Geothermal Energy

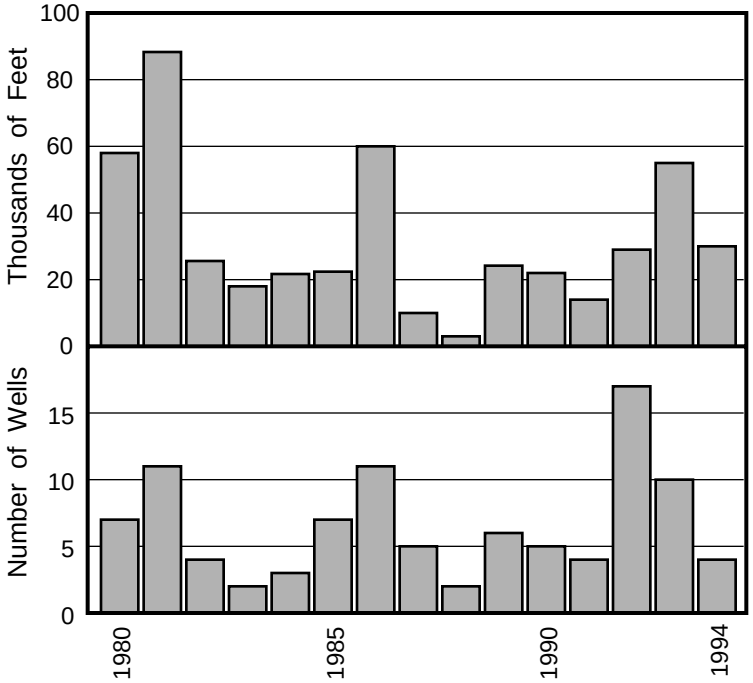
by Ronald H. Hess

Geothermal compilation of The Nevada Mineral Industry - MI Geothermal Sections by R. Hess, 1994-2006, Nevada Bureau of Mines and Geology.

MI - 1994 Geothermal Section

Thirty-five geothermal well permits were issued during 1994 by the Nevada Division of Minerals: seven industrial/commercial class wells, three domestic class, twenty-one observation or gradient wells, and four injection wells. During this same period four industrial/commercial class wells, two domestic class, five thermal gradient wells, and one injection well were reported to have been drilled. Total footage drilled for the period was about 30,000 feet.

During 1994 there were 160 federal geothermal noncompetitive leases covering 251,548 acres and 51 competitive federal leases covering 76,617 acres in Nevada. The annual rental fee paid for these leases was $570,000. Total gross electrical production from geothermal resources on public lands was 1,234,000 megawatt-hours; net production was 1,051,000 megawatt-hours. Gross electrical sales from federal lands was 101 million dollars. Production royalties on that amount equaled about $4.5 million. By regulation, half of all rental fees and royalties are returned to the state and in 1994 the total amount of fees returned to the state was $2,535,000.



Industrial-class (power generating) wells drilled in Nevada, 1980–1994.

NONDOMESTIC GEOTHERMAL WELLS REPORTED AS DRILLED OR COMPLETED IN NEVADA DURING 1994

Area	Company	Well name	Permit no.	Location	Type
Churchill County					
Bradys Hot Springs	Brady Power Partners	Injection Well #82A-11	370	NE¼ NE¼ S11,T22N,R26E	Injection
Bradys Hot Springs	Brady Power Partners	Production Well #48A-1	316	SE¼ SW¼ S1,T22N,R26E	Production
Desert Peak	Western States Geothermal	Production Well #86-21	417	SE¼ NE¼ S21,T22N,R27E	Production
Dixie Valley	Oxbow Geothermal	Production Well #36(13)-14	382	NE¼ SW¼ S23,T24N,R36E	Production
Washoe County					
Gerlach	San Emidio Resources, Inc.	Gerlach PA-94 GTG-3	393	SW¼ NW¼ S10,T32N,R23E	Thermal gradient
Gerlach	San Emidio Resources, Inc.	Observation Well #18-10	412	SW¼ SW¼ S10,T32N,R23E	Thermal gradient
Gerlach	San Emidio Resources, Inc.	Gerlach PA-94 GTG-7	395	SE¼ NE¼ S10,T32N,R23E	Thermal gradient
Gerlach	San Emidio Resources, Inc.	Gerlach PA-94 GTG-2	398	NE¼ NW¼ S10,T32N,R23E	Thermal gradient
San Emidio	Empire Farms, Inc.	Production Well #75B-16	403	NE¼ SE¼ S16,T29N,R23E	Production
Steamboat	S.B. Geo, Inc.	Thermal Gradient Hole MTH #21-33	384	NW¼ NW¼ S33,T18N,R20E	Thermal gradient

NEVADA GEOTHERMAL POWER PLANTS 1994

Plant name (year on line)	Production capacity[1] (MW)	1994 Production (MWh)		Location	Operator
		Gross	Net (sales)		
Beowawe (1985)	16.0	135,199	102,843	S13,T31N,R47E	Oxbow/Beowawe Geothermal Power Co. P.O. Box 6 Beowawe, NV 89821
Bradys Hot Springs (1992)	21.1	201,152	153,792	S12,T22N,R26E	Oxbow Power Services, Inc. P.O. Box 649 Fernley, NV 89408
Desert Peak (1985)	8.7	80,676	72,298	S21,T22N,R27E	Western States Geothermal Co. P.O. Box 2627 Sparks, NV 89432-2627
Dixie Valley[2] (1988)	66.0	507,280	458,164	S7,T24N,R37E S33,T25N,R37E	Oxbow Geothermal Corp. 5250 South Virginia St. Suite 304 Reno, NV 89502
Empire (1987)	3.6	13,969	9,025	S21,T29N,R23E	Nevada Operations, Inc. P.O. Box 1650 Fallon, NV 89407
Soda Lake No. 1 (1987) and Soda Lake No. 2 (1991)	16.6	123,289	95,351	S33,T20N,R28E	Nevada Operations, Inc. P.O. Box 1650 Fallon, NV 89407
Steamboat I, I-A (1986) and Steamboat II, III (1992)	48	398,822	300,293	S29,T18N,R20E	S.B. Geo, Inc. P.O. Box 18087 Reno, NV 89511
Stillwater (1989)	13.0	95,511	85,127	S1,T19N,R30E S6,T19N,R31E	Nevada Operations, Inc. P.O. Box 1650 Fallon, NV 89407
Wabuska (1984)	1.2	4,133	1,991	S15,16,T15N, R25E	Tad's 10 Julian Lane Yerington, NV 89447
Yankee Caithness (1988)	14.4	76,676	69,856	S5,6,T17N,R20E	Yankee Caithness J.V.L.P. P.O. Box 18160 Reno, NV 89511
TOTAL	208.6	1,636,707	1,348,740		

[1]Production capacity from currently developed geothermal resources.
[2]Gross output of the Dixie Valley plant occasionally exceeds 66 MW.
Sources: Nevada Division of Minerals, plant operators, and NBMG files.

Total Nevada geothermal electrical production from both federal and fee lands combined in 1994 was 1,636,707 megawatt-hours gross; net production was 1,348,740 megawatt-hours with an approximate sales value of $108,000,000 (Nevada Division of Minerals, 1995). Production capacity from the currently developed geothermal resources at ten existing geothermal power plants in Nevada is 208.6 megawatts. Nevada is second only to California in total installed geothermal generating capacity.

The Nevada Bureau of Mines and Geology (NBMG) released Open-File Report 94-2, *Nevada Low-Temperature Geothermal Resource Assessment: 1994*. This report was prepared as part of a study of low to moderate temperature geothermal resources of Nevada under the U.S. Department of Energy Low-Temperature Geothermal Resources and Technology Transfer Program. A hardcopy of the report with map and digital data on diskette is available for viewing or purchase at NBMG.

Beowawe

Oxbow/Beowawe Geothermal Power Co. modified its 1994 injection program at the 16 megawatt Beowawe plant. During 1994 injection was switched from zones in a distant cooler reservoir outside of the resource reservoir to injection back into the principal producing reservoir. This appears to have reversed a steady downward trend in temperature and pressure that has been occurring in the principal reservoir over the last several years. (Dick Benoit, personal commun., 1995; GRC Nevada Section Bulletin, v. 7, no. 2, April 1994).

Desert Peak

The Western States Geothermal Co., Desert Peak plant went on line in 1985. Production during 1994 was down slightly due to fill in the bottom of well no. 86-21. The plant was down two weeks to install a new turbine rotor. Overall on-line plant availability is 96.2% for 1994. (Nevada Division of Minerals, 1995)

Dixie Valley

Oxbow Geothermal Corp. Dixie Valley plant was down two weeks in April for plant maintenance and overhaul. Plant production was also interrupted from October 17 to October 26 due to a U.S. Navy helicopter that downed a power transmission line to the plant. These interruptions in production caused a 22,800 megawatt-hour drop in net production from 1993. (Dick Benoit, personal commun., 1995; Nevada Division of Minerals, 1995)

Fish Lake Valley

Fish Lake Power Co., a subsidiary of Magma Power Co., has filed with the Nevada Public Service Commission and the Bureau of Land Management for approval to construct a 16-megawatt-hour geothermal power plant in section 13, T1S, R35E, in Fish Lake Valley, Esmeralda County. The project anticipates a 30-year plant life, and the need for 15 geothermal production wells, eight injection wells, and a 29-mile transmission line that will connect to the grid at the Oasis substation on the Nevada/California state line. If the project gets approval it could be on-line in 1996. (Geothermal Progress Monitor, no.16, December 1994)

San Emidio Desert

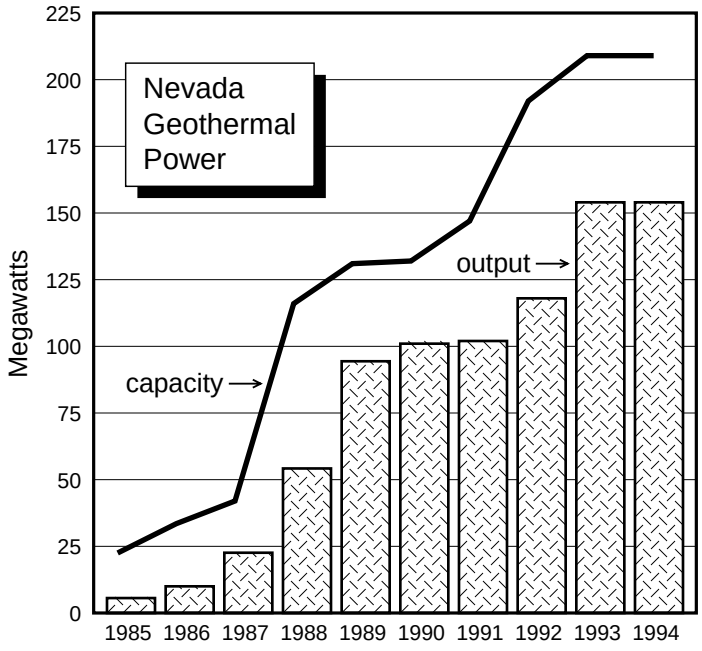
Integrated Ingredients vegetable dehydration plant was dedicated on May 25, 1994. It is in the San Emidio Desert area southwest of Gerlach. The plant is a few miles north of the Empire (OESI/AMOR II) electric-power plant. Integrated Ingredients (Spice Islands, Fleischmann's, and other brands) is part of international food manufacturer Burns Philp. The plant will use approximately 130°C geothermal fluid to heat process air for the dehydration system. About 14 million pounds of dry product will be produced annually: 60% onion and 40% garlic. A 350-foot production well, with a 75-horsepower pump, will produce up to 900 gallons per minute of 130°C water to the plant. It is estimated that maximum energy use is 45 million Btu per hour. The plant is designed to allow for construction of an additional dehydration production line and additional geothermal fluid for this equipment will be supplied by a second production well. (Geothermal Progress Monitor, No.16, December 1994)

Steamboat Springs

Yankee Caithness J.V.L.P. operates a 14.4-megawatt (gross) flash turbine system producing from a 338°F resource. The plant was down 34 days in 1994 and net production was 5,500 megawatt-hours less than in 1993. (Nevada Division of Minerals, 1995)

Wabuska

Tad's Enterprises Inc., Wabuska plant celebrated its tenth anniversary in July 1994. This was the first commercial geothermal power plant in Nevada. The plant capacity in 1984 was 600 kilowatts generated from a single Ormat Energy Converter. A second unit was installed in 1987, doubling the capacity to 1.2 megawatts. The plant operates on fluids at 225°F produced from a depth of 350 feet. (GRC Bulletin, July 1987; GRC Nevada Section Bulletin, v. 7, no. 2, April 1994)



Rated capacity and average net output of Nevada geothermal plants, 1985–1994. Average net output is annual sales in megawatt-hours divided by the number of hours in a year (8,760). No commercial geothermal power was produced in Nevada before 1985.

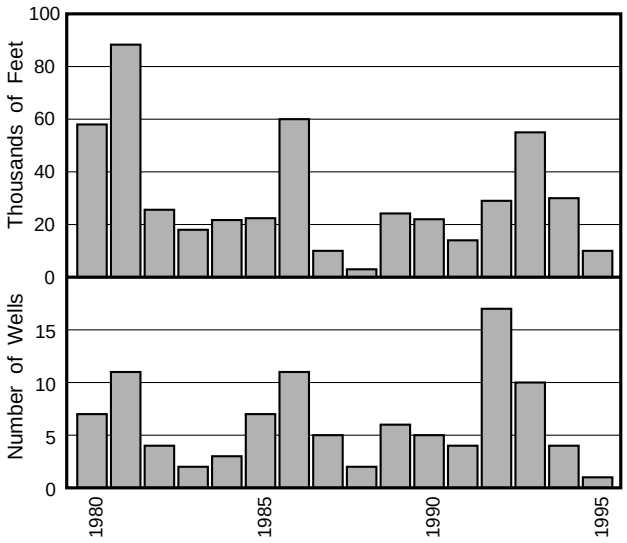
Geothermal Energy

by Ronald H. Hess

Geothermal development in Nevada has slowed over the past several years mainly due to the continuing low cost of conventional fossil fuels. At present low natural gas costs have made investment in new geothermal resource development and plant construction projects uncompetitive with fossil fuel power plants. This nationwide trend is obvious in Nevada where drilling has dropped to only two wells during 1995. Furthermore, it is expected that only one exploration well will be drilled in 1996. This well will be near the Fallon Naval Air Station, Churchill County, and may be the only geothermal exploration well drilled in the United States this year. This lull in the development of new geothermal resources will probably remain with us until the price of natural gas increases to a point that will make the cost of geothermal power production competitive. (Dick Benoit, Proceedings - Geothermal Program Review XIII, DOE, March 13-16, 1995)

Six geothermal power plants are currently planned for development in Nevada (see table on next page) but these await favorable power purchase agreements and increases in natural gas prices. If all of these plants are put on line over the next 6 years it would add approximately 190 megawatts (MW) of geothermal electrical production in Nevada. (Geothermal Resources Council Bulletin, May 1995, vol. 24, no. 5)

Nineteen geothermal well permits were issued during 1995 by the Nevada Division of Minerals: they include 12 industrial/commercial class wells, six observation or gradient wells, and one injection well. During this same period one industrial/commercial class well and one injection well were reported to have been drilled. Total footage drilled in 1995 was about 10,500 feet.



Industrial-class (power generating) wells drilled in Nevada, 1980–1995.

During 1995 there were 114 federal geothermal noncompetitive leases covering 163,000 acres and 35 competitive federal leases covering 49,000 acres in Nevada. This is a drop of 88,548 noncompetitive lease acres and 27,617 competitive lease acres from 1994 totals. The annual rental fee paid for these leases was $212,500. Total gross electrical production from geothermal resources on public lands was 1,225,000 megawatt-hours (MWh); net production was 1,042,000 MWh. Gross electrical sales from federal lands was $105.9 million. Production royalties on that amount

NONDOMESTIC GEOTHERMAL WELLS REPORTED AS DRILLED OR COMPLETED IN NEVADA DURING 1995

Area	Company	Well name	Permit no.	Location	Type
Churchill County					
Dixie Valley	Oxbow Geothermal	Production Well #73-7B	428	SE¼ NE¼ S7,T24N,R37E	Production
Washoe County					
Moana	Nevada Geothermal Utility Co.	Injection Well No. 4	410	SW¼ NW¼ S26,T19N,R19E	Injection

GEOTHERMAL PLANTS PLANNED FOR NEVADA

Owner	Site	Plant	Type	Rating MW
Caithness	Dixie Valley	Caithness I	Dual Flash	25
San Emidio Resources	San Emidio Desert	San Emidio	Binary	30
Earth Power Energy and Minerals	Hot Sulfur Springs	HSS	N/A	9.9
Far West	Steamboat	SB 4 SB 5	Binary Kalina Cycle	24 12
Ormat Energy Systems Inc.	Rye Patch	Rye Patch	Binary	N/A
N/A	Fallon Naval Facility	Fallon	N/A	90
			TOTAL:	190.9

Source: Geothermal Resources Council, May 1995, vol. 24, no. 5.

equaled $4,748,000. By regulation, half of all rental fees and royalties are returned to the state and in 1995 the total amount of fees returned to the state was $2,480,250.

Total Nevada geothermal electrical production from both federal and fee lands combined in 1995 was 1,642,201 MWh gross; net production was 1,360,107 MWh (Nevada Division of Minerals, 1996) with an approximate sales value of $108,800,000. Production capacity from the currently developed geothermal resources at ten existing geothermal power plants in Nevada is 210.5 MW. Nevada is second only to California in total installed geothermal generating capacity.

Beowawe

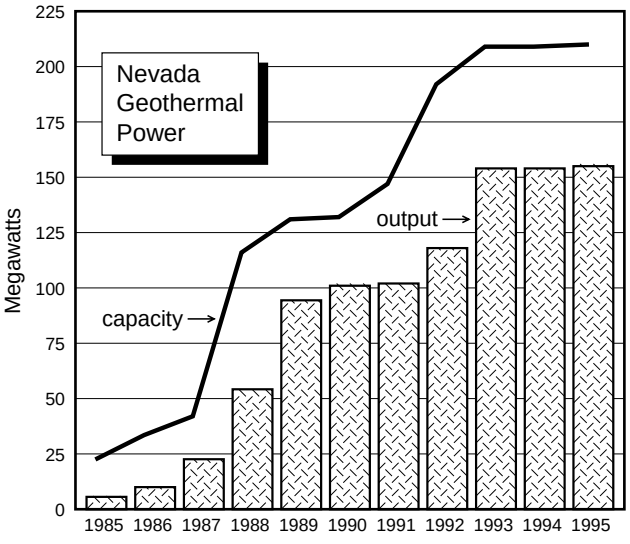
Oxbow/Beowawe Geothermal Power Co. production during 1995 was down because the plant at Beowawe was off line from October 14 to December 13, 1995 for major repairs on the main rotor and case. Net production for 1995 was 88,787 MWh as compared to 102,843 MWh for 1994. (Nevada Division of Minerals, 1996)

Desert Peak

The **Western States Geothermal Co., Desert Peak** plant went on line in 1985. Plant output during 1995 was down from 72,298 MWh net production in 1994 to 67,838 MWh net production for 1995. Production well 86-21 was worked over during February 1995 and has not yet returned to previous production levels. Overall on-line plant availability was 99.26% for 1995. (Nevada Division of Minerals, 1996)

Rye Patch

The **Rye Patch Limited Partnership (OESI)** has terminated work on the 95% complete 12.5-MW binary power plant at **Rye Patch**. At present they have only been able to identify a 6-MW proven resource. Sierra Pacific Power Co. has canceled the project's power purchase agreement, and with the project in default it



Rated capacity and average net output of Nevada geothermal plants, 1985–1995. Average net output is annual sales in megawatt-hours divided by the number of hours in a year (8,760). No commercial geothermal power was produced in Nevada before 1985.

is unlikely that further development work will take place in the near future. (Geothermal Resources Council Bulletin, May 1995, vol. 24, no. 5)

For those readers who are interested in discovering more about worldwide geothermal developments and have access to the Internet, the Geo-Heat Center, Oregon Institute of Technology - Klamath Falls, Oregon now has a homepage on the Internet at **http://www.oit.osshe.edu/~geoheat**. This homepage contains an article on what geothermal energy is, a list of services offered by the Institute, a publications list, a description of the Collocated Resources Study of Ten Western States, and text-only versions of the articles that appear in the Geo-Heat Center Quarterly Bulletin.

NEVADA GEOTHERMAL POWER PLANTS 1995

Plant name (year on line)	Production capacity[1] (MW)	1995 Production (MWh) Gross	Net (sales)	Location	Operator
Beowawe (1985)	16.7	104,966	88,787	S13,T31N,R47E	Oxbow/Beowawe Geothermal Power Co. HC 66, Unit 1, Box 16 Beowawe, NV 89821
Bradys Hot Springs (1992)	21.1	187,577	143,448	S12,T22N,R26E	Oxbow Power Services, Inc. P.O. Box 649 Fernley, NV 89408
Desert Peak (1985)	9.9	76,384	67,838	S21,T22N,R27E	Western States Geothermal Co. P.O. Box 2627 Sparks, NV 89432-2627
Dixie Valley[2] (1988)	66.0	531,220	479,956	S7,T24N,R37E S33,T25N,R37E	Oxbow Geothermal Corp. 5250 South Virginia St. Suite 304 Reno, NV 89502
Empire (1987)	3.6	12,324	7,446	S21,T29N,R23E	Nevada Operations, Inc. P.O. Box 1650 Fallon, NV 89407
Soda Lake No. 1 (1987) and Soda Lake No. 2 (1991)	16.6	128,135	100,085	S33,T20N,R28E	Nevada Operations, Inc. P.O. Box 1650 Fallon, NV 89407
Steamboat I, I-A (1986) and Steamboat II, III (1992)	48	414,013	313,255	S29,T18N,R20E	S.B. Geo, Inc. P.O. Box 18087 1010 Power Plant Dr. Reno, NV 89511
Stillwater (1989)	13.0	102,833	82,668	S1,T19N,R30E S6,T19N,R31E	Nevada Operations, Inc. P.O. Box 1650 Fallon, NV 89407
Wabuska (1984)	1.2	1,674	1,674	S15,16,T15N, R25E	Tad's 10 Julian Lane Yerington, NV 89447
Yankee Caithness (1988)	14.4	83,075	75,336	S5,6,T17N,R20E	Yankee Caithness J.V.L.P. P.O. Box 18160 Reno, NV 89511
TOTAL	210.5	1,642,201	1,360,493		

[1]Production capacity from currently developed geothermal resources.
[2]Gross output of the Dixie Valley plant occasionally exceeds 66 MW.
Sources: Nevada Division of Minerals, plant operators, and NBMG files.

Geothermal Energy

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MI - 1996 Geothermal Section

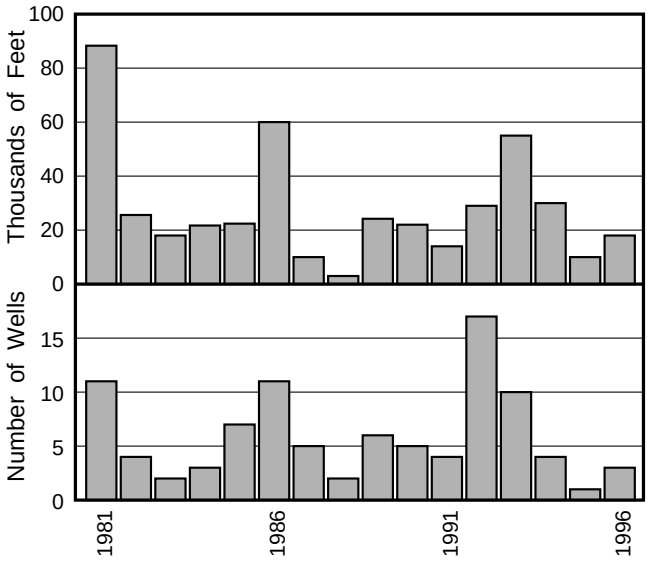
Seven geothermal well permits were issued during 1996 by the Nevada Division of Minerals: five industrial/ commercial class wells (including one redrill), one gradient well, and one redrill of an injection well. During the same period three industrial/commercial class wells (one redrill), one injection well, and one gradient well were reported to have been drilled. A total of about 21,300 feet was drilled during 1996.

During 1996 there were 102 federal geothermal noncompetitive leases in effect covering 153,377 acres and 43 competitive federal leases covering 51,251 acres in Nevada. This is a decrease of 9,623 noncompetitive lease acres and an increase of 2,251 competitive lease acres from 1995 totals. The annual rental fee paid for these leases was $183,875. Total gross electrical production from geothermal resources on public lands was 1,259,224 megawatt-hours (MWh); net production was approximately 1,050,000 MWh. Gross electrical sales from federal lands totaled $105 million. Production royalties on that amount equaled $4,897,128. By regulation, half of all rental fees and royalties are returned to the state and in 1996 the total amount of fees returned to the state was $2,540,502. (R. Hoops, personal commun., 1997, Bureau of Land Management)

Total Nevada geothermal electrical production from both federal and fee lands combined in 1996 was 1,668,428 MWh gross; net production was 1,358,558 MWh (Nevada Division of Minerals, 1997) with a sales value of about $108.7 million. Production capacity from the currently developed geothermal resources at ten existing geothermal power plants in Nevada is 210.5 megawatts. Nevada is second only to California in total installed geothermal generating capacity.

Bradys Hot Springs

A new production well, number 27-1, was brought on-line on October 24 by Brady Power Partners at the Bradys Hot Springs Plant. It replaced well number 56A-1 which was shut-in. The Bradys Power Plant produced 169,786 MWh gross (131,160 MWh net) during 1996, which was 17,791 MWh gross (12,288 MWh net) less than 1995 output. (Nevada Division of Minerals, 1997)



Industrial-class (power generating) wells drilled in Nevada, 1980-1996.

Dixie Valley

The U.S. Department of Energy, in a cooperative technology development program with Oxbow Geothermal Corp., is supporting a design and demonstration project of a low-temperature flash steam plant designed to utilize lower temperature fluids that are currently being discharged from the Dixie Valley Plant. This additional low-temperature steam flash plant should produce 4,690 kilowatts (kW) of additional power from 230EF fluid that is being discharged from the Dixie Valley Plant.

NONDOMESTIC GEOTHERMAL WELLS REPORTED AS DRILLED OR COMPLETED IN NEVADA DURING 1996

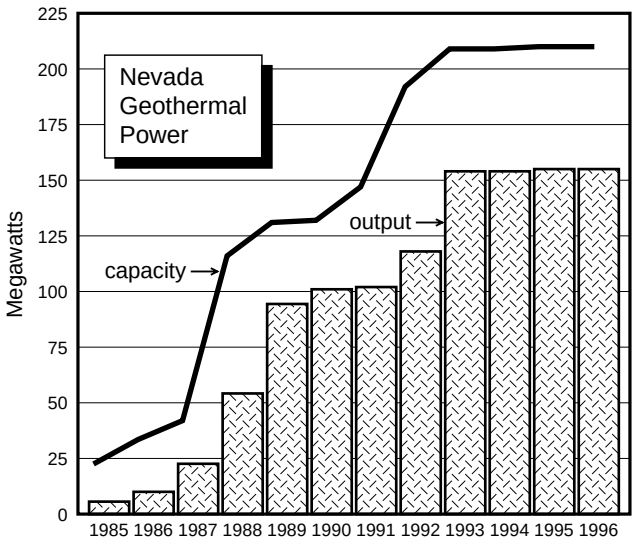
Area	Company	Well name	Permit no.	Location	Type
Churchill County					
Bradys Hot Springs	Brady Power Partners	Well #27-1	437	SW¼ SW¼ S1,T22N,R26E	Production
Dixie Valley	Oxbow Geothermal	Production Well #82A-7	88	NE¼ NE¼ S7,T24N,R37E	Production (redrill)
Dixie Valley	Oxbow Geothermal	Production Well #24-5	440	SW¼ NW¼ S5,T24N,R37E	Production
Stillwater	Oxbow Power Services	S.T. Well #1 (36-32)	431	NE¼ SW¼ S32,T18N,R30E	Thermal gradient
Washoe County					
Steamboat	Steamboat Development Corp.	Well IW-4 SDCT-35-28	299	NE¼ SW¼ S28,T18N,R20E	Injection (redrill)

If this project is successful it will demonstrate the ability to utilize flash steam power generation technology to develop lower temperature resources than previously thought feasible. It is anticipated that the installed cost of this flash plant addition will be less than $1,100 per kWe, which is significantly lower than $1,760 per kWe cost of an installed binary system. (Geothermal Progress Monitor No. 17, 1995).

Steamboat Hot Springs

Reno Energy, owned by Far West Capital Group, has requested approval to develop a heating district with the potential to eventually heat 30 million square feet of industrial and commercial space. The project is located in southern Reno, which is a rapidly developing area. It will use brine discharged from electrical generation plants currently operating at Steamboat to heat a freshwater closed loop system that will circulate throughout the heat district. The freshwater in the closed loop system will be heated to 240EF with connections to energy users metered for volume and energy consumption. The used brine from this process will be reinjected to the geothermal resource.

If all approvals are obtained, construction of the main freshwater loop is planned to begin in April of 1997 at a projected cost of $41 million. It is estimated that this system could save its customers between 35 and 55% of long term cost of conventional heating and cooling. (Reno Energy LLC News Release, 1996).



Rated capacity and average net output of Nevada geothermal plants, 1985–1996. Average net output is annual sales in megawatt-hours divided by the number of hours in a year (8,760). No commercial geothermal power was produced in Nevada before 1985.

NEVADA GEOTHERMAL POWER PLANTS 1996

Plant name (year on line)	Production capacity[1] (MW)	1996 Production (MWh) Gross	Net (sales)	Location	Operator
Beowawe (1985)	16.7	138,185	108,890	S13,T31N,R47E	Oxbow/Beowawe Geothermal Power Co. HC 66, Unit 1, Box 16 Beowawe, NV 89821
Bradys Hot Springs (1992)	21.1	169,786	131,160	S12,T22N,R26E	Brady Power Partners P.O. Box 649 Fernley, NV 89408
Desert Peak (1985)	9.9	74,290	65,792	S21,T22N,R27E	Western States Geothermal Co. P.O. Box 2627 Sparks, NV 89432-2627
Dixie Valley[2] (1988)	66.0	535,600	481,362	S7,T24N,R37E S33,T25N,R37E	Oxbow Geothermal Corp. 5250 South Virginia St., Suite 304 Reno, NV 89502
Empire (1987)	3.6	14,640	10,281	S21,T29N,R23E	Amor II Corporation P.O. Box 40 Empire, NV 89405
Soda Lake No. 1 (1987) and Soda Lake No. 2 (1991)	16.6	129,185	98,934	S33,T20N,R28E	Nevada Operations, Inc. 5500 Soda Lake Road Fallon, NV 89406
Steamboat I, I-A (1986) and Steamboat II, III (1992)	48.0	413,358	312,284	S29,T18N,R20E	S.B. Geo, Inc. P.O. Box 18199, 1010 Power Plant Dr. Reno, NV 89511
Stillwater (1989)	13.0	113,765	77,863	S1,T19N,R30E S6,T19N,R31E	Nevada Operations, Inc. 5500 Soda Lake Road Fallon, NV 89406
Wabuska (1984)	1.2	0	0	S15,16,T15N, R25E	Tad's 10 Julian Lane Yerington, NV 89447
Yankee Caithness (1988)	14.4	79,619	71,992	S5,6,T17N,R20E	Yankee Caithness J.V.L.P. P.O. Box 18160 Reno, NV 89511
TOTAL	210.5	1,668,428	1,358,558		

[1]Production capacity from currently developed geothermal resources.
[2]Gross output of the Dixie Valley plant occasionally exceeds 66 MW.
Sources: Nevada Division of Minerals, plant operators, and NBMG files.

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MI - 1998 Geothermal Section

Twenty new geothermal well permits were issued during 1998 by the Nevada Division of Minerals: they include 1 industrial/commercial class well, 13 gradient/observation wells, 4 injection wells, and 2 domestic wells. In addition 4 permits were issued to rework existing wells. During this same period 1 industrial class production well, 6 observation wells, 1 injection well, and one domestic well were reported to have been drilled.

During 1997, 14 new well permits were issued by the Nevada Division of Minerals: they included 4 industrial/commercial class wells, 9 gradient/observation wells, and 1 domestic well. During this same period 1 industrial class production well, 2 observation wells, and 1 domestic well were drilled.

There were 74 federal geothermal noncompetitive leases covering 110,800 acres and 54 competitive federal leases covering 58,900 acres in Nevada during 1998. This is an increase of 1,817 noncompetitive lease acres and an increase of 11,354 competitive lease acres from 1997 totals.

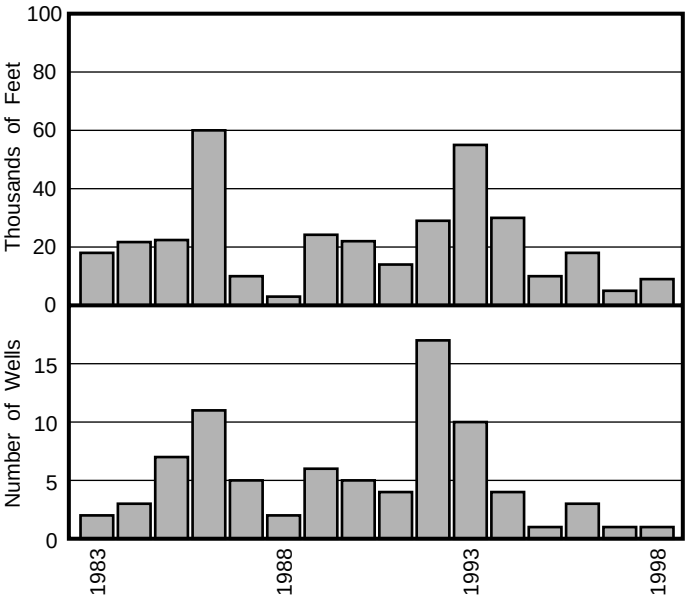
Total gross electrical production from geothermal resources on federal lands was 1.2 million megawatt-hours (MWh); net production was approximately 998,000 MWh. Gross electrical sales from federal lands was 80 million dollars. Production royalties on that amount equaled $4,200,000.

