RISK BASED APPROACH TO GEOTHERMAL PROJECT VALUATION

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ABSTRACT

Through combining elements of risk and resource assessment with financial information, it is possible to examine the cost of risk adjusted geothermal resource development. This is useful for a number of reasons, including determining a nominal valuation of a geothermal project at any stage during exploration and development.

The procedure is explained and a field example is given. It is concluded that this approach may assist with securing funds for early stage geothermal developments.

1. INTRODUCTION

To a geothermal developer, the ability to place a value on a project at any stage in the geothermal development cycle (Figure 1) is valuable in, for example:

- attracting early investors into the surface exploration stage;
- raising equity funds for an exploration drilling stage;
- Moving a project from first drilling through further drilling to prove and size the resource and on to financial closure, where an agreement is reached with a bank(s) for debt funding on a project finance basis, or similar.

The earlier the stage that an investor participates in a project, the higher is the investor's objectives for realising a profit. For example, an initial investor at the surface exploration stage will likely require a 50% return on capital, or more, over a relatively short project term of a few years, whereas a late stage investor such as power plant operator coming into a project at a late development stage, may well be comfortable with a utility type return of say 10% IRR over a project life of 30 years.

It all comes down to project risk – as a project is progressed through the development cycle, risk reduces and the certainty of a positive project outcome increases.

2. RISK ISSUES

An approach to assessing geothermal risk has been given by Barnett et al (2002) based on:

- a staged methodology for geothermal exploration and development (see Figure 1);
- success probabilities at each project stage, initially assigned from the results of a worldwide review of geothermal data (based on 94 geothermal power developments at 89 geothermal fields);
- a detailed knowledge of geothermal industry costs.

The key conclusions from that work are shown in Figures 2 and 3 and include:

- exploration and development risk progressively reduces as each project stage is successfully completed;
- at the completion of surface exploration field studies the probability of a successful project is quite low (at about 20%);
- the probability of project success then doubles with the completion of exploration drilling (at about 40%) and doubles again after completion of delineation drilling (80%);
- after completion of a delineation well drilling program, the level of project risk has dropped to a level (with an 80% success probability) that would be acceptable for seeking debt funding.

3. RESOURCE ISSUES

The requirements of Geothermal Resource Reporting Codes (e.g. the Australian and Canadian Codes) can be readily incorporated into the geothermal, development sequence as shown in Figure 4. These can then be combined with the risk issues above to generate Figure 5 which shows the reducing return with development time that an investor would likely accept. This figure was originally produced by McIlveen 2011 with the range of values on the Y axis being for Returns of 6% to 20%. While this range may be appropriate for the USA, it is more likely investors elsewhere in the world will require these values to be at least doubled in order to get their attention.

4. PROJECT VALUATION

Traditionally, geothermal projects have been developed by a single company, or by at most several companies in joint venture. In this case, project valuation is relatively unimportant until commissioning, or later.

In today's market, with more junior developers seeking to progress projects through to operating plant, it is becoming more typical for different partners to team with the lead developer at different stages in the overall project, with investors coming into and out of the project before it is fully developed. For instance, Partner A may team with the developer prior to drilling and fund the first exploration well. If this well succeeds then the partner may withdraw from the project and take a good profit. A further Partner might then get involved in meeting the bulk of funding through to financial closure after which a construction contractor builds the plant and then finally a power operations company might buy the plant and operate it long term. Each party will have different investment objectives.

In this environment, it is essential to develop project valuations throughout the project development from first drilling through to completion of commissioning to allow for estimation of likely project returns for an investment at any project stage.

Geothermal power projects are typically valued on the basis of DCF (discounted cash flow) financial models from the first year of commercial power generation. One approach to this is to establish an EV (Enterprise Value) for the project by taking some multiple of EBITDA (Earnings Before Interest, Taxes, Depreciation, and Amortization) from the first year of commercial operation. A multiple of 12 is commonly used in the industry which means that in Year 1 of commercial operation, a power plant could be expected to have a market value of 12*EBITDA.

Prior to the commissioning of a power plant, this method becomes increasingly tenuous, particularly at earlier project stages. One way to get round this problem is to risk-adjust the likelihood of project success at any stage in the project development cycle and then use this to adjust downwards the commercial valuation obtained for Year 1.

