ABSTRACT

GEOTHERMAL--TWO DECADES PAST, TWO DECADES FUTURE

Electric power generation in the U.S.A. using geothermal energy has grown from 11 MWe in 1960 to 78 MWe in 1970 to 812 MWe in 1980 with an additional 2350 MWe proposed through 1989. Projections suggest that, given the right financial, institutional, and technological climates, this power generation could grow to as much as 64,000 MWe by the year 2000. Similarly, direct heat applications of geothermal energy in the U.S.A. have grown from an unknown number of Quads in 1970 to 0.0115 Quads in 1980 with an additional 0.0096 Quads proposed. Projections suggest, for the favorable climates mentioned, that direct heat applications could utilize as much as 0.5 Quad by the year 2000. The pessimistic side of the story reveals that as few as 3300 MWe of electrical generating capability and less than 0.2 Quad of direct heat applications could result by the year 2000.

The common problems which are apt to stall both electric power generation and direct heat applications are: 1) difficulties in delineating reservoir character, size, and longevity; 2) difficulties in determining extent and regional geologic controls of geothermal districts; 3) Federal and State institutional barriers; and 4) the need to find a receptive utility/developer/consumer environment for geothermal energy. Over the last decade, institutional barriers have been the greatest deterrent to geothermal development, but with the passage of the Geothermal Steam Act of 1970, the National Energy Act of 1978 and with the expected passage of the Geothermal Omnibus Bill in 1981, these barriers will have diminished to manageable proportions. Industry, with Federal government incentives, is working its way around utility/developer/consumer problems. However, the remaining two problems, associated with geothermal

reservoirs and districts can be diminished with significant improvements in exploration and assessment technology and in reservoir engineering. For some length of time, perhaps as much as a decade, industry will require Federal assistance in solving the problems encountered in exploration and assessment technology and in reservoir engineering.

Geophysicists can make major contributions to geothermal electric power development and direct heat applications by improving the means and cost-effectiveness of methods for 1) detecting fracture systems which constitute most geothermal reservoirs; 2) direct and/or indirect detection of buried sources of heat; 3) predicting subsurface temperatures, fluid flow regimes, reservoir size, and reservoir longevity; and finally 4) modeling the earth faithfully in three-dimensions for fluid flow/heat flow, electrical methods, and high-resolution reflection seismic methods.

The decade 1960-1970 saw the emergence of an infant scientific and engineering infrastructure capable of working the problems posed by the need for, and profitable development of, geothermal resources; the decade 1970-1980 saw acceleration of geothermal development stimulated by Federal assistance and realignment of the world's financial structure; the next two decades will bear the fruit of the last two, but the challenges before society to accomplish something significant in renewable energy resources including geothermal are enormous. The challenge before industry and government clearly is to produce at least 50,000 MWe and at least 0.5 Quads of direct heat applications by the year 2000 so that geothermal becomes a strong component of our future energy mix.