By regulation, half of all Federal geothermal lease rental fees and production royalties are returned to the state. For 1998 $2.1 million dollars in royalty production fees should be returned to Nevada. Lease rental fee data for 1998 was not available as of press time. (R. Hoops, Bureau of Land Management, personal commun., 1999)

Total Nevada geothermal electrical production from both federal and fee lands combined in 1998 was 1,630,579 MWh gross; net production was 1,326,851 MWh (Nevada Division of Minerals, 1999) with an approximate sales value of $93,000,000. Production capacity from the currently developed geothermal resources at ten existing geothermal power plants in Nevada is 210.5 megawatts (MW). Installed equipment capacity based on equipment nameplate rating is 242.4 MW. Nevada is second only to California in total installed geothermal generating capacity.

Bradys Hot Springs and Desert Peak

The **Desert Peak** geothermal power plant, owned by **Western States Geothermal Co.,** is now connected to the general grid at the **Bradys Hot Springs** geothermal plant operated by **Brady Power Partners.** This change in point of sales means that the combined net production from both plants within the Known Geothermal Resource Area is now being purchased through the Bradys Hot Springs power purchase agreement with Sierra Pacific Power Company.



Industrial-class (power generating) wells drilled in Nevada 1982–1998. Depth taken from original drilling permit.

NONDOMESTIC GEOTHERMAL WELLS REPORTED AS DRILLED OR COMPLETED IN NEVADA DURING 1997 AND 1998

Area	Company	Well name	Permit#	Location	Type
Churchill County					
Brady Hot Springs	Brady Power Partners	Industrial Injection Well 74-25	480	NE¼, S25, T22N, R26E	Injection
	Brady Power Partners	Observation Well BCH #1	448	SE¼ SE¼, S36, T23N, R26E	Observation
	Brady Power Partners	Observation Well BCH #2	450	SE¼ NW¼, S1, T22N, R26E	Observation
	Brady Power Partners	Observation Well BCH #3	451	NW¼ SW¼, S12, T22N, R26E	Observation
	Brady Power Partners	Observation Well BCH #5	455	NE¼ SW¼, S25, T22N, R26E	Observation
	Brady Power Partners	Observation Well BCH #7	457	NW¼ SE¼, S25, T22N, R26E	Observation
	Brady Power Partners	Observation Well BCH #8	474	NE¼ NE¼, S25, T22N, R26E	Observation
	Brady Power Partners	Observation Well BCH #9	475	NE¼ NE¼, S25, T22N, R26E	Observation
	Brady Power Partners	Observation Well BCH #10	476	NE¼ NE¼, S25, T22N, R26E	Observation
Dixie Valley	Oxbow Geothermal	Production Well #46-32	446	NE¼ SW¼, S32, T25N, R37E	Industrial
Stillwater	AMOR IV Corp.	Production Well Stillwater #12A-6	447	NW¼ NW¼, S6, T19N, R31E	Industrial

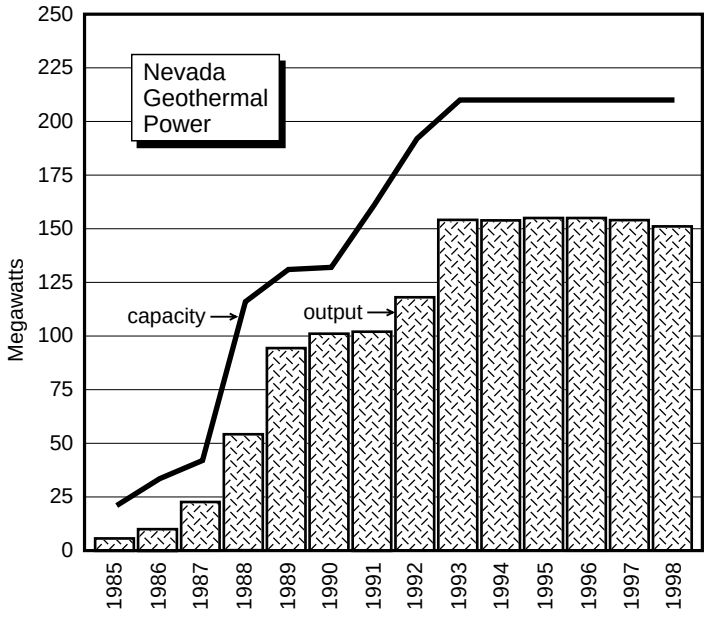
This arrangement insures that the Brady plant will be able to continue providing the minimum net electrical supply required by their existing power purchase agreement. (R. Hoops, personal commun., 1999; and J. Snow, Nevada Division of Minerals, personal commun., 1999)

The Bradys Power Plant produced 153,300 MWh gross (117,701 MWh net) and the Desert Peak Power Plant produced 69,488 MWh gross (59,638 MWh net) during 1998. (Nevada Division of Minerals, 1999)

Dixie Valley

The **Dixie Valley** power plant utilizes 250°C geothermal fluids, produced from a zone approximately 9,000 feet deep in a range-front fault/fracture system, to generate approximately 65 MW of electricity. The plant has been in production for 11 years and produces 5 million pounds per hour of mass flow from 10 production wells. Eight wells are used to re-inject 80% of the produced fluid. (Newsletter, Nevada Petroleum Society, April 29, 1999: Vol. XIV, Issue 2)

During 1998, small amounts of low-maturity oil was found trapped in some small wing valves on one production well and as scale on some hang down strings of several other production wells. This discovery has spurred oil exploration interests in the area and speculation as to the potential source rocks for the oil. The potential also exists to use the trace amounts of oil found in the fluids as a tracer in the geothermal system to help better understand the reservoir flow pattern and other sub-surface mechanisms associated with the resource. (Proceedings, Twenty-fourth Workshop on Geothermal Reservoir Engineering, Stanford University, Stanford, CA., January 25–27, 1999 and Newsletter, Nevada Petroleum Society, April 29, 1999: Vol. XIV, Issue 2)



Rated capacity and average net output of Nevada geothermal plants, 1985–1998. Average net output is annual sales in megawatt-hours divided by the number of hours in a year (8,760). No commercial geothermal power was produced in Nevada before 1985.

Rye Patch

During 1995 **Rye Patch Limited Partnership (OESI)** terminated work on the 95% complete 12.5 MW binary power plant located at **Rye Patch**. At the time they were only able to identify a 6 MW proven resource. Due to funding constraints and reservoir engineering problems Sierra Pacific cancelled the projects power purchase agreement and the project went into default. (Geothermal Resources Council Bulletin, May 1995, vol. 24, no. 5 and NBMG MI 1995)

Rye Patch Energy Company and **Mount Wheeler Power Company** are currently in negotiations which may allow the Rye Patch geothermal plant to be completed and brought on-line producing 6–7 MW of electricity from the already proven well field resource. After the plant is brought on-line ongoing development in the well field should provide enough additional resources to eventually bring the plant up to its rated net capacity of 12.5 megawatts. (J. Wood, Rye Patch Energy Co., personal commun., 1999)

Steamboat Hot Springs

S.B. Geo, Inc. at **Steamboat Geothermal Power Plant** have had some success in the development, construction, and testing of some high volume, high temperature down hole submersible pumps. It is reported that these pumps can deliver as much as 3,000 gallons per minute of 400°F+ geothermal fluids. (J. Snow, personal commun., 1999)

S.B. Geo, Inc. filed a drilling permit application for designation of an ongoing project area at their Steamboat area site. It has been approved as State geothermal permit number 458PA. The project area encompasses sections 28, 29, 32, and 33, T18N, R20E in Washoe County. The project area permit allows for future drilling of up to 15 production wells, 7 injection wells, and 6 observation wells. (Nevada Division of Minerals, 1999)

Reno Energy, owned by Far West Capital Group, has been granted approval to develop a heating district with the potential to eventually heat 30 million square feet of industrial and commercial space. The Reno Energy project is currently putting together the financing package necessary to start construction on phase I of the project and it is anticipated that they will be moving forward with the project in the near future. The project is located in southern Reno, which is a rapidly developing area. It will use left over brine from electrical generation plants currently operating at the Steamboat geothermal area to heat a freshwater closed loop system that will circulate throughout the heat district. The freshwater in the closed loop system will be heated to 240°F with connections to energy users metered for volume and energy consumption. The used brine from this process will be re-injected to the geothermal resource. Phase one of the project includes completion of the first loop through the

South Truckee Meadows area. (S. Johnson, Oxbow Power Services, Inc., personal commun., 1999; and Snow, J. personal commun., 1999) Projected cost of phase I is $41 million. It is estimated that this system could save its customers between 35 and 55% of the long-term cost of conventional heating and cooling. (Reno Energy LLC News Release, 1996)

NEVADA GEOTHERMAL POWER PLANTS 1998

Plant name (year on line)	Production capacity[1] (MW)	1998 Production (MWh) Gross	Net (sales)	Location	Operator
Beowawe (1985)	16.7 (16.6)	131,351	106,854	S13,T31N,R47E	Oxbow Power of Beowawe, Inc. HC 66, Unit 1, Box 16 Beowawe, NV 89821
Bradys Hot Springs (1992)	21.1 (26.4)	153,300	117,701	S12,T22N,R26E	Brady Power Partners P.O. Box 649 Fernley, NV 89408
Desert Peak (1985)	9.9 (11.0)	69,488	59,638	S21,T22N,R27E	Western States Geothermal Co. c/o Brady Power Partners P.O. Box 649 Fernley, NV 89408
Dixie Valley[2] (1988)	66.0 (62.0)	526,020	471,151	S7,T24N,R37E S33,T25N,R37E	Oxbow Geothermal Corp. 9790 Gateway Dr. Suite 220 Reno, NV 89511
Empire (1987)	3.6 (4.8)	33,069	30,103	S21,T29N,R23E	San Emidio Resources P.O. Box 40 Empire, NV 89405
Soda Lake No. 1 (1987) and Soda Lake No. 2 (1991)	16.6 (26.1)	121,419	87,538	S33,T20N,R28E	Constellation Operating Services 5500 Soda Lake Road Fallon, NV 89406
Steamboat I, I-A (1986) and Steamboat II, III (1992)	48.0 (58.6)	413,458	310,428	S29,T18N,R20E	S.B. Geo, Inc. P.O. Box 18199 1010 Power Plant Dr. Reno, NV 89511
Stillwater (1989)	13.0 (21.0)	98,356	67,843	S1,T19N,R30E S6,T19N,R31E	Constellation Operating Services 5500 Soda Lake Road Fallon, NV 89406
Wabuska (1984)	1.2 (1.45)	7,995	7,995	S15,16,T15N, R25E	Tad's Enterprises 3535 Southampton Dr. Reno, NV 89502
Yankee Caithness (1988)	14.4 (14.44)	76,123	67,600	S5,6,T17N,R20E	Yankee Caithness J.V.L.P. P.O. Box 18160 Reno, NV 89511
TOTAL	210.5 (242.4)	1,630,579	1,326,851		

[1]Production capacity from currently developed geothermal resources (equipment nameplate capacity in parenthesis).

[2]Gross output of the Dixie Valley plant occasionally exceeds 66 MW.

Sources: Plant operators, Nevada Division of Minerals, and NBMG files.

Brady Power Partners Geothermal Power Plant. ***Photo by Megan Hess, 1999.***

Geothermal Energy

by Ronald H. Hess

MI - 1999 Geothermal Section

Seven geothermal well permits were issued during 1999 by the Nevada Division of Minerals: they include six gradient/observation wells and one domestic well (Nevada Division of Minerals, 2000).

During 1999 there were 72 federal geothermal noncompetitive leases covering 107,000 acres and 54 competitive federal leases covering 51,600 acres in Nevada. This is a decrease of 3,800 noncompetitive lease acres and a decrease of 7,300 competitive lease acres from 1998 totals. Lease rental fees for 1999 totaled $199,800.

Total gross electrical production from geothermal resources on public lands was 1.21 million megawatt-hours (MWh); net production was about 1.01 million MWh. Gross electrical sales from federal lands was $80.3 million. Production royalties on that amount equaled $3,670,000.

By regulation, half of all Federal geothermal lease rental fees and production royalties are returned to the state. For 1999, $1,835,000 in royalty production fees and $99,900 in lease rental fees should be returned to Nevada (R. Hoops, personal commun., 2000, Bureau of Land Management).

Total Nevada geothermal electrical production from both federal and fee lands combined in 1999 was 1,599,040 MWh gross; net production was 1,288,649 MWh (Nevada Division of Minerals, 2000) with an approximate sales value of $90,000,000. Production capacity from the currently developed geothermal resources at ten existing geothermal power production sites in Nevada is 211.5 megawatts. Nevada is second only to California in total installed geothermal generating capacity.

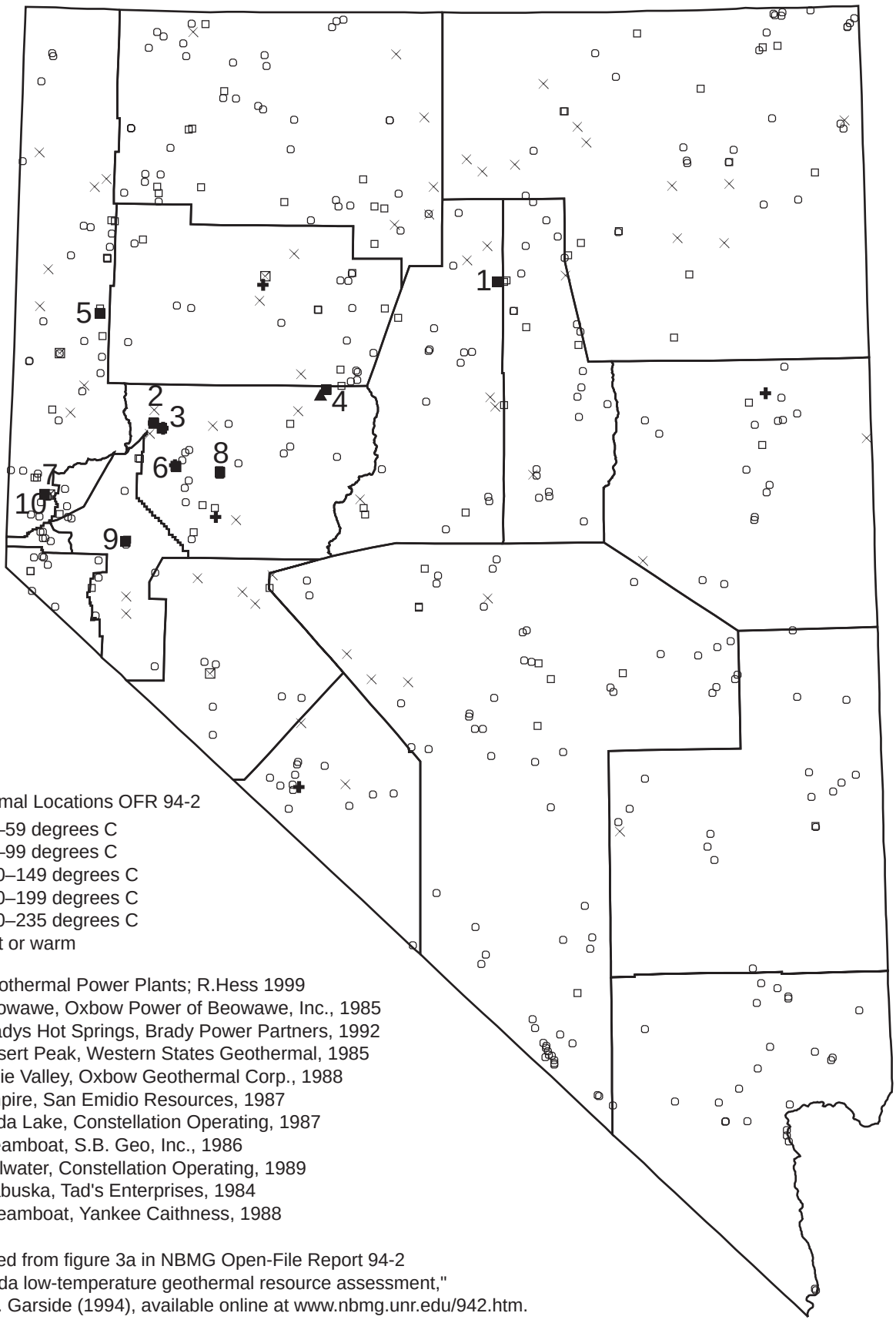
GeoPowering the West

A draft of a new initiative from the Department of Energy, entitled **GeoPowering the West**, has been released. The goals of the initiative are to have geothermal energy sources provide 10% of the electricity needs of Western States by 2020, provide the electrical or heat energy needs of at least 7 million U.S. homes by 2010, and double the number of states with geothermal electrical power production to eight by 2006. Implementation of this initiative will incorporate a broad education and outreach program, increased federal geothermal energy use, technology advancement and deployment initiatives, expanded exploration program, policy incentives, and institutional regulatory improvements. The draft document can be viewed on the web at <www.eren.doe.gov/geopoweringthewest>.

One of the first projects to develop out of this initiative is the “Geothermal Energy in Nevada and the West” conference held at the University of Nevada, Reno on July 6, 2000. This conference was co-hosted by U.S. Senator Harry Reid, U.S. Department of Energy, University of Nevada at Reno, and the Geothermal Energy Association. The Nevada Bureau of Mines and Geology released a new 1:1,000,000-scale geothermal resources map of Nevada at the conference; this map (NBMG Map 126) can be purchased from the NBMG publication sales office. Some of the digital data sets that went into the development of Map 126, including the no-longer-maintained U.S. Geological Survey geothermal database and the digital index to geothermal well files housed at NBMG, are available on the NBMG website at <www.nbmg.unr.edu/lists.htm>

NONDOMESTIC GEOTHERMAL WELLS REPORTED AS DRILLED OR COMPLETED IN NEVADA DURING 1999

Area	Company	Well name	Permit#	Location	Type
Churchill County					
Brady Hot Springs	Brady Power Partners	Industrial Injection Well 61-25	478	NE¼, S25, T22N, R26E	Injection
	Brady Power Partners	Industrial Injection Well 73-25	479	NE¼, S25, T22N, R26E	Injection
	Brady Power Partners	Industrial Injection Well 81-25	481	NE¼, S25, T22N, R26E	Injection
Washoe County					
Steamboat Hot Springs	Diocese of Reno (Bishop Manogue H.S.)	Gradient Well M1	489	NE¼ SW¼, S17, T18N, R20E	Gradient
	Yankee Caithness	Industrial Production Well 24-5	178	SW¼ NW¼, S5, T17N, R20E	Production



Geothermal Locations OFR 94-2

- ○ 18–59 degrees C
- □ 60–99 degrees C
- ⊠ 100–149 degrees C
- ✚ 150–199 degrees C
- ▲ 200–235 degrees C
- × Hot or warm

■ Geothermal Power Plants; R.Hess 1999

1. Beowawe, Oxbow Power of Beowawe, Inc., 1985
2. Bradys Hot Springs, Brady Power Partners, 1992
3. Desert Peak, Western States Geothermal, 1985
4. Dixie Valley, Oxbow Geothermal Corp., 1988
5. Empire, San Emidio Resources, 1987
6. Soda Lake, Constellation Operating, 1987
7. Steamboat, S.B. Geo, Inc., 1986
8. Stillwater, Constellation Operating, 1989
9. Wabuska, Tad's Enterprises, 1984
10. Steamboat, Yankee Caithness, 1988

Adapted from figure 3a in NBMG Open-File Report 94-2
"Nevada low-temperature geothermal resource assessment,"
by L.J. Garside (1994), available online at www.nbmg.unr.edu/942.htm.

Nevada Geothermal Resource Occurrences

Bradys Hot Springs and Desert Peak

Brady Power Partners, operators of the **Brady Hot Springs** geothermal power plant have subleased the **Desert Peak** geothermal power plant from **Western States Geothermal Company**. This followed an earlier agreement that allowed the electrical production from the Desert Peak power plant to be used to offset the electric load used by support equipment and injection pumps at the Brady Hot Springs power plant. The use of electrical output from Desert Peak to offset the parasitic equipment load at Bradys insures that the Brady plant will be able to continue providing the minimum net electrical supply required by their existing power purchase agreement (R. Hoops, personal commun., 1999, and Nevada Division of Minerals, 2000).

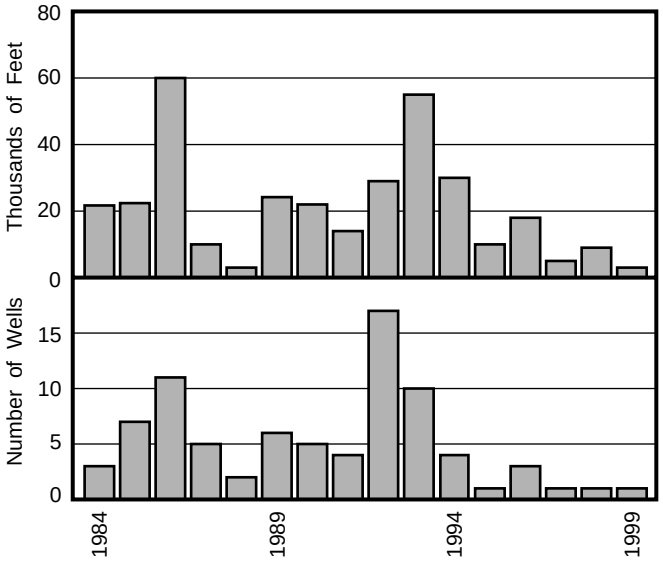
Brady Power Partners drilled several new injection wells during 1999 in development of a new injection field located 4 miles from the Brady Hot Springs Power plant. The injection wells were put online after completion of the pipe system to the new injection field. This new injection site was chosen in an effort to increase the time it takes for spent fluids to return to the production zone. The existing injection wells were returning fluids to the production zone so rapidly that it was lowering the temperature of the production fluids. The new injection field appears to have significantly less direct connectivity with the production reservoir than the older injection wells. Currently, fluid injection is split between the existing injection wells and the new injection wells based on the requirements to maintain the production reservoir water table level (J. Snow, personal commun., 2000, Nevada Division of Minerals).

During 1999 Brady Hot Springs Geothermal Power Plant produced a gross output of 141,444 MWh with a net production of 101,086 MWh. The Desert Peak Geothermal Power Plant produced a gross output of 62,604 MWh with a net production of 52,826 MWh (Nevada Division of Minerals, 2000).

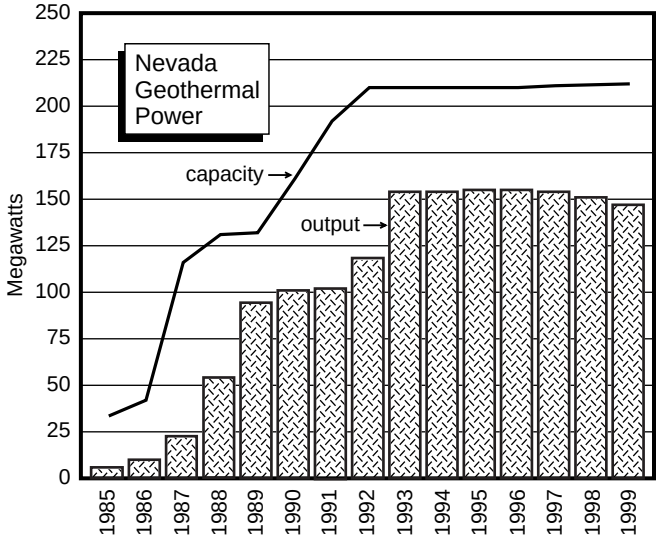
The Brady Hot Springs onion dehydration plant, operated by **Gilroy Foods** a subsidiary of **U.S.F.I.**, installed a second drying line, which has doubled their drying capacity. This plant was constructed in 1978 and originally designed to dry 25 to 30 million pounds of raw onions annually. The dehydration plant currently uses 1100 gallons per minute of geothermal fluids supplied directly from Brady Power Plant production wells. (L.J. Garside, 1980, The Nevada Mineral Industry 1979, NBMG Special Publication MI-1979; J. Snow, personal commun., 2000)

Dixie Valley

Negotiations pertaining to the potential sale of the **Oxbow Geothermal Corporation, Dixie Valley** power plant to **Caithness Power** are ongoing. More detailed information on the purchase is currently not available. The Dixie Valley power plant has been operated by Oxbow Geothermal Corporation since its startup in 1988. The Dixie Valley power plant utilizes 250°C geothermal fluids to generate about 66 megawatts. During 1999 it produced a gross output of 524,980 MWh with a net production of 469,769 MWh. The Dixie Valley geothermal plant is currently the single largest geothermal energy producer in Nevada.



Industrial-class (power generating) wells drilled in Nevada 1984–1999. Depth taken from original drilling permit.



Currently developed resource capacity and average net output of Nevada geothermal plants, 1985–1999. Average net output is annual sales in megawatt-hours divided by the number of hours in a year (8,760). No commercial geothermal power was produced in Nevada before 1985.

Empire

Empire Farms, a garlic and onion producer, operates a vegetable dehydration plant which uses geothermal fluids from the Empire geothermal area in northern Washoe County. Empire Farms received a $1.4 million low interest loan from the U.S. Department of Agriculture, Rural Housing Program, for construction of additional housing units for employees. Empire Farms routinely employs about 200 people; during harvest time this number increases to 450. Rental housing in the immediate area is limited and many employees commute from Fernley. Upon completion of the 20 additional units funded under this project there will be a total of 56 houses at Empire Farms. (Reno Gazette-Journal, May 22, 2000)

Empire Farms recently installed a preheater to the dehydration production facility to increase plant production. The plant utilizes geothermal fluids from production wells in the Empire geothermal field. After the fluid has been used at the dehydration facility it is piped to the Empire Geothermal Power Plant where, along with geothermal fluids produced directly from the geothermal field, it becomes the heat source for the binary generation plant (J. Snow, personal commun., 2000). The Empire Geothermal Power Plant came on-line in 1987 and has a rated binary generation capacity of 4.8 megawatts. During 1999 it produced a gross output of 36,622 MWh with a net production of 30,842 MWh.

Rye Patch

Rye Patch Energy Company and Mount Wheeler Power Company have completed negotiations that will allow more well field development for the Rye Patch geothermal plant. The first new well will be drilled in early 2000. This is an effort to better define the production field and secure adequate geothermal fluid so that the nearly complete Rye Patch geothermal plant can be brought on-line. When the plant is brought on-line it is anticipated that electrical production from the plant will be wheeled to the Mount Wheeler service area in eastern Nevada.

NEVADA GEOTHERMAL POWER PLANTS 1999

Plant name (year on line)	Production capacity[1] (MW)	1999 Production (MWh) Gross	Net (sales)	Location	Operator
Beowawe (1985)	16.7 (16.6)	129,301	105,769	S13,T31N,R47E	Oxbow Power of Beowawe, Inc. HC 66, Unit 1, Box 16 Beowawe, NV 89821
Bradys Hot Springs (1992)	21.1 (26.4)	141,444	101,086	S12,T22N,R26E	Brady Power Partners P.O. Box 649 Fernley, NV 89408
Desert Peak (1985)	9.9 (11.0)	62,604	52,826	S21,T22N,R27E	Western States Geothermal Co. c/o Brady Power Partners P.O. Box 649 Fernley, NV 89408
Dixie Valley[2] (1988)	66.0 (62.0)	524,980	469,769	S7,T24N,R37E S33,T25N,R37E	Oxbow Geothermal Corp. 9790 Gateway Dr. Suite 220 Reno, NV 89511
Empire (1987)	4.6 (4.8)	36,622	30,842	S21,T29N,R23E	San Emidio Resources P.O. Box 40 Empire, NV 89405
Soda Lake No. 1 (1987) and Soda Lake No. 2 (1991)	16.6 (26.1)	125,660	91,944	S33,T20N,R28E	Constellation Operating Services 5500 Soda Lake Road Fallon, NV 89406
Steamboat I, I-A (1986) and Steamboat II, III (1992)	48.0 (53.7)	405,224	301,188	S29,T18N,R20E	S.B. Geo, Inc. P.O. Box 18199 1010 Power Plant Dr. Reno, NV 89511
Stillwater (1989)	13.0 (21.0)	94,822	65,194	S1,T19N,R30E S6,T19N,R31E	Constellation Operating Services 5500 Soda Lake Road Fallon, NV 89406
Wabuska (1984)	1.2 (1.45)	8,207	8,207	S15,16,T15N, R25E	Tad's Enterprises 3535 Southampton Dr. Reno, NV 89509
Yankee Caithness (1988)	14.4 (14.44)	70,176	61,824	S5,6,T17N,R20E	Yankee Caithness J.V.L.P. P.O. Box 18160 Reno, NV 89511
TOTAL	211.5 (237.5)	1,599,040	1,288,649		

1. Production capacity from currently developed geothermal resources (equipment nameplate capacity in parentheses). *Sources:* Plant operators, Nevada Division of Minerals, and NBMG files.

2. Gross output of the Dixie Valley plant occasionally exceeds 66 MW.

Oxbow Geothermal Plant, Dixie Valley. ***Photo by Ron Hess, 1999.***

Geothermal Energy

by Ronald H. Hess

MI - 2000 Geothermal Section

Four geothermal well permits were issued during 2000 by the Nevada Division of Minerals: one industrial production well, one injection well, one gradient/ observation well, and one domestic well (Nevada Division of Minerals, 2001).

Due to ongoing difficulties in the electrical utilities industry, the year 2000 Federal geothermal lease, royalty, and energy sales information had not been compiled by the U.S. Bureau of Land Management in time to be included in this publication. This information will be included in next year's review of the geothermal industry.

Total Nevada geothermal electrical production from both federal and fee lands combined in 2000 was 1,572,958 megawatt-hours (MWh) gross; net production was 1,257,781 MWh (Nevada Division of Minerals, 2001). Due to the ongoing confusion in the California utilities industry, a firm sales value for Nevada geothermal electrical production was not available at the time of publication. It is anticipated that the total sales value for 2000 will be approximately $90 million. Production capacity from the currently developed geothermal resources at ten existing geothermal power production sites in Nevada is 216.5 megawatts. Nevada is second only to California in total installed geothermal generating capacity.

GeoPowering the West

A draft of a new initiative from the Department of Energy (DOE), entitled ***GeoPowering the West***, has been released. The goals of the initiative are to have geothermal energy sources provide 10% of the electricity needs of the western states by 2020, provide the electrical or heat energy needs of at least 7 million U.S. homes by 2010, and double the number of states with geothermal electrical power production to eight by 2006. Implementation of this initiative will incorporate a broad education and outreach program, increased federal geothermal energy use, technology advancement and deployment initiatives, expanded exploration and resource development program, policy incentives, and institutional regulatory improvements. More information on this initiative can be viewed on the web at <www.eren.doe.gov/geopoweringthewest>.

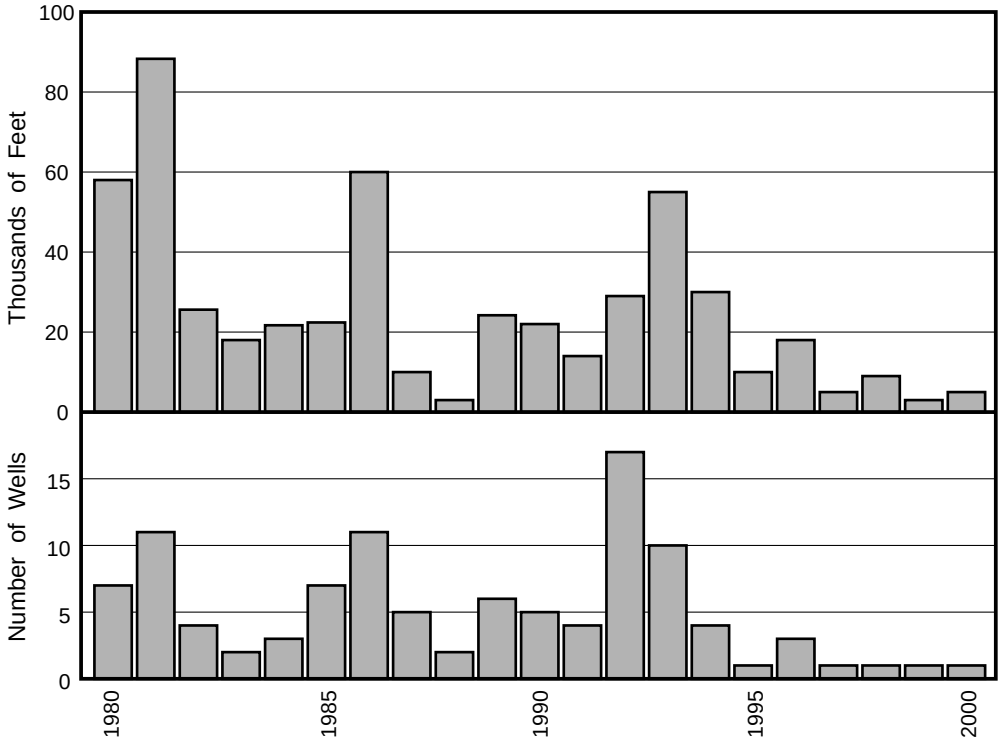
One of the first projects to develop out of this initiative was the *Geothermal Energy in Nevada and the West* conference held at the University of Nevada, Reno Campus on July 6, 2000. This conference was co-hosted by U.S. Senator Harry Reid, U.S. Department of Energy, University of Nevada at Reno, and the Geothermal Energy Association. A 1:1,000,000-scale geothermal resources map of Nevada (NBMG Map 126) was released at the conference and is available at the Nevada Bureau of Mines and Geology publication sales office. This map shows the potential for additional geothermal resource development in Nevada and the rest of the country. Under the GeoPowering the West Initiative, DOE announced on August 9, 2000, the creation of 21 new cooperative cost-share partnership projects between DOE and the geothermal industry. Six of these partnerships have projects that are located in Nevada:

(1) Empire Energy, LLC.—Empire Geothermal Area
(2) Steamboat Envirosystems, LLC.—Reno
(3) Coso Operating Co., Caithness Resources, Inc. —Steamboat Geothermal Area
(4) Mount Wheeler Power Co.—Rye Patch Geothermal Area
(5) Normex Corp,—Blue Mountain Geothermal Area
(6) S.B. Geo, Inc.—Steamboat Geothermal Area

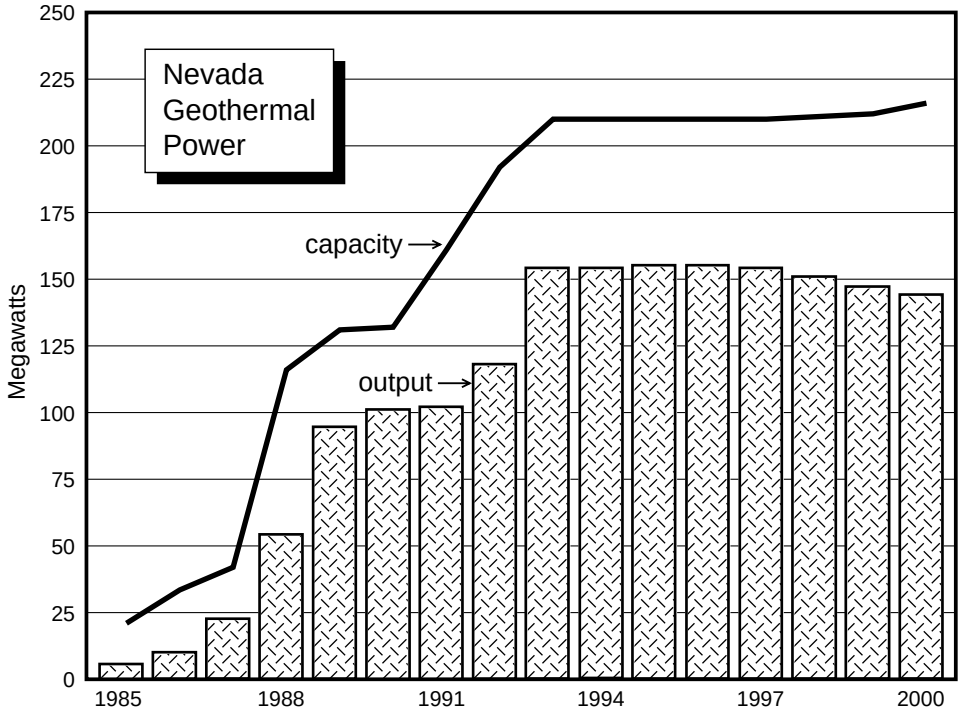
The first-year funding commitment for the DOE share of costs for the six Nevada projects is $706,197. (Bulletin Geothermal Resources Council, July/August 2000, v. 29, no. 4)

NONDOMESTIC GEOTHERMAL WELLS REPORTED AS DRILLED OR COMPLETED IN NEVADA DURING 2000

Area	Company	Well name	Permit#	Location	Type
Pershing County					
Rye Patch	Mt. Wheeler Power	Industrial Production Well 72-28	490	NE^{1}_{4}, NE^{1}_{4}, S28, T31N, R33E	Production
Washoe County					
Steamboat Hot Springs	Yankee Caithness	Industrial Production Well 24-5	178	SW^{1}_{4} NW^{1}_{4}, S5, T17N, R20E	Production



Industrial-class (power generation) wells drilled in Nevada, 1980–2000. Depth taken from original drilling permit.