As an example, the data in Table 1 relates to nominal development costs and revenues for a 50MWe geothermal power plant in Chile. Analysis of these data gives an EBITDA in Production Year 1 of USD 41m, which after allowance for debt results in a EV of $323m for an EBITDA multiple of 12. Using the success probability figures given in Table 1, together with various EV values ranging from 2 to 12, gives the pre-commissioning project valuations given in the right hand column of Table 1 for each of the various project development stages.

These data are shown plotted in Figure 7 for which points to note include:

- The EV multiple of 12*EBITDA is well above the level of capital cost expenditure throughout all phases of the development cycle;
- A lower EV multiple is indicated to be more appropriate for the earlier project phases;
- An EV multiple of 3 matches closely the cumulative capital cost expenditure through to Financial Closure;
- Earlier project stages than Financial Closure require lower capital cost input than project valuations based on an EV multiple of 3. This would provide an appropriate reward for early stage / higher risk investors for the project stages of Surface Exploration, Delineation Drilling and Additional Steam Drilling;
- Once financial closure has been reached, project valuations quickly increase, more or less in direct proportion to the capital required to complete the project, with EV multiples increasing from 3 at the commencement of construction to 12 at the commencement of power generation.

5. CONCLUSIONS

Through combining elements of risk and resource assessment with financial information, it is possible to examine the risk adjusted cost geothermal resource development. This is useful for a number of reasons, including determining a nominal valuation of a geothermal project during exploring and development.

It is proposed that the following valuation methodology be applied to geothermal project developments prior to commissioning:

- From the stages of First Deep Exploration Drilling through to Financial Closure, project value is given by an assumed EV of 3* EBITDA in Production Year 1 * Probability of success at any particular project stage
- At commencement of plant operation, project value is given by an assumed EV of 12*EBDITA

Application of these criteria, or similar, usefully serve to simplify the entry and exit of investors at any stage in a project and would likely assist with securing funds for the early, higher risk stages in the geothermal development cycle where a proportionally higher return is expected by early investors.

REFERENCES

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Table 1: Nominal geothermal development costs and risk profile for a Greenfield 50MWe first stage development in Chile. Key assumption is that no slim holes are drilled, with the first drilling being a standard size deep exploration hole in the indicated center of the field model. Figures in blue are equity injections from the developer prior to financial closure. Items in red text are key commercial risk stage gates.

Project Stage	Amount		Probability of Success (from Fig 2 and 3)	Valuation ($m) for EV=12* EBITDA	Valuation ($m) for EV=3* EBITDA
	USD m		%		
Reconnaissance	$	0.2	10%	32	
Geophysics	$	1.0	20%	65	
Pre Feasibility Study	$	0.3	20%	65	16
First deep exploration well	$	13	40%	129	32
Deep delineation drilling	$	27	80%	258	65
Feasibility Study	$	0.5	80%	258	65
Additional steam proving	$	24	85%	275	69
Financial closure	$	1.0	90%	291	73
Drill balance production wells	$	42	95%	307	77
Drill reinjection wells	$	28	95%	307	77
Construct power Plant	$	100	95%	307	77
Construct SGS	$	18	95%	307	77
Construct transmission	$	20	95%	307	77
Commission power plant			100%	323	81
Totals	**$**	**275**			

