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UTILITY INDUSTRY ESTIMATES OF GEOTHERMAL ELECTRICITY

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ABSTRACT

The 1981 annual EPRI survey of the nation's electric utilities continues to show a rapid growth of geothermal electric generating capacity through the year 2000. Announced plans for geothermal capacity for 2000 has grown to 4480 MWe, an increase of 36% from the 1980 survey. More than half of this capacity is from liquid-dominated resources in the western states. Survey results are reinforced by data from the Western Systems Coordinating Council which indicate that geothermal electricity could account for 5% of the system's total energy requirement by 2000. Survey trends indicate that the possible growth of geothermal electricity could reach 10,800 MWe by 2000 representing an overall growth rate of 12% per annum over the rest of this century.

Power plant size will vary. The first generating unit at each new geothermal field is likely to be small. The minimum commercial-size power plant will be as low as 1 MWe but is more likely to be in the range of 10-20 MWe for smaller utilities. About one third felt that 50 MWe would be the optimum commercial size while two thirds felt that 100 MWe would be optimum.

INTRODUCTION

The potential for producing electric power from indigenous United States geothermal resources, as estimated by the electric utilities, has been surveyed annually since 1977. Data for these reports are taken from two sources: forecasts of future year generating capacity as detailed by the National Electric Reliability Council (NERC); and informal estimates by individual utilities in response to the annual EPRI survey.

Since most of the NERC forecast of geothermal capacity is from the western states comprising the Western Systems Coordinating Council (WSCC), these data are examined separately. Another area of the United States where geothermal development is proceeding rapidly is the Gulf States region. Based on present exploration activities, the utilities in this area have begun to consider electricity-grade geopressured resources in long-term plans. A third type of geothermal resource, the petrothermal deposits that may be distributed widely, has not yet been sufficiently developed for consideration as future generating capacity by the electric utilities.

NERC DATA

The annual changes for additional installed geothermal generating capacity, included in these annual reports, were not available from NERC since the last one was reported (Kruger and Roberts, 1980). The annual changes for the ten-year period 1980-1989 are thus given in terms of electricity generation by energy source (NERC, 1980). Table 1 shows the distribution by energy sources in gigawatt hours (GWh) actual for 1980 and estimated for 1989. The data for the WSCC western states compared to the data for the contiguous 48 states show several interesting features.

The national picture for the 10-year period shows a modest growth rate in electricity generation of 3.3% per annum, less half that of the prior decades. This growth is noted by a major increase in coal utilization coupled to a major decrease in oil and gas consumption. Although moderate in size, a major growth occurs in nuclear power. Geothermal resources on a national basis continue as a small fraction of the energy mix.

In the western states, hydro power in 1980 was still the most utilized energy source, slightly exceeding oil and gas. The 10-year forecast for WSCC shows a constant generation by hydro power with no growth in capacity, thus representing a declining fraction of the total. Oil and gas shows a significant decrease more than offset by the large increases in coal and uranium utilization. The forecast growth of more than 10% per annum over the decade brings geothermal energy to a significant fraction of the total electric energy generation in the western states. If the growth rate continues through the remainder of this century, geothermal electricity will grow to about 50 GWh by the year 2000, representing more than 5% of the western states' electricity budget.

EPRI SURVEY RESULTS

The results of the fifth annual EPRI survey of the geothermal plans of the nation's electric utilities most likely to include geothermal capacity are shown in Table 2. Contributions from Canadian provinces' part of WSCC are included with the north-west states region. Mexican utilities were surveyed for the first time, and their data are compared to the United States data.

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The regional forecasts for the 1981 survey in Table 2 were compared to the 1980 survey (Kruger and Roberts, 1980). The data still show a major fraction of the total capacity in the California/Hawaii region representing the established Geysers vapor-dominated resource, but a significantly growing contribution from the liquid-dominated resources in the remainder of the area. A rapid growth of geothermal energy utilization is forecast for the Northwest (which includes British Columbia and Alaska). The only region to lower its estimates is the southwest states, indicating a much slower growth rate than previously considered probable.