Currently developed resource capacity and average net output of Nevada geothermal plants, 1985–2000. Average net output is annual sales in megawatt-hours divided by the number of hours in a year (8,760). No commercial geothermal power was produced in Nevada before 1985.

Bradys Hot Springs and Desert Peak

Western States Geothermal Co. has sold the Brady Hot Springs geothermal power plant to **ORMAT International, Inc.** for $20.5 million. ORMAT International, Inc. has also obtained the lease for the **Desert Peak** Geothermal Power Plant, which is owned by **Florida Power and Light Co**. The Bradys Hot Springs geothermal power plant has a long-term sales contract with Sierra Pacific Power Co. that runs until 2022. The Desert Peak plant does not have a long-term contract but has an intertie line connecting it to the Bradys power plant, allowing it to sell its production under Bradys long-term sales agreement. This is possible because both plants are located within the same Known Geothermal Resource Area (KGRA). (Bulletin Geothermal Resources Council, March/April 2001, v. 30, no. 2)

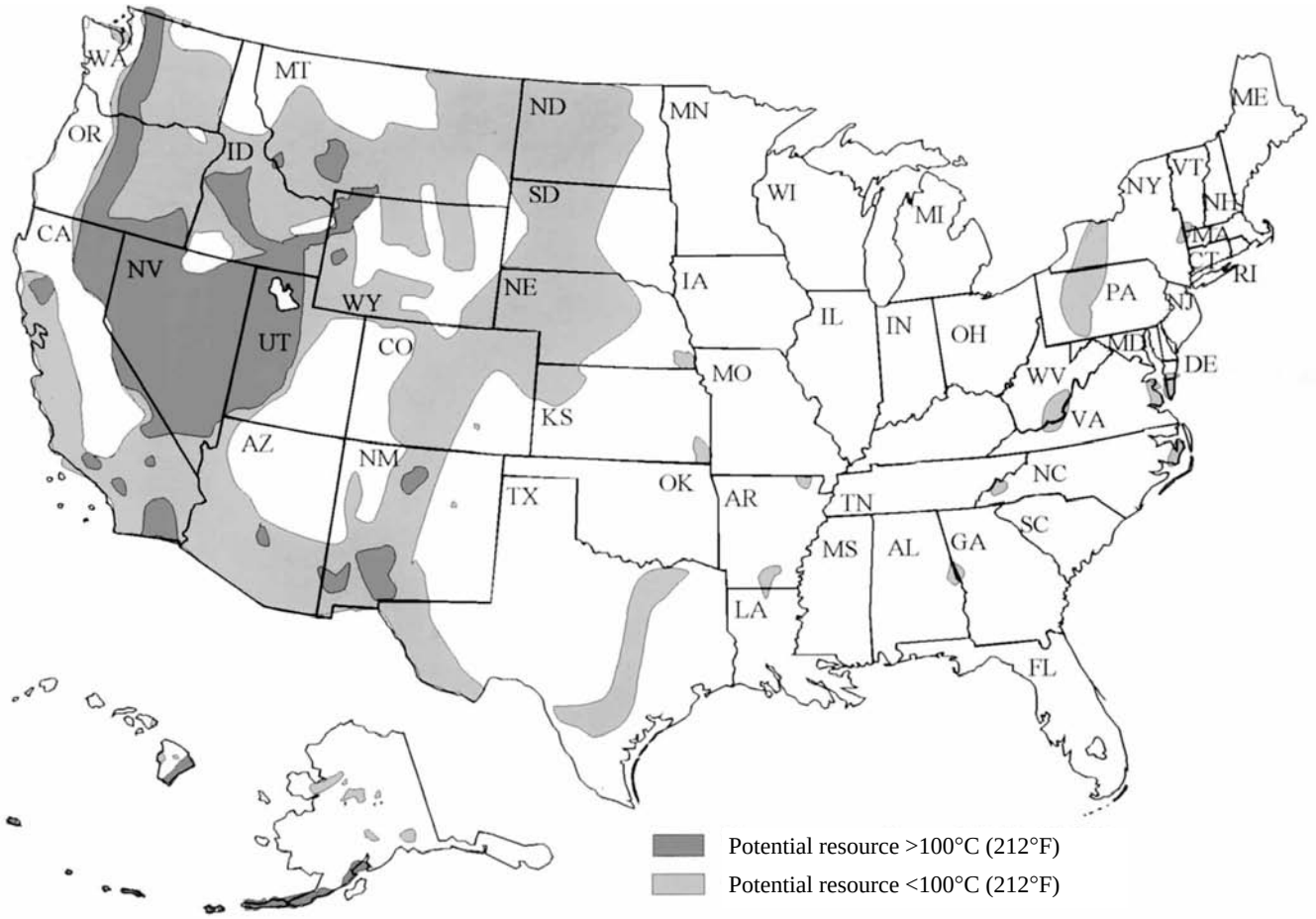
The Bradys Hot Springs geothermal power plant had a gross output of 132,180 MWh and a net production of 87,144 MWh during 2000. The Desert Peak geothermal power plant had a gross output of 62,551 MWh and a net production of 52,536 MWh. (Nevada Division of Minerals, 2001)

Dixie Valley

Oxbow Geothermal Corporation sold the Dixie Valley power plant to **Caithness Dixie Valley, LLC**. The Dixie Valley power plant had been operated by Oxbow Geothermal Corp. since its startup in 1988. The Dixie Valley power plant utilizes 250°C geothermal fluids to generate approximately 66 megawatts of electricity. During 2000 it had a gross output of 512,930 MWh and a net production of 457,096 MWh. The Dixie Valley geothermal plant is currently the single largest geothermal energy producer in Nevada. (Nevada Division of Minerals, 2001)

Moana Geothermal Area

The Warren Estates and Manzanita Estates Residential Geothermal Space Heating District, operated by the **Nevada Geothermal Utility Co.** since 1983, obtained permission from the Nevada Public Service Commission to switch from BTU meters to a flat-rate customer billing system. This follows a long history of problems and inaccuracies associated with the BTU meters.



Known and potential geothermal resources.

Compiled by the Energy and Geoscience Institute, University of Utah.

When the district was first established, each residence was equipped with a BTU meter to measure the amount of energy used. This value became the basis for calculating each residence's space and water heating bill. The BTU meters that were initially installed measured flow rate and fluid temperature drop between inlet and outlet to compute the heat energy consumption in therms (100,000 BTUs). With ongoing problems associated with the meters (caused by corrosion, exposure to the elements, breakage, old age, and general unreliability) the Nevada Geothermal Utility Co. obtained approval from the Nevada Public Utilities Commission to develop and implement a flat-rate billing system. It is based in part on square footage being heated and additional rates for swimming pools, spas, and driveway deicing. This billing system is scheduled to be reviewed by the Public Utilities Commission during 2001.

The Warren Estates and Manzanita Estates Residential Geothermal Space Heating District covers 130 acres and includes 100 residences that currently have contracts with Nevada Geothermal Utility Co. for geothermal space and water heat. The company has two production wells that produce water at 200°F+. Geothermal fluids are pumped at between 250 and 350 gallons/minute to surface heat exchangers and then injected back into the reservoir. Hot water from the heat exchanger at 180°F is circulated through an underground piping system to the residences in the district. (Flynn, T., 2000, Flat-Rate vs. BTU Meters, Warren Estates and Manzanita Estates Residential Geothermal District Space Heating, Reno, Nevada; *in* Geo-Heat Center Quarterly Bulletin, v. 21, no. 2)

Rye Patch

The **Mount Wheeler Power Co.** has successfully completed a new production well in the Rye Patch geothermal area. This well is part of an effort to better define the production field and secure adequate geothermal fluid so that the nearly complete Rye Patch geothermal power plant can be brought online. It is anticipated that one or two more wells will be drilled. (Bill Ehni, personal commun., 2001) Mount Wheeler Power Co. has also received a DOE development assistance contract as part of the DOE GeoPowering the West

NEVADA GEOTHERMAL POWER PLANTS 2000

Plant name (year on line)	Production capacity[1] (MW)	2000 Production (MWh) Gross	Net (sales)	Location	Operator
Beowawe (1985)	16.7 (16.6)	123,799	101,436	S13,T31N,R47E	Beowawe Power, LLC HC 66, Unit 1, Box 16 Beowawe, NV 89821
Bradys Hot Springs (1992)	21.1 (26.4)	132,180	87,144	S12,T22N,R26E	Brady Power Partners P.O. Box 649 Fernley, NV 89408
Desert Peak (1985)	9.9 (11.0)	62,551	52,536	S21,T22N,R27E	Western States Geothermal Co. c/o Brady Power Partners P.O. Box 649 Fernley, NV 89408
Dixie Valley[2] (1988)	66.0 (62.0)	512,930	457,096	S7,T24N,R37E S33,T25N,R37E	Caithness Dixie Valley, LLC 9790 Gateway Dr. Suite 220 Reno, NV 89511
Empire (1987)	4.6 (4.8)	39,612	33,897	S21,T29N,R23E	Empire Energy, LLC P.O. Box 40 Empire, NV 89405
Soda Lake No. 1 (1987) and Soda Lake No. 2 (1991)	16.6 (26.1)	119,884	85,934	S33,T20N,R28E	Constellation Operating Services 5500 Soda Lake Road Fallon, NV 89406
Steamboat I, I-A (1986) and Steamboat II, III (1992)	53.0 (58.7)	397,146	295,697	S29,T18N,R20E	S.B. Geo, Inc. P.O. Box 18199 1010 Power Plant Dr. Reno, NV 89511
Stillwater (1989)	13.0 (21.0)	92,069	58,714	S1,T19N,R30E S6,T19N,R31E	Constellation Operating Services 5500 Soda Lake Road Fallon, NV 89406
Wabuska (1984)	1.2 (1.45)	8,207	8,207	S15,16,T15N, R25E	Tad's Enterprises, LLC 2181 Stone Hill Circle Reno, NV 89509
Yankee Caithness (1988)	14.44 (14.44)	84,580	77,120	S5,6,T17N,R20E	Yankee Caithness J.V.L.P. 9790 Gateway Drive, Suite 220 Reno, NV 89511
TOTAL	216.5 (242.5)	1,572,958	1,257,781		

1. Production capacity from currently developed geothermal resources (equipment nameplate capacity in parentheses). *Sources:* Plant operators, Nevada Division of Minerals, and NBMG files.
2. Gross output of the Dixie Valley plant occasionally exceeds 66 MW.

Initiative. Total DOE funding could go as high as $1.6 million dollars over 3 years with a private funding match of $405,000. (Bulletin Geothermal Resources Council, July/August 2000, v. 29, no. 4)

Steamboat Hot Springs

S.B. Geo, Inc. is planning a 30-megawatt expansion of its existing power production capacity at Steamboat Hot Springs. This is in addition to a new 1-megawatt, skid-mounted power plant that has been installed as a test system (R.C. Burch, Nevada Petroleum Society presentation, Feb. 1, 2001). New exploration drilling will be undertaken by S.B. Geo, Inc., as part of a cost-share program with DOE. Part of the program includes a 2000-foot core hole, which will better define the geologic structure that controls the available geothermal resource. This cooperative program, in which DOE will fund 75% and S.B.Geo, Inc. will fund 25% of the drilling costs, was developed and funded under the DOE GeoPowering the West Initiative. DOE funding is projected to be $269,792 over 3 years with private funding match of $67,448 (Bulletin Geothermal Resources Council, July/August 2000, v. 29, no. 4, and March/April 2001, v. 30, no. 2).

The Steamboat Hot Springs geothermal power plant had a gross output of 397,146 MWh with a net production of 295,697 MWh during 2000. Also located in the Steamboat Hot Springs KGRA is the Yankee Caithness geothermal power plant, which had a gross output of 84,580 MWh and a net production of 77,120 MWh (Nevada Division of Minerals, 2001).

Binary generation units at the Empire Farms geothermal plant and garlic and onion drying facility. ***Photo by Larry Garside, 2001.***

Geothermal Energy

by Ronald H. Hess

MI - 2001 Geothermal Section

Three geothermal well permits were issued during 2001 by the Nevada Division of Minerals: they include one industrial production well, one domestic well, and two gradient/observation wells. (Nevada Division of Minerals, 2002)

During 2001 there were a total of 77 federal geothermal noncompetitive leases covering 111,836 acres and 40 competitive federal leases covering 44,227 acres in Nevada. Lease activity during the year included the issuance of 11 noncompetitive leases for 15,774 acres and 6 competitive leases for 10,068 acres. Lease rental fees for 2001 totaled $200,292 and the competitive lease sale generated an additional $240,159 for a total $440,451 in lease revenue for 2001. Total lease rental revenue for the year 2000 was $164,380. (Lowman, W. oral commun., 2002, Bureau of Land Management)

The Bureau of Land Management held a competitive lease sale in September 2001. Bids were received for tracts in the Rye Patch and Gerlach Known Geothermal Resource Areas (KGRA). The total of high bids for the sale exceeded $240,000. Individual tracts received bids of $35 to $51 per acre, which are bid amounts not seen since the early 1980s. (R. Hoops oral commun., 2002, Bureau of Land Management)

Total gross electrical production during 2001 from geothermal resources on public lands was 1.02 million megawatt-hours (MWh); net production was approximately 875,000 MWh. Gross electrical sales from federal lands was $61.1 million. Production royalties on that amount equaled $2,340,000. Total gross electrical production data for the year 2000 were not available by the publication date for MI-2000 but are included here for completeness. Total gross electrical production during 2000 from geothermal resources on public lands was 1.13 million MWh; net production was approximately 921,000 MWh. Gross electrical sales from federal lands was $58.2 million. Production royalties on that amount equaled $2,219,000.

By regulation, half of all Federal geothermal lease rental fees and production royalties are returned to the state. For 2001, $1,170,000 in royalty production fees and $220,226 in lease rental fees and bonus bid fees should be returned to Nevada. (R. Hoops and W. Lowman, Bureau of Land Management, oral commun., 2002)

Total Nevada geothermal electrical production from both federal and fee lands combined in 2001 was 1,539,878 MWh gross; net production was 1,247,651 MWh (Nevada Division of Minerals, 2002) with an approximate sales value of $87.2 million. Production capacity from the currently developed geothermal resources at ten existing geothermal power production sites in Nevada is 216.5 megawatts (MW). The table of Nevada geothermal power plants lists operators, plant locations, and energy production for individual Nevada geothermal power producers. Nevada is second only to California in total installed geothermal generating capacity.

Nevada State Legislature

The 2001 State Legislature passed and the Governor signed into law Senate Bill (SB) 372, which pertains to renewable energy resources. It requires, based on an escalating scale over time, that a certain percentage of electricity sold to customers in Nevada be generated from renewable resources. This bill represents a significant move forward in requiring utilities to obtain and distribute electricity generated from renewable resources.

The minimum required renewable energy portion of an electrical provider's portfolio starts at 5% for the years 2003 and 2004. The minimum required increases in steps until 2013 when it reaches 15%. Section 10, number 1 and 2, concerning the portfolio standard, from SB 372 are presented here:

NONDOMESTIC GEOTHERMAL WELLS REPORTED AS DRILLED OR COMPLETED IN NEVADA 2000–2001

Area	Company	Well name	Permit#	Location	Type
Churchill County					
Stillwater	Terra Thermal Power LLC	Commercial Production Well SF 62-30	495	NW^{1}_{4} NE^{1}_{4}, S30, T20N, R31E	Production
Pershing County					
Rye Patch	Mt. Wheeler Power	Thermal Gradient MW5	488	SW^{1}_{4}, NW^{1}_{4}, S28, T31N, R33E	Gradient
Rye Patch	Mt. Wheeler Power	Industrial Production Well 72-28	490	NE^{1}_{4}, NE^{1}_{4}, S28, T31N, R33E	Production
Washoe County					
Steamboat Hot Springs	Yankee Caithness	Industrial Production Well 24-5	178	SW^{1}_{4} NW^{1}_{4}, S5, T17N, R20E	Production

SB 372 - Sec. 10. 1. For each provider of electric service, the commission shall establish a portfolio standard for renewable energy. The portfolio standard must require each provider to generate or acquire electricity from renewable energy systems in an amount that is:

(a) For calendar years 2003 and 2004, not less than 5 percent of the total amount of electricity sold by the provider to its retail customers in this state during that calendar year.

(b) For calendar years 2005 and 2006, not less than 7 percent of the total amount of electricity sold by the provider to its retail customers in this state during that calendar year.

(c) For calendar years 2007 and 2008, not less than 9 percent of the total amount of electricity sold by the provider to its retail customers in this state during that calendar year.

(d) For calendar years 2009 and 2010, not less than 11 percent of the total amount of electricity sold by the provider to its retail customers in this state during that calendar year.

(e) For calendar years 2011 and 2012, not less than 13 percent of the total amount of electricity sold by the provider to its retail customers in this state during that calendar year.

(f) For calendar year 2013 and for each calendar year thereafter, not less than 15 percent of the total amount of electricity sold by the provider to its retail customers in this state during that calendar year.

2. In addition to the requirements set forth in 1, the portfolio standard for each provider must require that:

(a) Of the total amount of electricity that the provider is required to generate or acquire from renewable energy systems during each calendar year, not less than 5 percent of that amount must be generated or acquired from solar renewable energy systems.

(b) If the provider acquires electricity from a renewable energy system pursuant to a renewable energy contract with another party:

(1) The term of the renewable energy contract must be not less than 10 years, unless the other party agrees to a renewable energy contract with a shorter term; and

(2) The terms and conditions of the renewable energy contract must be just and reasonable, as determined by the commission. If the provider is a public utility and the commission approves the terms and conditions of the renewable energy contract between the provider and the other party, the renewable energy contract and its terms and conditions shall be deemed to be a prudent investment and the provider may recover all just and reasonable costs associated with the renewable energy contract.

3. If, for the benefit of one or more of its retail customers in this state, the provider has subsidized, in whole or in part, the acquisition or installation of a solar thermal energy system which qualifies as a renewable energy system and which reduces the consumption of electricity, the total reduction in the consumption of electricity during each calendar year that results from the solar thermal energy system shall be deemed to be electricity that the provider generated or acquired from a renewable energy system for the purposes of complying with its portfolio standard.

In Section 4 and Section 13 number 3, allowable renewable energy sources are listed:

Section. 4. "Biomass" means any organic matter that is available on a renewable basis, including, without limitation:

1. *Agricultural crops and agricultural wastes and residues;*
2. *Wood and wood wastes and residues;*
3. *Animal wastes;*
4. *Municipal wastes; and*
5. *Aquatic plants.*

Section 13, number 3. As used in this section:

(a) "Biomass" has the meaning ascribed to it in section 4 of this act.

(b) "Renewable energy" means a source of energy that occurs naturally or is regenerated naturally, including, without limitation:

(1) Wind;
(2) Solar energy;
(3) Geothermal energy; and
(4) Biomass.

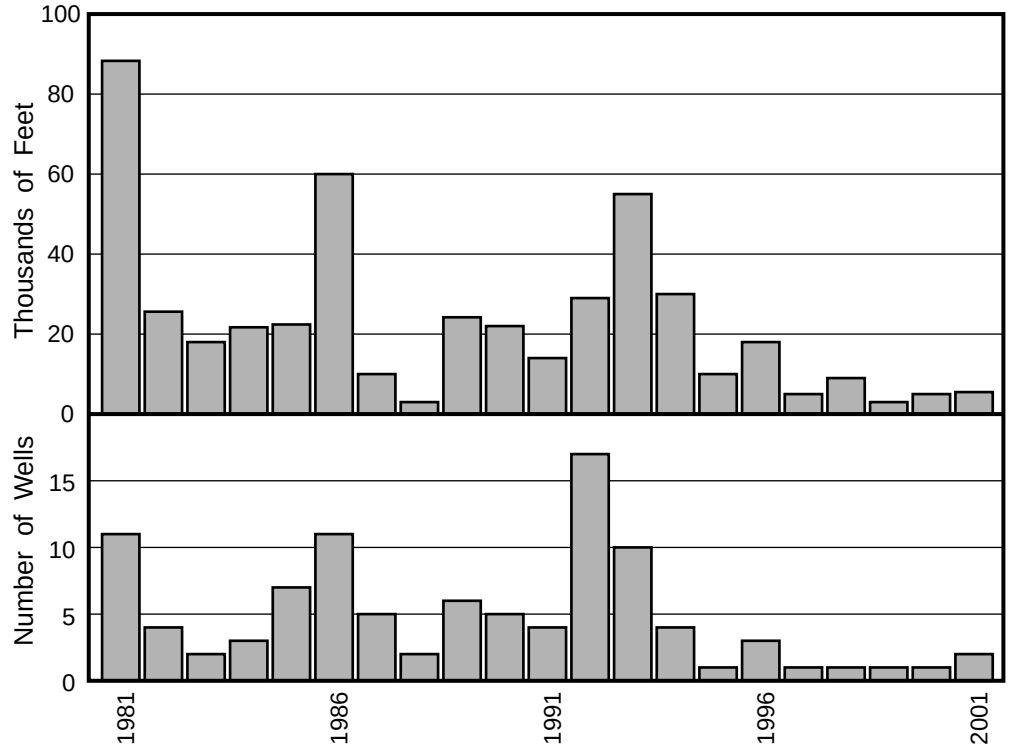
The term does not include coal, natural gas, oil, propane or any other fossil fuel, or nuclear energy.

The complete text of this bill can be viewed on the Web at "http://www.leg.state.nv.us/71st/Reports/history.cfm?ID=4214."

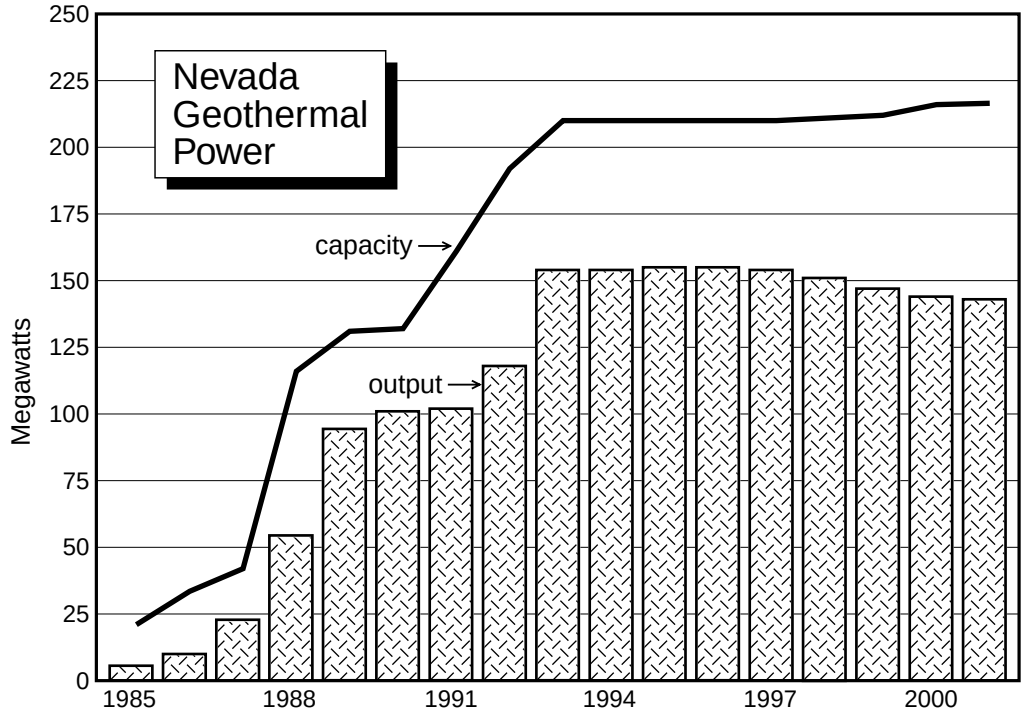
GeoPowering the West

The Department of Energy initiative, **GeoPowering the West**, is picking up momentum. Its goals are to assist the public and private sector to ensure that geothermal energy sources will provide 10% of the electricity needs of Western States by 2020, provide the electrical or heat energy needs of at least 7 million U.S. homes by 2010, and double the number of states with geothermal electrical power production to eight by 2006.

This initiative, through various outreach activities, will provide technical, legislative, and funding assistance to help ensure that federal programs for efficient energy and clean power technologies are implemented at regional, State, and local levels. Implementation of this program will incorporate a broad education and outreach program, increased federal geothermal energy use,



Industrial-class (power-generation) wells drilled in Nevada, 1981–2001. Depth taken from original drilling permit.



Currently developed resource capacity and average net output of Nevada geothermal plants, 1985–2001. Average net output is annual sales in megawatt-hours divided by the number of hours in a year (8,760). No commercial geothermal power was produced in Nevada before 1985.

technology advancement and deployment initiatives, expanded exploration and resource development program, policy incentives, and institutional regulatory improvements. A large part of this program will be carried out through use of cooperative cost-share partnership projects between DOE, various research entities, and the geothermal industry. More information on this program can be found at "http://www.eren.doe.gov/geopoweringthewest/." (Framel, C., Geothermal Resources Council Workshop, Reno, NV, April 2002)

Bradys Hot Springs and Desert Peak

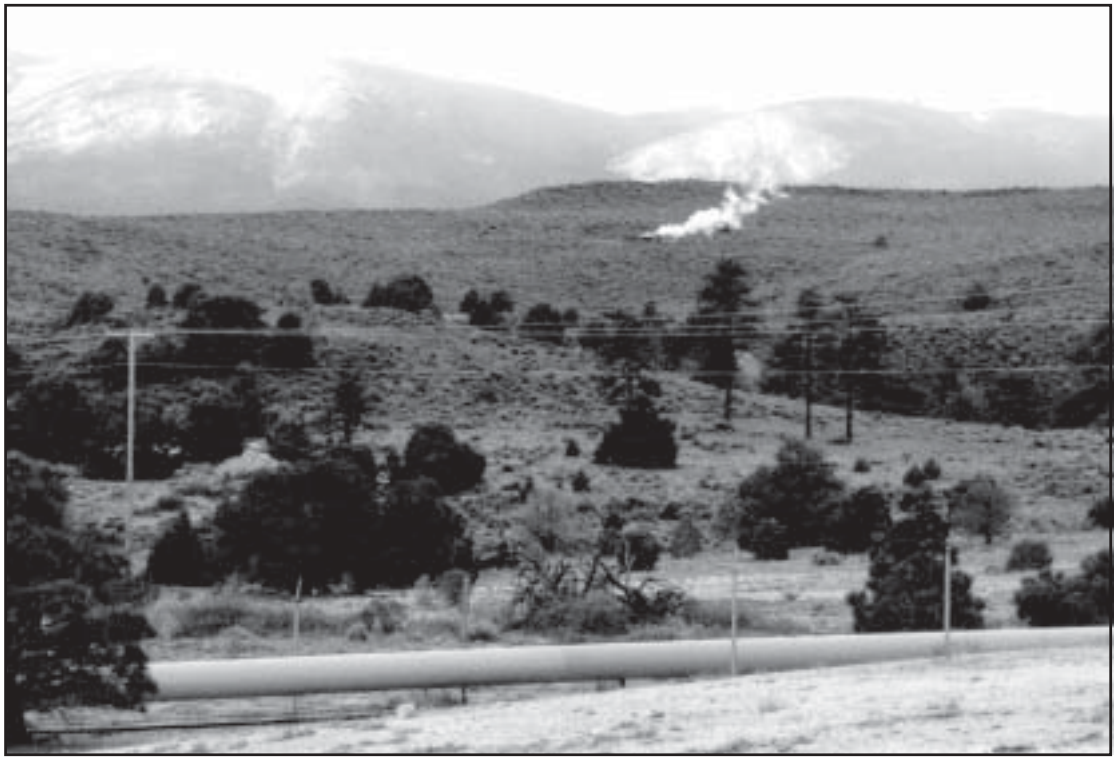
Western States Geothermal Company has sold the **Brady Hot Springs Geothermal Power Plant** to **ORMAT International, Inc.** for $20.5 million. ORMAT International, Inc., has also obtained the lease for the **Desert Peak** Geothermal Power Plant which is owned by **Florida Power and Light Company**. The Brady Hot Springs Geothermal Power Plant has a long-term sales contract with Sierra Pacific Power Company that runs until 2022. The Desert Peak plant does not have a long-term contract but has an intertie line to the Brady power plant allowing it to sell its production under the Brady long-term sales agreement. This is possible because both plants are located within the same Known Geothermal Resource Area (KGRA). An expansion project at Brady Hot Springs is currently being planned for 2002. (Bulletin Geothermal Resources Council, March/April 2001, Vol. 30, Number 2, and Snow, J., Nevada Division of Minerals, 2002)

The Brady 21.1-MW dual-flash geothermal plant produces from 6 production wells with an average depth of 3,057 feet and average fluid temperature of 312ºF. The plant has eight injection wells with an average injection fluid temperature of 238ºF. The Brady plant also supplies geothermal fluid to the Brady Hot Springs onion dehydration plant operated by **Gilroy Foods,** a subsidiary of **U.S.F.I.** The Desert Peak 9.9-MW dual-flash geothermal plant produces from two production wells with an average depth of 3,683 feet and fluid temperature of 312ºF. Desert Peak has two injection wells with an average depth of 4,000 feet and injection temperature of 198ºF. (Snow, J., Nevada Division of Minerals, 2002)

During 2001, Brady Hot Springs Geothermal Power Plant produced a gross output of 120,768 MWh with a net production of 77,725 Mwh. The Desert Peak Geothermal Power Plant produced a gross output of 57,609 MWh with a net production of 48,201 MWh. (Nevada Division of Minerals, 2002)

Fallon Naval Air Station

Since the 1970s, the U.S. Navy has conducted a series of studies aimed at better defining the geothermal resource of the Naval Air Station located south of Fallon,



Steam plume in center of photo is the new exploration core hole MTH 24-33 at Steamboat Hot Springs. View is to the south from the Steamboat I geothermal power plant area. ***Photo by R. Hess, 2001.***

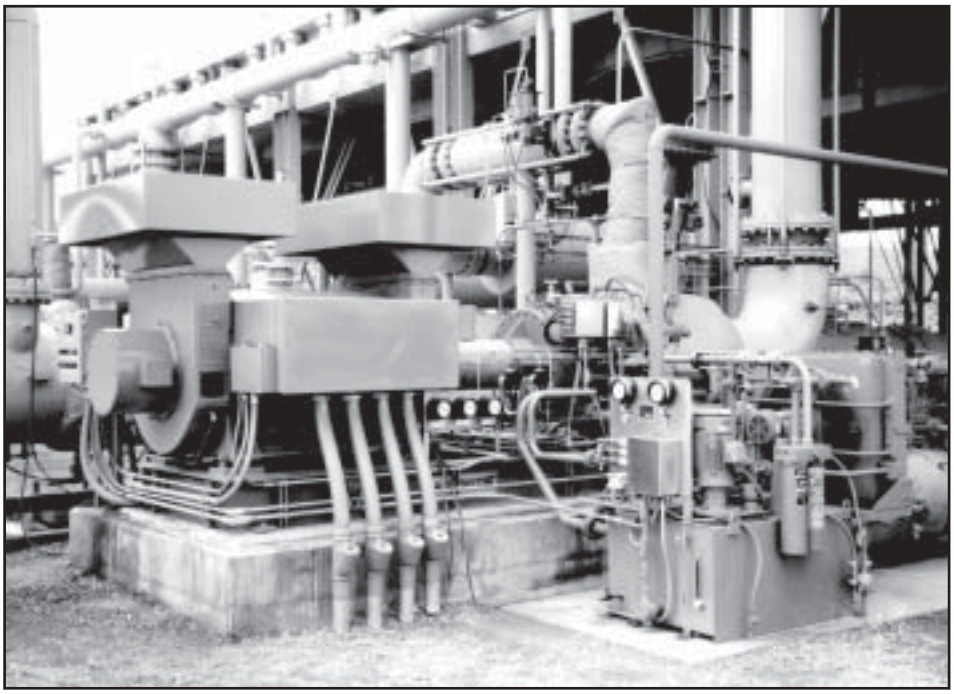
Nevada. The Navy drilled a 6,952 foot well in August of 1993, which had a maximum high temperature reading of 376ºF during a successful flow test. Geothermal fluid is believed to exist below an area of 10 km^2 or more. Current minimum estimated power potential of the Fallon geothermal resource is 30 MW. In 2001, the Navy requested pre-qualification information from interested geothermal developers and circulated a request for proposals from qualified firms. The Navy is proceeding to develop a public/private venture agreement for the purpose of efficiently utilizing the Fallon geothermal resource to produce electricity for the benefit of the Navy and the public. (Bulletin Geothermal Resources Council, July/August 2001, vol. 30, no. 4; and Garside, L.J. and others, *Status of Nevada Geothermal Resource Development - Spring 2002* - GRC Proceedings - in press)

Steamboat Hot Springs - S.B. Geo, Inc.

