

LEVELIZED COST OF GEOTHERMAL POWER - HOW SENSITIVE IS IT?

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ABSTRACT

This paper analyzes the sensitivity of the levelized cost of geothermal power to: (a) capital cost; (b) operations-and-maintenance (O&M) cost; (c) make-up well drilling cost; (d) resource characteristics (well productivity and its rate of decline); (e) development and operational options (installed plant capacity, number of years of make-up well drilling, and project life); and (f) macro-economic climate (interest and inflation rates). We consider here the levelized cost of power (in cents per kilowatt-hour) over the project life, the capital cost being amortized over 30 years; any royalties, tax burden, or tax credit are ignored. A range of development sizes, from 5 to 150 MW, with 50 MW as the base case, is considered. The economy of scale in both capital cost and O&M cost, as well as the higher productivity decline rate due to increased installed capacity, are taken into account. The capital cost does not include transmission line cost or any unusually site-specific costs of regulatory compliance or environmental impact mitigation.

Levelized power cost is sharply reduced if full generation capacity is maintained, by drilling make-up wells, for at least the first 10 years or so following plant start-up; however, continuing make-up well drilling beyond about 20 years does not reduce levelized cost any further. The minimum achievable levelized cost (on the order of 3.4¢/kWh) is relatively insensitive to plant capacity because a faster well productivity decline rate for a larger plant capacity counters the economy of scale. In the unlikely situation of well productivity decline being insensitive to plant capacity, levelized cost does decline with increasing plant capacity. There are significant opportunities to reduce power cost as site-specific experience is gained in resource management and power plant operation throughout the project life. Levelized power cost is most sensitive to unit O&M cost followed by unit capital cost, interest rate and inflation rate in the decreasing order of sensitivity; it is relatively insensitive to resource-related issues of well productivity, drilling cost per well and well productivity decline rate. The macro-economic climate has relatively minor impact on levelized power cost. Operating small power plants (less than 50 MW capacity) beyond their typical amortization period of 30 years can substantially reduce levelized cost. In the unusual situation of an absence of economy of scale, levelized cost increases with plant capacity, the minimum achievable level still being 3.4¢/kWh. In the very unlikely situation of both well productivity decline as well as unit capital and O&M costs being insensitive to plant capacity, the minimum achievable levelized cost would be on the order of 3.6¢/kWh. For a 50 MW power plant today, the levelized power cost would be in the range of 3.6 to 4.1 ¢/kWh.

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