential assessed within that volume or for the project as a whole (though that does not guarantee any individual well will necessarily be commercially successful).

PROBABLE means the portion of the resource that is less reliably defined than the Proven area but with sufficient indicators of resource temperature from nearby wells or from geothermometry on natural surface discharges to characterise resource temperature and chemistry and with less direct measures such as geophysics or temperature gradient wells indicating the extent of resource. Probable resource will often surround Proven resource.

INFERRED means the area/volume of resource that has less direct indicators of resource characteristic and extent, but still a sound basis for assuming that a reservoir exists, estimating resource temperature and having some indication of extent.

The term **RESERVES** is only to be used for those portions of Proven or Probable **RESOURCES** that are generally accepted to be commercially extractable with existing technology and prevailing market conditions. The differentiation between commercial and sub-commercial is not to be strictly interpreted as implying that commercial feasibility has been demonstrated. Rather it is intended to enable identification of the portion of heat that can be readily extracted using current commercial practices from that portion which still requires substantive improvements in technical or cost terms to be viable.

Inferred resources are not considered to be sufficiently reliably defined to constitute Reserves. Only Proven and Probable Reserves should be used when considering the economic feasibility of a project. The process of conducting a feasibility study should refine the assessment of Reserves using more project-specific technical, environmental, regulatory and commercial criteria.

A large fraction of the stored heat contained in the commercial reserves will be left in the geothermal reservoir at the time that development ceases and is thus classed as Unrecoverable.

Reporting requirements will need to be part of any classification and definition code. The information and assumptions used to define the classification and to assess energy available must be explicitly stated in the assessment, and form an integral part of any reserves statement or notice.

Following the SPE and mineral industry lead, there should be guidelines for reporting aggregations of resources and reserves otherwise the informational benefits of the classification are lost. Resources and Reserves must not be aggregated and must be clearly differentiated in any statements. Proven and Probable Reserves can be aggregated but must also be reported separately in the same statement.

PRACTICAL APPLICATION

Assessing Deliverability and Commercial Energy Recovery

While complex numerical reservoir simulations linked with wellbore flow models can be used to determine maximum energy extraction from the resource as it is known, simpler methods (which are often more appropriate for the level of knowledge available) are more commonly used in the early stages of resource evaluation. These simpler methods tend to rely upon volumetric assessment of heat in place and estimates of the portion that can be recovered for use at the surface based upon several key resource parameters. This is examined in more detail in the following section.

For geothermal fields the dominant factor affecting the recoverable energy deliverability, which divides the total heat in-place into commercial Reserves and sub-commercial Resources, is the resource temperature. The fluid pressure and formation permeability will interact with the fluid temperature to influence deliverability but typically there will be a minimum useful temperature at which commercial deliverability can be achieved. This is referred to here as the Base Temperature. Only higher grade heat above the base temperature is commercially available at the surface for sale as process heat or conversion to electricity.

There has been variability within the industry on the definition of a base temperature to determine the boundary between reserves and resources. We suggest that the base temperature should be that minimum which allows commercial deliverability from wells – effectively reflecting the heat that can actually be extracted from the reservoir. The USGS and many other practitioners have included all the energy above the local thermodynamic rejection temperature i.e. reserve plus resource that is not commercially extractable and then used a recovery factor to estimate the commercially useful heat fraction. This recovery factor estimates both fraction of heat below the commercially useful temperature and the fraction of unrecoverable heat.

We strongly suggest that it is more appropriate to first estimate the heat that can be extracted from the reservoir and then to separately allow for an efficiency of converting that into end-user energy (electricity or production heat). Using the base temperature to exclude the contingent resource and a separate recovery factor to exclude the unrecoverable heat from the reserves estimation is more consistent with the SPE/WPC classification.