S.B. Geo, Inc. is developing a 30-MW expansion of its existing power production capacity at **Steamboat Hot Springs**. (Burch, R.C., Nevada Petroleum Society presentation, Feb. 1, 2001)

A new exploration core hole MTH 24-33 (State geothermal well permit #493) was completed during 2001 by S.B. Geo, Inc., as part of a cost share program with the Department of Energy (DOE). This 2000-foot core hole has a recorded temperature of 324ºF and will help to better define the subsurface structure and available geothermal resource. This is a cooperative program in which DOE funded 75% and S.B.Geo, Inc. funded 25% of the drilling cost. This project was developed and funded under the DOE GeoPowering the West Initiative. DOE funding in this cooperative project is projected to be $269,792 over 3 years with a private funding match of $67,448. (Price, W., Geothermal Resources Council Workshop, Reno, NV., April 2002, and Bulletin Geothermal Resources Council, March/April 2001, vol. 30, no. 2 and July/August 2000, vol. 29, no. 4)

Other activities at SB Geo include ongoing development and application of new submersible geothermal production pump technology. Advantages of submersible pumps include increased efficiency and flow rates, no ancillary pumps needed, no down-hole lube string, and reduced visual impact. New designs using advanced technology and materials are extending the expected pump life, reducing pump generated heat which reduces wear on pump components and improves pump efficiency. A new GE rotoflow expansion turbine was put on line as a replacement for a failed turbine on one of the original binary generation units. The new turbine increased unit production efficiency by 18%. Improvements to this unit include a higher efficiency reduction gear assembly, improved monitoring and protection equipment, updated control system, and precise speed control technology. The cost effectiveness, improved performance, and overall success of this turbine upgrade will help justify future similar turbine upgrades to existing older equipment. (Price, W., Geothermal Resources Council Workshop, Reno, NV., April 2002)



New GE rotoflow expansion turbine, center right in photo, installed by S.B. Geo, Inc. at Steamboat Hot Springs. *Photo by R. Hess, 2001.*

The **S.B. Geo Steamboat Hot Springs geothermal power plant** had a gross output of 403,852 MWh and a net production of 299,705 MWh during 2001. (Nevada Division of Minerals, 2002)

Steamboat Hot Springs-Yankee Caithness

Also located in the **Steamboat Hot Springs** KGRA is the **Yankee Caithness Geothermal Power Plant,** which completed work on production well number 24-5 this year. Caithness is actively looking at potential ways to develop more of the existing geothermal resource in the area and increase their long term electrical production. (Geothermal Resources Council Workshop, Reno, Nv., April 2002)

The Caithness plant is a 14.4-MW dual-flash geothermal power plant which operates on 317ºF fluids from three production wells with an average depth of 2,588 feet. Injection is accomplished with one well at a depth of 3,115 feet with a fluid injection temperature of 273ºF. (J. Snow, Nevada Division of Minerals, 2002). During 2001 the **Yankee Caithness Geothermal Power Plant** had a gross output of 96,875 MWh and a net production of 88,000 MWh. (Nevada Division of Minerals, 2002)

For further information on geothermal resources in Nevada check the following Web sites or contact Ron Hess at 775-784-6691 Ext. 121 or via email at rhess@unr.edu:

- Great Basin Center for Geothermal Energy at the University of Nevada, Reno: www.unr.edu/geothermal/index.html,
- Oregon Institute of Technology, Klamath Falls, Oregon, Geo-Heat Center: http://geoheat.oit.edu,
- Geothermal biz.com: http://www.geothermal-biz.com,
- Geothermal information at the Nevada Bureau of Mines and Geology Web site: ftp://ftp.nbmg.unr.edu/pub/geotherm/readme.htm and ftp://ftp.nbmg.unr.edu/pub/web/nvgeowel.txt,
- Nevada Commission on Mineral Resources, Division of Minerals: http://minerals.state.nv.us/programs/ogg.htm,
- Southern Methodist University Geothermal Lab: www.smu.edu/geothermal,
- Geothermal Industry Temperature Profiles from the Great Basin, by John H. Sass, Susan S. Priest, Arnold J. Blanton, Penelope C. Sackett, Stephanie L. Welch, and Mark A. Walters; USGS Open-File Report 99-425 online version 1.0 on the Web at http://wrgis.wr.usgs.gov/open-file/of99-425/webmaps/home.html.

NEVADA GEOTHERMAL POWER PLANTS 2001

Plant name (year on line)	Production capacity[1] (MW)	2001 Production (MWh) Gross	Net (sales)	Location	Operator
Beowawe (1985)	16.7 (16.6)	128,871	105,886	S13,T31N,R47E	Beowawe Power, LLC 9790 Gateway Dr., Suite 220 Reno, NV 89511
Bradys Hot Springs (1992)	21.1 (26.0)	120,768	77,725	S12,T22N,R26E	Brady Power Partners 980 Greg Street Sparks, NV 89431
Desert Peak (1985)	9.9 (11.0)	57,609	48,201	S21,T22N,R27E	Western States Geothermal Co. c/o Brady Power Partners 980 Greg Street Sparks, NV 89431
Dixie Valley (1988)	66.0 (62.0)	512,313	459,699	S7,T24N,R37E S33,T25N,R37E	Caithness Dixie Valley, LLC 9790 Gateway Dr. Suite 220 Reno, NV 89511
Empire (1987)	4.6 (4.8)	37,443	30,690	S21,T29N,R23E	Empire Energy, LLC P.O. Box 40 Empire, NV 89405
Soda Lake No. 1 (1987) and Soda Lake No. 2 (1991)	16.6 (26.1)	96,746	75,633	S33,T20N,R28E	Constellation Operating Services 5500 Soda Lake Road Fallon, NV 89406
Steamboat I, I-A (1986) and Steamboat II, III (1992)	53.0 (58.7)	403,852	299,705	S29,T18N,R20E	S.B. Geo, Inc. P.O. Box 18199 1010 Power Plant Dr. Reno, NV 89511
Stillwater (1989)	13.0 (21.0)	79,287	56,462	S1,T19N,R30E S6,T19N,R31E	Constellation Operating Services 5500 Soda Lake Road Fallon, NV 89406
Wabuska (1984)	1.2 (1.45)	6,114	5,650	S15,16,T15N, R25E	Homestretch Geothermal P.O. Box 1150 Leeds, UT 84746
Yankee Caithness (1988)	14.44 (14.44)	96,875	88,000	S5,6,T17N,R20E	Yankee Caithness J.V.L.P. 9790 Gateway Drive, Suite 220 Reno, NV 89511
TOTAL	216.5 (242.0)	1,539,878	1,247,651		

1. Production capacity from currently developed geothermal resources (equipment capacity in parentheses).
Sources: Plant operators, Nevada Division of Minerals, and NBMG files.

Geothermal Energy

by Ronald H. Hess

MI - 2002 Geothermal Section

During 2002 the Nevada Division of Minerals issued the 500th geothermal well permit since 1983 when the Nevada State Legislature enacted Nevada Revised Statute 534A.060, which required permit approval by the administrator of the Division of Minerals to drill or operate a geothermal well or drill an exploratory well in Nevada. It is estimated that well over 200 assorted geothermal gradient, test, and development wells were drilled in Nevada prior to the establishment of permitting requirements. The Nevada Division of Minerals is the State agency that regulates geothermal well permitting, drilling operations, field development, and field production operations. The Web address for the Nevada Division of Minerals is *http://minerals.state.nv.us/index.htm*.

The Nevada Division of Minerals issued 14 geothermal well permits during 2002: one project area permit, four industrial production wells, two domestic wells, and seven gradient/observation wells (Nevada Division of Minerals, 2003).

During 2002 there were 157 federal geothermal leases covering 211,300 acres in Nevada. The Bureau of Land Management (BLM) has received 188 applications for geothermal leases through its noncompetitive process for geothermal projects over the last two years. Of these, 123 are pending. The BLM expects to lease 400,000 acres for potential geothermal development. (Geothermal-biz.com Newsletter, October 2002, Issue no. 3)

Lease activity during the year included the issuance of 84 noncompetitive leases for 135,543 acres and 17 competitive leases for 32,454 acres. The competitive lease sale generated $311,160 in bonus bid revenue for 2002. Total lease rental revenue value for 2002 was $244,600. (R. Hoops, BLM, oral commun., 2003)

Total gross electrical production during 2002 from geothermal resources on public lands was 1.1 million megawatt-hours (MWh), an increase of 80,000 MWh over 2001; net production was approximately 979,500 MWh, an increase of 104,500 MWh over 2001. Gross electrical sales from federal lands were $49.2 million. Production royalties on that amount equaled $1.7 million. This represents a drop of $11.9 million in gross sales and a $640,000 drop in production royalties from 2001.

Gross sales value over the past two years has dropped significantly. This is primarily due to a drop in purchase price at plants that have long-term contracts that were heavily front-end loaded and guaranteed a high per-kilowatt purchase price over the first 10 years of the contract life and are now entering the second phase of the contract period at a reduced purchase price. (R. Hoops, BLM, oral commun., 2003)

By regulation, half of all Federal geothermal lease rental fees and production royalties are returned to the state. For 2002, $850,000 in royalty production fees $155,580 in bonus bid fees, and $122,300 in lease rental revenue should be returned to Nevada. (R. Hoops and J. Lewis, BLM, oral commun., 2003)

Total Nevada geothermal electrical production, in 2002, from both federal and fee lands combined was 1,602,100 MWh gross and net production was 1,250,887 MWh (Nevada Division of Minerals, 2003) with an approximate sales value of $64 million. Production

NONDOMESTIC GEOTHERMAL WELLS REPORTED AS DRILLED OR COMPLETED IN NEVADA 2002

Area	Company	Well name	Permit#	Location	Type
Churchill County					
Soda Lake	AMOR IX Corporation	Soda Lake 22-33	499	NW¼ SE¼, S33, T20N, R28E	Production
Stillwater	Stillwater Holdings LLC	Commercial Production Well SF 62A-30	495	NW¼ NE¼, S30, T20N, R31E	Production
Stillwater	Stillwater Holdings LLC	Industrial Production Well 53-30	501	SW¼ NE¼, S30, T20N, R31E	Production
Stillwater	Stillwater Holdings LLC	Industrial Production Well 45-30	503	NE¼ SW¼, S30, T20N, R31E	Production
Stillwater	Stillwater Holdings LLC	Thermal Gradient Hole 23-29	504	SW¼ NW¼, S29, T20N, R31E	Gradient
Stillwater	Stillwater Holdings LLC	Thermal Gradient Hole 44-20	505	NE¼ SW¼, S20, T20N, R31E	Gradient
Stillwater	Stillwater Holdings LLC	Observation Well 31-30	506	NE¼ NW¼, S30, T20N, R31E	Observation
Stillwater	Stillwater Holdings LLC	Observation Well SH 1-72-31	508	NE¼ NE¼, S31, T20N, R31E	Observation
Humboldt County					
Blue Mountain	Noramax Corporation	Deep Blue No. 1	500	SE¼ SW¼, S14, T36N, R34E	Observation
Washoe County					
Steamboat Hot Springs	SB Geo Inc.	Observation Well MTH 24-33	493	SW¼ NW¼, S33, T18N, R20E	Observation

capacity from the currently developed geothermal resources at ten existing geothermal power production sites in Nevada is 221.5 megawatts (MW); currently installed equipment, or nameplate, capacity for the same sites total 244.3 MW. The table of Nevada geothermal power plants lists operators, plant locations, and energy production for individual Nevada geothermal power producers. Nevada is second only to California in total installed geothermal generating capacity.

Nevada State Legislature

The 2001 State Legislature passed Senate Bill (SB) 372, which included requirements for Nevada's Renewable Energy Portfolio Standard. It requires, based on an escalating scale over time starting at 5% in 2005 and increasing to 15% by 2015, that a certain percentage of electricity sold to customers in Nevada be generated from renewable resources. This bill represents a significant move forward in requiring utilities to obtain and distribute electricity generated from renewable resources. According to Geothermal-biz.com Newsletter, October 2002, Issue No. 3, "Nevada will be the third-largest producer of green power in the country by 2012, ranking behind only the larger states of California and Texas, an updated study by the Union of Concerned Scientists (UCS) shows."

The complete text of SB 372 can be viewed at *www.leg.state.nv.us/71st/Reports/history.cfm?ID=4214*.

In response to this requirement, four new geothermal power production contracts with Nevada Power Co. were approved by the Public Utilities Commission of Nevada. The four new power plants should be online by the middle of 2005 and receive 4.2 to 5.2 cents per kilowatt-hour over the next 20 years. The projects to be built include:

Desert Peak 2 (25 MW) and **Desert Peak 3** (13 MW) in Churchill County.
Hot Sulphur Springs (25 MW) in Elko County.
Steamboat IV (44 MW) in Washoe County.

It is estimated that the projects will employ about 500 people during construction and employ about 65 people on a permanent basis when complete (Bulletin Geothermal Resources Council, March/April 2003, v. 32, no. 2).

Redfield Campus

The University of Nevada, Reno (UNR) and Advanced Thermal Systems, Inc. (ATS) have signed a 30-year agreement to provide geothermal power and heat to the new UNR Redfield Campus located just southwest of Reno. ATS has committed to construct and operate an 11-MW Kalina Cycle geothermal power plant near the new campus to provide electricity for the campus with excess production to be sold to Sierra Pacific Power Co. The Kalina Cycle process utilizes an ammonia-water mix as a working fluid that is vaporized in a heat exchanger by geothermal fluids and then used to power turbine generators in the power plant. ATS will also provide hot and cold water to support a hydroponics and aquaculture research program.

When complete, the Redfield Campus will be the only college campus in the world to be completely powered by renewable energy resources. ATS has also agreed to construct a modern 800-square-foot classroom as part of the project. As part of the agreement, campus energy costs will be set at $210,000 per year and increases will be limited to 1% annually. In ten years UNR will have an option to purchase the project. (Bulletin Geothermal Resources Council, March/April 2003, vol. 32, no. 2; and the Nevada Geothermal Update, Nevada Division of Minerals, March 2003).

Blue Mountain Geothermal Area

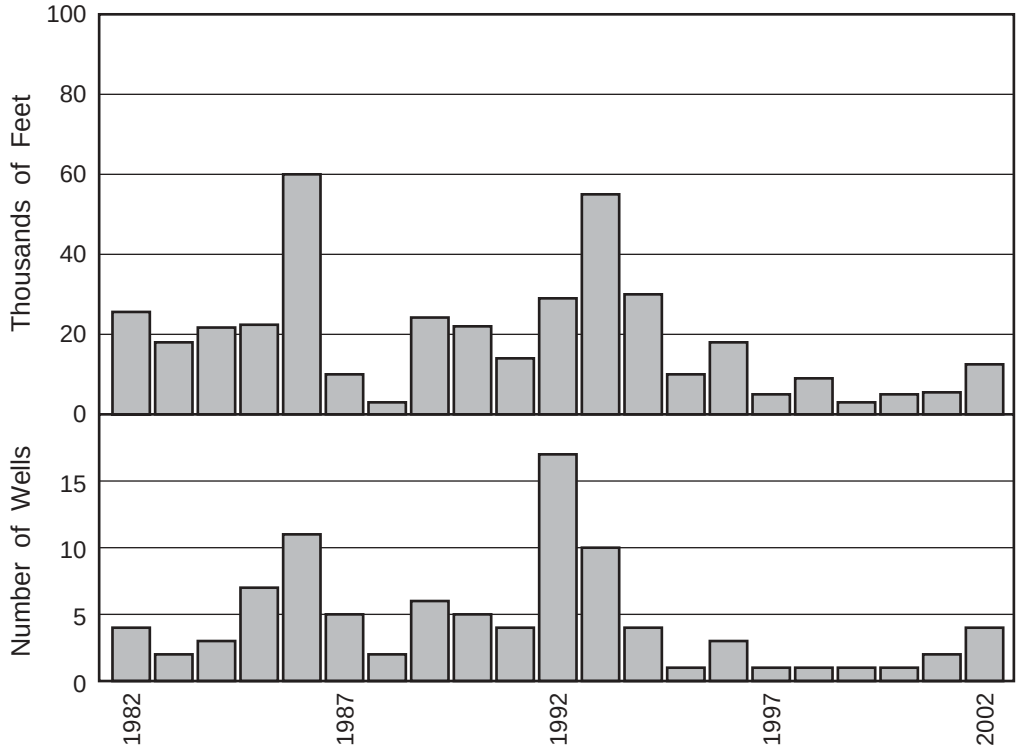
Noramex Corp. applied for and received a drilling permit for the Observation Well Deep Blue No. 1, permit number 500. The Blue Mountain Geothermal area is located at T36N, R34E in south-central Humboldt County. According to a press report this well reached 672 meters (2,200 feet0 in depth and had a recorded temperature of 146ºC. (Nevada Geothermal Update, Nevada Division of Minerals, March 2003)

The Blue Mountain area was originally explored for gold potential. During exploratory drilling they noted high temperatures when pulling the drill steel. Because of this near surface temperature anomaly the property was explored for geothermal potential in the late 1990s to present. **Nevada Geothermal Power Inc.** has reported that it believes the property has a potential resource capable of producing 100 MW. (Nevada Geothermal Power Inc. Web Informational Flyer, 2003, *www.continentalridge.com/blue-mountain-geothermal.htm*).

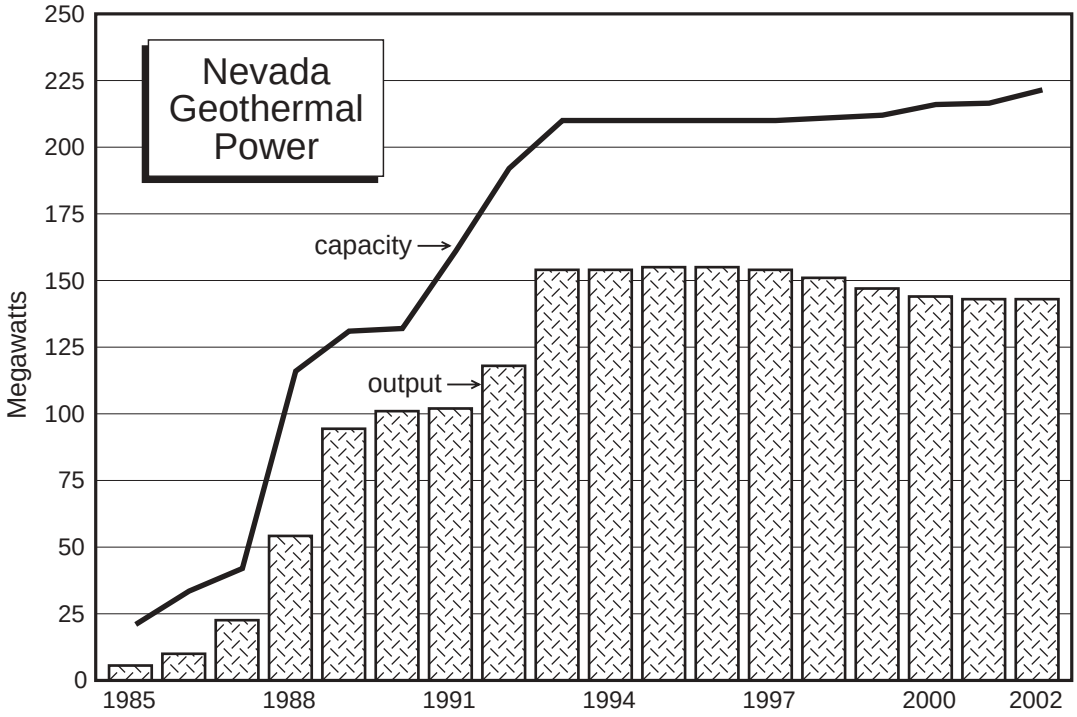
Bradys Hot Springs

Brady Power Partners installed a new 5-MW Binary Ormat Energy Converter during 2002. This unit has two turbines that turn one generator. The unit uses leftover brine from the production cycle of the existing Dual Flash plant. Prior to the installation of the binary system, spent brine was injected back into the ground at 225ºF. Current average injection temperature after cycling the brine through the binary system is 178ºF. Production well head temperatures range from 287ºF at the wells north of the plant to 340ºF for one of the southern wells located on the west side of Interstate 80. The inlet fluid temperature of the flash plant is 308ºF. (C.L. Morris, oral commun., 2003, Brady Power Partners; and Nevada Division of Minerals, 2003)

In addition to the new 5-MW binary unit the original Brady dual-flash geothermal plant is rated at 21.1 MW. Current production is from five production wells during the summer and four during the winter with an average



Industrial-class (power-generation) wells drilled in Nevada, 1982–2002. Depth taken from original drilling permit.



Currently developed resource capacity and average net output of Nevada geothermal plants, 1985–2002. Average net output is annual sales in megawatt-hours divided by the number of hours in a year (8,760). No commercial geothermal power was produced in Nevada before 1985.

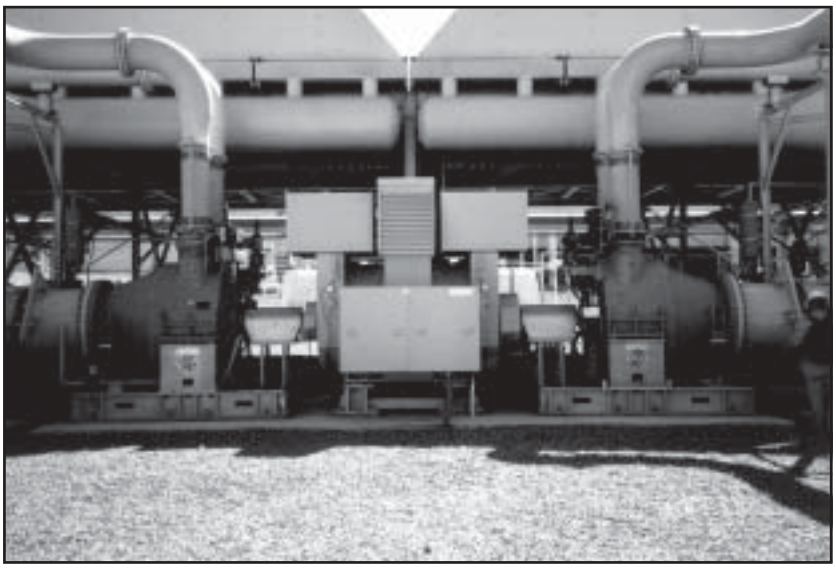
depth of 3,057 feet. During 2002, Brady Hot Springs Geothermal Power Plant produced 198,100 MWh gross and 113,632 MWh net. The Brady plant also supplies geothermal fluid to the Brady Hot Springs onion dehydration plant operated by **Gilroy Foods**, a subsidiary of **U.S.F.I.** (Nevada Division of Minerals, 2003)

Desert Peak

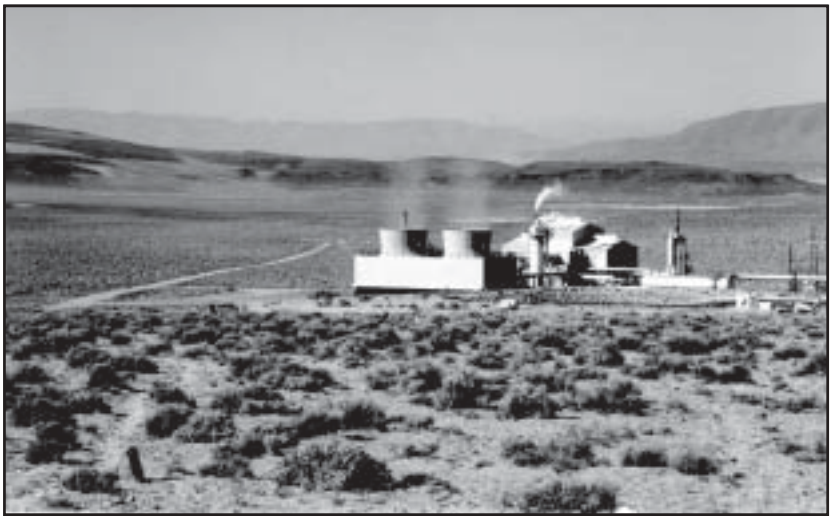
Brady Power Partners has received the Public Utilities Commission approval on two new geothermal power production contracts with Nevada Power Co. This will allow for the development and construction of **Desert Peak 2** (25 MW) and **Desert Peak 3** (13 MW) power plants. These plants should go online in 2005.

Ormat has been selected by the Department of Energy, under the Enhanced Geothermal Systems program, to develop and demonstrate a resource enhancement project at Desert Peak. The project is designed to fracture a low permeability zone in an effort to produce an additional 2-5 MW of resource at the existing plant. (Geothermal-biz.com Newsletter, October 2002, Issue No. 3)

The Desert Peak 9.9-MW dual-flash geothermal plant produces from two production wells with an average depth of 3,683 feet and fluid temperature of 312ºF. Desert Peak has two injection wells with an average depth of 4,000 feet and injection temperature of 225ºF. During September 2002 the average gross plant output was 7 MW. During 2002 the Desert Peak Power Plant produced 58,094 MWh gross and 47,456 MWh net. (Nevada Division of Minerals, 2003)



Brady Power Plant new 5-MW binary generation unit showing the generator in center and 2 turbine power units, one on each side of the generator. ***Photo by R. Hess, 2002.***



Desert Peak Power Plant. ***Photo by R. Hess, 2002.***

Hot Sulphur Springs

Earth Power Resources, Inc., has received a power purchase agreement from Nevada Power Co. and will build a 25-MW binary geothermal plant at Hot Sulphur Springs geothermal area in Elko County. It is anticipated that the plant will come online sometime in 2005. (Nevada Power news release, November 26, 2002 and Nevada Division of Minerals, 2003)

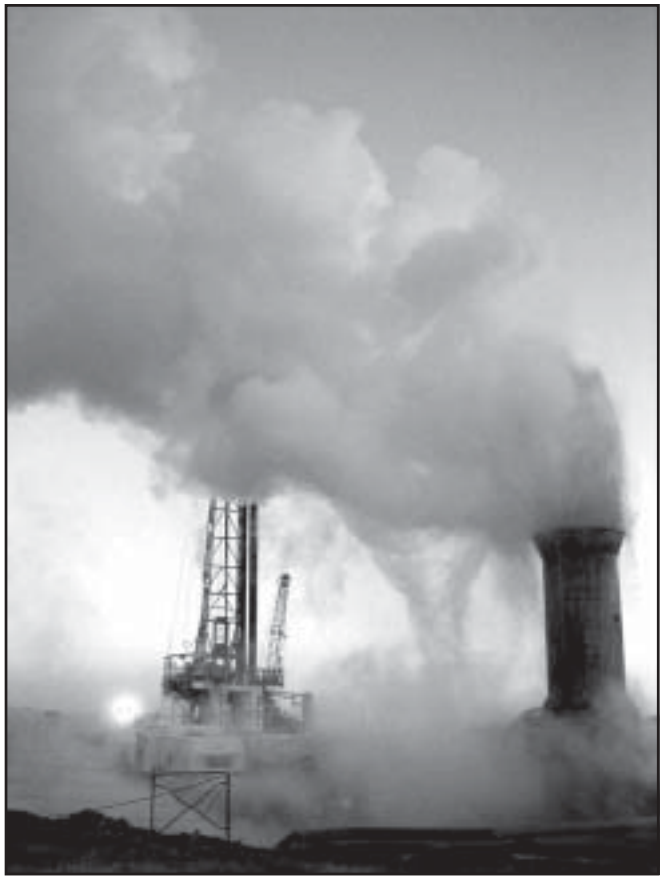
F.E. Berkman (The Tuscarora, Nevada Geothermal Prospect, a case history, November 17, 1980, NBMG geothermal files) identified the geothermal area as located on the west side of the Independence Mountains at the north end of the Independence Valley graben. The geothermal area includes "6 springs, one geyser and one fumerole. These occur in a narrow zone approximately 3 km long within the Midas fault zone. Waters from the hot springs were analyzed and subsurface temperatures of 228°C and 167°C were indicated by the Na-K-Ca and silica geothermometers."

In an AMAX Exploration, Inc., Tuscarora Area, Nevada, Final Report, (August 1981, NBMG files), H.D. Pilkington reported that a test discovery well, with a total depth of 5,454 feet, encountered a low-temperature reservoir. There was some difficulty in completing the well due to some lost circulation zones. Drilling on the well had to be stopped short of target and before a high temperature reservoir was discovered. The well was flow tested at approximately 1,200 barrels per hour with temperatures ranging from 156° to 225°F.

Rye Patch

During 1995 Rye Patch Limited Partnership (OESI) terminated work on the 95% complete 12.5-MW binary power plant at Rye Patch. At the time they were only able to identify a 6-MW proven resource. Due to funding constraints and reservoir engineering problems Sierra Pacific cancelled the projects power purchase agreement and the project went into default. (Geothermal Resources Council Bulletin, May 1995, vol. 24, no. 5 and NBMG Special Publication MI-1995)

Mount Wheeler Power Co. took over development from Rye Patch Energy Co. The Mount Wheeler Power Co. successfully completed the Rye Patch 72-28 production well during 2001. This well is part of an effort to better define the production field and secure adequate geothermal fluid so that the nearly complete Rye Patch geothermal power plant can be brought online. During a short-term flow test this well produced 297°F fluid at a rate of 3,600 gallons per minute from a production zone 1,900 feet below ground surface. Other wells drilled earlier in the area, such as the 44-28, had a recorded down-hole flowing temperature of 400°F and the E-1 well had the highest static bottom-hole temperature of 353°F at 1,835 feet. It is anticipated that one or two more wells will be drilled. (Bill Ehni, personal commun., 2003)



Mount Wheeler Power's Rye Patch 72-28 well during a 6 hour rig test on May 26, 2001. ***Photo by Wm.J. Ehni, A. Bailey, and R. Ewel.***

Steamboat Hot Springs - S.B. Geo

Advanced Thermal Systems has received a 44-MW power purchase contract from Sierra Pacific/Nevada Power. Steamboat IV, a 44-MW Kalina Cycle binary power plant, will be constructed and should be online in 2005. The Kalina Cycle process uses a closed system with an ammonia-water working fluid that is heated in a heat exchanger by the heat contained in the geothermal production fluid. The heated ammonia-water working fluid, when vaporized, is used to turn turbines that power the generators. This system, besides being very efficient, can also be adapted to different resource temperatures by simply changing the percentage of the ammonia-water mix.

The SB Geo Steamboat Hot Springs Geothermal Power Plants, during 2002, had a gross output of 387,015 MWh and a net production of 285,256 MWh (Nevada Division of Minerals, 2003).

Steamboat Hot Springs - Yankee Caithness

Also located in the Steamboat Hot Springs KGRA is the Yankee Caithness Geothermal Power Plant. The Caithness plant is a 14.4-MW dual-flash geothermal power plant that operates on 317°F fluids from three production wells with an average depth of 2,588 feet. Injection is accomplished with one well at a depth of 3,115 feet with a fluid injection temperature of 273°F. During 2002 the Yankee Caithness Geothermal Power Plant had a gross output of 89,456 MWh and a net production of 81,200 MWh. (Geothermal Resources Council Workshop, Reno, NV, April 2002; and Nevada Division of Minerals, 2003)

Stillwater

Stillwater Holdings, LLC of Westport Connecticut , applied for and received a geothermal project area permit, #502PA, for their planned drilling program at Stillwater. The project area plan includes development of eight production wells, one injection well, and two observation wells in Section 30, T20N, R31E, three injection wells and one observation well in Section 29, T20N, R31E; and one observation well in Section 20, T20N, R31E. All wells have an estimated total depth of 2,500 feet. During 2002 Stillwater Holdings, LLC spudded and/or completed three production wells and four gradient/observation wells. Two of the production wells predated the project area permit.

