

THE ECONOMICS OF SUSTAINABLE GEOTHERMAL DEVELOPMENT

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ABSTRACT

In planning the development of a geothermal field, there is a trade-off between plant capacity and the cost of make-up drilling. A larger plant benefits from economics of scale in the construction and operation of surface facilities. On the other hand, a larger plant also places a greater load on the geothermal reservoir, which causes higher rates of decline in well productivity. Greater decline rates for existing wells require a larger number of make-up wells. Because the cost of make-up wells occurs later in the project life, this cost has relatively less impact on project economics than the up-front cost of plant construction. Similarly, the loss of revenue from a decline in output late in a project's life is much less significant than revenue foregone at the start of a project due to limited plant capacity.

By way of illustration, this paper compares conservative and aggressive development scenarios for a hypothetical geothermal field. In the conservative scenario, the developer installs plant capacity that is assumed to represent a modest load on the reservoir (30 MW). Declines in well productivity are less than 2% per year, plant output is sustained at full capacity throughout the project life, and make-up drilling increases the number of production wells by about 40%. In the aggressive scenario, the developer installs three times the amount of plant capacity (90 MW), which is assumed to be at or near the maximum sustainable capacity of the reservoir. Declines in well productivity start at 20% per year and taper gradually to 3% per year. Plant output is sustained at full capacity only through year 20 of a 30-year project life, declining gradually thereafter to about 70% of full capacity. Make-up drilling increases the number of production wells by more than 2½ times.

An economic analysis based on these assumptions shows that the aggressive scenario has a better discounted return on investment (DROI) and a present worth (PW) almost three times as large as the conservative scenario, despite the large amount of make-up drilling and the late-term declines in output.

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