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## U.S. GEOTHERMAL INDUSTRY EXPANSION OUTLOOK

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### ABSTRACT

An outlook for the expansion of the U.S. geothermal electric power industry is presented. Plants currently under power sales agreements and plants short-listed or in negotiation with utilities for power sales agreements are listed. Industry plans include the addition of at least 682 MW of generating capacity during the remainder of the decade. Upcoming utility requests for proposals, with portions set aside for renewable energy projects, are discussed.

### INTRODUCTION

The U.S. geothermal industry experienced a slow down in 1990, after tripling installed capacity during the 1980's (795 MW were added in the first half of the decade and 1,320 MW were added in the second half (Rannels and McLarty, 1990)). There has been concern by some industry followers about the immediate future of the industry and its ability to endure the current environment of cheap natural gas and relatively low demand for new capacity. To gain a perspective on the expansion outlook for the industry, the authors searched recent literature and contacted utilities and geothermal developers to construct a list of projects scheduled for development. Some scheduled projects and utility solicitations may have been missed, and information of others may not yet be public. However, the information collected indicates that the geothermal electric industry will continue to expand, albeit at a somewhat slower pace.

### PLANNED CAPACITY

The U.S. geothermal industry has announced plans to add 682 MW of additional geothermal electric capacity through the year 2000. The plans include 22 new plants and expansion of 3 existing plants. Nine of the new plants will be located at eight previously undeveloped geothermal fields (see Table 1). Two will be the first such projects in their respective states, Alaska and Oregon.

For the purposes of this paper, non-speculative plants are defined as those with firm power sales agreements or those where circumstances are such that it is reasonable to expect they will be constructed. Of the 682 MW of

planned capacity, 390 MW are considered non-speculative. Eight plants, totalling 322 MW, have firm power sales agreements with utilities. The first 60 MW of the LADWP Coso development is included in the non-speculative category because the utility is believed to be committed to the project and is currently negotiating with developers. The 8 MW expansion of the Caithness plant at Steamboat Springs, Nevada, is also included in the non-speculative category because of the advanced stage of equipment procurement and power sales negotiations.

Of the 682 MW of planned capacity, 292 MW may be considered somewhat speculative because of the lack of power sales agreements. However, the combination of sponsoring company/utility/agency, advancement of negotiations/RFP/etc, and respective climate for development/local acceptance is sufficiently optimistic for these speculative plants to be included in the total. The speculative plants include:

- Eugene Water & Electric Board (EWEB) - 30 MW
- Fallon Naval Center - 160 MW
- Calpine/Los Angeles Department of Water & Power (C/LADWP) Coso - 90 MW
- Ormat Energy Systems (OESI) Unalaska - 12 MW

Non-speculative and speculative annual incremental capacity additions are presented graphically in Figure 1 and in tabular form in Table 2. All the individual planned projects are listed in Table 3.

### OFFERED CAPACITY

An additional 164 - 224 MW of geothermal electric capacity have been offered for sale to various utilities in response to competitive Requests for Proposals (See Table 4). Offered capacity, as used in this paper, includes new plant proposals which have been either "short-listed" or invited to enter into power sales contract negotiations. Such offers document a sponsor's ability and willingness to develop new power projects, especially when bids require accompanying fees or deposits. These projects have not been financed or scheduled for construction but have been deemed "real" by potential power purchasers. For example, three Magma plants short-listed by the City of Anaheim municipal utility are especially promising since the city has expressed a preference for renewable

energy projects. Only one other renewable energy project, a waste to energy facility, was included in the Anaheim short list.

#### REQUESTS FOR PROPOSALS

It is probable that Southern California Edison and San Diego Gas & Electric will issue requests for proposals for additional electric capacity in the third quarter of 1992. These requests will probably include a 275 MW set-aside for renewable energy projects as mandated by the state of California (California Public Utilities Commission, 1992). Geothermal projects should compete well for this set-aside.

