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## RESOURCE RISKS IN GEOTHERMAL DEVELOPMENT

David R. Butler  
Chevron Resources Company

Risks that concern geothermal resource producers can be put into these general categories:

- Prospect Risk. For each commercial geothermal field discovered, some large number of prospects must be evaluated geologically and geophysically.
- Drilling Risk. Some percentage of the prospects evaluated geologically and geophysically will be drilled to result in the one commercial discovery.
- Evaluation Risk. Likewise, some percentage of the prospects drilled will require some greater or lesser amount of additional drilling and testing before the producer knows for sure which prospect comprises the commercial discovery.
- Sales Risk. At present, most producers do not intend to generate electricity. Therefore, before development can proceed, a purchaser must agree to buy the resource produced for a price that will allow an adequate return to the producer.
- Development Risk. In the full development of a commercial discovery, some unsuccessful wells will be drilled. It is believed this risk will be quite low.
- Reservoir Risk. This can be an area of uncertainty, and the magnitude of risk will probably vary considerably, depending on the specific circumstances.

These simple categories are those which are of immediate concern to producers and do not reflect political, social, economic, and other risks in the real world that are less amenable to quantification.

Natural resource producers are accustomed to prospect, drilling, evaluation, and development risks and are willing to assume the high risks inherent in the prospect, drilling, and evaluation stages if they can expect a return commensurate with the risk.

However, sales and reservoir risks associated with geothermal development are relative unknowns at the present time. It appears that sales risk is highly dependent on reservoir risk, purchasers seem reluctant to enter into a sales contract with producers unless it can be shown that there is little or no reservoir risk. In fact, it appears that most prospective purchasers want some form of

guarantee that the geothermal reservoir will produce at acceptable conditions for a period of 25 to 30 years.

Natural resource producers in many instances have geological, geophysical, and engineering staffs that are capable of assessing the reservoir risk, so the producer can decide if the risk justified his considerable investment in wells and the other producing facilities necessary to develop and produce the geothermal field.

Normally, producers will make their assessment of the reservoir risk available to prospective purchasers. However, purchasers are not likely to have in their organization the technical capability to evaluate this information in a manner that will enable them to commit to the considerable investment for construction of power plants and related facilities. Thus, the tendency has developed for purchasers to demand indemnification of the reservoir risk.

Producers are reluctant to indemnify the reservoir for two main reasons. First, producers are taking all the exploration and development risk and assuming a considerable portion of the reservoir risk by their investment in producing facilities intended to last for the life of the reservoir. Second, indemnification represents a long-term liability on the producer's books.

I would like to suggest for consideration a means whereby the risk to the purchaser can be ameliorated. ERDA has in effect a loan guarantee program for geothermal exploration and development. This is one of the vehicles by which the federal government encourages geothermal development during the early higher risk phases. Ideally, as private industry gains confidence through experience, federal participation should phase out.

As regards reservoir risk, ERDA has, or can retain, technical personnel who can assess the degree of reservoir risk inherent in a geothermal development project from reservoir data acquired by the producer. Based on their assessment, ERDA can indemnify the purchaser's reservoir risk by means of loan guarantees for power plant construction. Based on assessment of reservoir data, these loan guarantees would carry considerably less risk of default than guarantees for exploration ventures. Furthermore, the amount of loaned capital at risk under the guarantee would decline progressively as the reservoir proved to be capable of sustaining adequate production over the years of amortization.

The foregoing suggestion would seem to be an acceptable solution to the problem of reservoir risk as it pertains to monetary indemnification of the purchaser's investment in the geothermal power plant. A more perplexing problem is the makeup of lost capacity in a purchaser's supply grid in the event the geothermal reservoir should fail. In this instance, ERDA or other federal participation in the indemnification of reservoir risk would be further required to assure that alternate sources, swaps, and/or purchases of electricity would be made available such that the purchaser would not suffer loss of service or loss of return anticipated from the geothermal installation.

With time and experience in reservoir prediction in a particular province, it is likely that the need for federal guarantees of reservoir risk will diminish. This situation seems to offer one of the few ideal situations under which federal participation is warranted - large commitments to begin with in terms of both provinces and projects, but phasing out completely with time and increased experience on the part of producer and purchaser.