THE NEVADA GEOTHERMAL INDUSTRY - 1996

Thomas Flynn
Division of Earth Sciences
University of Nevada, Las Vegas
Reno, NV 89503

INTRODUCTION

Nevada ranks second in the United States for overall geothermal utilization and number one on a per capita basis (Table 1). Nevada's geothermal power plants generate approximately 210 megawatts (MWe) of electricity (gross), enough for about 200,000 households. Modern development began during the 1980s; but, geothermal utilization can be traced from prehistoric applications by indigenous Native Americans to modern uses. In July 1984, the first electricity generated from a Nevada geothermal resource occurred at Wabuska, in Lyon County. The binary electric power plant yielded an output of 600 kW, and the electricity was purchased by Sierra Pacific Power Company. Today, Nevada's geothermal resources support twelve electric power plants at ten sites, representing a total investment of approximately $450,000,000. Several large-scale direct-use projects have also provided significant economic and environmental benefits. Conservative estimates suggest that the 210 MWe presently produced in Nevada could easily be doubled or tripled, from identified existing geothermal resources if sufficient market demand exists.

Table 1. States That Produce Geothermal Electricity

State	Population	Installed Geothermal	Watts/Person
Nevada	1,200,000	210 MWe	173
California	30,000,000	2,500 MWe	83
Hawaii	1,120,000	25 MWe	22
Utah	1,730,000	33 MWe	5

Population data from 1990 Census. Electric power data (Hoops, 1994)

Geothermal resource development in Nevada accelerated in the 1980s for several reasons: the finite-nature and volatile costs of conventional fossil fuels, economic and institutional incentives, the environmental impacts of combustion, and technological advances within the geothermal industry. The key to sustained development is to balance long-term energy demands and costs, with long-term environmental and economic benefits. This report examines the historical development, describes recent events, and suggests several possible futures for geothermal energy in Nevada.

HISTORY

Commercial-scale geothermal development began in the United States in 1960 with the start-up of the first power plant at the Geysers field in northern California. Subsequent development continued at a moderate pace until the energy crisis and Arab Oil Embargo in 1974. Geothermal energy resources were identified as a way to preserve indigenous petroleum resources and ensure future energy supplies. Major project development accelerated in the western United States and can be traced to post-crisis development incentives including government sponsored research programs, changes in the laws governing geothermal leases on public lands, economic incentives by electrical utilities, and advances in energy conversion equipment.

Several technologies have been developed to extract heat efficiently from hot water resources including single flash, dual flash and binary-cycle systems (Table 2). Most of the conventional flash plants operate at higher temperatures and use a portion of the geothermal fluid in the cooling and condensation cycle, which conserves potable water supplies.

ELECTRIC POWER GENERATION

Low- to moderate-temperature geothermal resources are becoming increasingly more attractive as a prime source for the generation of electricity for several reasons. Geothermal technology has advanced rapidly in the areas of binary power systems, reliability, and dry cooling systems. Binary power plants generally tap lower temperature resources than flash plants and utilize a second working fluid, in addition to the geothermal fluid, to produce electricity. Typical installations operate at temperatures between 120ºC and 180ºC, and use either pentane or iso-pentane as a secondary working fluid.

DIRECT UTILIZATION

As the name implies, direct-use application employ geothermal heat directly, with no conversion to electric power. Nevada ranks number one for direct utilization of geothermal energy. Mining, aquaculture and agriculture benefit from the direct utilization of geothermal resources. The Elko County School District and the Elko Heat Company operate geothermal district space heating systems that provide hot water to municipal, residential and commercial establishments. The Elko Heat Company, one of Nevada's largest geothermal district heating system, has provided service to Elko since

Table 2. Nevada's Geothermal Power Plants

Plant Name Owner/Operator	County	Year On-Line	Installed Capacity (MWe)	Estimated Cost of Construction ($000)	System Type
Wabuska - Tad's	Lyon	1984, 87*	1.2	2,000	Binary Cycle
Desert Peak - California Energy	Churchill	1985	10.0	18,000	Single Flash
Beowawe - Oxbow	Lander	1985	16.3	30,000	Dual Flash
Steamboat - Far West	Washoe	1986, 88, 92	47.0	70,000	Binary Cycle
Soda Lake - OESI	Churchill	1987, 91	23.0	45,000	Binary Cycle
Empire - OESI	Washoe	1987	4.8	12,000	Binary Cycle
Steamboat - Caithness	Washoe	1988	13.5	30,000	Single Flash
Dixie Valley - Oxbow	Churchill	1988	62.0	140,000	Dual Flash
Stillwater - OESI	Churchill	1989	13.0	37,000	Binary Cycle
Brady's - Brady Power Partners/Oxbow	Churchill	1992	20.0	65,000	Single Flash

* Note: Multiple years indicate power plant additions or modifications.