A fundamental criterion in the choice of base temperature will be whether the power prices justify pumping. Where power prices are low, the base temperature may have to be set at the minimum at which wells will self discharge, which will itself be depend on the depth of the reservoir. In that case there may be a large difference, possibly as much as 100 ºC, between the Base Temperature which determines *which reservoir volumes* are to be included in a resource or reserve, and the rejection temperature from, say, a binary plant which is the basis for the assumed conversion efficiency. For example, in a location with power prices as low as 3 USc/kWh (such as New Zealand), a liquid dominated resource sector at less than 180 ºC may have no value as wells will not self-discharge, but fluid that is brought to the surface in other hotter sectors can have energy extracted possibly down to less than 90 ºC.

Where wells are available such as in Proven Resource or Proven Reserves, then the resource and well permeability characteristics should be sufficiently defined to enable a sound and specific assessment of what resource drawdown conditions would represent practical minimum limits for well deliverability. The energy that can be extracted in that case should be based on such assessment.

Information Required for Proven, Probable and Inferred

Different levels of information are required about a geothermal field in order for part or all of it to be classed as Proved, Probable or Inferred. Our suggestions regarding the types of information required are tabulated below.

Table 1. Indicative guidelines for the type of data to be used in resource classification.

	PROVEN	**PROBABLE**	**INFERRED**
VOLUME			
Area	Extent of measured high temperatures in wells at selected depth interval, allowing some zone around wells to be included, and considering well spacing as a guide to confidence that reservoir character is reliably defined	Extent of inferred high temperature at selected depth interval based on : • Geophysics surveys • Shallow temperature gradients, surface heat flow • Presence of adjacent proven area	Extent of inferred high temperature at selected depth interval based on : • Locations of surface activity e.g. springs and fumeroles • Surface heat flow • Some geophysics mapping may be available
Depth	Maximum depth attained by drilling plus reasonable drainage distance below bottom of well. Governed by temperatures in the outflow area.	Thickness defined by geophysics, or adjacent wells Maximum depth expected to be attained by drilling plus reasonable drainage from deeper.	Assessed from hydrology, structure. Maximum depth expected to be attained by drilling plus reasonable drainage distance and as
DELIVERABILITY			
Fluid Temperature	Measured well temperatures or discharge enthalpy and confirmed by geothermometry	Temperature estimated from extrapolation of known temperatures or chemical geothermometry using conceptual hydrological model.	Estimated temperatures from surface geochemistry
Base temperature	Minimum temperature required for wells to self-discharge in conventional geothermal development. For pumped flows the minimum economic fluid temperature for commercial energy extraction. This temperature can change with time as project economics change or new technology is available.	Minimum temperature required for wells to self-discharge in conventional geothermal development. For pumped flows the minimum economic fluid temperature for commercial energy extraction. Estimate from assumptions on reservoir character	Minimum temperature required for wells to self-discharge in conventional geothermal development. For pumped flows the minimum economic fluid temperature for commercial energy extraction. Estimate from assumptions on reservoir character
Permeability and pressure	Proven sustained discharge flows from deep well(s).	Inferred extension of faults or aquifer permeability. Liquid pressures inferred from wells in adjacent Proved area or shallow wells.	Measured surface heat flows. Liquid pressures and permeability inferred from shallow wells or spring flows. Inferred fault or aquifer permeability.
Chemistry	No major problems with fluid acidity or uncontrollable solids deposition from fluids discharged from existing wells.	No major problems with fluid acidity or uncontrollable solids deposition in wells in adjacent Proved area.	No major problems with fluid acidity or uncontrollable solids deposition in existing nearby wells or indicated by surface sampling.

This is graphically illustrated with some examples representing various stages in an imaginary development in Figure 2.