#### OUTLOOK

The outlook for the industry during the 1990's is a continued expansion, but at a slower pace than during the 1980's. New capacity added in the 1990's will not likely match the 2,115 MW added during the 1980's. Current competitive factors supporting this outlook include low prices for other fuels (mainly natural gas), a less favorable regulatory climate than in the 1980's, decreased demand for new capacity, and utility plans to rely heavily on conservation measures and demand side management to defer new capacity additions. Also missing in the 1990's will be the capacity buildup at The Geysers, which accounted for over half the growth during the 1980's.

New capacity additions during the decade will be offset somewhat by the retirement of older plants, probably all in The Geysers geothermal field. Pacific Gas & Electric has already retired Units 1 - 4 and 15, and is in the process of decommissioning them. Of the total 2,870 MW installed in the U.S. since 1962, 230 MW had been retired or removed from operation by the end of 1991 (including about 180 MW at The Geysers), leaving approximately 2,640 MW operational. However, due to steam shortages at The Geysers, generating capacity there is 1,250 MW (as of April, 1992), resulting in an effective total capacity of about 2,100 MW.

With experts predicting output from The Geysers to decline by about 10% annually over the remainder of the decade (Barker, et. al., 1989), an additional 700 MW of capacity may be lost during this period. However, this decline estimate is based on a closed system model, and the actual decline may be less if influenced by reservoir recharge. The power production decline may be alleviated somewhat through implementation of improved reservoir management practices and power plant modifications designed to increase efficiency. Also, Calpine Corporation announced the existence of a substantial new steam resource in a previously undeveloped area of The Geysers. What effect this may have on the overall decline of the field remains to be seen.

If output from The Geysers declines 10% annually, and all 682 MW of planned capacity are added, the effective total capacity at the end of year 2000 will be at least

2,065 MW. The total could be as much as 2,490 MW if all offered projects in Table 4 are accepted and at least 200 MW of the 275 MW renewable set-aside are won by geothermal projects.

#### CONCLUSION

Current industry plans for expansion include 390 MW of non-speculative capacity, 292 MW of speculative capacity, and 164 - 224 MW of offered capacity. The minimum additional capacity expected by the end of 2000 is 682 MW and could be as high as 1,106 MW if all offered projects are accepted and geothermal proposals capture 200 MW of the 275 MW set-aside. Based on current estimates of decline at The Geysers, total capacity at the end of 2000 should be at least 2,065 MW and perhaps as much as 2,490 MW. It is also expected that additional plants, not listed in this paper, will be built. Since any estimate of the number and size of these additional plants would be highly speculative, expansion estimates through the year 2000 are based on current information, and thus may be considered minimum estimates of probable expansion.