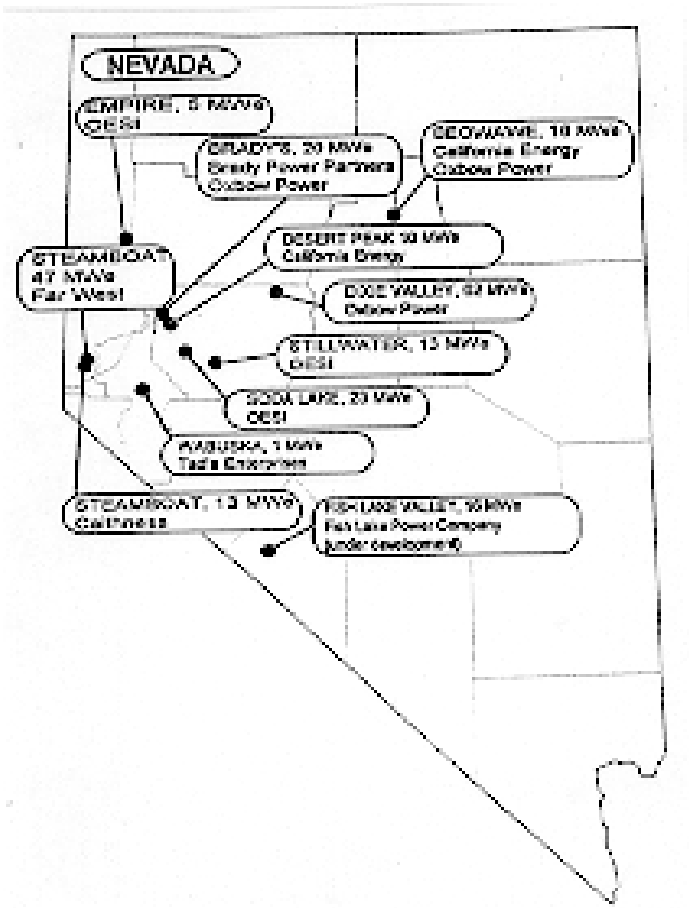

Figure 1. Location of Nevada's geothermal power plants showing production in megawatts and the name of the plant operator.

1982. Approximately 250 homes and businesses in Reno use geothermal energy for space heating. The Warren Estates subdivision supplies hot water to more than 100 private homes from a single geothermal well. Two food dehydration plants now produce dried garlic and onion using geothermal heat as the heat energy source. Geothermal fluids are used in gold mines to accelerate cyanide heap leaching and extent the leaching season. Energy tax credits for geothermal projects provided a 40% "write off" on capital investments placed online before June 1985. This single item was responsible for 70 to 80% of all residential geothermal installations in Nevada.

REGULATORY ASPECTS

Development of geothermal resources in Nevada is regulated by a combination of federal and state agencies. The principal federal agency is the Bureau of Land Management (BLM). The BLM regulates drilling and resource development. The principal state agencies include the Division of Minerals (drilling permits), Division of Environmental Protection (injection permits), Division of Water Resources (drilling and water consumption), and the Public Service Commission of Nevada (economics and power purchase agreements). In Washoe County, a permit is required from the Air Quality Management Division of the Washoe County Health Department.

ECONOMICS

Historically, renewable energy sources have been perceived as being non-competitive with fossil fuels. Many of the power plants in Nevada receive higher-than avoided cost payments for electric power. These contracts were developed to offset some of the initial capital expenses associated with well drilling and equipment purchases. Two power plants in Nevada (Steamboat Units 2 & 3) were constructed as a result of winning competitive bids with conventional power plants because of higher fuel prices in 1989. Electric power generated from geothermal resources is purchased by two utility companies: Sierra Pacific Power Company of Reno, Nevada and Southern California Edison Company.

Many utility companies, including Sierra Pacific Power Company, recognize the value of including renewables in their resource mix. Geothermal energy, for example, is included in many utility energy portfolios along with fossil-fuels in California, Nevada, Hawaii and Utah. Nevada benefits from the use of renewable resources, especially geothermal, as evidenced by the various revenues earned from geothermal operations. The Nevada Department of Taxation, Division of Assessment Standards, reports that net proceeds tax, property tax and county tax payables have increased for geothermal plants throughout the state, especially in rural areas such as Churchill County (Table 3).

Leasing and Royalties

Leaseholds in the United States have stabilized since 1991. Nevada leads the nation in geothermal leaseholds with approximately 29,000 acres. California and Utah follow, and New Mexico, which does not produce electricity, has nearly 5,000 acres of geothermal leases. Hawaii's geothermal resources are all produced on fee land.