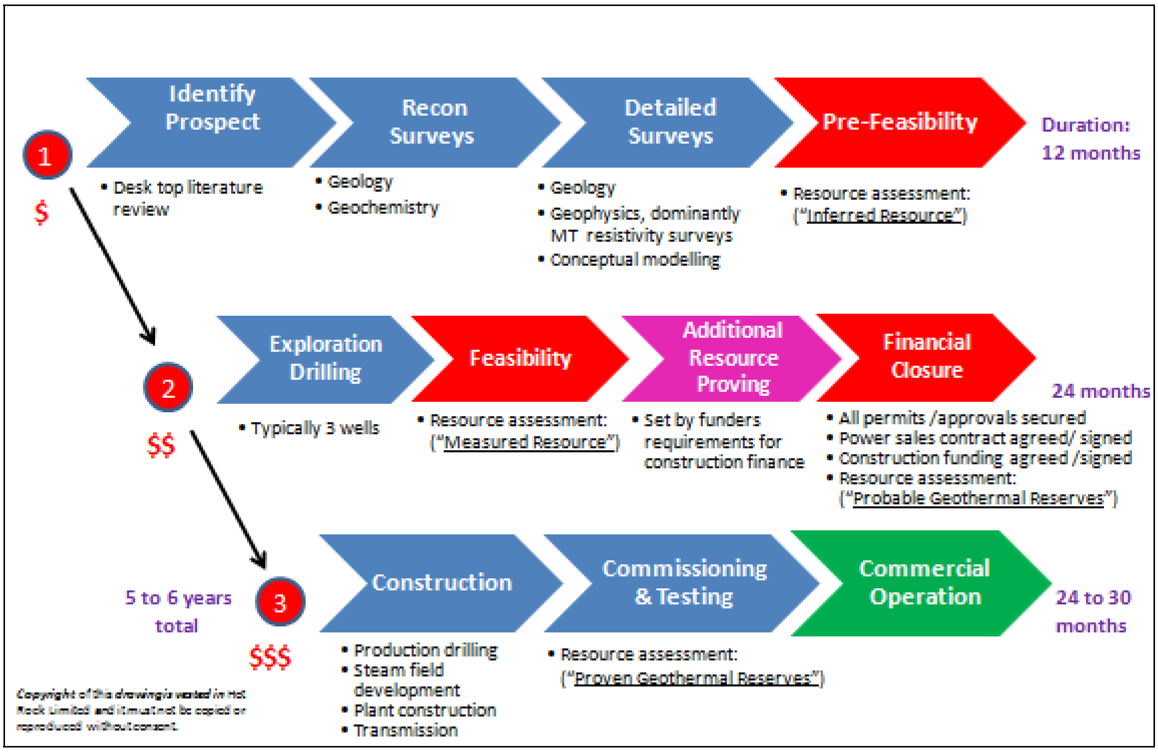

Figure 1: The geothermal development cycle showing work sequence, work activities and progressive improvements in resource and reserve definitions with time

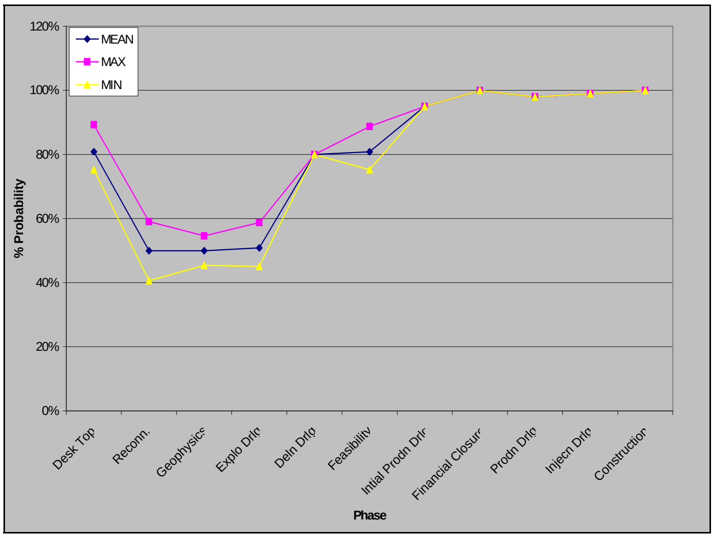

Figure 2: The probability of proceeding to the next stage at any stage in the geothermal development cycle (modified from Barnett et al, 2002)

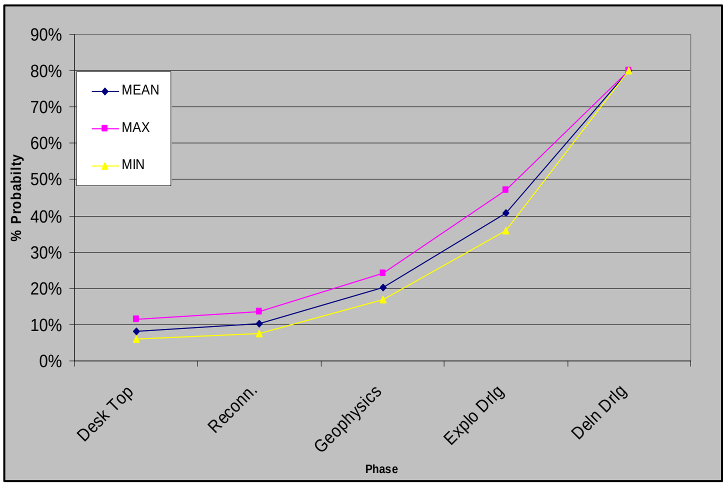

Figure 3: The absolute probability of proving a viable geothermal project, from initial desk top review to completion of delineation drilling after which financial closure from a debt funder would be obtained (from Barnett et.al., 2002).

