ESTIMATING THE VALUE OF A GEOTHERMAL RESOURCE TO AN ELECTRIC UTILITY

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INTRODUCTION

The decision of an electric utility to accept a particular price for a geothermal resource depends on the "value" placed upon that resource by the utility. This "value" includes a variety of factors, some of which consist of different portions of the cost or price of the resource, but many of which are not directly related to the cost of the resource, and some of which are intangible and thus difficult to quantify. A decision whether or not to invest in a geothermal resource would depend upon all of these factors. The facts considered by a utility in evaluating and comparing alternative sources of electricity are presented below, and an evaluation of geothermal energy is given with a view toward identifying some of its advantages and disadvantages, and some of the difficulties that would have to be resolved in a pricing arrangement. The particular viewpoint taken is that of an investor-owned utility in the Pacific Northwest - Portland General Electric Company (PGE).

CHARACTERISTICS OF GEOTHERMAL ENERGY

Several characteristics peculiar to the geothermal industry are considered important in an evaluation of geothermal energy. The most often noted of these characteristics is the requirement that geothermal energy be used where it is produced, and, therefore, that a power plant to convert geothermal fluids to electricity must be built at or near the reservoir. This results in a relationship between field producer and power plant operator that has been characterized as a "one market-one supplier" situation; this relationship poses certain constraints on the types of field-plant arrangements that are viable.

Another significant characteristic of geothermal energy is the relatively small optimal plant size - on the order of 50-100 MW. While this characteristic is disadvantageous from a utility's viewpoint because economies of scale are not possible, this property of geothermal power plants also has advantages in terms of greater flexibility of scheduling and reliability of operation.

The nature of geothermal reservoirs is such that in most cases wells will have to be run continuously, resulting in decreased flexibility in the operation of the power plant. Geothermal power plants are not expected to be load-following. It may be possible to operate wells continuously while at times bypassing the power plant and directly reinjecting the fluid into the reservoir; however, the extent to which this practice is possible and the effect of such a practice on the quality and longevity of the reservoir is difficult to predict at the present time. It may also be possible to control the flow rate of wells, particularly pumped wells, or to turn off the wells during seasonal periods of low energy demand. However, our current state of knowledge is such that the feasibility of these options is uncertain.

The relative youth of the geothermal industry, compared with more traditional forms of generation, also must be considered when estimating the value of a geothermal resource to an electric utility. Large uncertainties exist with respect to the cost of the resource and to the size, reliability, and longevity of the field. Because of the unique relationship between field producer and utility noted above, uncertainties with respect to the size and life of the resource are especially significant. Utilities will need to have some assurance that the fuel supply exists and is reliable, or else must factor this aspect of risk into the revenue requirements for a geothermal power plant. On the other hand, geothermal energy is one new fuel alternative that appears to be commercially viable now or in the near future and as such should be given serious attention by utilities.

For an Oregon utility, geothermal energy has a special attractiveness in that it is one of few fuel resources indigenous to that state (besides hydroelectric power; Oregon has only a few minor coal deposits). Finally, although some environmental difficulties exist, these difficulties appear to be surmountable and, on the whole, geothermal energy appears to be an environmentally acceptable resource. These characteristics may help to make it an attractive fuel alternative to government and the general public.

OPTIONS FOR OBTAINING GEOTHERMAL ENERGY

Three basic options exist for a utility considering investment in geothermal energy. The "classic" arrangement is where a resource company explores, develops, and operates the field, and sells the fuel to an electric utility which builds and operates the power plant and transmission lines. Alternatively, a utility might purchase part or full ownership of the field and thus be responsible for development and operation of both field and power plant. A third possibility is for the utility to purchase busbar power from some company who owns and operates a power plant producing electricity from geothermal energy. In this third alternative, the utility would still be responsible for transmitting the electricity to the load center. The costs, benefits, and risks to a utility (and consequently the "price" acceptable to the utility) differ for each of these three alternatives.