Production during 2002 at the existing Stillwater power plant was 78,040 MWh gross output and 50,580 MWh net production with an average production fluid temperature of 293°F. (Nevada Division of Minerals, 2003)

New Nevada Geothermal Map

The Nevada Bureau of Mines and Geology has released a new 1:750,000-scale color map showing geothermal resources in Nevada. The map entitled “Nevada geothermal resources,” NBMG Map 141, is authored by Lisa Shevenell and Larry J. Garside. The map shows active direct-use applications and power plants as of May 2003, and all known thermal springs and wells on a topographic base map. This map may be purchased at the Nevada Bureau of Mines and Geology publications office or on the Web at *www.nbmg.unr.edu/sales.htm*

For further information on geothermal resources in Nevada check the following Web sites or contact Ron Hess at 775-784-6691 ext. 121 or via e-mail at *rhess@unr.edu*:

- Geothermal information at the Nevada Bureau of Mines and Geology Web site *www.nbmg.unr.edu/geothermal/*
- Nevada Commission on Minerals, Nevada Division of Minerals at *http://minerals.state.nv.us/* or *http://minerals.state.nv.us/programs/ogg.htm*
- Great Basin Center for Geothermal Energy at *www.unr.edu/geothermal/index.html*
- GEO-HEAT CENTER, at *http://geoheat.oit.edu/*, Oregon Institute of Technology, Klamath Falls, Oregon.
- Geothermal biz.com *www.geothermal-biz.com/* is part of the U.S. Department of Energy-led GeoPowering the West (GPW) initiative to dramatically increase the use of geothermal energy in the western United States, Alaska, and Hawaii.
- GeoPowering the West at *www.eere.energy.gov/geopoweringthewest/*
- Southern Methodist University Geothermal Lab at page *www.smu.edu/geothermal/*
- Geothermal Industry Temperature Profiles from the Great Basin, by John H. Sass, Susan S. Priest, Arnold J. Blanton, Penelope C. Sackett, Stephanie L. Welch, and Mark A. Walters; USGS Open-File Report 99-425 online version 1.0 on the Web at *http://wrgis.wr.usgs.gov/open-file/of99-425/webmaps/home.html*
- Nevada Public Utilities Commission *www.puc.state.nv.us/*
- Nevada State Office, Bureau of Land Management, Nevada Geothermal Program *www.nv.blm.gov/minerals/geothermal/index.htm*

NEVADA GEOTHERMAL POWER PLANTS 2002

Plant name (year on line)	Production capacity[1] (MW)	2002 Production (MWh) Gross	Net (sales)	Location	Operator
Beowawe (1985)	16.7 (16.6)	115,123	93,569	S13,T31N,R47E	Beowawe Power, LLC 9790 Gateway Dr., Suite 220 Reno, NV 89511
Bradys Hot Springs (1992)	26.1 (26.1)	198,100	113,632	S12,T22N,R26E	Brady Power Partners 980 Greg Street Sparks, NV 89431
Desert Peak (1985)	9.9 (12.5)	58,094	47,456	S21,T22N,R27E	Western States Geothermal Co. c/o Brady Power Partners 980 Greg Street Sparks, NV 89431
Dixie Valley (1988)	66.0 (62.0)	527,457	471,646	S7,T24N,R37E S33,T25N,R37E	Caithness Dixie Valley, LLC 9790 Gateway Dr. Suite 220 Reno, NV 89511
Empire (1987)	4.6 (4.8)	30,977	25,321	S21,T29N,R23E	Empire Energy, LLC P.O. Box 40 Empire, NV 89405
Soda Lake No. 1 (1987) and Soda Lake No. 2 (1991)	16.6 (26.1)	110,109	76,924	S33,T20N,R28E	Constellation Operating Services 5500 Soda Lake Road Fallon, NV 89406
Steamboat I, I-A (1986) and Steamboat II, III (1992)	53.0 (58.6)	387,015	285,256	S29,T18N,R20E	S.B. Geo, Inc. P.O. Box 18199 1010 Power Plant Dr. Reno, NV 89511
Stillwater (1989)	13.0 (21.0)	78,040	50,580	S1,T19N,R30E S6,T19N,R31E	Stillwater Holdings, Geothermal Management Services LLC 4785 Lawrence Lane Stillwater, NV 89406
Wabuska (1984)	1.2 (2.2)	7,729	5,303	S15,16,T15N, R25E	Homestretch Geothermal P.O. Box 1150 Leeds, UT 84746
Yankee Caithness (1988)	14.44 (14.44)	89,456	81,200	S5,6,T17N,R20E	Yankee Caithness J.V.L.P. 9790 Gateway Drive, Suite 220 Reno, NV 89511
TOTAL	221.5 (244.3)	1,602,100	1,250,887		

1. Production capacity from currently developed geothermal resources (equipment capacity in parentheses).
Sources: Plant operators, Nevada Division of Minerals, and NBMG files.

Geothermal Energy

by Ronald H. Hess

MI - 2003 Geothermal Section

Twenty-seven geothermal well permits were issued during 2003 by the Nevada Division of Minerals: two project area permits, six industrial production wells, one industrial injection well, two domestic wells, and sixteen gradient/observation wells. (Nevada Division of Minerals, 2004)

During 2003 there were 195 federal noncompetitive leases covering 295,800 acres and 72 federal competitive leases covering 90,400 acres in Nevada. Total lease rental revenue value for 2003 was $288,600. (R. Hoops, BLM, oral commun., 2004)

Total gross electrical production during 2003 from geothermal resources on public lands was 1.12 million megawatt-hours (MWh), an increase of 20,000 MWh over 2002; net production was approximately 938,500 MWh, a decrease of 41,000 MWh from 2002. Gross electrical sales from federal lands were $52.4 million, an increase of $3.2 million over 2002. Production royalties on that amount equaled $1.8 million. By regulation, half of all Federal geothermal lease rental fees and production royalties are returned to the state. For 2003, $144,300 in lease rental fees and $900,000 in royalty production fees should be returned to Nevada (R. Hoops, BLM, oral commun., 2004) .

Total Nevada geothermal electrical production in 2003 from both federal and fee lands combined was 1,637,028 MWh gross and net production was 1,175,560 MWh (Nevada Division of Minerals, 2004) with an approximate sales value of $65 million. Production capacity from the currently developed geothermal resources at ten existing geothermal power production sites in Nevada is 221.5 megawatts (MW); currently installed equipment, or nameplate, capacity for the same sites total 244.3 MW. The table of Nevada geothermal power plants lists operators, plant locations, and energy production for individual Nevada geothermal power producers. Nevada is second only to California in total installed geothermal generating capacity.

The 2001 State Legislature passed Senate Bill (SB) 372, which included requirements for Nevada's Renewable Energy Portfolio Standard. It requires, based on an escalating scale over time starting at 5% in 2005 and increasing to 15% by 2015, that a certain percentage of electricity sold to customers in Nevada be generated from renewable resources, including geothermal energy. This bill represents a significant move forward in requiring utilities to obtain and distribute electricity generated from renewable resources.

In response to this requirement, four new geothermal power production contracts with Nevada Power Co. were approved by the Public Utilities Commission of Nevada. These plants should be on line by the middle of 2005 and receive 4.2 to 5.2 cents per kilowatt-hour over the next 20 years. The projects to be built are Desert Peak 2 (25 MW) and Desert Peak 3 (13 MW) in Churchill County, Hot Sulphur Springs (25 MW) in Elko County, and Steamboat IV (44 MW) in Washoe County.

NONDOMESTIC GEOTHERMAL WELLS REPORTED AS DRILLED OR COMPLETED IN NEVADA DURING 2003

Area	Company	Well name	Permit#	Location	Type
Churchill County					
Desert Peak	Ormat Nevada, Inc.	Thermal Gradient ST 11 (c)	517	NE¼ SW¼, S15, T22N, R27E	Gradient
Desert Peak	Ormat Nevada, Inc.	Thermal Gradient ST 12 (a)	518	SE¼ NW¼, S21, T22N, R27E	Gradient
Desert Peak	Ormat Nevada, Inc.	Industrial Production Well 43-21	521	SE¼ NW¼, S21, T22N, R27E	Production
Desert Peak	Ormat Nevada, Inc.	Industrial Production Well 27-15	529	SW¼ SW¼, S15, T22N, R27E	Production
Desert Peak	Ormat Nevada, Inc.	Industrial Production Well 74-21	536	SE¼ NE¼, S21, T22N, R27E	Production
Elko County					
Hot Sulphur Springs	Earth Power Resources	Industrial Production Well 46-8 (57-8)	527	SW¼ SW¼, S8, T41N, R52E	Production
Hot Sulphur Springs	Earth Power Resources	Observation Well 67-8 (65-8)	528	NE¼ SE¼, S8, T41N, R52E	Observation
Washoe County					
Rye Patch	Presco Energy LLC	Thermal Gradient P 3-1	511	NE¼ NW¼, S3, T31N, R33E	Gradient
Rye Patch	Presco Energy LLC	Thermal Gradient P 10-1	513	SW¼ NE¼, S10, T31N, R33E	Gradient
Rye Patch	Presco Energy LLC	Thermal Gradient P 32-2	515	NE¼ SW¼, S32, T32N, R33E	Gradient
Washoe County					
Fly Ranch	SB Geo, Inc.	Thermal Gradient 11-12-TG	520	NW¼ NW¼, S12, T34N, R23E	Gradient
Steamboat Hot Springs	Yankee Caithness JV	Industrial Production Well 21B-5	525	NW¼ NW¼, S5, T17N, R20E	Observation
Steamboat Hot Springs	Yankee Caithness JV	Industrial Injection Well 64-32	530	SW¼ NE¼, S32, T18N, R20E	Injection

The Nevada Renewable Energy and Energy Conservation Task Force released a report estimating that full and continued implementation of the Nevada Renewable Portfolio Standard could add nearly $21.5 billion in gross State product by 2035 and over the same period add nearly 5,500 jobs related to the economic impacts of renewable energy (geothermal, wind, and solar) (Bulletin Geothermal Resources Council, May/June 2003, v. 32, no. 3).

Nevada Bureau of Mines and Geology Geothermal Website

A new Geothermal Resources of Nevada website (www.nbmg.unr.edu/geothermal/gthome.htm) has been launched by the Nevada Bureau of Mines and Geology (NBMG) and the Great Basin Center for Geothermal Energy with partial financial assistance from the 2001 DOE State Energy Program. It is an online update to "Thermal Waters of Nevada" by Larry Garside and John Schilling, published by NBMG in 1979. The website provides updated geochemical data and maps for geothermal resources in the state. The Web interface uses an interactive map to locate data about various thermal resources in Nevada.

GPS and Crustal Strain Measurements May Target New Geothermal Resources

Geoffrey Blewitt, NBMG geophysicist, reported the first assessment of data quality from a 30-station semi-continuous GPS network, installed to determine millimeter-level strain changes in the Earth's crust that might be used to target new geothermal resources. This network has been under construction for the first half of the fiscal year and came on line in late January 2004. Initial results from the first 60 days of operation show that station positions estimated every 24 hours repeat to within 1 to 2 mm in longitude and latitude. The goal is to resolve station motions to less than one millimeter per year, and then use 2–3 years of data to create a strain tensor map to identify areas undergoing active transtensional tectonics. Initial results show that the network is meeting the required level of data precision.

Blue Mountain Geothermal Area

Noramex Corp., a wholly owned subsidiary of Nevada Geothermal Power, Inc. (NGP), completed the observation well Deep Blue No. 1 (DB 1, permit number 500) to 2,205 feet. This well recorded temperatures of 145°C at 2,115 feet and a zone of 1,200 feet of high permeability rock in the highest temperature portion of the well. In April of 2004, a step-out well, Deep Blue No. 2 (DB 2), was spudded approximately 1 kilometer away from DB 1. The purpose of DB 2 is to test a series of northeast-trending young faults that appear to be related to the geothermal resource in this area and to better define and delineate the overall thermal anomaly. As of May 2004 it was reported that DB 2 had been drilled to a depth of 1,028 meters and had a maximum recorded temperature of 165°C (Bulletin Geothermal Resources Council, May/June 2004, v. 33, no. 3).

An excerpt from a Nevada Geothermal Power Inc., May 6, 2004, press release about DB 2 states "The maximum temperature measured in the well was 167°C (330°F) at 585 meters (1,920 feet) depth. A potential geothermal production zone between 515 and 760 meters (1690–2493 feet) is characterized by greater than 150°C (300°F) temperatures measured after 6 hours static time, multiple crystal-lined, open fractures and vuggy quartz veins."

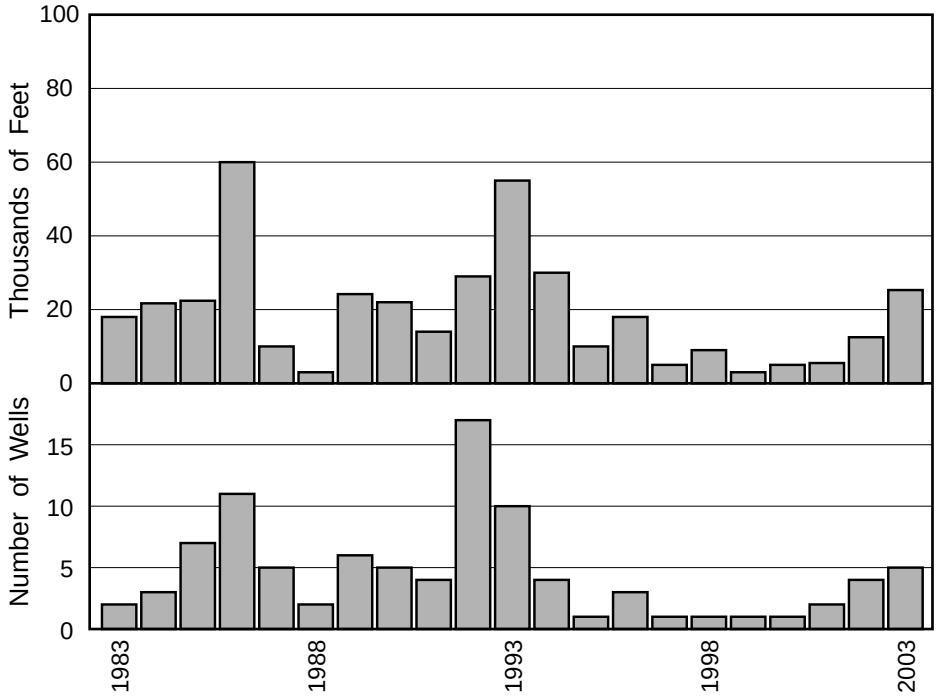
The U.S. Department of Energy (DOE) under the Geothermal Resource Exploration and Definition II (GRED II) program awarded Noramex Corp. a grant of $659,000, with Noramex to provide $164,000 in cost share, to assist in the DB 2 drilling project. Preliminary results from earlier exploration data and the above drilling indicate that a 30-megawatt (MW) geothermal power plant is feasible at Blue Mountain and with continued resource exploration and development the area may be able to produce upwards of 100 MW (Bulletin Geothermal Resources Council, May/June 2004, v. 33, no. 3).

Noramex Corp. applied to the Nevada Division of Minerals for and received an additional 15 geothermal well drilling permits for a series of 500-foot thermal gradient test wells in the Blue Mountain area (State permit numbers 545 through 559).

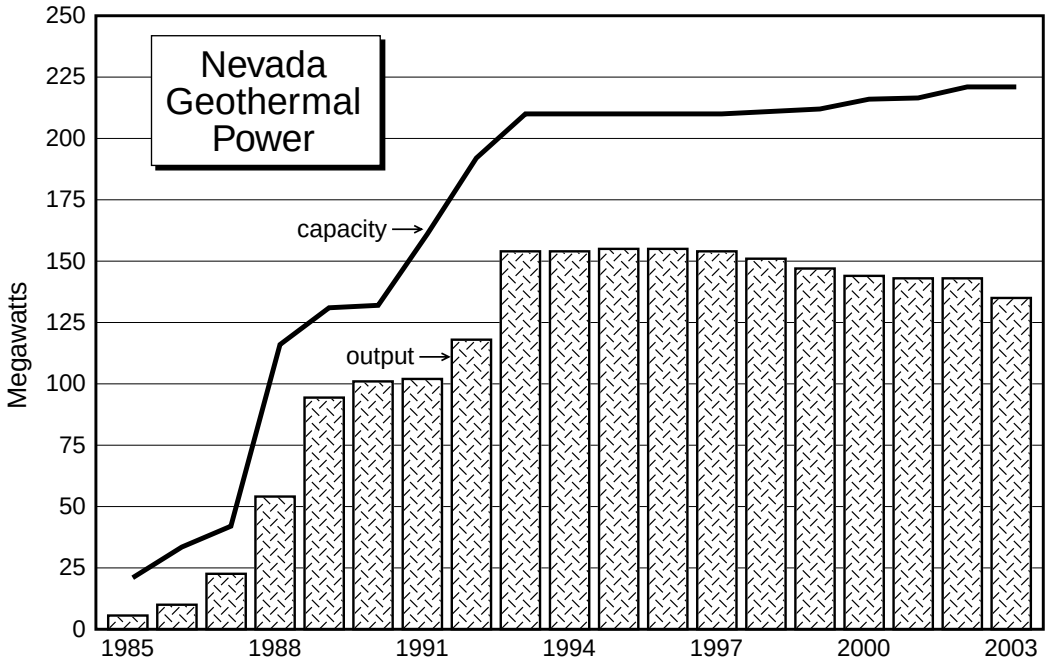
The Blue Mountain area, located at T36N, R34E in south-central Humboldt County, was originally explored for gold potential. During exploratory drilling they noted high temperatures when pulling the drill steel. Because of this near surface temperature anomaly, the property was explored for geothermal potential from the late 1990s to present. Nevada Geothermal Power, Inc., holds the geothermal leases to 7,680 acres and has reported that it believes the property to have a potential resource capable of producing 100 MW. (Nevada Geothermal Power Inc. Web Informational Flyer, 2003, (*www.continentalridge.com/blue-mountain-geothermal.htm*)

Hot Springs (Tipton) Ranch - Pumpernickel Valley

Noramex Corp., a wholly owned subsidiary of Nevada Geothermal Power, Inc. (NGP) has undertaken a geothermal development project in Pumpernickel Valley, Humboldt County, at the Hot Springs - Tipton Ranch geothermal area. They have acquired the leases for and surrounding an area where near boiling hot springs occur. Based on chemistry, NGP believes that at depth the temperature of the source fluids for a series of hot springs that occur along a one-mile section of a fault running through the geothermal area could be as high as 170°C (340°F). (Nevada Geothermal Power Inc., Pumpernickel



Industrial-class (power-generation) wells drilled in Nevada, 1982–2003. Depth taken from original drilling permit.



Currently developed resource capacity and average net output of Nevada geothermal plants, 1985–2003. Average net output is annual sales in megawatt-hours divided by the number of hours in a year (8,760). No commercial geothermal power was produced in Nevada before 1985.

Geothermal Project Development Program Outlined, May 6, 2004, press release)

An excerpt from Geothermal Resources of Nevada as updated on the web at *www.nbmg.unr.edu/geothermal/site.php?sid=Hot Springs (Tipton) Ranch* on the Hot Springs Tipton Ranch or Pumpernickel Valley (as updated 2003) reads:

> Hot springs at Tipton Ranch in Secs. 4, 5, T33N, R40E have reported temperatures as high as 85°C (Mariner and others, 1974), although one spring with a temperature of 87°C was sampled in September 2002. There are numerous springs and seeps, some discharging gas, along a N20°E fault that forms the boundary of the Sonoma Range in that area. The spring deposits are predominantly travertine with a trace of siliceous sinter. Most springs are relatively low flow, but the combined discharge from the area likely exceeds 400 L/min. The "best" estimates of the thermal-aquifer temperature are 194–196°C (Mariner and others, 1974), whereas the Na-K-Ca estimate based on 2002 samples is slightly lower at 175 to 192°C. Wollenberg (1974b) reported that slightly anomalous radioactivity (up to 22.5 μR/hr) is present at the springs. In 1974 Magma Power Co. drilled a geothermal well at Tipton Ranch to a total depth of 919.6 m (3,071 feet). Bottom-hole temperature was logged at 135°C after 10 hours of circulation, with the last 91 m having a gradient of 0.16°C/m (6.5°F/100 feet; Skip Matlick, personal comm.). In September 2002, the well was flowing at the surface through a leak in the casing and water was depositing travertine over the well head and surrounding area. Wellhead temperature was 95°C. The well has also previously been called the "Pumpernickel Valley well."

Fly Ranch

The U.S. Department of Energy (DOE) under the Geothermal Resource Exploration and Definition II (GRED II) program awarded **Advanced Thermal Systems, Inc.** a grant to perform geophysical testing to site and then drill a well to test the resource at **Fly Ranch Hot Springs** in Northern Washoe County (Bulletin Geothermal Resources Council, January/February 2003, v. 33, no. 1).

Rye Patch (Humboldt House) - Florida Canyon Geothermal System

The UNR-Great Basin Center for Geothermal Energy, in partnership with PRESCO Energy LLC and Apollo Gold Inc./Florida Canyon Mining Inc., has received $499,997 for the "Exploratory Drilling Program to Evaluate the Lifetime and Current Potential of the Florida Canyon Geothermal System, Pershing County Nevada." The program's objectives are to develop new methods of evaluating the lifetime and resource potential of geothermal systems in general, and to develop the geothermal resources within the Humboldt House Geothermal Area (HHGA), which may be the single largest geothermal production field in Nevada. For more information, contact Gina Tempel at: *gina@mines.unr.edu.*

Between May and July 2003, the Great Basin Center for Geothermal Energy at the University of Nevada, Reno (UNR) successfully drilled and completed five research wells located near the Florida Canyon Mine. These wells were funded by the U.S. Department of Energy grant to UNR in collaboration with Presco Energy and Apollo Gold. All wells were completed as temperature gradient wells at the following depths: one well to 500 feet, three wells to 1,000 feet, and one well to 1,500 feet. A total of 1,850 feet of core was obtained from three wells. The five wells were being monitored quarterly for temperature, and the cores were being studied using geochemical and petrographic techniques at UNR. (An excerpt from Geothermal Resources of Nevada as updated on the web at *www.nbmg.unr.edu/geothermal/site.php?sid=Rye Patch.*)

Salt Wells - Nevada Geothermal Specialists

A new company, Nevada Geothermal Specialists, successfully obtained 2,500 acres in the Salt Wells area, Churchill County, during this summer's Bureau of Land Management geothermal lease auction. This geothermal area was originally discovered by Anadarko Petroleum Corporation in the 1980s. If the permitting and approval process go as planned Nevada Geothermal Specialists hope to develop a 10-MW power plant on the site by late 2005. (Bulletin Geothermal Resources Council, March/April 2004, v. 33, no. 2)

Steamboat Hot Springs - ORMAT

ORMAT executed a letter of intent to acquire **Steamboat 2 and 3** binary power plants, surrounding land, and associated geothermal resources. Cost of the purchase was $32.5 million. ORMAT had already acquired Steamboat 1 and 1A power plants. ORMAT built the original Steamboat 1 plant in 1985. Shortly afterwards they built the 1A plant and then in 1990 Steamboat 2 and 3 were brought on-line, all built by ORMAT. (Bulletin Geothermal Resources Council, July/August 2003, v. 32, no. 4)

The **SB Geo Steamboat Hot Springs Geothermal Power Plants** had a gross output of 390,951 MWh and a net production of 287,672 MWh during 2003. (Nevada Division of Minerals, 2004)

Steamboat Hot Springs - Yankee Caithness

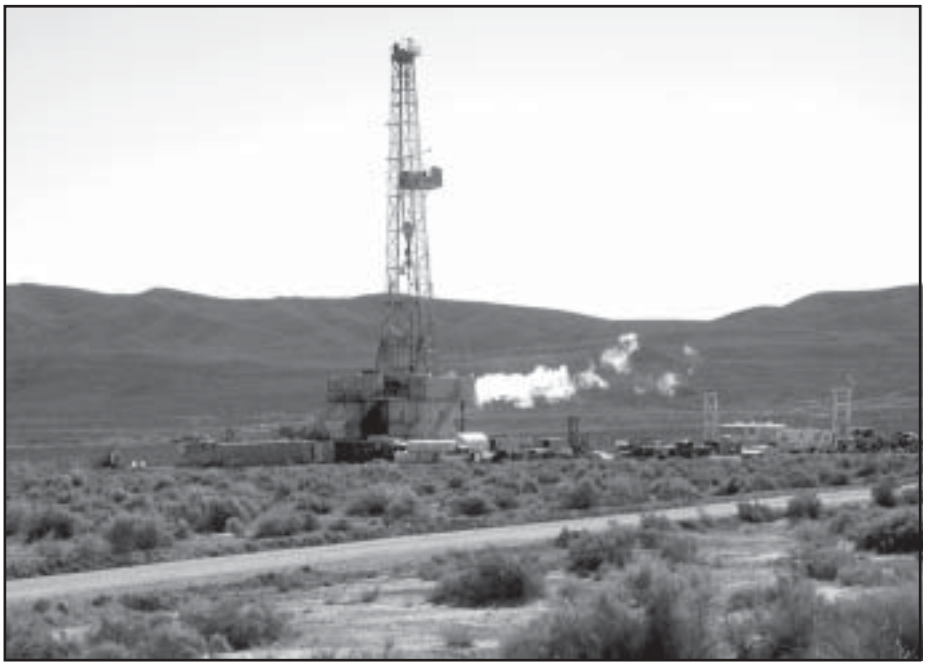
Also located in the **Steamboat Hot Springs** KGRA is the **Yankee Caithness Geothermal Power Plant**. During 2003 the 14.4-megawatt plant had a gross output of 65,810 MWh and a net production of 58,144 MWh. (Nevada Division of Minerals, 2004)

Nevada Geothermal Resources Map

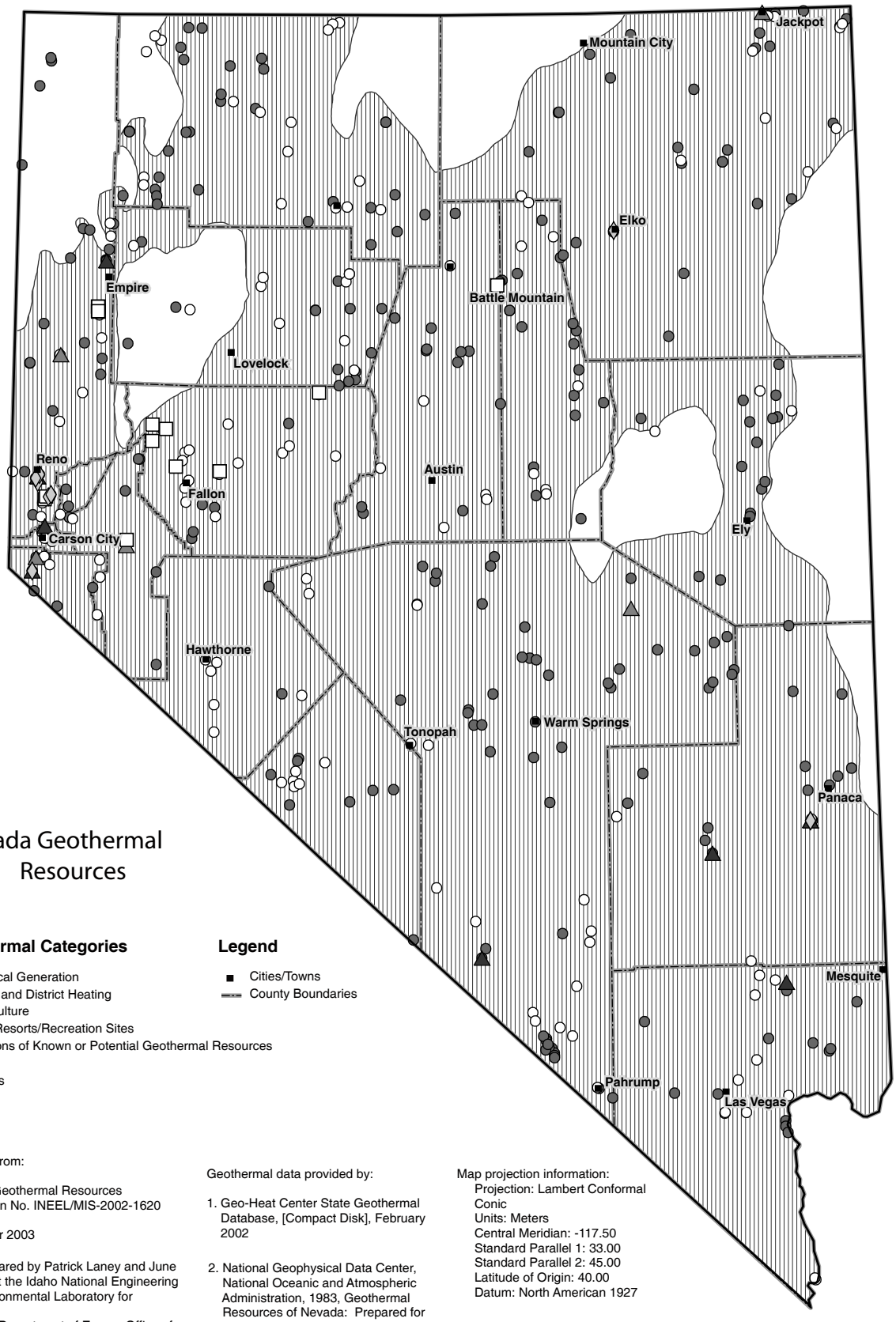
NBMG Map 141, ***Nevada Geothermal Resources***, authored by Lisa Shevenell and Larry J. Garside, shows active direct-use applications and power plants as of May 2003, and all known thermal springs and wells on a topographic base map. This 1:750,000-scale color map may be purchased at the Nevada Bureau of Mines and Geology publications office or on the Web at *www.nbmg.unr.edu/sales.htm*.

For further information on geothermal resources in Nevada check the following Web sites or contact Ron Hess at 775-784-6691 ext. 121 or via Email at *rhess@unr.edu*:

- Geothermal information at the Nevada Bureau of Mines and Geology Web site *www.nbmg.unr.edu/geothermal/*.
- Nevada Commission on Minerals, Nevada Division of Minerals at *http://minerals.state.nv.us/* or *http://minerals.state.nv.us/programs/ogg.htm*.
- Great Basin Center for Geothermal Energy at *www.unr.edu/geothermal/index.html*.
- GEO-HEAT CENTER, at *http://geoheat.oit.edu/*, Oregon Institute of Technology, Klamath Falls, Oregon.
- DOE/INEEL Geothermal Resource Location Maps for 13 Western States at *http://geothermal.id.doe.gov/maps-software.shtml*.
- Geothermal biz.com (*www.geothermal-biz.com/*) is part of the U.S. Department of Energy-led GeoPowering the West (GPW) initiative to dramatically increase the use of geothermal energy in the western United States, Alaska, and Hawaii.
- GeoPowering the West at *www.eere.energy.gov/geopoweringthewest/*.
- Southern Methodist University Geothermal Lab Web page *www.smu.edu/geothermal/*.
- Geothermal Industry Temperature Profiles from the Great Basin, by John H. Sass, Susan S. Priest, Arnold J. Blanton, Penelope C. Sackett, Stephanie L. Welch, and Mark A. Walters; USGS Open-File Report 99-425 online version 1.0 on the Web at *http://wrgis.wr.usgs.gov/open-file/of99-425/webmaps/home.html*.
- Nevada Public Utilities Commission *www.puc.state.nv.us/*.
- Nevada State Office, Bureau of Land Management, Nevada Geothermal Program *www.nv.blm.gov/minerals/geothermal/index.htm*.



C. and L. drill rig at Brady Hot Springs drilling geothermal observation well 88-11 during the summer of 2004. *Photo by Larry Garside.*



Nevada Geothermal Resources

Geothermal Categories

- Electrical Generation
- Space and District Heating
- Aquaculture
- Spas/Resorts/Recreation Sites
- Regions of Known or Potential Geothermal Resources
- Wells
- Springs

Legend

- Cities/Towns
- County Boundaries

Adapted from:

Nevada Geothermal Resources
Publication No. INEEL/MIS-2002-1620
Rev. 1
November 2003

Map prepared by Patrick Laney and June Brizzee at the Idaho National Engineering and Environmental Laboratory for

The U.S. Department of Energy Office of Energy Efficiency and Renewable Energy Geothermal Technologies Program

Geothermal data provided by:

1. Geo-Heat Center State Geothermal Database, [Compact Disk], February 2002

2. National Geophysical Data Center, National Oceanic and Atmospheric Administration, 1983, Geothermal Resources of Nevada: Prepared for the Geothermal and Hydropower Technologies Division United States Department of Energy, Map 1:500,000

Map projection information:
Projection: Lambert Conformal Conic
Units: Meters
Central Meridian: -117.50
Standard Parallel 1: 33.00
Standard Parallel 2: 45.00
Latitude of Origin: 40.00
Datum: North American 1927

NEVADA GEOTHERMAL POWER PLANTS 2003

Plant name (year on line)	Production capacity[1] (MW)	2003 Production (MWh) Gross	Net (sales)	Location	Operator
Beowawe (1985)	16.7 (16.6)	125,742	102,805	S13,T31N,R47E	Beowawe Power, LLC 9790 Gateway Dr., Suite 220 Reno, NV 89521
Bradys Hot Springs (1992)	26.1 (26.1)	223,596	85,010	S12,T22N,R26E	Brady Power Partners 980 Greg Street Sparks, NV 89431
Desert Peak (1985)	9.9 (12.5)	99,606	43,967	S21,T22N,R27E	Western States Geothermal Co. c/o Brady Power Partners 980 Greg Street Sparks, NV 89431
Dixie Valley (1988)	66.0 (62.0)	493,532	441,767	S7,T24N,R37E S33,T25N,R37E	Caithness Dixie Valley, LLC 9790 Gateway Dr. Suite 220 Reno, NV 89521
Empire (1987)	4.6 (4.8)	26,717	17,190	S21,T29N,R23E	Empire Energy, LLC P.O. Box 40 Empire, NV 89405
Soda Lake No. 1 (1987) and Soda Lake No. 2 (1991)	16.6 (26.1)	105,612	73,438	S33,T20N,R28E	Constellation Operating Services 5500 Soda Lake Road Fallon, NV 89406
Steamboat I, I-A (1986) and Steamboat II, III (1992)	53.0 (58.6)	390,951	287,672	S29,T18N,R20E	S.B. Geo, Inc. P.O. Box 18199 1010 Power Plant Dr. Reno, NV 89511
Stillwater (1989)	13.0 (21.0)	96,267	59,717	S1,T19N,R30E S6,T19N,R31E	Stillwater Holdings, LLC 1755 East Plumb Ln. #160 Reno, NV 89509
Wabuska (1984)	1.2 (2.2)	9,195	5,850	S15,16,T15N, R25E	Homestretch Geothermal P.O. Box 1150 Leeds, UT 84746
Yankee Caithness (1988)	14.44 (14.44)	65,810	58,144	S5,6,T17N,R20E	Yankee Caithness J.V.L.P. 9790 Gateway Drive, Suite 220 Reno, NV 89521
TOTAL	221.5 (244.3)	1,637,028	1,175,560		

1. Production capacity from currently developed geothermal resources (equipment capacity in parentheses).
Sources: Plant operators, Nevada Division of Minerals, and NBMG files.