The overall national picture is shown in Table 3 which compares the five annual surveys (Kruger and Roberts, 1977, 1978, 1980; Roberts and Kruger, 1979). It appears that the 1985 forecasts are becoming well fixed in that the announced, probable, and possible capacity is asymptotically approaching about 1880 MWe, an increase of approximately 20% from the announced value of 1574 MWe in the 1980 survey and about the same magnitude as the probable value of 1912 MWe. The announced values for future years all show increases from the 1980 survey values. The probable totals show a more moderate growth rate but a greater probable capacity of about 7800 MWe in the year 2000. The level of possible capacity appears to have reached an asymptotic value of about 10,800 MWe. Based on the probable 1985 value of 1880 MWe, this capacity represents a growth rate of 12% per annum, which is considered significant by the electric utilities.

Part of the 1981 survey was devoted to several questions regarding geothermal power plant size. The objective was to gain some insight into the size distribution of power plants in the near and intermediate term. One can conclude from the results of this part of the survey that there is a trend toward smaller power plants for the first generating unit at each new geothermal field.

The data are scattered but 10 MWe appears to be most preferred. The minimum size being considered for commercial use is as low as one MWe but the strongest preference is for 50 MWe with somewhat lesser interest in the 10-20 MWe range. With regard to the optimum commercial size unit about two thirds indicated a preference for 100 MWe with about one third showing interest in the 50 MWe size.

REFERENCES

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TABLE 1

ELECTRIC GENERATION BY ENERGY SOURCE*

	NERC (U.S., GWh)					
	Oil/Gas	Coal	Hydro	Nuclear	Geothermal	Total
1980 - Actual	638	1185	235	308	5.9	2370
(% total)	(26.9)	(50.0)	(9.9)	(13.0)	(0.24)	-
1989 - Estimated	462	1722	226	846	16	3280
(% total)	(14.1)	(52.5)	(6.9)	(25.8)	(0.5)	-
[growth, %/a]	[-3.2]	[3.8]	[-0.4]	[10.6]	[10.5]	[3.3]
	WSCC (West, GWh)					
	Oil/Gas	Coal	Hydro	Nuclear	Geothermal	Total
1980 - Actual	146	125	153	20.9	5.9	453
(% total)	(32.2)	(27.5)	(33.7)	(4.6)	(1.3)	-
1989 - Estimated	109	235	153	115	16.0	639
(% total)	(17.1)	(36.7)	(23.9)	(18.0)	(2.5)	-
[growth, %/a]	[-2.9]	[6.5]	[0]	[18.6]	[10.5]	[3.5]

* National Electric Reliability Council, 10th Annual Review of Overall Reliability of the North American Bulk Power Systems, August, 1980.

TABLE 2

1981 EPRI UTILITY GEOTHERMAL SURVEY

Area	Capacity (MWe) by Year				
	1980 Actual	1985 Est	1990 Est	1995 Est	2000 Est
AZ/NM/NV	0				
Announced		50	50	50	50
Probable		50	150	300	350
Possible		50	275	600	800
CA/HA	918				
Announced		1795	3229	3740	4301
Probable		1810	3307	4191	5377
Possible		1810	3487	4751	6371
OR/WA/BC/AL	0				
Announced		0	0	0	0
Probable		7	202	654	1814
Possible		7	479	1689	3289
CO/ID/MO/UT	0				
Announced		20	120	130	130
Probable		20	180	280	280
Possible		20	180	280	280
GULF STATES	0				
Announced		0	0	0	0
Probable		0	10	15	30
Possible		0	27	70	125
TOTALS	918				
Announced		1865	3399	3920	4481
Probable		1887	3849	5440	7851
Possible		1887	4448	7390	10811

TABLE 3

COMPARISON OF THE ANNUAL EPRI SURVEYS

	<u>U.S. Geothermal Electric Power Capacity (MW)</u>			
	<u>1985</u>	<u>1990</u>	<u>1995</u>	<u>2000</u>
Announced				
1977	1178	1378	1678	1828
1978	2019	3019	3619	3919
1979	2057	2242	2512	2832
1980	1574	2294	2599	3299
1981	1865	3399	3920	4481
Probable				
1977	2528	3258	4358	5358
1978	2664	5414	7473	9023
1979	2564	4577	6108	7288
1980	1912	4216	5681	7416
1981	1887	3849	5440	7851
Possible				
1977	2858	4268	6268	8868
1978	3374	7664	11323	14723
1979	2999	6443	9188	10888
1980	2177	5203	8106	10761
1981	1887	4448	7390	10811