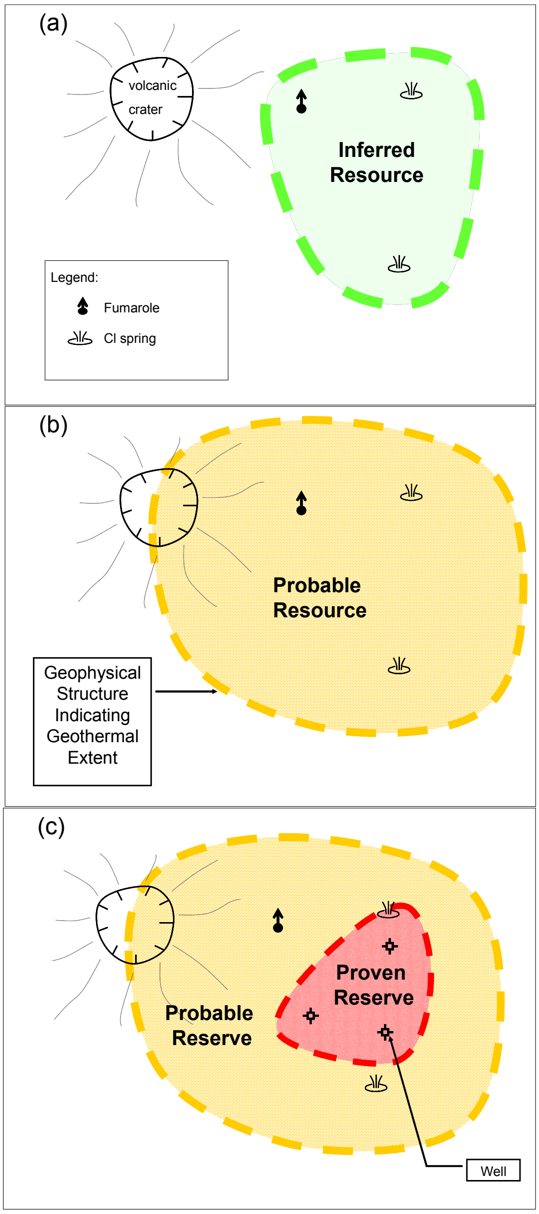

Figure 2. Examples of application of the proposed classifications. a) Inferred Resource based on surface thermal features and geological setting. b) Probable Resource based on (a) with additional comprehensive geophysical information that improves definition of depth and extent of geothermal system. c) Proven and Probable Reserves based on (b) after the drilling of successful exploration wells.

ENERGY RESERVE ESTIMATION

At different stages of a geothermal development the methods used to assess the geothermal reserves will vary according to the available information. Methods for assessing energy that can be extracted include:

- Estimation of natural heat flow representing long term sustainable energy available
- Analogies based on other fields that have been produced for a long period
- Volumetric assessment of heat in place and the portion that can be extracted
- Lumped parameter models
- Well decline analysis
- Numerical reservoir models

All of these can have a place in energy reserve assessment and can be applied deterministically or through some form of probabilistic approach. The detailed evaluation of the applicability of these methods within a geothermal reserves classification system should be a subsequent exercise, however some issues related to these are worth investigating here.

We suggest that wherever possible these methods should be applied (and their sensitivity tested) with consideration of the classifications of resource area as proposed above. As far as possible the areas of resource defined by known parameters and reliability of control information should be evaluated separately and then later aggregated appropriately. This is preferable to diluting areas that are truly proven with broader areas of probable or inferred resource and attempting to derive reliable definition of proven/probable/inferred based on probabilistic distributions.

Heat Flow and Analogy

Prior to deep drilling only limited and uncertain estimates are possible. Wisian proposed using a multiple of surface heat flow (Wisian et al, 2001) to estimate the productive capacity. This method can serve as a sensibility check on other methods, but is difficult to apply to particular resource areas as it is highly dependant on the hydrology of the system.

Empirical methods based on analogy can be used, for example the power density defined as megawatt capacity divided by the productive area of the field (Grant, 2000) although this area may be quite uncertain. This can be applied to areas of resource as defined by exploration and drilling.

Sanyal proposed a variation of this technique using reservoir simulation to estimate the natural state recharge as a basis (Sanyal, 2005) but this requires deep drilling information to calibrate the model.

Volumetric Methods

Volumetric resource estimation is most commonly used in the later stages of geothermal exploration after drilling has started, although may be used if good surface indications and geophysical surveys are available. Volumetric stored heat assessments are well established within the geothermal industry and we agree with Sanyal and Sarmiento that volumetric estimation is the only one of the methods consistently applicable for resource estimation at this stage of knowledge (Sanyal and Sarmiento, 2005). A number of fields have been developed on this basis in the Philippines for example and have had sufficiently long operational histories to verify this method.