Geothermal Energy

by Ronald H. Hess

Preprint from "The Nevada Mineral Industry - 2004" Nevada Bureau of Mines and Geology Special Publication MI-2004.
September 2005, Ron Hess

Twenty-seven geothermal well permits were issued during 2004 by the Nevada Division of Minerals: one project area permit, four industrial production well permits, two industrial injection well permits, four domestic well permits, and sixteen gradient/observation well permits. Nineteen geothermal wells, of all types, were reported as drilled during 2004. (Nevada Division of Minerals, 2005)

During 2004 there were 143 federal noncompetitive leases covering 215,956 acres and 55 federal competitive leases covering 83,656 acres in Nevada. At the end of 2004 the U.S. Bureau of Land Management had 129 pending lease applications totaling 224,104 acres. Total lease rental revenue value for 2004 was $239,800. (R. Hoops, BLM, oral commun., 2005)

Total gross electrical production during 2004 from geothermal resources on public lands was 1.21 million megawatt-hours (MWh), an increase of 90,000 MWh over 2003; net production was approximately 1.01 MWh, a increase of 70,090 MWh from 2003. Gross electrical sales from federal lands was $57 million, an increase of $4.6 million over 2003. Production royalties on that amount equaled $2.1 million. By regulation, half of all Federal geothermal lease rental fees and production royalties are returned to the state. For 2004, $119,900 in lease rental fees and $1,050,250 in royalty production fees should be transferred to the State of Nevada. (R. Hoops, BLM, oral commun., 2005)

Total Nevada geothermal electrical production in 2004 from both federal and fee lands combined was 1,670,364 MWh gross and net production was 1,284,746 MWh (Nevada Division of Minerals, 2005) with an approximate sales value of $73 million. Production capacity from the currently developed geothermal resources at ten existing geothermal power production sites in Nevada is 221.5 megawatts (MW); currently installed equipment, or nameplate, capacity for the same sites total 244.3 MW. The table of Nevada geothermal power plants lists operators, plant locations, and energy production for individual Nevada geothermal power producers. The table of proposed electrical generation plants in Nevada lists conventional, geothermal, and other renewable energy power projects that are currently under construction or planned for Nevada. If all of these power projects are completed as planned they will add approximately 4,870 MW of gross electrical production to the Nevada grid by 2010.

NONDOMESTIC GEOTHERMAL WELLS REPORTED AS DRILLED, REDRILLED, OR COMPLETED IN NEVADA DURING 2004

Area	Company	Well name	Permit#	Location	Type
Churchill County					
Bradys Hot Springs	Ormat Nevada, Inc. 9 LLC	Observation Well 88-11	535	SE^{1}_{4} SE^{1}_{4}, S11, T22N, R26E	Observation
Desert Peak	Ormat Nevada, Inc. 3 LLC	Industrial Production Well 74-21	536	SE^{1}_{4} NE^{1}_{4}, S21, T22N, R27E	Production
Desert Peak	Ormat Nevada, Inc. 3 LLC	Industrial Production Well 77-21	538	NE^{1}_{4} SE^{1}_{4}, S21, T22N, R27E	Production
Dixie Valley	Caithness Dixie Valley	Industrial Injection Well SW Lamb No. 2	539	NE^{1}_{4} NE^{1}_{4}, S13, T24N, R36E	Injection
Elko County					
Hot Sulphur Springs	Earth Power Resources	Industrial Production Well 46-8 (57-8)	527	SW^{1}_{4} SW^{1}_{4}, S8, T41N, R52E	Production
Hot Sulphur Springs	Earth Power Resources	Observation Well 67-8 (65-8)	528	NE^{1}_{4} SE^{1}_{4}, S8, T41N, R52E	Observation
Humboldt County					
Blue Mountain	Noramex Corp.	Observation Well Deep Blue No. 2	532	SW^{1}_{4} NE^{1}_{4}, S14, T36N, R34E	Observation
Blue Mountain	Noramex Corp.	Thermal Gradient TG-1	545	SE^{1}_{4} NW^{1}_{4} SW^{1}_{4}, S1, T36N, R34E	Gradient
Blue Mountain	Noramex Corp.	Thermal Gradient TG-2	547	SW^{1}_{4} SE^{1}_{4} SE^{1}_{4}, S1, T36N, R34E	Gradient
Blue Mountain	Noramex Corp.	Thermal Gradient TG-3	548	NE^{1}_{4} SE^{1}_{4} SW^{1}_{4}, S11, T36N, R34E	Gradient
Blue Mountain	Noramex Corp.	Thermal Gradient TG-4	550	NE^{1}_{4} SW^{1}_{4} SE^{1}_{4}, S11, T36N, R34E	Gradient
Blue Mountain	Noramex Corp.	Thermal Gradient TG-5	552	NW^{1}_{4} NW^{1}_{4} NW^{1}_{4}, S13, T36N, R34E	Gradient
Blue Mountain	Noramex Corp.	Thermal Gradient TG-8A	554	NE^{1}_{4} NE^{1}_{4} SE^{1}_{4}, S14, T36N, R34E	Gradient
Blue Mountain	Noramex Corp.	Thermal Gradient TG-9	555	NE^{1}_{4} SW^{1}_{4} SE^{1}_{4}, S23, T36N, R34E	Gradient
Blue Mountain	Noramex Corp.	Thermal Gradient TG-14A	559	SE^{1}_{4} SE^{1}_{4} SE^{1}_{4}, S15, T36N, R34E	Gradient
Washoe County					
Steamboat Hot Springs	Steamboat Hills	Industrial Injection Well 64A-32	560	NW^{1}_{4} SE^{1}_{4}, S32, T18N, R20E	Injection

PROPOSED ELECTRICAL GENERATION PLANTS IN NEVADA - 2005
Public Utilities Commission of Nevada, 2005

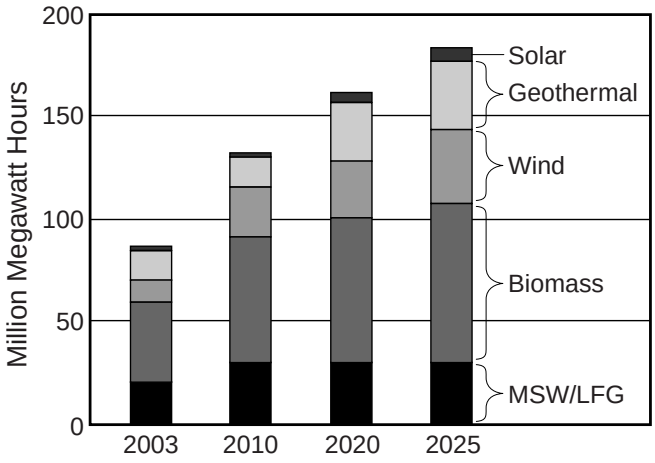
Name/Owner	Gross Megawatts	Plant Type	Location	Date Announced	Construction Status	Proposed On-line Date
Desert Peak 2/Ormat	25	Geothermal	Desert Peak KGRA, Churchill County	Nov. 2002	Expected Aug. 2005	Feb. 2006
Galena 1/Ormat	20	Geothermal	Steamboat KGRA, Washoe County	July 2004	Under Construction	Mar. 2006
Galena 2/Ormat	13	Geothermal	Steamboat KGRA, Washoe County	Nov. 2002	Expected Nov. 2005	Aug. 2006
Boulder City Solar Project/ Solargenix Energy	50	Solar	El Dorado Valley, Clark County	Dec. 2002	Expected Mid-2005	Fall 2006
Ely Wind Generation Facility/ Carlson & Associates	50	Wind	Ruth, White Pine County	Nov. 2002	Expected 2006	Early 2007
Hot Sulphur Springs/ Earth Power Resources	25	Geothermal	Hot Sulphur Springs, Elko County	Nov. 2002		Power Purchase Contract Terminated
Chuck Lenzie Generating Station/ Nevada Power Company	1200	Natural Gas-Fired Combined Cycle	Moapa Valley, Clark County	Jun. 2004	Under Construction	Late 2005
Harry Allen Unit 4/ Nevada Power Company	80	CombustionTurbine Peaking Plant	Harry Allen Plant, Clark County	Jul. 2003	Under Construction	Summer 2006
Blue Mountain Geothermal/ Nevada Geothermal Power	30	Geothermal	Blue Mountain, Humboldt County	Oct. 2002	Ongoing Drilling	Mid 2006
Granite Fox Power Project/ Sempra Energy	1450	Coal Fired	Gerlach, Washoe County	Winter 2004		
Western 102 Generation Project/ Barrick Goldstrike Mines	115	Gas Fired Reciprocating Engines	Near Tracy, Storey County	Spring 2004	Under Construction	Sep. 2005
Salt Wells Geothermal Project/ Nevada Geothermal Specialists	10	Geothermal	Salt Wells, Churchill County	Spring 2004	Ongoing Drilling	Late 2005
White Pine Project/LS Power	1600	Coal Fired	White Pine County	Winter 2004		Expected 2010
TS Power Plant/ Newmont Mining Corporation	200	Coal Fired	Eureka County	Spring 2004	Expected 2005	Mid 2007

National Outlook

The national outlook for growth in renewable electric energy technologies is good. According to the Annual Energy Outlook 2005, produced by the Energy Information Administration, total renewable energy generation (including hydro, geothermal, wind, solar, and biomass) will grow from 359 million MWh in 2003 to 489 million MWh in 2025, which is a 1.4% increase annually. It is anticipated that the current geothermal electrical production in the western United States of 13 million MWh will increase to 33 million MWh by 2025. (Annual Energy Outlook 2005 With Projections to 2025, February 2005, Energy Information Administration, U.S. Department of Energy, www.eia.doe.gov/oiaf/aeo/) Currently Nevada is second only to California in total installed geothermal generating capacity.

Honey and Geothermal Heat

John Roth, a beekeeper in the Stillwater area, plans to use geothermal water to heat and thin raw honey before filtration and mixing. He will be circulating geothermal water through a small honey storage room raising the ambient air temperature to 110°F. The warmed honey will then be filtered and some batches of honey mixed before packaging and sale. He will be running about 1,700 hives during 2005 with an estimated production of 2,750 gallons of honey. (Bulletin Geothermal Resources Council, January/February 2005, v. 34, no. 1) This is not the first use of geothermal water to aid in the production of Nevada honey. During the 1940s, Herbert Hess, a beekeeper in the Reno area, used hot water at Steamboat Springs south of Reno to liquefy large batches of crystallized honey before shipment to market.



Projected nonhydroelectric renewable electricity generation, 2003–2025. MSW/LFG is municipal solid waste and landfill gas.

(Annual Energy Outlook 2005 with Projections to 2025, February 2005, Energy Information Administration, U.S. Department of Energy, www.eia.doe.gov/oiaf/aeo/)

Blue Mountain Geothermal Area, Humboldt County

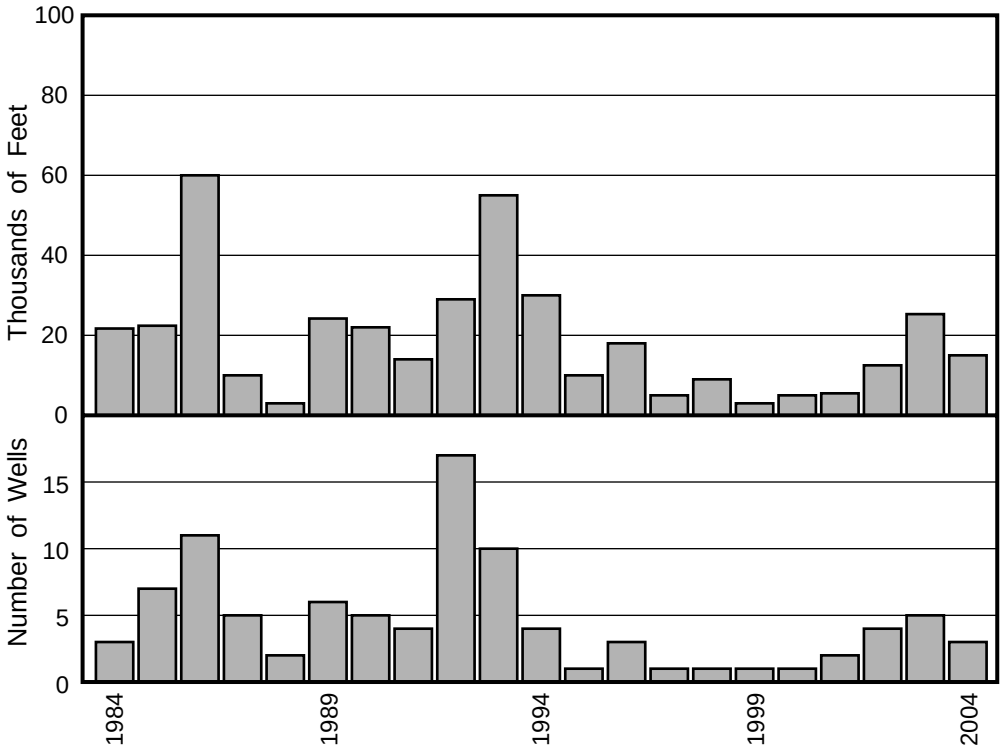
Noramex Corp., a wholly owned subsidiary of Nevada Geothermal Power, Inc. (NGP), drilled the observation Well Deep Blue No. 2 (DB 2), permit number 532, to 3,700 feet. This well recorded a high temperature of 333°F at 1,900 feet and a zone from 656 to 1,920 feet with temperatures above 302°F. This well has since been deepened to approximately 4,993 feet. The well has also been successfully injection tested. Results from the injection test and geothermal fluid chemistry "indicate a shallow, 302 to 329°F geothermal zone at 656 to 1,920 feet, fed by a deeper and probably higher temperature resource." It is possible that a deeper, high temperature (392 to 464°F) reservoir may exist at about 4,920 to 6,560 feet. NGP is planning to drill three 13-inch production test wells to better define production capacity and reservoir response. One of these wells will probably go deeper, 4,500 to 5,900 feet, to explore for a possible higher temperature resource at depth. If successful, these test wells will be converted to production wells for a power plant. Currently, NGP believes that the resource will support a 30-MW power plant, and this number will be refined by test results from the three large diameter test wells. (Bulletin Geothermal Resources Council, January/February 2005, v. 34, no. 1 and Nevada Division of Minerals, 2005)

DB 2 was a step-out well from observation Well Deep Blue No. 1 (DB 1), permit number 500, which is about 0.5 mile away and was drilled to 2,205 feet. This well recorded temperatures of 293°F at 2,115 feet and a zone of 1,200 feet of high permeability rock in the highest temperature portion of the well.

The U.S. Department of Energy (DOE) under the Geothermal Resource Exploration and Definition II (GRED II) program awarded Noramex Corp. a grant of $659,000, with Noramex to provide $164,000 in cost share, to assist in the DB 2 drilling project. Preliminary results from earlier exploration data and the above drilling indicate that a 30-MW geothermal power plant is feasible at Blue Mountain. (Bulletin Geothermal Resources Council, May/June 2004, v. 33, no. 3)

Noramex Corp. applied to the Nevada Division of Minerals for and received an additional 15 geothermal well drilling permits for a series of 500-foot thermal gradient test wells in the Blue Mountain area (State permit numbers 545 through 559).

The Blue Mountain area, located at T36N, R34E in south-central Humboldt County, was originally explored for gold potential. During exploratory drilling they noted high temperatures when pulling the drill steel. Because of this near surface temperature anomaly the property was explored for geothermal potential in the late 1990s to present. Nevada Geothermal Power, Inc., holds the geothermal leases to 7,680 acres and has reported that it believes the property to have a potential resource capable of producing 100 MW. (Nevada Geothermal Power Inc. Web Informational Flyer, 2003)



Industrial-class (power generating) wells drilled in Nevada, 1984–2004. Depth taken from original drilling permit.

Beowawe Geothermal Area, Lander/Eureka Counties

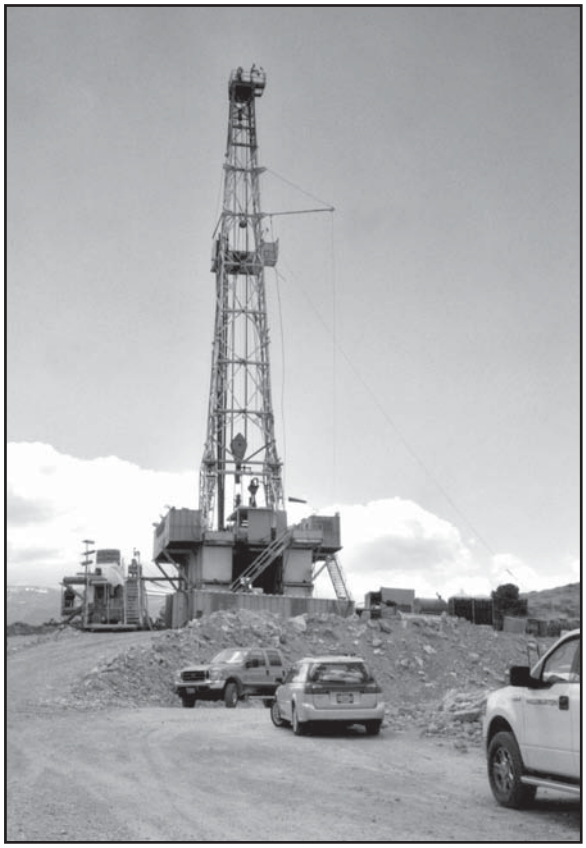
Beowawe Power LLC/Caithness Operating has signed a 20-year power sales contract with Sierra Pacific Power Company. The contract takes effect January 2006. Their existing contract with Southern California Edison expires in December of 2005. Well permit number 565 was issued to Beowawe in January of 2005 for a new production well number 57-13. Drilling is expected to start in August 2005. The Beowawe power plant came on-line in December of 1985 and has an equipment generating capacity of 16.6 MW. In 2004, electrical production at the plant was 124,501 MWh gross with 101,696 MWh net generation. (Nevada Division of Minerals, 2005)

Steamboat Hot Springs, Washoe County

Ormat Nevada Inc. (ORMAT) purchased the Yankee Caithness Steamboat geothermal power plant and associated geothermal resources for a reported purchase price of $20.15 million. The 14.4-MW power plant was wholly-owned and operated by Caithness, which had a long-term power sales agreement with Sierra Pacific Power Company. All operations have been turned over to ORMAT. ORMAT now owns and operates the Yankee plant, and through earlier acquisitions, Steamboat plants 1 and 1A (purchased June 2003) and plants 2 and 3 (purchased February 2004). It is hoped that through this consolidation of the power plants and resources the geothermal resource as a whole can be more efficiently managed. (ORMAT News Release, Sparks, NV, May 20, 2004)

ORMAT has broken ground on the Galena Geothermal Project at Steamboat. This project will include the construction of two new binary power plants and associated geothermal production and injection facilities. The last geothermal power plant constructed at Steamboat was brought on-line in 1991. These two 10-MW plants will use geothermal fluids from existing wells complemented by fluid from a new production well that is currently being tested. It was determined that the production field for the existing plants, with better flow management, would be capable of supplying a large portion of the fluid required for the new plants. ORMAT already has a power purchase agreement in place with Sierra Pacific Power Company for the energy that will be generated from the Galena Project. (Nevada Division of Minerals, 2005)

Construction of the Galena project at Steamboat Hot Springs is underway. This photo shows the ongoing construction of one of the two banks of condenser towers that will be part of the new geothermal power plant. *Photo by R. Hess, June 2005.*



Drill rig putting down Industrial Production Well 78-29 (State Permit Number 563) at Steamboat Hot Springs in preparation for the Galena project expansion. *Photo by R. Hess, June 2005.*

Stillwater Geothermal Area, Churchill County

AMP Resources, LLC. purchased the Stillwater Power Plant and associated geothermal resources from Stillwater Holdings, LLC., effective 12/31/2004. The Stillwater power plant came on-line in December of 1989 and has an equipment generating capacity of 21 MW. In 2004 electrical production at the plant was 104,686 MWh gross and 65,218 MWh net generation.

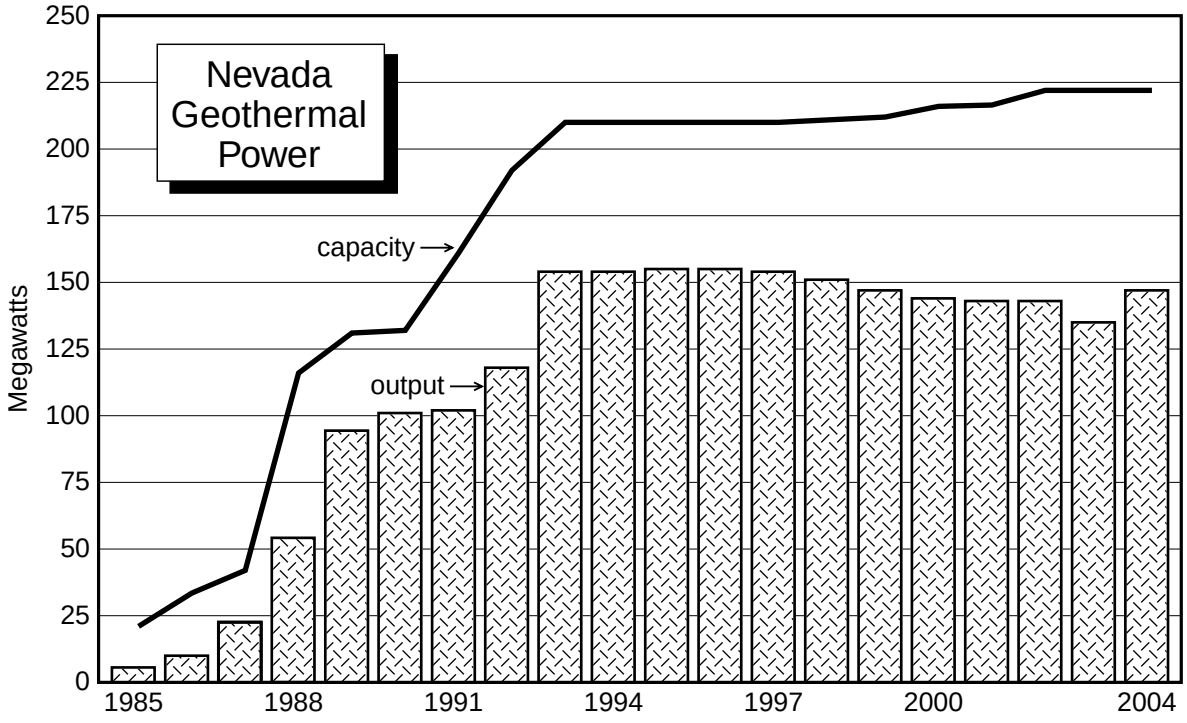
Desert Peak Geothermal Area, Churchill County

Ormat Nevada, Inc. is constructing a new binary power plant near the existing 9.9 MW dual flash geothermal power plant at Desert Peak. The new project, Desert Peak 2, is currently planned to consist of two independently operated Ormat Energy Converter (OEC) units. OEC-1 will be a 15-MW gross binary power plant cooled by a bank of air condensers. OEC-2 will be an 11-MW gross binary power plant unit cooled by a new two-cell condenser tower. The Desert Peak 2 project may be down sized to 10-15 MW gross depending on an ongoing project evaluation. Power generated from this project will be sold to Nevada Power Company. (The Public Utilities Commission of Nevada, Docket No. 05 3024, April 27, 2005 and Nevada Division of Minerals, 2005)

The existing geothermal power plant at Desert Peak produces from two production wells with an average depth of 3,683 feet and fluid temperature of 312°F. Desert Peak has two injection wells with an average depth of 4,000 feet and injection temperature of 198°F. In 2004, this plant had a gross output of 62,345 MWh and a net production of 52,125 MWh. (Nevada Division of Minerals, 2005)

Eight Mile Flat (Salt Wells), Churchill County

Nevada Geothermal Specialists, LLC has received approval from the U.S. Bureau of Land Management to construct a 20-MW power plant at Eight Mile Flat near Salt Wells. As part of the Salt Wells project they currently plan to build a 10-MW power plant by the end of 2005 and bring a second 10-MW facility on-line by the end of 2006. A new 6-mile-long, 230-KV power line will link the plants to the Sierra Pacific Power Company grid. At the end of 2004, AMP Resources, LLC. purchased the Salt Wells geothermal project, including all associated resource assets, from Nevada Geothermal Specialists, LLC. (Lahontan Valley News and Fallon Eagle Standard, March 1, 2005 and Nevada Division of Minerals, 2005) This geothermal area was originally drilled by Anadarko Petroleum Corporation in the early 1980s. (Bulletin Geothermal Resources Council, March/April 2004, v. 33, no. 2)



Currently developed resource capacity and average net output of Nevada geothermal plants, 1985–2004. Average net output is annual sales in megawatt-hours divided by the number of hours in a year (8,760). No commercial geothermal power was produced in Nevada before 1985.

Prior to AMP Resources, LLC's taking over the Salt Wells project the Nevada Division of Minerals issued a geothermal project area permit (#564PA) to Nevada Geothermal Specialists, LLC for this project. It anticipates development of six production wells with an estimated depth of 1,000 feet, four injection wells with an estimated depth of 3,000 feet, and ten observation wells with an estimated depth of 1,000 feet. One of the first wells drilled under this geothermal project area permit was the Industrial Production Well PW-2 (permit #568), which was drilled in the spring of 2005 to a depth of 471 feet (143.6 m) by Amp Resources, LLC. Static temperature surveys showed a peak temperature of 145°C and a flowing temperature of 140°C. The well flowed at a rate of 2,500 gallons per minute for 46 hours with no drawdown. (Nevada Division of Minerals, 2005, and Geothermal Resources of Nevada as updated on the web at "*www.nbmg.unr.edu/geothermalsite.php?sid=Eightmile%20Flat*")

Hot Sulphur Springs, Elko County

Earth Power Resources, Inc. announced in November 2002 that they had received a power purchase agreement from Nevada Power Co. and would build a 25-MW binary geothermal plant at Hot Sulphur Springs geothermal area located 60 miles northwest of Elko in Elko County. It was anticipated that the plant would come on line in 2005. However, due to delays in project development, the power purchase agreement has been terminated. (Nevada Power news release, November 26, 2002 and Public Utilities Commission of Nevada, 2005)

Hot Springs (Tipton) Ranch, Pumpernickel Valley, Humboldt County

Noramex Corporation, a wholly owned subsidiary of Nevada Geothermal Power, Inc. (NGP) has undertaken a geothermal development project in Pumpernickel Valley, Humboldt County, at the Hot Springs - Tipton Ranch geothermal area. They have acquired the leases for and surrounding an area where near boiling hot springs occur. Based on chemistry, NGP believes, that at depth the temperature of the source fluids for a series of hot springs that lay along a one-mile section of a fault running through the geothermal area could be as high as 170°C (338°F). (Nevada Geothermal Power Inc., Pumpernickel Geothermal Project Development Program Outlined, May 6, 2004, press release)

NGP announced on Oct. 14, 2004 that Inovision Solutions Inc., will fund exploration and development for the Pumpernickel Valley project to earn a 50% joint venture interest. Noramex has also been awarded a U.S. Department of Energy (DOE) cost-sharing contract where the DOE will fund 80% and Noramex will be responsible for 20% of an initial field evaluation program at the Pumpernickel project. Total budget for this work is $740,340 and will include a 3-D "E-SCAN" resistivity survey and six temperature gradient holes. In July of 2005 the Nevada Division of Minerals granted drilling permits for nine thermal gradient wells in sections 5, 9, 27, and 33 of Township 33 North , Range 40 East. (Nevada Division of Minerals, 2005)

Black Warrior Peak, Washoe County

Noramex Corporation, a wholly owned subsidiary of Nevada Geothermal Power, Inc. (NGP), has filed a geothermal lease application for 640 acres located in Section 8, T23N R25E, a project area they are calling Black Warrior Peak. The application is currently pending. This is in the same area that Noramex has acquired lease rights on 7 square miles of private land near Black Warrior Peak. The leases on private land are subject to a 3.5% royalty on gross revenue from electricity sales; however, NGP can purchase the royalty for $1,000,000. The private leases include surface and water rights. (Nevada Division of Minerals, 2005)

Nevada Geothermal Resources Map

The map entitled "Nevada geothermal resources," NBMG map 141 second edition, is authored by Lisa Shevenell and Larry J. Garside. The color map, 1:750,000-scale, shows active direct-use applications and power plants as of 2004 and all known thermal springs and wells on a topographic base map. This map may be purchased at the Nevada Bureau of Mines and Geology publications office or on the Web at *www.nbmg.unr.edu/sales/*. An Acrobat pdf file format version of this map can also be viewed and downloaded for free from the Web at www.nbmg.unr.edu/dox/m141.pdf

An interactive version of this map can be accessed at *www.nbmg.unr.edu/geothermal/gtmap.pdf*. You can pan around on the interactive map, click on a geothermal area, and it will present detailed information on the particular geothermal resource, with many sites having additional links to detailed maps and photos.

Geothermal Bibliography

An on-line searchable bibliography of approximately 1,400 geothermal references can be accessed on the Nevada Bureau of Mines and Geology Web site at www.nbmg.unr.edu/geothermal/biblio/find.htm . The full list of references can also be downloaded as a Microsoft Word file.

The Geothermal Resources map and the online bibliography are just two of the many online resources and links that are available under the general geothermal information Web page at the Nevada Bureau of Mines and Geology Web site *www.nbmg.unr.edu/geothermal/*.

Web Links to Other Geothermal Information

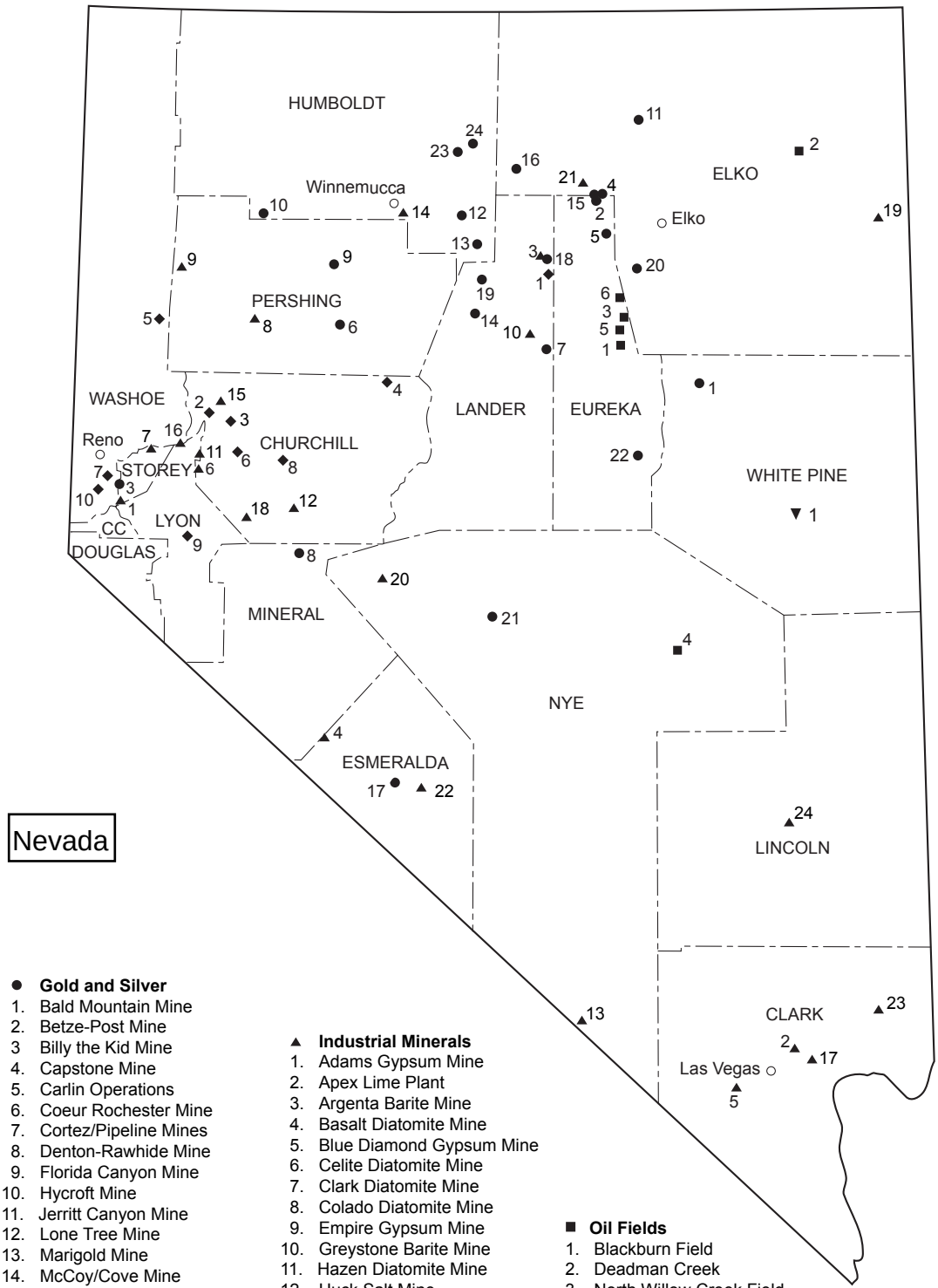
For further information on geothermal resources in Nevada check the following Web sites or contact Ron Hess at 775-784-6691 ext. 121 or via e-mail at *rhess@unr.edu*.

