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THE FUTURE OF GEOTHERMAL ENERGY: AN ASSESSMENT OF THE ENERGY SUPPLY POTENTIAL OF ENGINEERED GEOTHERMAL SYSTEMS (EGS) FOR THE UNITED STATES

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SYNOPSIS

Scope: A comprehensive assessment of enhanced, or engineered, geothermal systems was carried out by an 18-member panel assembled by the Massachusetts Institute of Technology (MIT) to evaluate the potential of geothermal energy becoming a major energy source for the United States. Geothermal resources span a wide range of heat sources from the Earth, including not only the more easily developed, currently economic hydrothermal resources; but also the Earth's deeper, stored thermal energy, which is present anywhere. Although conventional hydrothermal resources are used effectively for both electric and nonelectric applications in the United States, they are somewhat limited in their location and ultimate potential for supplying electricity. Beyond these conventional resources are EGS resources with enormous potential for primary energy recovery using heat-mining technology, which is designed to extract and utilize the earth's stored thermal energy. In between these two extremes are other unconventional geothermal resources such as coproduced water and geopressured geothermal resources. EGS methods have been tested at a number of sites around the world and have been improving steadily. Because EGS resources have such a large potential for the long term, we focused our efforts on evaluating what it would take for EGS and other unconventional geothermal resources to provide 100,000 MWe of base-load electric-generating capacity by 2050. Although somewhat simplistic, the geothermal resource can be viewed as a continuum in several dimensions. The grade of a specific geothermal resource would depend on its temperature-depth relationship (i.e., geothermal gradient), the reservoir rock's permeability and porosity, and the amount of fluid saturation. High-grade hydrothermal resources have high average thermal gradients, high rock permeability and porosity, sufficient fluids in place, and an adequate reservoir recharge of fluids – all EGS resources lack at least one of these. For example, reservoir rock may be hot enough but not produce sufficient fluid for viable heat extraction, either because of low formation permeability/connectivity and insufficient reservoir volume, and/or the absence of naturally contained fluids. Three main components were considered in the analysis: 1. Resource – estimating the magnitude and distribution of the U.S. EGS resource. 2. Technology – establishing requirements for extracting and utilizing energy from EGS reservoirs including drilling, reservoir design and stimulation, and thermal energy conversion to electricity. 3. Economics – estimating costs for EGS-supplied electricity on a national scale using newly developed methods for mining heat from the earth. Developing levelized energy costs and supply curves as a function of invested R&D and deployment levels in evolving U.S. energy markets.

THE FULL REPORT

The complete report is available on the Proceedings CD with file name FUTURE.PDF.

This report is also available on the Internet at:
http://geothermal.inel.gov and
http://www1.eere.energy.gov/geothermal/egs_technology.html
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