CRITERIA USED IN COMPARING GENERATION ALTERNATIVES

The financial criteria used to evaluate generation alternatives can be summarized as follows. The major goal is to minimize the cost or the revenue requirements, levelized over the life of the plant, for the generation of electricity, usually expressed in $/kW-yr or mills/kWh. Given a "best estimate" for the levelized revenue requirements, a second major goal is to minimize the risk associated with the cost of the resource; that is, to consider the range or the probability distribution of the revenue requirements for each alternative resource. While an analysis of the expected revenue requirements and the risks associated with various generation alternatives usually determines which alternative should be selected, a third criteria exists, which may override the results of analyzing the first two criteria. This third consideration is the impact of an option on the near-term future of the utility in terms of revenue requirements, rate adjustments, capitalization structure, and so on. An option which appears most desirable over the long-term may be rejected because of unacceptable impacts in the near future.

Therefore, when evaluating a geothermal resource and determining what price would be acceptable, PGE would analyze: (1) the busbar price of the electricity, (2) transmission system capital and operating costs, (3) total fixed (or "ownership") costs versus operating (or "incremental") costs, (4) long-term levelized costs versus initial year costs, (5) costs/kWh versus absolute cost in $/yr revenue requirements, (6) impacts on near-term rate adjustments, and (7) existence of tax incentives and the ability of the company to take advantage of them. The importance of each of these criteria will vary for different alternatives; again, the decision would be based on minimizing the expected revenue requirements subject to the existence of unacceptable risks or near-term impacts.

In addition to the factors noted above, several important considerations exist that do not directly involve the cost of the generation resource being evaluated. Perhaps most obviously, the acceptability of a price for a particular resource depends on the prices of competitive resources. Whether or not a pricing strategy for electricity from geothermal energy is indexed to the prices of competitive fuels, PGE will consider the prices of competitive fuels when evaluating geothermal opportunities. Not only current prices must be considered but also the expected future prices of competitive fuels. It may be desirable to invest in a resource which is currently higher in price but which may be expected not to escalate as rapidly as its competitors or whose future price may be less uncertain. Additionally, the expected plant operating factors (number of hours operating per year) can have a significant impact on the relative economics of competitive resources.

A critical consideration is that of availability. As is well known, this issue of availability, often determined politically rather than otherwise, has become crucial over the last several years. In addition to current availability, the assurance of future supply is important. Flexibility in adding generation capacity of a particular type of resource is another somewhat intangible consideration. In particular, relative lead times for different types of power plants can be a critical factor.

The larger picture of a balanced resource mix and the availability of different options for generating electricity are also important considerations. Geothermal energy should be evaluated according to the part it will play in a mix of baseload, intermediate, and peaking resources. It is also useful simply as an additional option for generating electricity; in this sense it helps to provide the variety of resources necessary to provide security in an uncertain environment.

Finally, public acceptance of a resource, much of which revolves around the question of environmental suitability, is becoming increasingly critical. Public acceptance of a resource not only eases the implementation of that particular resource, but may also improve the general attitude of the public toward a utility which then impacts on the success of other utility projects.

The importance of these less tangible criteria for the pricing of electricity from geothermal energy is that these considerations will enter into an estimation of its value as a resource alternative, and thus into the determination of what would be an acceptable price for geothermal energy.

EVALUATING GEOTHERMAL ENERGY

The following discussion provides a background for an evaluation of geothermal energy, and the three options for obtaining geothermal energy, from the viewpoint of an electric utility.

Assuming that the field producer sells the geothermal fluid to a utility, the price of the fuel for a hot water resource is estimated to run from half to significantly more than half of the total busbar cost of electricity. This relatively high incremental cost would tend to suggest that electricity from geothermal energy be used as a peaking or, more likely, an intermediate resource (similar to coal); however, the requirement that wells be run continuously seems to restrict it to a baseload resource. The degree to which some flexibility may be gained so that the power plants need not operate continuously is uncertain. From a utility's viewpoint, some degree of control over maintenance downtime of field equipment would be desirable in order to schedule such downtime with periods of low energy demand. These factors will have to enter into any pricing arrangement between field producer and utility. Where geothermal energy is used as a baseload resource, its record of high plant operating factors may have a positive impact on its economics relative to competitive fuels.