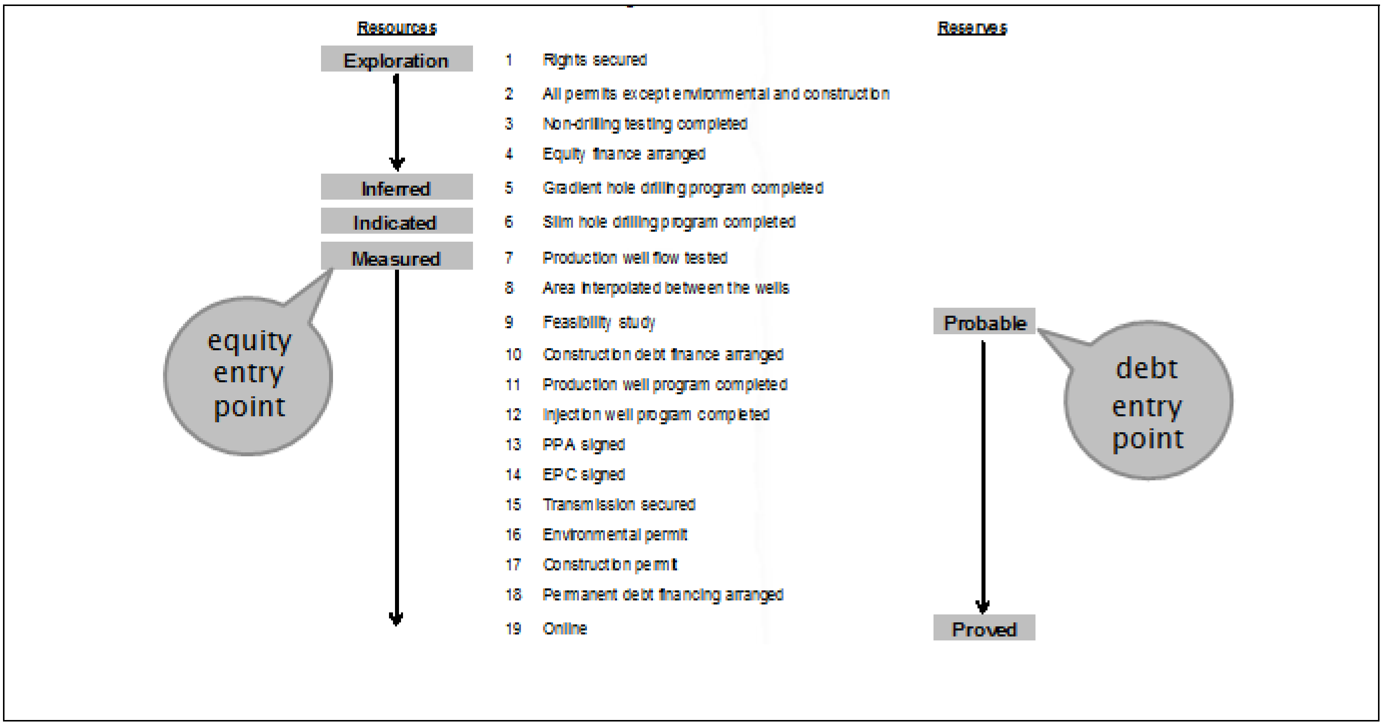

Figure 4: The geothermal development cycle coupled with the requirements of Geothermal Resource Reporting Codes, and equity and debt requirements and timing (modified from McIlveen, 2011).

