ECONOMIC MODELING FOR GEOTHERMAL RESERVOIRS AND POWERPLANTS

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Our work on reservoir modeling is mainly from a cost accounting standpoint. Our interest has been concerned with the economic aspects of reservoir exploration, development, and operation and the impact of these activities on the ultimate cost of geothermal energy. We have modeled the above ground aspects of delivering energy from geothermal wells, but we have treated the below ground flow as a "black box" which yields a fluid of specified characteristics at the wellhead. We hope to include a physical simulation model of geothermal reservoirs in our economic model sometime in the future. We have developed, under ERDA sponsorship, an economic model for geothermal cost analysis, called GEOCOST.

The GEOCOST computer program is a simulation model which calculates the cost of generating electricity from geothermal energy. GEOCOST will simulate the production of electricity from most types of geothermal resources. It is composed of two principal parts: a reservoir model which simulates the exploration, development, and operation of a geothermal reservoir, and a powerplant model which simulates the design, construction, and operation of the powerplant. Five different powerplant types can be simulated: flashed steam, binary fluid cycle, a hybrid combined flashed steam-binary fluid cycle, total flow, and geopressured reservoirs.

Sensitivity analysis can be performed, using the reservoir and powerplant models, to determine the relative effect of different economic parameters, assumptions, and uncertainties on the cost of generating electricity. The GEOCOST program can be used to:

- determine the economic incentives for specific geothermal research and development programs and projects.
- determine potential economic impacts of uncertainties in technology.
- identify major cost components of geothermal energy, and
- provide a systematic method for assessing the economic potential for each type of geothermal resource and power cycle.

Combined with resource assessment information, GEOCOST can be used to define the potential supply curve (price/quantity relationship) for geothermal energy. This supply curve forms the basis for: 1) assessing the potential role of geothermal energy in competition with other sources of energy, and 2) estimating potential economic incentives for new research and development programs.

GEOCOST can simulate nearly any financial and tax structure through varying the rates of return on equity and debt, the debt-equity ratios, and tax rates. The reservoir model and the powerplant model may have the same or separate financial structures and costs of capital. The plant and reservoir life can be varied over a long period, currently up to 50 years.

The GEOCOST program calculates the cost of energy based on the principle that the present worth of the revenues will be equal to the present worth of the expenses including investment return over the economic life of the plant and/or reservoir. The present worth factor is determined by the capital structure and rates of return on invested capital for the enterprise.

The results of analyses using the GEOCOST model have shown that the reservoir characteristics, in particular the fluid temperature, well flow rate, and well drilling and fluid extraction costs, are the most important variables which will determine the cost of geothermal energy.