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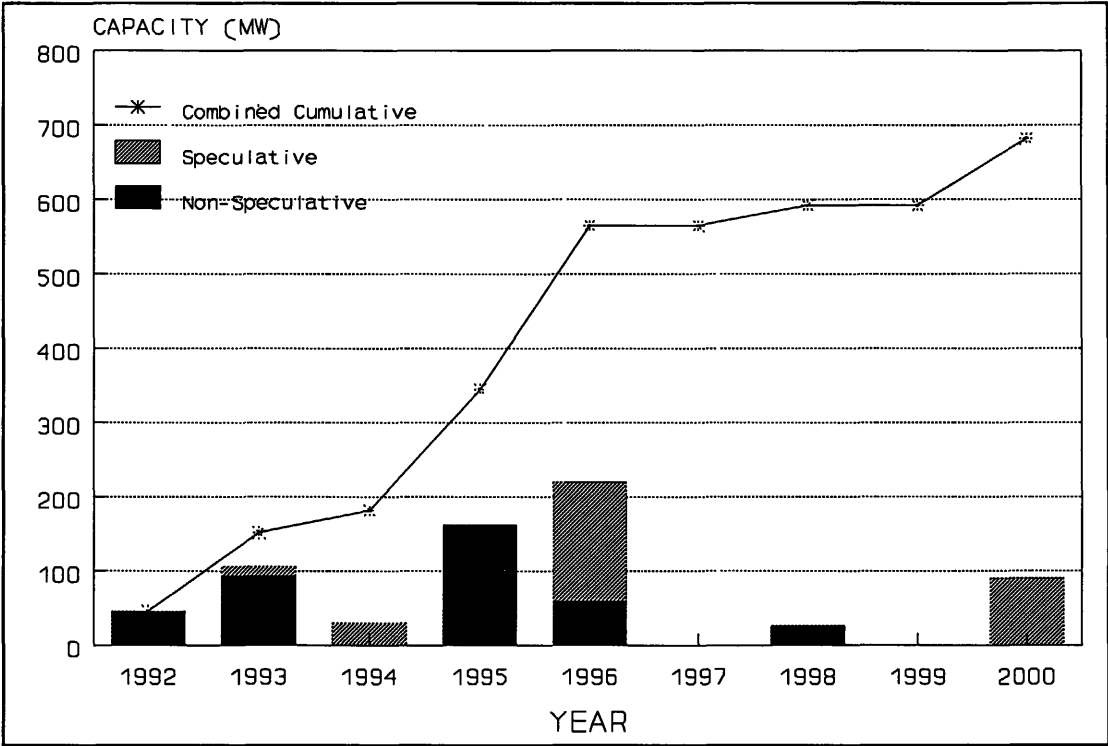


Figure 1. Non-Speculative and Speculative Planned Capacity Additions. (27 MWs at San Emidio arbitrarily assigned completion date of 1998.)

| <u>YEAR</u> | <u>SITE &amp; STATE</u>  | <u>MW</u> |
|-------------|--------------------------|-----------|
| 1992        | Puna, HA                 | 25        |
| 1992        | Brady Hot Springs, NV    | 20        |
| 1992        | Ryepatch, NV             | 28        |
| 1993        | Unalaska Island, AK      | 12        |
| 1993        | Surprise Valley, CA      | 10        |
| 1994        | Bend, OR                 | 30        |
| 1995        | Fishlake, NV             | 14        |
| 1996        | Fallon Naval Station, NV | 160       |

Table 1. Undeveloped sites scheduled for development.

| <u>YEAR</u> | <u>PLANNED NET CAPACITY ADDITIONS (MW)<sup>(1)</sup></u> |                    |              |
|-------------|--|--------------------|--------------|
|             | <u>NON-SPECULATIVE</u>                                   | <u>SPECULATIVE</u> | <u>TOTAL</u> |
| 1992        | 46   | 0                  | 46           |
| 1993        | 94   | 12                 | 106          |
| 1994        | 0  | 30                 | 30           |
| 1995        | 163  | 0                  | 163          |
| 1996        | 60   | 160                | 220          |
| 2000        | 0  | 90                 | 90           |
| TBD         | 27   | 0                  | 27           |
|             | -----  | -----              | -----        |
| Totals:     | 390  | 292                | 682          |

(1) Totals for 1993, 1994 and 1995 may be affected by actual timing of Caithness plants 1 through 7 at Dixie Valley and Steamboat Springs.

Table 2. Planned annual capacity additions.