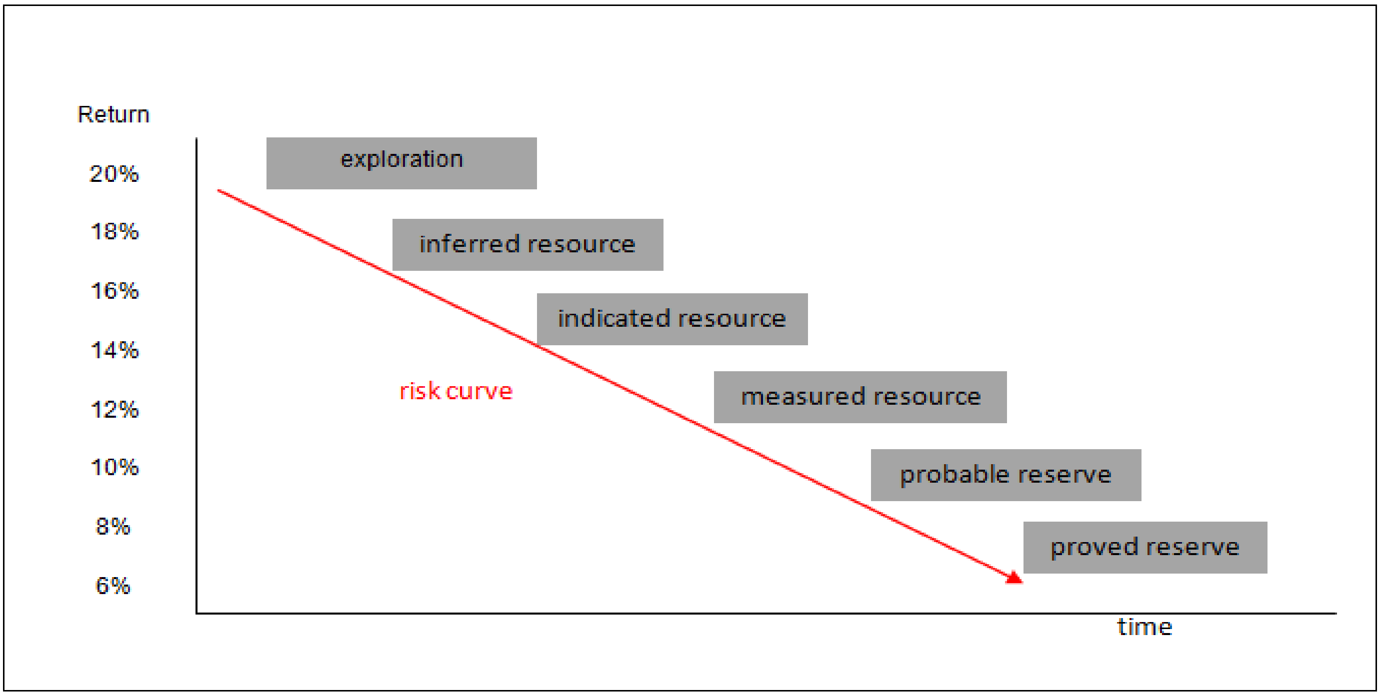

Figure 5: Expected investor returns coupled to Geothermal Resource Code assessments of geothermal resource development capacity (modified from McIlveen, 2011)