The "one market-one supplier" property of electricity from geothermal energy results in significant uncertainties in field size, reliability, and longevity that must be worked into any arrangements between a field producer and a utility. The field producer will want to assure a buyer for a future field that is not yet proven, while the utility may not wish to commit its funds until a field of adequate size is proven. The utility will also wish to require insurance in the event of decline of fluid quality or early depletion of the field. Hopefully these uncertainties will become less critical as the geothermal industry matures. In addition, the unique field-plant relationship makes the location of the field with respect to load center and transmission facilities especially critical. A field of lower quality close to a major load center may be more valuable than a field of higher quality far away from load centers or existing transmission facilities.

The small size of a geothermal electric plant, while not providing economies of scale, may prove to be more reliable and may provide greater flexibility in scheduling small additions of generating capacity. In addition to the greater reliability of small power plants, failure of a small plant will have far less impact on the total generating system. The economics of a smaller plant will have less impact on total utility revenue requirements; thus a somewhat higher price in mills/kWh might be acceptable for a smaller plant if other advantages accrue to that plant.

The indigenous nature of geothermal energy, besides enhancing public acceptance, also provides greater reliability of supply and possibly greater control and, hence, less uncertainty with respect to the price of the resource. Finally, as noted, although geothermal energy is still an emerging resource, it is hoped that it will provide significant quantities of commercially competitive power within the near or middle term future. Therefore, it is a resource that utilities should support.

No absolute preference exists at the present time for any of the three options for obtaining geothermal energy outlined above. Nevertheless, some of the advantages and disadvantages of each of these options, and the difficulties that would have to be resolved in each case, are summarized below.

PGE does not currently foresee a large availability of geothermal busbar electricity produced by non-utility companies. It is believed that a utility would be able to generate electricity cheaper and more reliably; therefore, the price of purchased electricity is expected to be higher than the busbar cost would be if the utility generated the electricity. This option, however, does possess certain advantages that may offset the expected higher price. These advantages mostly involve a low capital outlay with consequently low risk (although some risk to the utility is involved in constructing transmission facilities for a power source that may prove unreliable). On the other hand, this option provides the least degree of utility control over the amount and timing of electricity generation and over production reliability. The fact that the cost of this busbar electricity is totally incremental - and may be expensed to offset revenues - may or may not be an advantage, depending on the individual utility.

The "classic" arrangement provides the utility with costs that are divided between fixed and operating. Capitalization is significant in this case, although incremental costs (mostly fuel) are also high. The utility would not bear the risks associated with field exploration and development, except as they are reflected in the fuel costs. The utility's major concern lies with the uncertainties in field size, reliability, and longevity. The uncertainty in field size impacts on the question of when power plant construction should begin, and when and what size of transmission facilities should be constructed. These factors will need to enter into the agreement between field producer and utility, including the amount and timing of prices. The utility will also wish to have some insurance with respect to field reliability and longevity; several suggestions for resolving this uncertainty have been offered, including federally funded insurance and accelerated depreciation methods. Finally, as has been noted, it may be desirable to include provisions for obtaining flexibility in capacity expansion and plant operating schedules. Any such provisions for flexible field expansion and plant operation will also have to enter into the pricing agreement.

The third option in reality encompasses many options consisting of various degrees of utility participation in field development. This option results in a higher percentage of fixed costs and lower incremental costs, since field capital costs would be assigned to fixed charges. The attractiveness of this option stems mainly from the greater control over field development and operation that the utility would possess. Whether this option would be economically advantageous for the utility is uncertain at this time, as the rate of return required by a utility depends upon the perceived risk of a project. Much depends upon whether or not the Public Utilities Commission would allow the ratepayers to bear the risks of such a venture (this is particularly true if the utility participates in field exploration as well as development). The willingness of the PUC to allow the risks of field development to flow into the rate base will depend largely on how great these risks are perceived to be in terms of the probability and magnitude of loss. It is likely that the PUC would look more favorably upon joint ventures, for example, between a utility and a resource company. Even if the risks of field development are born by the stockholders rather than the ratepayers, the PUC will have control over the rate of the return to the stockholders by controlling the price the utility is allowed to pay (itself) for the fuel. In addition to these difficulties, this option includes administrative headaches, due to a new type of utility project, which are lacking in the other options.

It is hoped that the preceding discussion will give resource companies and others an idea of the type of analysis performed by one utility in evaluating and comparing alternative sources of electricity, and how one utility might evaluate different options for obtaining geothermal energy.