- Nevada Commission on Minerals, Nevada Division of Minerals at *http://minerals.state.nv.us/* or *http://minerals.state.nv.us/programs/ogg.htm*
- Great Basin Center for Geothermal Energy at *www.unr.edu/geothermal/index.html*
- GEO-HEAT CENTER, at *http://geoheat.oit.edu/* , Oregon Institute of Technology, Klamath Falls, Oregon
- DOE/INEEL Geothermal Resource Location Maps for 13 Western States at *http://geothermal.id.doe.gov/maps-software*
- Geothermal biz.com *www.geothermal-biz.com/* is part of the U.S. Department of Energy-led GeoPowering the West initiative to dramatically increase the use of geothermal energy in the western United States, Alaska, and Hawaii.
- GeoPowering the West Web site at www.eere.energy.gov/geothermal/deployment_gpw.html
- Southern Methodist University Geothermal Lab Web page *www.smu.edu/geothermal/*
- Geothermal Site Identification And Qualification Report, prepared for: California Energy Commission, Public Interest Energy Research (PIER) Program. Report prepared by GeothermEx, Inc. This report provides summary information on potential power producing geothermal resources within California and Western Nevada that could supply additional power to the California market. The report can be found at *www.geothermex.com/CEC-PIER_Reports.htm*
- Geothermal Industry Temperature Profiles from the Great Basin, by J.H. Sass, S.S. Priest, A.J. Blanton, P.C. Sackett, S.L. Welch, and M.A. Walters; USGS Open-File Report 99-425 online version 1.0 at *http://pubs.usgs.gov/of/1999/of99-425/webmaps/home.html*
- Nevada Public Utilities Commission *www.puc.state.nv.us/*

NEVADA GEOTHERMAL POWER PLANTS 2004

Plant name (year on line)	Production capacity[1] (MW)	2004 Production (MWh) Gross	Net (sales)	Location	Operator
Beowawe (1985)	16.7 (16.6)	124,501	101,696	S13,T31N,R47E	Caithness Operating Beowawe Power, LLC 9790 Gateway Dr., Suite 220 Reno, NV 89521
Bradys Hot Springs (1992)	26.1 (26.1)	224,308	122,403	S12,T22N,R26E	Brady Power Partners/ORMAT 980 Greg Street Sparks, NV 89431
Desert Peak (1985)	9.9 (12.5)	62,345	52,125	S21,T22N,R27E	Brady Power Partners/ORMAT 980 Greg Street Sparks, NV 89431
Dixie Valley (1988)	66.0 (62.0)	561,998	506,851	S7,T24N,R37E S33,T25N,R37E	Caithness Dixie Valley, LLC 9790 Gateway Dr. Suite 220 Reno, NV 89521
Empire (1987)	4.6 (4.8)	32,182	21,574	S21,T29N,R23E	Empire Energy, LLC P.O. Box 40 Empire, NV 89405
Soda Lake No. 1 (1987) and Soda Lake No. 2 (1991)	16.6 (26.1)	103,037	71,409	S33,T20N,R28E	Constellation Operating Services 5500 Soda Lake Road Fallon, NV 89406
Steamboat I, I-A (1986) and Steamboat II, III (1992)	53.0 (58.6)	396,006	292,426	S29,T18N,R20E	Steamboat Development Corp./ORMAT 980 Greg Street Sparks, NV 89431
Stillwater (1989)	13.0 (21.0)	104,686	65,218	S1,T19N,R30E S6,T19N,R31E	Amp Resources Stillwater Holdings, LLC 1755 East Plumb Ln. #160 Reno, NV 89509
Wabuska (1984)	1.2 (2.2)	10,473	6,436	S15,16,T15N,R25E	Homestretch Geothermal P.O. Box 1150 Leeds, UT 84746
Steamboat Hills formerly Yankee Caithness (1988)	14.44 (14.44)	50,828	44,608	S5,6,T17N,R20E	Steamboat Hills, LP 980 Greg Street Sparks, NV 89431
TOTAL	221.5 (244.3)	1,670,364	1,284,746		

1. Production capacity from currently developed geothermal resources (equipment capacity in parentheses).
Sources: Plant operators, Nevada Division of Minerals, and NBMG files.



● Gold and Silver

1. Bald Mountain Mine
2. Betze-Post Mine
3. Billy the Kid Mine
4. Capstone Mine
5. Carlin Operations
6. Coeur Rochester Mine
7. Cortez/Pipeline Mines
8. Denton-Rawhide Mine
9. Florida Canyon Mine
10. Hycroft Mine
11. Jerritt Canyon Mine
12. Lone Tree Mine
13. Marigold Mine
14. McCoy/Cove Mine
15. Meikle Mine
16. Midas Mine
17. Mineral Ridge Mine
18. Mule Canyon Mine
19. Phoenix Project
20. Rain Mine
21. Round Mountain Mine
22. Ruby Hill Mine
23. Turquoise Ridge Joint Venture
24. Twin Creeks Mine

▼ Copper

1. Robinson Mine

▲ Industrial Minerals

1. Adams Gypsum Mine
2. Apex Lime Plant
3. Argenta Barite Mine
4. Basalt Diatomite Mine
5. Blue Diamond Gypsum Mine
6. Celite Diatomite Mine
7. Clark Diatomite Mine
8. Colado Diatomite Mine
9. Empire Gypsum Mine
10. Greystone Barite Mine
11. Hazen Diatomite Mine
12. Huck Salt Mine
13. IMV Nevada Clay
14. MIN-AD Dolomite Mine
15. Moltan Diatomite Mine
16. NCC Limestone Quarry
17. PABCO Gypsum
18. Popcorn Perlite Mine
19. Pilot Peak Limestone Quarry
20. Premier Magnesite Mine
21. Rossi Barite Mine
22. Silver Peak Lithium Carbonate
23. Simplot Silica Products
24. Tenacity Perlite Mine

■ Oil Fields

1. Blackburn Field
2. Deadman Creek
3. North Willow Creek Field
4. Railroad Valley (Eagle Springs, Trap Spring, Currant, Sand Dune, Grant Canyon, Bacon Flat, Kate Spring, Duckwater Creek, Sans Spring, and Ghost Ranch Fields)
5. Three Bar Field
6. Tomera Ranch Field

◆ Geothermal Power Plants

1. Beowawe
2. Bradys Hot Springs
3. Desert Peak
4. Dixie Valley
5. Empire
6. Soda Lake No. 1 and No. 2
7. Steamboat I, IA, II, and III
8. Stillwater
9. Wabuska
10. Yankee Caithness

Major mines, oil fields, and geothermal plants, 2004.

Geothermal Energy

by Ronald H. Hess

From: The Nevada Mineral Industry - 2005
Special Publication MI-2005
Nevada Bureau of Mines and Geology

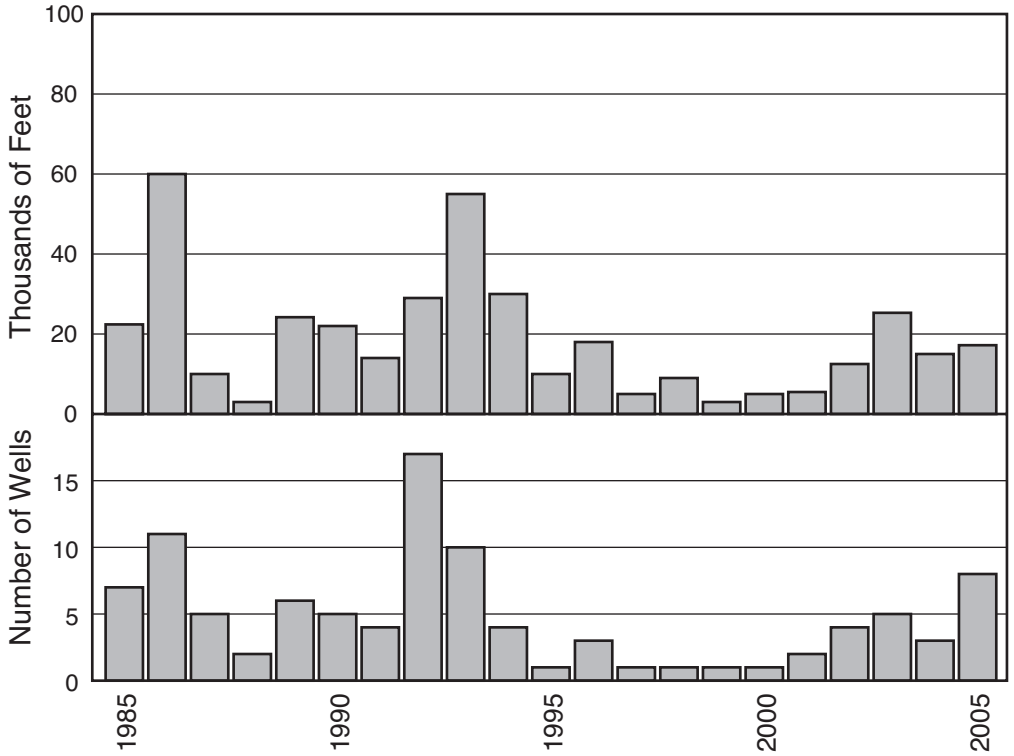
Sixty-seven geothermal well permits were issued during 2005 by the Nevada Division of Minerals: four project area permits, 17 industrial production well permits, seven industrial injection well permits, three domestic well permits, and 36 gradient/observation well permits. A total of 34 geothermal wells of all types were reported as drilled during 2005. (Nevada Division of Minerals, 2006)

During 2005 there were 160 federal noncompetitive leases covering 244,261 acres and 66 federal competitive leases covering 85,257 acres in Nevada. Total lease rental revenue value for 2005 was $255,825. (Rich Hoops, BLM, oral commun., 2006)

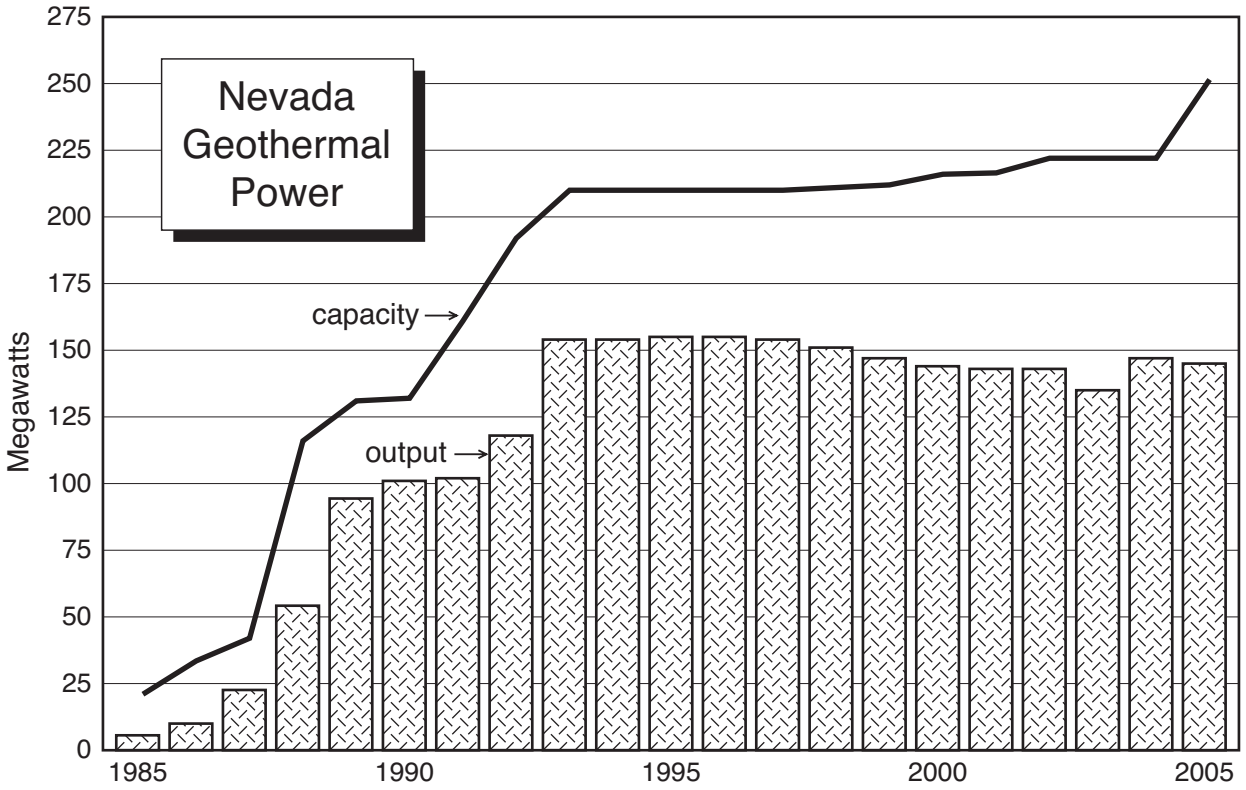
Total gross electrical production during 2005 from geothermal resources on public lands was 1.18 million megawatt-hours (MWh), a decrease of 30,000 MWh over 2004; net production was approximately 993,909 MWh, a decrease of 16,091 MWh from 2004. Gross electrical sales from federal lands was $57.6 million, an

NONDOMESTIC GEOTHERMAL WELLS REPORTED AS DRILLED, REDRILLED, OR COMPLETED IN NEVADA DURING 2005

Area	Company Name	Well name	Permit#	Location	Type	Permitted Depth
Churchill County						
Eightmile Flat (Salt Wells)	NV Geothermal Specialists, LLC	Industrial Production Well PW-1	566	NW¼ NW¼, S36, T17N, R30E	Production	750
	NV Geothermal Specialists, LLC	Industrial Production Well PW-2	568	SW¼, NW¼, S36, T17N, R30E	Production	750
	NV Geothermal Specialists, LLC	Industrial Production Well PW-3	569	SE¼, SE¼, S26, T17N, R30E	Production	750
	NV Geothermal Specialists, LLC	Industrial Injection Well IW-1	571	SE¼, NE¼, S36, T17N, R30E	Injection	1500
	NV Geothermal Specialists, LLC	Observation Well IW-2	572	SE¼, NE¼, S36, T17N, R30E	Observation	1500
Stillwater	AMP Resources (Stillwater), LLC	Industrial Injection Well 34-7	594	SE¼, NW¼, S7, T19N, R31E	Injection	1200
	AMP Resources (Stillwater), LLC	Industrial Injection Well 54-7	595	SW¼, NE¼, S7, T19N, R31E	Injection	1400
	AMP Resources (Stillwater), LLC	Industrial Production Well 67-19	606	SW¼, SE¼, S19, T20N, R31E	Injection	2600
Humboldt County						
Blue Mountain	Noramex Corp.	Thermal Gradient TG-13	557	SW¼, SW¼, NE¼, S15, T36N, R34E	Gradient	500
Hot Springs (Tipton)	Noramex Corp.	Thermal Gradient Well PVTG-H	597	NW¼, NW¼, S33, T33N, R40E	Gradient	1000
Ranch (Pumpernickel Valley)	Noramex Corp.	Thermal Gradient Well PVTG-C	599	NE¼, NE¼, S5, T33N, R40E	Gradient	1000
	Noramex Corp.	Thermal Gradient Well PVTG-E	600	SE¼, SW¼, S33, T33N, R40E	Gradient	1000
	Noramex Corp.	Thermal Gradient Well PVTG-J	601	SE¼, NE¼, S33, T33N, R40E	Gradient	1000
	Noramex Corp.	Thermal Gradient Well PVTG-GB	607	NW¼, NE¼, S9, T33N, R40E	Gradient	1640
Lander County						
Beowawe Geysers	Beowawe Power, LLC	Industrial Production Well 57-13	565	SW¼, SE¼, S13, T31N, R47E	Production	8500
Hot Springs at Hot Springs Point, Grass Valley	Ormat Nevada, Inc.	Thermal Gradient Well #1 / 44-16	580	NW¼, SE¼, S16, T24N, R47E	Gradient	500
	Ormat Nevada, Inc.	Thermal Gradient Well #2 / 67-16	581	SE¼, SE¼, S16, T24N, R47E	Gradient	500
	Ormat Nevada, Inc.	Thermal Gradient Well #3 / 14-15	582	SW¼, NW¼, S15, T24N, R47E	Gradient	500
	Ormat Nevada, Inc.	Thermal Gradient Well #4 / 66-21	583	NE¼, SE¼, S21, T24N, R47E	Gradient	500
	Ormat Nevada, Inc.	Thermal Gradient Well #5 / 11-15	584	NW¼, SW¼, S15, T24N, R47E	Gradient	500
Lyon County						
Hazen (Patua Hot Springs)	Geothermal Rail Ind. Dev., LLC	Thermal Gradient Well HTG 2	610	SE¼, NW¼, NW¼, S19, T20N, R26E	Gradient	500
	Geothermal Rail Ind. Dev., LLC	Thermal Gradient Well HTG 3	611	NW¼, NW¼, NW¼, S17, T20N, R26E	Gradient	500
	Geothermal Rail Ind. Dev., LLC	Thermal Gradient Well HTG 4	612	NW¼, SW¼, S17, T20N, R26E	Gradient	500
Nye County						
Hot Creek Canyon	NV Geothermal Specialists, LLC	Thermal Gradient Well UHCR-1	585	SW¼, NW¼, S29, T8N, R50E	Gradient	500
	NV Geothermal Specialists, LLC	Thermal Gradient Well UHCR-3	586	SE¼, NW¼, S22, T8N, R50E	Gradient	500
	NV Geothermal Specialists, LLC	Thermal Gradient Well UHCR-4	587	NE¼, SE¼, S33, T8N, R50E	Gradient	500
	NV Geothermal Specialists, LLC	Thermal Gradient Well UHCR-5	588	NE¼, SE¼, S32, T8N, R50E	Gradient	500
	NV Geothermal Specialists, LLC	Thermal Gradient Well UHCR-15	616	NW¼, NE¼, S1, T7N, R50E	Gradient	500
Washoe County						
Steamboat Hot Springs	ORNI 7, LLC	Industrial Production Well 78-29	563	SE¼, SE¼, S29, T18N, R20E	Production	1000
	Steamboat Development Corp.	Industrial Production Well 38B-28	567	SE¼, SW¼, S28, T18N, R20E	Production	850
	Steamboat Hills, LLC	Industrial Injection Well 42-32	575	NE¼, NW¼, S32, T18N, R20E	Injection	1500
	Steamboat Hills, LLC	Industrial Production Well 44-32	577	SE¼, NW¼, S32, T18N, R20E	Production	1500
	Steamboat Hills, LLC	Industrial Production Well 34-32	578	SE¼, NW¼, S32, T18N, R20E	Production	1500



Industrial-class (power generating) wells drilled in Nevada, 1984–2005. Depth taken from original drilling permit.



Currently developed resource capacity and average net output of Nevada geothermal plants, 1985–2005. Average net output is annual sales in megawatt-hours divided by the number of hours in a year (8,760). No commercial geothermal power was produced in Nevada before 1985.

increase of $600,000 over 2004. Production royalties on that amount equaled $2.1 million. By regulation, half of all Federal geothermal lease rental fees and production royalties are returned to the state. For 2005, $127,912 in lease rental fees and $1,050,000 in royalty production fees should be returned to Nevada. (Rich Hoops, BLM, oral commun., 2006)

Total Nevada geothermal electrical production in 2005 from federal and fee lands combined was 1,590,940 MWh gross and 1,268,791 MWh net (Nevada Division of Minerals, 2006) with a sales value of about $73.5 million, including capacity payment. Production capacity from the currently developed geothermal resources at ten existing geothermal power production sites in Nevada is 251.5 megawatts (MW), a 30 MW increase from 2004. This increase in production capacity had little effect on 2005 production figures because it came online late in the year. Currently installed equipment, or nameplate, capacity for the same sites totals 274.3 MW. The table of Nevada geothermal power plants lists operators, plant locations, and energy production for individual Nevada geothermal power producers. Nevada is second only to California in total installed geothermal generating capacity in the United States.

The Geothermal Energy Association (GEA) released a report entitled "Update on US Geothermal Power Production and Development, March 14, 2006". This report states that at present there is 157 MW of new geothermal generating capacity under construction in the western states. Identified as under construction in Nevada are projects at Desert Peak, Steamboat (Galena project), and Stillwater. These projects represent 60 MW of new geothermal production or 38.2% of the 157 MW geothermal plant capacity that is currently under construction in the West.

Nevada geothermal projects identified as in initial exploration, with approximate potential of 138 MW, include Emigrant, Grass Valley, Hawthorne Army Depot, and the Pyramid Lake Paiute Reservation. Other projects identified as currently drilling, with approximate potential of 55 MW, include Blue Mountain and Pumpernickel Valley. Projects in the final permitting stage, with approximate potential of 70 MW, include the Beowawe addition, Fallon Naval Air Base, Salt Wells, and Steamboat Hills (Galena) binary project. (Update on US Geothermal Power Production and Development, March 14, 2006, Geothermal Energy Association)

The following list of currently active projects in Nevada was excerpted from "Update on US Geothermal Power Production and Development, March 14, 2006" with the permission of the Geothermal Energy Association:

Phase 1: Identifying site, secured rights to resource, initial exploration drilling

- Emigrant - 49–118MW - ESMERALDA ENERGY CO.
- Grass Valley - 20MW - Ormat
- Hawthorne Army Depot - 10MW minimum
- Pyramid Lake Paiute Reservation - 25MW - The drilling of thermal gradient holes began in November, 2005

Phase 2: Drilling and Confirmation being done; PPA not secured

- Blue Mountain - 30MW
- Pumpernickel - 20–30MW - Nevada Geothermal Power

Phase 3: Securing PPA and final permits

- Beowawe addition - 20MW - Caithness
- Fallon Naval Base - 30MW - US NAVY geothermal program - contract w/ Ormat
- Salt Wells - 12MW - AMP RESOURCES
- Steamboat Hills binary - Galena (5–10MW) - ORMAT

Phase 4: Under Construction

- Desert Peak - 15MW - ORMAT
- Galena 2 - 18MW - ORMAT
- Stillwater 27MW addition - AMP RESOURCES (AMP will be building a 37MW plant, while decommissioning the existing 10MW plant, thus resulting in a 27MW addition.)

Unconfirmed: Proposed projects that may or may not have secured the rights to the resource, but exploration has been done

- Black Warrior - 50MW
- Fish Lake - 50MW
- Hot Sulphur Springs (Tuscarora) - Received GRED III funding - WGA report said 20MW near-term
- Reese River - Received GRED III funding. WGA report said 18MW near-term - Western Geothermal Partners
- Rye Patch 12MW - A power plant already exists on the site. The site will require further drilling for development. Rye Patch received GRED I money.
- Silver Peak - WGA report said 50MW near-term

If all 13 confirmed projects are completed (including those currently under construction), geothermal power output in Nevada would increase by about 323 MW, which will more than double the existing geothermal generating capacity in Nevada.

Nevada Office of Energy

The Nevada Office of Energy (NSOE) was created in 2001 by the Nevada State Legislature. The legislation, combined with earlier statues, provided for general duties including: energy and energy conservation, preparation of petroleum allocation and rationing plans (including administration of federal allocation programs), authorization to create regulations regarding energy conservation in buildings, administration of federal energy grant programs, and general provisions related to conflicts of interest. In later sessions, the Legislature authorized the NSOE to develop a program and distribute funds to install or improve net metering installations.

Beowawe Geothermal Area, Lander/Eureka Counties

Beowawe Power LLC/Caithness Operating has signed a 29-year power sales contract with Sierra Pacific Power Co. that took effect January 2006. Their existing contract with Southern California Edison expired in December 2005. The Beowawe power plant came on-line in December 1985 and has an equipment generating capacity of 16.6 MW. In 2005 electrical production at the plant was 106,464 MWh gross with 87,042 MWh net generation. (Nevada Division of Minerals, 2006)

Black Warrior Peak, Washoe County

Noramex Corporation, a wholly owned subsidiary of Nevada Geothermal Power, Inc. (NGP), has filed a geothermal lease application for 640 acres, located in Section 8, T23N, R25E, a project area they are calling Black Warrior Peak. The application is currently pending. This is in the same area that Noramex has acquired lease rights on 7 square miles of private land near Black Warrior Peak. The temperature gradient in this area was recorded as greater than 200ºC/km in 10 shallow gradient test holes drilled by Phillips Petroleum in the

PROPOSED ELECTRICAL GENERATION PLANTS IN NEVADA - 2006
Public Utilities Commission of Nevada, 2006

Name/Owner	Gross Megawatts	Plant Type	Location	Date Announced	Construction Status	Proposed On-line Date
Desert Peak 2/Ormat	25	Geothermal	Desert Peak KGRA, Churchill County	Nov. 2002	Complete	June 2006
Burdette 1/Ormat	20	Geothermal	Steamboat KGRA, Washoe County	July 2004	Complete	Online
Galena 2/Ormat[1]	13	Geothermal	Steamboat KGRA, Washoe County	Nov. 2002	Drilling	Late 2006
Boulder City Solar Project/ Solargenix Energy[2]	50	Solar	El Dorado Valley, Clark County	Dec. 2002	Under Construction	Early 2007
Ely Wind Generation Facility/ Carlson & Associates[3]	50	Wind	Ruth, White Pine County	Nov. 2002	Expected 2006	2007
Chuck Lenzie Generating Station/ Nevada Power Company[4]	1200	Natural Gas-Fired Combined Cycle	Moapa Valley, Clark County	June 2004	Complete	Mid 2006
Harry Allen Unit 4/ Nevada Power Company	80	CombustionTurbine Peaking Plant	Harry Allen Plant, Clark County	July 2003	Under Construction	Summer 2006
Tracy Combined Cycle GT Sierra Pacific Power Company	514	Combined Cycle	Tracy Power Plant, Storey County	July 2004	Under Construction	June 2008
Blue Mountain Geothermal/ Nevada Geothermal Power	30	Geothermal	Blue Mountain, Humboldt County	Oct. 2002	Drilling	2007
Granite Fox Power Project/ Sempra Energy	1450	Coal Fired	Gerlach, Washoe County	Winter 2004		
Western 102 Generation Project/ Barrick Goldstrike Mines[5]	115	Gas Fired Reciprocating Engines	Near Tracy, Storey County	Spring 2004	Completed	Dec. 2005
Salt Wells Geothermal Project/ Nevada Geothermal Specialists	10	Geothermal	Salt Wells, Churchill County	Spring 2004	Transmission line construction to design	2007
White Pine Project/ LS Power Associates	1600	Coal Fired	White Pine County	Winter 2004		Expected 2010
Ely Energy Project Sierra Pacific Power Company	1500+	Coal Fired	White Pine County	Jan. 2006		750 MW in 2011 + 750 MW in 2014
Ely Energy Project Sierra Pacific Power Company	1000	Coal Fired	White Pine County	Jan. 2006		TBD[6]
TS Power Plant/ Newmont Mining Corporation	200	Coal Fired	Eureka County	Spring 2004	Under Construction	June 2008
Toquop Energy Project/ Sithe Global	750	Coal Fired	Lincoln County	Mar. 2003		2010
Fallon Naval Air Station/Ormat	30	Geothermal	Churchill County	Jan. 2006		2010 - Phase 1
No. Nevada Corrections Center State of Nevada, Department of Corrections	1	Biomass	Carson City	Nov. 2005	Under Construction	early 2007

[1]Project location was changed from Desert Peak to Steamboat.
[2]Project has applied for participation in the Temporary Renewable Energy Development Program.
[3]Project has applied for participation in the Temporary Renewable Energy Development Program. Expansion phases planned.
[4]Nevada Power acquired the partially constructed power plant from Duke Energy.
[5]Barrick Goldstrike Mines exited Sierra Pacific's system under AB 661 and will sell 8MW back to the utility.
[6]Date to be determined for two 500-MW coal gasification units.

early 1980s. These holes where spread over a wide area with the deepest (NV-ST-1) recording a bottom-hole temperature of 128ºC at 552 m. (Nevada Geothermal Power Inc., Report for the year ending June 30, 2005)

Blue Mountain Geothermal Area, Humboldt County

Nevada Geothermal Power, Inc. (NGP), is starting their initial production well drilling program. Four 13-inch-diameter wells will be drilled to a depth of 4,000 feet to a moderate temperature geothermal target that has been identified in earlier drilling. One of these wells will go to 6,500 feet to explore for a hotter, 450ºF, reservoir that is predicted based on shallow geothermal fluid chemistry data. The current drilling program is aimed at developing a 30-MW power plant. If a suitable geothermal resource is identified in the deep well the production potential for this site could be as high as 100 MW. (Blue Mountain Geothermal Project, Nevada Geothermal Power, Inc., press release, May 15, 2006) The Blue Mountain area is located at T36N, R34E in south-central Humboldt County, Nevada.

Buffalo Valley Hot Springs, Lander County

Ormat Nevada, Inc. submitted applications to drill 10 temperature gradient wells and four observation wells spread through sections 22, 24, 25, 26, 27, 34, and 35 of T29N, R41E. (Nevada Geothermal Update, April 2006, Nevada Division of Minerals) The Buffalo Valley Hot Springs are located in the southeast part of Buffalo Valley in Section 23, T29N, R41E. They have historically reported surface temperatures up to 79°C mainly from 11 springs over an area of 1.2 hectares. The estimated thermal reservoir temperature using the silica geothermometer is 125°C. In 2002 temperatures ranged from 12 to 77.3°C in the 58 springs measured. The Na-K-Ca temperature from 2002 data is 130°C. Thermal groundwater is present over an area of about 5 km^2, with temperatures up to 89°C encountered in shallow test holes. (Geothermal Resources of Nevada as updated on the web at *www.nbmg.unr.edu/geothermal/site.php?sid=Buffalo%20Valley%20Hot%20Springs*).

Desert Peak Geothermal Area, Churchill County

Ormat Nevada, Inc. is planning to construct a new binary power plant near the existing 9.9-MW dual flash geothermal power plant at Desert Peak. The new project, Desert Peak 2, will consist of two independently operated Ormat Energy Converter (OEC) units. OEC-1 will be a 15-MW gross binary power plant cooled by a bank of air condensers. OEC-2 will be an 11-MW gross binary power plant unit cooled by a new two-cell condenser tower. Power generated from this project will be sold to Nevada Power Co. (The Public Utilities Commission of Nevada, Docket No. 05-3024, April 27, 2005)

The existing geothermal power plant at Desert Peak is a 9.9-MW dual-flash plant that produces from two production wells with an average depth of 3,683 feet and fluid temperature of 312ºF. Desert Peak has two injection wells with an average depth of 4,000 feet and injection temperature of 198ºF. The Desert Peak plant came online in 1985 and during 2005 had a gross output of 60,771 MWh and a net production of 50,506 MWh. (Nevada Division of Minerals, 2006)

Eight Mile Flat (Salt Wells), Churchill County

Nevada Geothermal Specialists, LLC. has received approval from the U.S. Bureau of Land Management to construct a 20-MW power plant at Eight Mile Flat near Salt Wells. As part of the Salt Wells project, they currently plan to build a 10-MW power plant first and bring a second 10-MW facility on-line later if the geothermal resource will support it. A new 6-mile-long, 230KV power line will link the plant to the Sierra Pacific Power Co. grid. At the end of 2004, AMP Resources, LLC. purchased the Salt Wells geothermal project, including all associated resource assets, from Nevada Geothermal Specialists, LLC. (Lahontan Valley News and Fallon Eagle Standard, March 1, 2005 and Nevada Division of Minerals, 2005) This geothermal area was originally drilled by Anadarko Petroleum Corporation in the early 1980s. (Bulletin Geothermal Resources Council, March/April 2004, v. 33, no. 2)

AMP Resources, LLC. has secured a new power sales contract for about 12 MW with Sierra Pacific Power Co. This will allow them to move forward with construction of the first Salt Wells Plant. (AMP Resources project web site: *www.ampresources.com/projects.php*)

Prior to AMP Resources, LLC taking over the Salt Wells project, the Nevada Division of Minerals issued a geothermal project area permit (#564PA) to Nevada Geothermal Specialists, LLC for this project. It anticipates development of six production wells with an estimated depth of 1,000 feet, four injection wells with an estimated depth of 3,000 feet, and ten observation wells with an estimated depth of 1,000 feet. One of the first wells drilled under this geothermal project area permit was the Industrial Production Well PW-2 (permit #568) drilled by Amp Resources, LLC in the spring of 2005 to a depth of 471 feet (143.6 m). Static temperature surveys showed a peak temperature of 145ºC and a flowing temperature of 140ºC. The well was flowed at a rate of 2,500 gallons per minute for 46 hours with no drawdown. (Nevada Division of Minerals, 2005, and Geothermal Resources of Nevada as updated on the web at *www.nbmg.unr.edu/geothermal/site.php?sid=Eightmile%20Flat*).

Fallon Naval Air Station, Churchill County

ORMAT Technologies has received a contract to build a 30-MW geothermal power plant at the Fallon Naval Air Station. The contract was signed on December 20, 2005

for a period of 50 years. The Navy will receive 5% of gross income for the first 20 years of power production and 15% of gross income for the remaining 30 years of the contract. Under terms of the contract, ORMAT will be responsible for drilling production and injection wells and for plant facility design and construction. Power produced by the plant will be sold to Sierra Pacific Power Co.

ORMAT anticipates spending $80 million in development of the resource and construction of the plant. A drilling program in the 4,000-acre project area will be undertaken to better define the extent and potential of the resource. ORMAT is also looking into obtaining rights on some potential geothermal resources located on BLM ground adjacent to the Naval Air Station. (Bulletin Geothermal Resources Council, January/February 2006, v. 35, no. 1)

Since the 1970s, the U.S. Navy has conducted a series of studies aimed at better defining the geothermal resource of the Naval Air Station. The Navy drilled a 6,952-foot well in August 1993, which had a maximum high temperature reading of 376ºF during a successful flow test. Geothermal fluid is believed to exist below an area of 10 km^2 or more. Current minimum estimated power potential of the Fallon geothermal resource is 30 MW. (Bulletin Geothermal Resources Council, July/August 2001, vol. 30, no. 4; and Garside, L.J. and others, Status of Nevada Geothermal Resource Development, Spring 2002, GRC Proceedings)

Hazen (Patua Hot Springs) Geothermal Area, Lyon and Churchill Counties

Geothermal Rail Industrial Development, LLC., (GRID) is developing a large renewable energy commercial and industrial park on property it owns in the Hazen geothermal area east of Reno. GRID currently owns approximately 4,500 acres in Lyon and Churchill Counties. They are pursuing acquisition of geothermal rights on additional acreage. During 2005 they drilled four geothermal gradient wells. This location is close to major highway and railway connections and less than an hour drive to an airport. Part of this area is located adjacent to the community of Fernley, Nevada. (Nevada Division of Minerals, 2006 and GRID Website, *www.gridusa.biz/index.htm*)

Hot Springs (Tipton) Ranch, Pumpernickel Valley, Humboldt County

Nevada Geothermal Power, Inc. (NGP), has completed a detailed gravity survey consisting of 282 stations in 14 east-west lines across the valley and fault zone within the project area. The project is located around a group of hot springs adjacent to the Pumpernickel Valley fault system. The survey has assisted in mapping the valley faults and their relationship to the geothermal resource. This survey, combined with an earlier resistivity survey, will help define the extent of the geothermal resource and assist in targeting future drilling.

NGP has a 100% leasehold interest in a 5 square mile area of potential geothermal lands from Newmont USA Ltd., and Inovision Solutions Inc. has an option to earn 50% joint venture interest in the NGP geothermal lease. Inovision, in exercising this option, will have to make certain cash payments, issue common shares to NGP, and commit $4.4 million in project development expenditures over 5 years. (Bulletin Geothermal Resources Council, March/April 2006, v. 35, no. 2)

Pyramid Lake Geothermal Area, Washoe County

The Pyramid Lake Paiute Tribe is undertaking the Pyramid Lake Energy Project to develop geothermal resources on their reservation. The project includes geophysical, gravity, and magnetic surveys in addition to a thermal gradient drill-hole program. Drilling of the gradient holes started in November of 2005 and three had been completed by March 2006 (Nevada Geothermal Update, April 2006, Nevada Division of Minerals). Part of the exploration and geophysical work is being done in collaboration with the University of Nevada, Reno, Great Basin Center for Geothermal Energy.