The use of the classification areas will require the appropriate selection of parameters for deterministic or probabilistic estimates of energy available from each area. This also encourages banding according to known resource quality variations such as temperature as it varies from the centre to the margins of a resource.

The selection of base temperature will guide the classification of resource sector and the amount of energy that can be delivered by wells, and then separately the conversion efficiency of that energy into the target use can be estimated based on various quality parameters such as temperature or enthalpy and assumed conversion technology.

Consideration of Dynamic Changes

Geothermal systems differ significantly from mineral and petroleum resources because they are continually being replenished by an on-going flow of heat from depth by conduction or by convection of water. At a later stage in development, after production and reinjection have started, the reserves are influenced by the performance of the wells and especially by the hot and cold recharge to the reservoir. Traditionally stored heat assessments have ignored recharge as this is believed to yield a conservative estimate of the reserves.

Muffler and Cataldi (1977) concluded that resupply of heat to hot-water systems of high natural discharge should not be neglected i.e. the resupply heat can be greater than 10% of the recoverable heat calculated from storage alone. Experience since then in geothermal systems such as Wairakei-Tauhara and Nesjavellir has demonstrated that in favourable situations recharge can supply a substantial proportion of the heat extracted and can extend the productive life of the resource.

On the other hand, there are a number of fields including Ohaaki and Tiwi where the resource has been depleted by ingress of low temperature groundwater cooling part of the high temperature rock. Similarly, there are geothermal fields where reinjection wells have lead to short-circuiting of low temperature injectate, which has depleted the reserves by cooling part of the reservoir below the commercially viable base temperature.

For regular updating of reserves in a developed field, or for assessments based on fields that have some history of production the conventional stored heat calculation is not adequate. Dynamic changes (observed or predicted) need to be accommodated in the assessments or included within more sophisticated numerical models. Reservoir simulation is considered to be the most applicable method for estimating remaining reserves for geothermal fields under production. A reservoir model provides a deterministic estimate of the reserve, although in some fields multiple model runs have been used for probabilistic assessments (Hoang *et al* 2005).

Probabilistic Assessment of Reserves

The SPE/WPC Guidelines discuss the use of deterministic (risk-based) and probabilistic (uncertainty-based) methods of resource assessment. Probabilistic methods provide a structured approach that accounts for both the uncertainty in each of the parameters that affect reserves of individual development and production. Probabilistic methods help ensure that quoted quantities are appropriate relative to the requirements of certainty.

We suggest that probabilistic methods should appropriately be applied separately to the Proven, Probable and Inferred areas of resource and hence to improve understanding of the reliability of each of these. Care needs to be taken in this case to ensure that any dependencies between parameters in each area are correctly managed in the probabilistic process.

CONCLUSION

To appropriately encourage investors while realistically expressing uncertainties, our industry has an obligation to develop an agreed methodology for defining reserves. If we do not, then it is most likely that regulators will impose some standardisation that will only relate well to one sector without sound consideration of the now broad base of geothermal systems being developed and the technologies being used or developed for energy extraction and conversion.

The development of such a methodology should benefit all sectors of the industry. Although developers and their consultant advisors will not have quite the same freedom to quote numbers on any basis they choose, developers will ultimately benefit from increased market confidence and consultants will be essential in certification using appropriate application of resource and power development knowledge within the methodology.

The R&D sector will be able to demonstrate the value from improving the commercialisation of extracting energy from more difficult resources such as the objective of the current EGS program in the US. This process will widen the resource base and enable greater portions to be classified as Reserves.

It is highly desirable that any system works to the benefit of all geothermal sectors and for large and small developers while meeting the needs of financing and stock market regulators.

We suggest to the geothermal community that it is vital that our industry takes the lead in establishing a systematic approach to energy reserves assessment before such a requirement is forced upon us. The approach presented here is suggested as a starting point for focussed discussion and we hope that the challenge is taken up by our professional organisations which are the most obvious bodies to lead this process with strong contribution from their membership including developers, consultants and researchers.

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