The Bureau of Land Management collects royalties on geothermal energy produced on federal leases both on electricity and on heat. Land leased within a KGRA or on the basis of competitive bids is charged $2.00/acre; all other land is charged $1.00/acre. The royalty rate is ten percent of gross proceeds, minus transmission and generation deductions. The result is a royalty rate equal to 3.5 to 4 percent of the gross proceeds. This number is significantly lower than the 10 to 15 percent originally proposed in the Geothermal Steam Act of 1971.

In 1992, Nevada produced 1,219,700 megawatt hours (MWh) of geothermal electricity and a sales volume of about $85 million dollars, based on a net production of 1,034,800 MWh. In addition, federal geothermal leases on 348,000 acres generated rent and royalty fees of $2,926,200, according to Bureau of Land Management reports (Hoops, 1994). In 1994, geothermal electric power on federal land was 1,033,665 MWh for a total sales volume of 98,563,783. A total of $4,476,624 dollars were collected. Figures are incomplete for 1995; but, through September, royalties collected equal $3.2 million. One-half of these revenues are returned to Nevada's general fund (Hoops, 1995).

Table 3. Revenue and Taxes Received from Geothermal Operations in Nevada

Year	Actual Gross Proceeds	Actual Net Proceeds	Actual County Tax	Property Assessed Value	Property Taxes Due
1989	$58,876,628	$18,114,494	$345,516	$63,134,750	$1,342,691
1990	$68,003,694	$28,133,212	$631,253	$53,105,610	$1,258,415
1991	$74,253,212	$29,570,221	$694,578	$57,328,100	$1,400,386
1992	$82,814,226	$35,602,681	$864,815	$60,957,720	$1,990,902
1993	$102,164,450	$37,432,245	$827,645	$68,211,000	$1,656,424

Data Source: Nevada Department of Taxation (NDT, 1994).

ENVIRONMENTAL

Based on 210 MWe produced by Nevada's geothermal power plants, the following volumes of fossil fuels were conserved: 821,100 tons of coal, or 3,066,000 barrels of oil, or 18,396,000 million cubic feet of natural gas (Goddard, et al., 1989). Electric power generation and the preservation of the environment are of tremendous importance to Nevada's utility industry. Geothermal power plants, for example, have incorporated several award-winning technologies. California Energy Co., Ormat Energy Systems, Inc. (OESI), and Pacific Gas & Electric Co. have received environmental awards for their role in reducing greenhouse gases and ozone depleting chemicals. The awards recognize the reduction in pollutants achieved by modifications to the power generation process. Sierra Pacific was recognized in the June 1994 issue of Money Magazine as an environmental leader among the top utilities from around the country who are "outstanding in pollution control, hazardous waste reduction, and energy conservation." More recently, Sierra Pacific was one of six utilities to receive acid rain bonus allowances from the U.S. Environmental Protection Agency for undertaking energy efficiency and renewable energy measures. Some of this recognition can be attributed directly to the incorporation of geothermal energy into the utility resource plan.

CONCLUSIONS

It has been projected that geothermal capacity and generation in the USA could realistically increase from 2,590 MWe in 1990 to 23,400 MWe in the year 2030 (EIA, 1991). These forecast amounts were based on expected expansions from fields developed in California, Nevada and Utah, as well as the development of new fields in Oregon, Hawaii and New Mexico. However, these assessments require that renewable energies receive a share of the power market along with existing electricity generation technologies.

Geothermal development has accelerated in the last fifteen years largely as a result of government supported financial incentives that can be traced to the Arab Oil Embargo. The relatively benign nature of the resource has also contributed to development of both electric power and direct use projects. By the year 2010, the electric capacity for northern Nevada is projected to be about 2000 MWe. An achievable goal is to produce an additional 200 MWe of geothermal power over the next 15 years, which requires 20% of the resource mix is derived from renewable energy. Given the present avoided costs for electric power, the restructuring of the entire electric power industry, the present abundance of natural gas and hydo-power, the lack of a clear energy policy, and the equivocal arguments associated with global warming and greenhouse gases, the future of Nevada's geothermal resources is uncertain.

Since the use of additional renewable resources enhances our national energy security, reduces regional air pollution, and provides increased visibility, these actions should be encouraged on the federal level with a combination of tax credits and financial incentives. When all of the environmental and economic aspects are factored, geothermal energy is competitively priced, produces minimal or negligible atmospheric emission, can be developed as smaller, economically sized plants to closely match load growth, provides long-term, high-capacity factor operation, and represents fuel diversification to assure long-term, reliable electric power.

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