| PLANT                                | LOCATION                             | COMPANY                      | MW       | DATE         | COMMENTS  |
|--------------------------------------|--------------------------------------|------------------------------|----------|--------------|---|
| Brady Hot Springs I                  | Brady H.S., Fernly, NV               | NV Geothermal Power Partners | 20       | 1992         | Power sales contract with Sierra Pacific.   |
| Caithness Binary                     | Steamboat Springs, NV                | Caithness                    | 8        | 1993         | Bottoming cycle downstream from existing flash plant.   |
| Caithness 1                          | Dixie Valley, NV                     | Caithness                    | 19       | 1995         | SO-4 contract with SCE, sunset date of September 1995.  |
| Caithness 2 - 7                      | Dixie Valley & Steamboat Springs, NV | Caithness                    | 130      | 1995         | Six SO-2 contracts with SCE, 3 at each site, with sunset dates of September 1995; some may be built sooner. |
| Eugene Water & Electric Board (EWEB) | Bend, OR                             | EWEB and California Energy   | 30       | 1994         | Speculative, date estimated.  |
| Fallon Navy Plants                   | Fallon, NV                           | TBD                          | 160      | 1996         | Navy about to issue RFP; No power sales agreement as of yet; date estimated.                                |
| Fishlake I                           | Fishlake, NV                         | Magma Power                  | 14       | 1995         | SO-4 contract with SCE.   |
| LADWP Coso                           | China Lake, CA                       | LADWP & Calpine              | 60<br>90 | 1996<br>2000 | Currently negotiating for 1996 increment.   |
| Lake City Unit 1                     | Lake City, CA                        | Transpacific & Constellation | 10       | 1993         | Power sales contract with Pugen Sound Power & Light   |
| Magma Del Ranch                      | Imperial Valley, CA                  | Magma Power                  | 6        | 1993         | Expansion of existing plant.  |
| Magma Elmore                         | Imperial Valley, CA                  | Magma Power                  | 6        | 1993         | Expansion of existing plant.  |
| Magma Leathers                       | Imperial Valley, CA                  | Magma Power                  | 6        | 1993         | Expansion of existing plant.  |

Table 3. Planned U.S. Geothermal Power Plants

| PLANT             | LOCATION              | COMPANY                       | MW    | DATE | COMMENTS                                  |
|-------------------|-----------------------|-------------------------------|-------|------|---|
| OESI Unalaska     | Unalaska Island, AK   | Alaska Energy Authority, OESI | 12    | 1993 | Speculative; date estimated.              |
| OESI Puna Venture | Puna, HA              | OESI/Constellation on         | 30    | 1993 | Well control problems delay start-up.     |
| Ryepatch A        | Carson, NV            | OESI                          | 14    | 1993 | Power sales contract with Sierra Pacific. |
| Ryepatch B        | Carson, NV            | OESI                          | 14    | 1993 | Power sales contract with Sierra Pacific. |
| San Emidio I      | San Emidio, NV        | San Emidio Resources          | 5     | TBD  | Power sales contract with Sierra Pacific. |
| San Emidio II     | San Emidio, NV        | San Emidio Resources          | 22    | TBD  | Power sales contract with Sierra Pacific. |
| Steamboat 2       | Steamboat Springs, NV | Steamboat Development Co.     | 13    | 1992 | Power sales contract with Sierra Pacific. |
| Steamboat 3       | Steamboat, NV         | Steamboat Development Co.     | 13    | 1992 | Power sales contract with Sierra Pacific. |
|                   |                       |                               | ----- |      |   |
|                   |                       | Total:                        | 682   |      |   |

Table 3 (Continued). Planned U.S. Geothermal Power Plants

| <u>Development Company</u> | <u>Project Location</u>      | <u>Requestor</u>     | <u>Size</u>  |
|----------------------------|------------------------------|----------------------|--------------|
| Unocal Geothermal          | Glass Mountain, CA           | BPA Pilot Program    | 10 - 30 MW   |
| TransPacific Geothermal    | Vail, OR                     | BPA Pilot Program    | 10 - 30 MW   |
| TransPacific Geothermal    | Lake City, CA (Lake City II) | BPA All Resources    |              |
|                            |                              | RFP Short List       | 10 - 30 MW   |
| California Energy Co.      | Desert Peak, NV              | BPA, NCPA, PSP&L RFP | 20 MW        |
| Magma Power                | Salton Sea                   | City of Anaheim, CA  | 14 MW        |
| Magma Power                | Salton Sea                   | City of Anaheim, CA  | 50 MW        |
| Magma Power                | Salton Sea                   | City of Anaheim, CA  | 50 MW        |
|                            |                              | Total:               | 164 - 224 MW |

Table 4. Offered U.S. Geothermal Power Plants.