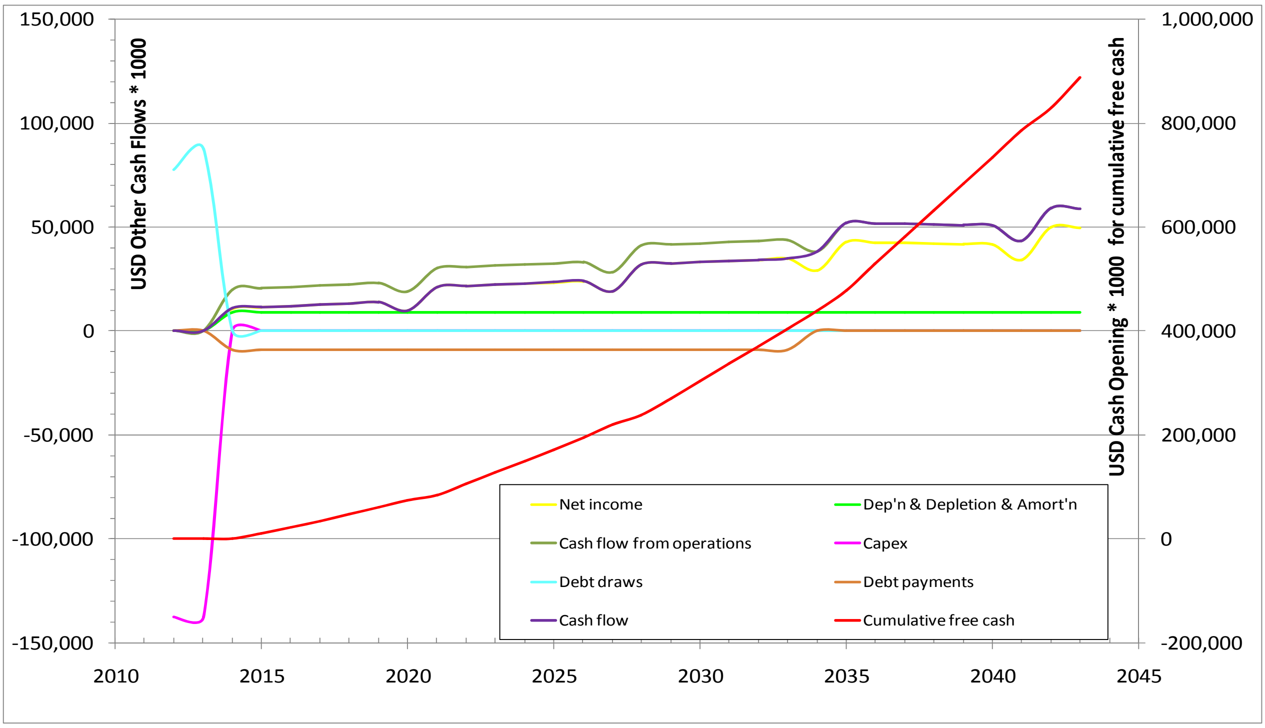

Figure 6: 30 year cash flows for the example 50MWe project, based on a selling price of electricity of $100 MWh (in 2012).

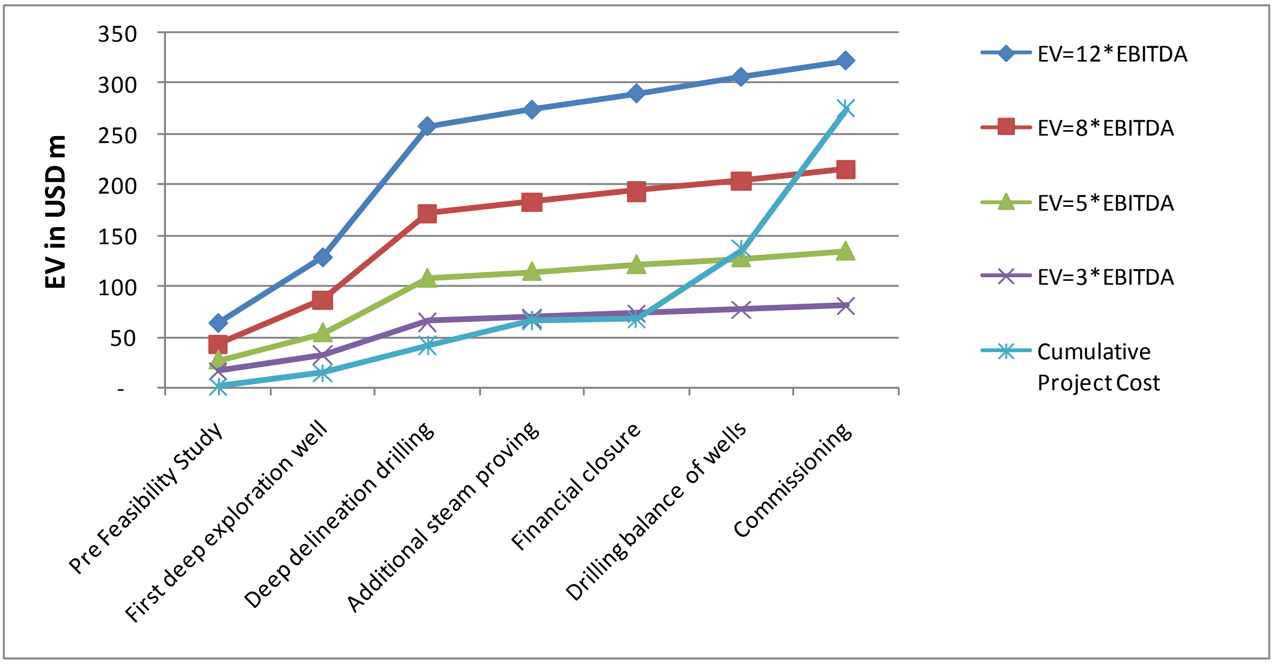

Figure 7: Project EV multiple values ranging from 2 to 12 times EBITDA, together with project capital costs during the project development cycle