Steamboat Hot Springs, Washoe County

Ormat Nevada Inc. (ORMAT) has brought online the Richard Burdette Power Plant, which is part of the Galena Geothermal Project. This plant was formerly known as the Galena 1 project but has been renamed in honor of Governor Kenny Guinn's late energy advisor Richard Burdette Jr. The state-of-the-art 27-MW (nameplate capacity) power plant was completed on November 14, 2005 only 8 months after the ground breaking ceremony. This is the first power plant constructed in Nevada under the Nevada Renewable Portfolio Standard (RPS) legislation. It is a binary, air-cooled power plant with a closed fluid production cycle that allows 100% of geothermal fluids to be re-injected. (Nevada Geothermal Update, April 2006, Nevada Division of Minerals)

On May 9, 2006 Sierra Pacific Resources and ORMAT Technologies Inc. jointly announced that Sierra Pacific Power Co., Sierra Pacific Resources northern Nevada utility, and ORNI 14 LLC, a subsidiary of ORMAT Nevada, Inc., signed a 20-year 20-MW Power Purchase Agreement (PPA) for Galena No. 3, a new geothermal power plant being built as part of the Galena Geothermal Project. This plant is expected to increase the output currently supplied from the Steamboat Hot Springs to Sierra Pacific Power Co. by between 15 and 25 MW. The design of the Galena No. 3 plant will be similar to the Richard Burdette Power Plant above. (ORMAT press release, Reno, Nevada, May 9, 2006)

Stillwater Geothermal Area, Churchill County

AMP Resources, LLC. purchased the Stillwater Power Plant and associated geothermal resources from Stillwater Holdings, LLC., effective 12/31/2004. In August 2005 Amp Resources applied to the Nevada Public Utilities Commission (PUC) for a permit to construct a 37-MW binary geothermal power plant adjacent to the existing Stillwater power plant. In May 2006 the Nevada PUC approved a permit to build a 26-MW power plant. Upon completion the new power plant will replace the existing Stillwater plant, online since 1989, which will be dismantled. When the new plant is completed, in late 2007, it will be known as Stillwater 2 Geothermal Power Plant (AMP Resources Web Site: *www.ampresources.com/*). In 2005 electrical production at the Stillwater plant was 99,345 MWh gross with 60,321 MWh net generation. (Nevada Division of Minerals, 2006)

Nevada Geothermal Resources Map

The map entitled "Nevada geothermal resources," NBMG map 141 second edition, is authored by Lisa Shevenell and Larry J. Garside. The color map, 1:750,000-scale, shows active direct-use applications and power plants as of 2005, and all known thermal springs and wells on a topographic base map. This map may be purchased at the Nevada Bureau of Mines and Geology publications office or on the Web at *www.nbmg.unr.edu/sales/*. An Acrobat pdf file format version of this map can also be viewed and downloaded for free from the Web at *www.nbmg.unr.edu/dox/m141.pdf*.

A Web-enabled interactive version of this map can be accessed at www.nbmg.unr.edu/geothermal/gtmap.pdf . You can pan around on the interactive map, click on a geothermal area, and it will present detailed information on the particular geothermal resource, with many sites having additional links to maps and photos.

Geothermal Bibliography

An on-line searchable bibliography of approximately 1,400 geothermal references can be accessed on the Nevada Bureau of Mines and Geology Web site at *www.nbmg.unr.edu/geothermal/biblio/find.htm*. The full list of references can also be downloaded as a Microsoft Word file.

The Geothermal Resources map and the online bibliography are just two of the many online resources and links that are available under the general geothermal information Web page at the Nevada Bureau of Mines and Geology Web site *www.nbmg.unr.edu/geothermal/*.

The U.S. Department of Energy (DOE) Geothermal Technologies Program and the DOE Office of Scientific and Technical Information (OSTI) have scanned approximately 3,300 agency and national lab technical reports. These files are in a PDF, full text searchable, format and accessible online at *www.osti.gov/energycitations/*.

Web Links to Other Geothermal Information

For further information on geothermal resources in Nevada check the following Web sites or contact Ron Hess at 775-784-6691 Ext. 121 or via Email at *rhess@unr.edu*:

- Nevada Commission on Minerals, Nevada Division of Minerals at *http://minerals.state.nv.us/* or *http://minerals.state.nv.us/programs/ogg.htm.*
- Great Basin Center for Geothermal Energy at *www.unr.edu/geothermal/index.html*. This site contains geothermal exploration data, interactive maps, lease and incentive program information, and numerous geothermal digital data sets.
- GEO-HEAT CENTER, at *http://geoheat.oit.edu/*, Oregon Institute of Technology, Klamath Falls, Oregon.
- DOE/INEEL Geothermal Resource Location Maps for 13 Western States at *http://geothermal.id.doe.gov/maps-software*.
- Geothermal biz.com *www.geothermal-biz.com/* is part of the U.S. Department of Energy-led GeoPowering the West (GPW) initiative to dramatically increase the use of geothermal energy in the western United States, Alaska, and Hawaii.
- GeoPowering the West Web site at *www.eere.energy.gov/geopoweringthewest/*.
- Southern Methodist University Geothermal Lab Web page *www.smu.edu/geothermal/*.
- Geothermal Site Identification And Qualification Report, Prepared For: California Energy Commission, Public Interest Energy Research (PIER) Program. Report prepared by GeothermEx, Inc. This report provides summary information on potential power producing geothermal resources within California and Western Nevada that could supply additional power to the California market. The report can be found at *www.geothermex.com/CEC-PIER_Reports.htm*.
- Summary of Supporting Data for USGS Regional Heat-flow Studies of the Great Basin, 1970–1990, by John H. Sass, Susan S. Priest, Arthur H. Lachenbruch, S. Peter Galanis, Jr., Thomas H. Moses, Jr., John P. Kennelly, Jr., Robert J. Munroe, Eugene P. Smith, Frederick V. Grubb, Robert H. Husk, Jr., and Charles W. Mase; USGS Open-File Report 2005-1207 online version 1.0 on the Web at *http://pubs.usgs.gov/of/2005/1207/*.
- Geothermal Industry Temperature Profiles from the Great Basin, by John H. Sass, Susan S. Priest, Arnold J. Blanton, Penelope C. Sackett, Stephanie L. Welch, and Mark A. Walters; USGS Open-File Report 99-425 online version 1.0 on the Web at *http://wrgis.wr.usgs.gov/open-file/of99-425/webmaps/home.html*.

- Nevada Public Utilities Commission: *www.puc.state.nv.us/*.
- The Bureau of Land Management is pleased to announce that the public reports for the Land and Mineral Records-LR2000 system is now available for online use from 4:00 AM to 11:00 PM Mountain Time. The Bureau of Land Management Land and Mineral Records-LR2000 system Web address is *http://www.blm.gov/lr2000/*.
- GeoCommunicator is the publication site for the Bureau of Land Management's National Integrated Land System (NILS). GeoCommunicator provides searching, accessing and dynamic mapping of data for federal land stewardship, land and mineral use records, and land survey information. GeoCommunicator provides spatial display for land and mineral cases from BLM's LR2000 system. The Web address for the GeoCommunicator is *www.geocommunicator.gov/*.

NEVADA GEOTHERMAL POWER PLANTS 2005

Plant name (year on line)	Production capacity[1] (MW)	2005 Production (MWh) Gross	Net (sales)	Location	Operator
Beowawe (1985)	16.7 (16.6)	106,464	87,042	S13,T31N,R47E	Caithness Operating Beowawe Power, LLC 9790 Gateway Dr., Suite 200 Reno, NV 89521 (775) 850-2266
Bradys Hot Springs (1992)	26.1 (26.1)	165,493	115,838	S12,T22N,R26E	Brady Power Partners/ORMAT P.O. Box 649 Fernley, NV 89408 (775) 423-5800
Desert Peak (1985)	9.9 (12.5)	60,771	50,506	S21,T22N,R27E	Brady Power Partners/ORMAT P.O. Box 649 Fernley, NV 89408 (775) 423-5800
Dixie Valley (1988)	66.0 (62.0)	564,464	511,340	S7,T24N,R37E S33,T25N,R37E	Caithness Dixie Valley, LLC 9790 Gateway Dr., Suite 200 Reno, NV 89521 (775) 850-2266
Empire (1987)	4.6 (4.8)	33,814	23,317	S21,T29N,R23E	Empire Energy, LLC P.O. Box 40 Empire, NV 89405 (775) 557-2015
Soda Lake No. 1 (1987) and Soda Lake No. 2 (1991)	16.6 (26.1)	98,516	67,746	S33,T20N,R28E	AMOR IX 5500 Soda Lake Road Fallon, NV 89406 (775) 867-5093
Steamboat I, I-A (1986) and Steamboat II, III (1992) and Galena (2005)	83.0 (88.6)	381,246	282,563	S29,T18N,R20E	ORMAT Nevada 1010 Power Plant Road Reno, NV 89502 (775) 852-1444
Stillwater (1989)	13.0 (21.0)	99,345	60,321	S1,T19N,R30E S6,T19N,R31E	Amp Resources Stillwater Holdings, LLC 4785 Lawrence Lane Stillwater, NV 89406 (775) 329-0700
Wabuska (1984)	1.2 (2.2)	8,661	5,782	S15,16,T15N,R25E	Homestretch Geothermal 1147 N. Daybreak Dr. Washington, UT 84780 (435) 668-6003
Steamboat Hills formerly Yankee Caithness (1988)	14.44 (14.44)	72,166	64,336	S5,6,T17N,R20E	ORMAT Nevada 1010 Power Plant Road Reno, NV 89502 (775) 852-1444
TOTAL	251.5 (274.3)	1,590,940	1,268,791		

1. Production capacity from currently developed geothermal resources (equipment capacity in parentheses).
Sources: Plant operators, Nevada Division of Minerals, and NBMG files.

Geothermal Energy

by Ronald H. Hess

From: The Nevada Mineral Industry - 2006
Special Publication MI-2006
Nevada Bureau of Mines and Geology

Forty-three geothermal well permits were issued during 2006 by the Nevada Division of Minerals: one project area permit, 12 industrial production well permits, one commercial production well permit, one commercial injection well permit, three domestic well permits, 10 gradient well permits, and 15 observation well permits. A total of 14 geothermal wells of all types were reported as drilled during 2006. (Nevada Division of Minerals, 2007)

In Nevada, during 2006, there were 236 federal noncompetitive leases covering approximately 344,375 acres, an increase from 2005 of 76 leases and 100,114 acres. In 2006 there were 66 federal competitive leases covering 84,614 acres in Nevada, the number of competitive leases were unchanged from 2005. Total lease rental revenue value for 2006 was $370,000, an increase from the previous year of $114,175. In comparison, during 2006 there were 552 geothermal leases nationwide covering 593,200 acres of which 302 leases covering 428,989 acres were in Nevada. (Rich Hoops, BLM, oral commun., 2007)

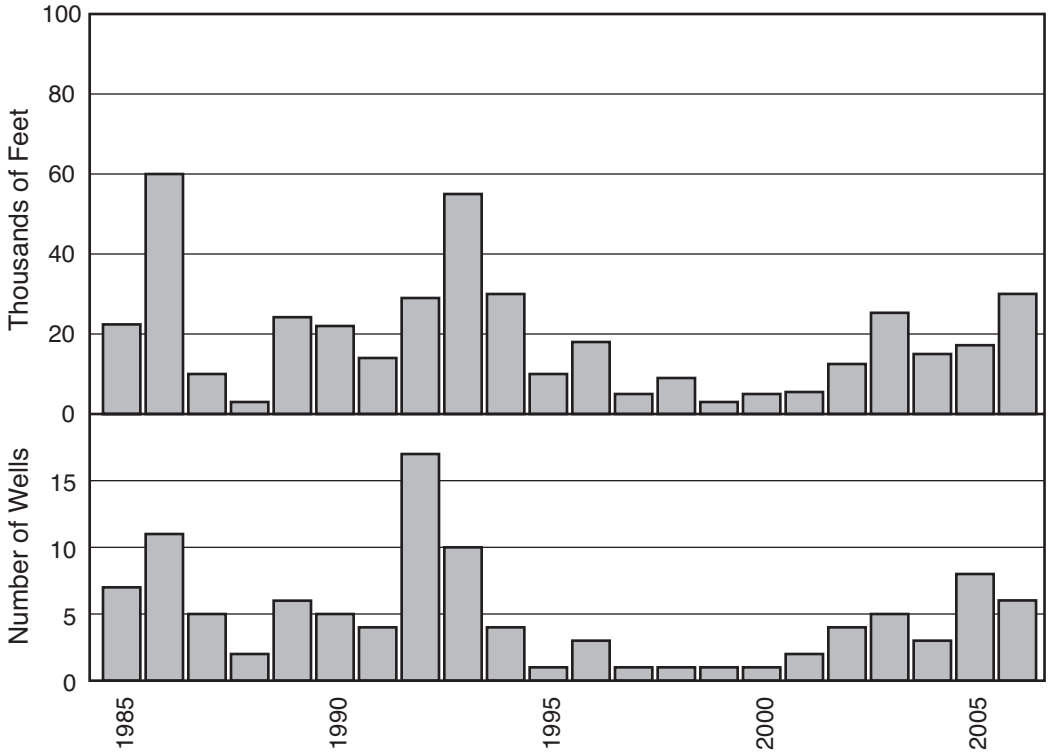
Total gross electrical production during 2006 from geothermal resources on public lands was 1.16 million megawatt-hours (MWh), a decrease of 17,000 MWh from 2005; net production was approximately 995,800 MWh, an increase of 1,891 MWh over 2005. Gross electrical sales from federal lands in 2006 were $55.6 million, a decrease of $2 million from 2005. Geothermal production royalties for Nevada was $2 million in 2006. By regulation, half of all Federal geothermal lease rental fees and production royalties are returned to the state. For 2006, $185,000 in lease rental fees and $1,000,000 in royalty production fees should be returned to Nevada. (Rich Hoops, BLM, oral commun., 2007)

Total Nevada geothermal electrical production in 2006 from federal and fee lands combined was 1,683,585 MWh gross and 1,332,997 MWh net (Nevada Division of Minerals, 2007) with an approximate sales value of $74.4 million. This was an increase in gross production of 92,645 MWh and net production of 64,206 MWh from 2005. Production capacity from the currently developed geothermal resources at ten existing geothermal power production sites in Nevada is 264.7 megawatts (MW), a 13.2 MW increase from 2005. Currently installed equipment, or nameplate, capacity for the same sites totals 284.9 MW. The table on page 77 lists operators, plant locations, and energy production for individual Nevada geothermal power producers at the end of 2006. Nevada is second only to California in total installed geothermal generating capacity.

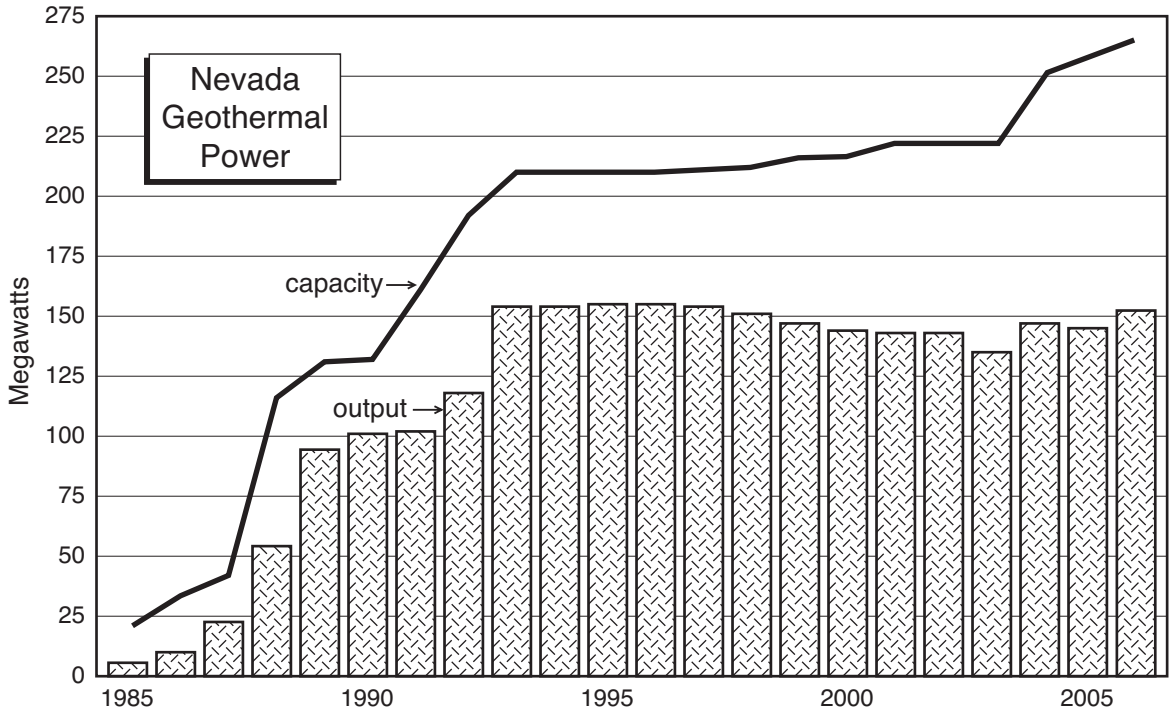
The geothermal resources map of the United States on page 72, based on estimated subterranean temperatures at a depth of 6 kilometers, indicates that

NONDOMESTIC GEOTHERMAL WELLS REPORTED AS DRILLED, REDRILLED, OR COMPLETED IN NEVADA DURING 2006

Area	Company Name	Well name	Permit#	Location	Type	Permitted Depth (feet)
Humboldt County						
Blue Mountain	Noramex Corp. (NV Geothermal Power)	Thermal Gradient TG-7	613	NW¼, NW¼, S14, T36N, R34E	Gradient	1640
	Noramex Corp. (NV Geothermal Power)	Thermal Gradient TG-12	614	SW¼, SE¼, S22, T36N, R34E	Gradient	1640
	Noramex Corp. (NV Geothermal Power)	Industrial Production Well 26A-14	617	NW¼, SW¼, S14, T36N, R34E	Production	6000
	Noramex Corp. (NV Geothermal Power)	Industrial Production Well 38-14	618	SW¼, SW¼, S14, T36N, R34E	Production	6000
	Noramex Corp. (NV Geothermal Power)	Industrial Production Well 34-23	639	SE¼, NW¼, S23, T36N, R34E	Production	6000
	Noramex Corp. (NV Geothermal Power)	Industrial Production Well 66-14	640	NW¼, SE¼, S14, T36N, R34E	Production	6000
Elko County						
Humboldt Wells	Vosika King Limited Partnership	Commercial Production Well	622	Wells, Nevada	Production	600
Hot Sulphur Springs (Tuscarora Geothermal Area)	TG Power, LLC	Observation Well 87-5	674	SE¼, SE¼, S5, T41N, R52E	Observation	3500
Esmeralda County						
Fish Lake Valley	Esmeralda Energy Company	Observation Well Emigrant 17-31	643	SW¼, SW¼, S31, T1N, R37E	Observation	4000
Washoe County						
Steamboat Hot Springs	Steamboat Development Corp.	Industrial Production Well 38B-28	567	SE¼, SW¼, S28, T18N, R20E	Production	850
Gerlach	Gerlach Green Energy, LLC	Industrial Production Well 68-3	633	SW¼, SE¼, S3, T32N, R23E	Production	6000



Industrial-class (power generating) wells drilled in Nevada, 1985–2006. Depth taken from original drilling permit.



Currently developed resource capacity and average net output of Nevada geothermal plants, 1985–2006. Average net output is annual sales in megawatt-hours divided by the number of hours in a year (8,760). No commercial geothermal power was produced in Nevada before 1985.

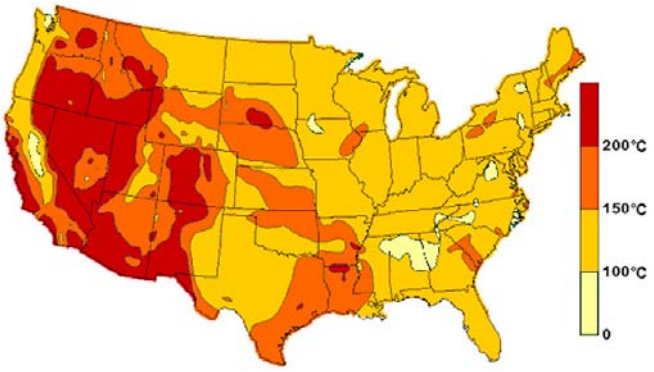
Nevada will continue to be a prime location for the development of various types of energy production facilities that will utilize naturally occurring steam, hot water, and hot dry rocks. (U.S. Department of Energy - Energy Efficiency and Renewable Energy Geothermal Technologies Program; www.eere.energy.gov/geothermal/printable_versions/geomap.html)

The availability of this resource will ensure that the geothermal industry in Nevada will continue to grow and develop a wide variety of clean renewable energy projects for the foreseeable future.

The table on proposed power generation plants in Nevada (from the Public Utilities Commission of Nevada, May 2007) includes both conventional and renewable power generation projects. For the 21 projects listed, it shows the project proposed size, location, permitting status, and if project construction has started.

Desert Peak Geothermal Area, Churchill County

Ormat Nevada, Inc. has constructed a new 23-MW binary power plant near the old 9.9-MW dual flash geothermal power plant at Desert Peak. The original geothermal power plant at Desert Peak came online in 1985 and was decommissioned in May 2006. The new plant came online in August 2006. Power generated from this project will be sold to Nevada Power Co. (The Public Utilities Commission of Nevada, Docket No. 05-3024, April 27, 2005 and Nevada Division of Minerals, 2007)



Geothermal resources map of the United States (2006) showing the estimated subterranean temperatures at a depth of 6 kilometers. To determine the Earth's internal temperature at any depth below the capabilities of normal well drilling, multiple data sets are synthesized. The data used for this figure are: thermal conductivity, thickness of sedimentary rock, geothermal gradient, heat flow, and surface temperature. (U.S. Department of Energy - Energy Efficiency and Renewable Energy Geothermal Technologies Program)

Eight Mile Flat (Salt Wells), Churchill County

Prior to AMP Resources, LLC taking over the Salt Wells project, the Nevada Division of Minerals issued a geothermal project area permit (#564PA) to Nevada Geothermal Specialists, LLC for this project. It anticipated development of six production wells with an estimated depth of 1,000 feet, four injection wells with an estimated depth of 3,000 feet, and ten observation wells with an estimated depth of 1,000 feet. One of the first wells drilled under this geothermal project area permit was the Industrial Production Well PW-2 (permit #568) drilled by Amp Resources, LLC in the spring of 2005 to a depth of 471 feet (143.6 m). Static temperature surveys showed a peak temperature of 145ºC and a flowing temperature of 140ºC. The well was flowed at a rate of 2,500 gallons per minute for 46 hours with no drawdown. (Nevada Division of Minerals, 2005, and Geothermal Resources of Nevada as updated on the Web at www.nbmg.unr.edu/geothermal/site.php?sid=Eightmile%20Flat)

A transmission line to the site of the proposed 26-MW power plant has been completed. (Great Basin Center for Geothermal Energy, Current Geothermal Exploration Activity: www.unr.edu/geothermal/explactivity.htm) On March 20, 2007, Enel North America, Inc. purchased AMP Resources, LLC. from AMP Capital Partners and a minority investor. Enel North America, Inc. is a subsidiary of Enel S.p.A., Italy. The Nevada Division of Minerals has issued a geothermal project area permit (#698PA) to Enel Salt Wells, LLC, to drill up to eight production wells each with an estimated depth of 1,000 feet, eight injection wells with an estimated depth of 3,000 feet each, and 10 observation wells. The project area is located in Sections 23, 24, 25, 26, 35, and 36 of T17N, R30E.

Desert Peak geothermal area, Churchill County, Ormat Nevada, Inc. The water cooling tower and fan cooling towers to the right in the picture and the equipment around them are part of the new Desert Peak geothermal power plant. The larger structures in the center rear of the photo are parts of the old Desert Peak power plant that is now decommissioned. (*Ron Hess photo*)

PROPOSED ELECTRICAL GENERATION PLANTS IN NEVADA - 2007
Public Utilities Commission of Nevada, 2007

Name/Owner	Gross Megawatts	Plant Type	Location	Date Announced	Construction Status	Proposed On-line Date
Galena 2/Ormat	10	Geothermal	Steamboat KGRA, Washoe County	Nov. 2002	Under Construction	Late 2006
Nevada Solar One/ Solargenix Energy	50	Solar	El Dorado Valley, Clark County	Dec. 2002	Under Construction	Early 2007
Ely Wind Generation Facility/ Carlson & Associates	50	Wind	Ruth, White Pine County	Nov. 2002		2007
Harry Allen Unit 4/ Nevada Power Company	80	CombustionTurbine Peaking Plant	Harry Allen Plant, Clark County	July 2003	Under Construction	Summer 2006
Tracy Combined Cycle GT Sierra Pacific Power Company	514	Combined Cycle	Tracy Power Plant, Storey County	July 2004	Under Construction	June 2008
Falkner 1/ Nevada Geothermal Power	25	Geothermal	Blue Mountain, Humboldt County	Oct. 2002	Drilling	December 2009
Granite Fox Power Project/ Sempra Energy	1450	Coal Fired	Gerlach, Washoe County	Winter 2004		
Galena 3/Ormat	20	Geothermal	Steamboat, Washoe County	May 2006	Under Construction	Early 2008
Salt Wells Geothermal Project/ Nevada Geothermal Specialists	17	Geothermal	Salt Wells, Churchill County	Spring 2004		August 2008
White Pine Project/ LS Power Associates	1600	Coal Fired	White Pine County	Winter 2004		2010
Ely Energy Project/ Sierra Pacific Power Company	1500	Coal Fired	White Pine County	Jan. 2006		2011-2013
Ely Energy Project - Phase 2/ Sierra Pacific Power Company	1000	Coal Fired	White Pine County	Jan. 2006		TBD
TS Power Plant/ Newmont Mining Corporation	206	Coal Fired	Eureka County	Spring 2004	Under Construction	May 2008
Toquop Energy Project/ Sithe Global	750	Coal Fired	Lincoln County	Mar. 2003		2010
Carson Lake - Fallon Naval Air Station/Ormat	30	Geothermal	Churchill County	July 2006	PPA Contract signed	Mid 2008 Phase 1
N. Nevada Corrections Center/ State of Nevada, Department of Corrections	1	Biomass	Carson City	Nov. 2005	Under Construction	Early 2007
Buffalo Valley (ORNI 15)/Ormat	32	Geothermal	Lander County	July 2006	PPA Contract signed	Mid 2008
Stillwater/AMP Resources	34	Geothermal	Churchill County	2006	Contract filed for approval	August 2008
Hot Sulphur Springs/ TG Power	25	Geothermal	Elko County	Late 2006		2008
Carson Lake (ORNI 16)/Ormat	24	Geothermal	Churchill County	2006	Contract filed for approval	December 2009
Vulcan Power/Fish Creek	30	Geothermal	Esmeralda County	2006	SCE contract approval	TBA

Stillwater Geothermal Area, Churchill County

AMP Resources, LLC. purchased the Stillwater Power Plant and associated geothermal resources from Stillwater Holdings, LLC., effective 12/31/2004. In August 2005, Amp Resources applied to the Nevada Public Utilities Commission (PUC) for a permit to construct a 37-MW binary geothermal power plant adjacent to the existing Stillwater power plant. In May 2006 the Nevada PUC approved a permit to build a 26-MW power plant. Upon completion the new power plant will replace the existing Stillwater plant, online since 1989, which will be dismantled. When the new plant is completed in late 2007, it will be known as Stillwater 2 Geothermal Power Plant. On March 20, 2007, Enel North America, Inc. purchased AMP Resources, LLC. from AMP Capital Partners and a minority investor. Enel North America, Inc. is a subsidiary of Enel S.p.A., Italy. In 2006 electrical production at the Stillwater plant was 84,727 MWh gross with 49,352 MWh net generation. (Nevada Division of Minerals, 2007)

Blue Mountain Geothermal Area, Humboldt County

Nevada Geothermal Power, Inc. (NGP), has started its initial production well drilling program. Four 13-inch-diameter wells will be drilled to a depth of 4,000 feet to a moderate temperature geothermal target that was identified in earlier drilling. One of these wells will go to 6,500 feet to explore for a hotter (450ºF) reservoir that is predicted based on shallow geothermal fluid chemistry data. The current drilling program is aimed at developing a 30-MW power plant. If a suitable geothermal resource is identified in the deep well, the production potential for this site could be as high as 100 MW. NGP has increased its leased ground to approximately 9,600 acres. (Blue Mountain Geothermal Project, Nevada Geothermal Power, Inc., press release, May 15, 2006, and Bulletin Geothermal Resources Council, May/June 2006, v. 35, no. 3) The Blue Mountain area is located at T36N, R34E in south-central Humboldt County, Nevada.

Blue Mountain geothermal area, Humboldt County, Nevada Geothermal Power Co. industrial production well 23-14 (Nevada state permit number 635) being flow tested. Approximate flow rate of 1,800 gallons per minute at +/-375º F at the well head. (*Ron Hess photo*)

Hot Springs (Tipton) Ranch, Pumpernickel Valley, Humboldt County

Nevada Geothermal Power, Inc. (NGP) and ORMAT Technologies, Inc. have entered into an agreement to construct a binary geothermal power plant at NGP's Pumpernickel Valley project area. Part of this agreement included acquiring a 933.5-acre lease from ORMAT to consolidate NGP's land holdings in the project area. NGP has also acquired an additional 1,920-acre lease directly from the BLM. These leases are a significant increase to the previous holdings the company has in Pumpernickel Valley.

Upcoming development work will include drilling up to three 820-foot gradient wells to better define the geothermal resource and then drill a deep production test well to confirm the potential of the geothermal field. (Bulletin Geothermal Resources Council, July/October 2006, v. 35, no. 4)

Beowawe Geothermal Area, Lander/Eureka Counties

Beowawe Power LLC/Caithness Operating signed a 29-year power sales contract with Sierra Pacific Power Co., which took effect January 2006. Their existing contract with Southern California Edison expired in December 2005. The Beowawe power plant came on-line in December 1985 and has an equipment generating capacity of 16.6 MW. In 2006 electrical production at the plant was 132,747 MWh gross and 113,935 MWh net. (Nevada Division of Minerals, 2007)

Buffalo Valley Hot Springs, Lander County

Ormat Nevada, Inc. submitted applications to drill 10 temperature gradient wells and four observation wells spread through Sections 22, 24, 25, 26, 27, 34, and 35 of T29N, R41E. (Nevada Geothermal Update, April 2006, Nevada Division of Minerals) The Buffalo Valley Hot Springs are located in the southeast part of Buffalo Valley in Section 23, T29N, R41E. They have historically reported surface temperatures up to 79°C mainly from 11 springs over an area of 1.2 hectares. The estimated thermal reservoir temperature using the silica geothermometer is 125°C. In 2002 temperatures ranged from 12 to 77.3°C in the 58 springs measured. The Na-K-Ca temperature from 2002 data is 130°C. Thermal groundwater is present over an area of about 5 square kilometers, with temperatures up to 89°C encountered in shallow test holes. (Geothermal Resources of Nevada as updated on the web at www.nbmg.unr.edu/geothermal/site.php?sid=Buffalo%20Valley%20Hot%20Springs).

Grass Valley Area, Lander County

A subsidiary of Ormat Technologies, Inc. announced that it had signed a 20-year Power Purchase Agreement (PPA) with Nevada Power Company for energy that will be produced from the Grass Valley Geothermal Power Plant, which will be built in Lander County Nevada. The plant will have a gross output of between 18 and 30 MW. (www.ormat.com/investor-relations/news-releases/5/24/07) The site is in the vicinity of Hot Springs at Hot Springs Point, on the west side of Grass Valley, Lander County. A series of gradient and observation well permits have been issued with some having already been drilled. The wells are in Sections 15, 16, and 21 of T24N, R47E. In 2005 Ormat ran chemical analyses on 90.5ºC hot spring discharge that indicated a potential 177ºC reservoir temperature based on silica geothermometery. Ormat developed a geologic model that indicates that a concealed fault may exist 760 meters northeast of the hot springs. It is probable that hot water circulating up this fault is providing source fluids for the nearby hot springs. (Geothermal Resources of Nevada, Hot Springs at Hot Springs Point (Grass Valley), on the Web at www.nbmg.unr.edu/geothermal/site.php?sid=Hot%20Springs%20at%20Hot%20Springs%20Point.

Wabuska Hot Springs, Lyon County

Homestretch Geothermal, operator of the Wabuska Geothermal Power Plant, and Infinifuel Biodiesel entered into an agreement to form Infinifuel Wabuska, LLC. Using a reconditioned former ethanol plant, Infinifuel Wabuska is currently producing under 1 million gallons per year of biodiesel but has the capacity to produce 4–5 million gallons per year as sources for the raw materials are developed. Biodiesel is a diesel fuel replacement that can be created from vegetable and other plant oils, and will run in unmodified diesel engines. The company is working with the University of Nevada Reno Agricultural Extension office and the Desert Research Institute to experiment with and promote the planting of various oilseed crops as a rotation crop with hay and alfalfa in Nevada. If successful it would produce a cost-effective local source of raw material for the biodiesel plant. Algae is also being considered as a source crop for the plant. The algae, using warm geothermal water, could be grown and harvested on site. The plant is using electricity and hot water produced from the existing Wabuska Geothermal Power Plant to power the biodiesel conversion process. (Geothermal Heat Center Bulletin, March 2007 and Infinifuel Biodiesel announcement: www.infinifuel.com/wabuska.htm)

The Wabuska power plant came on-line in 1984 and has an equipment generating capacity of 2.2 MW. In 2006 electrical production at the plant was 8,234 MWh gross with 5,120 MWh net generation. (Nevada Division of Minerals, 2007)

Pyramid Lake Geothermal Area, Washoe County

The Pyramid Lake Paiute Tribe is undertaking the Pyramid Lake Energy Project to develop geothermal resources on their reservation. The project includes geophysical, gravity, and magnetic surveys in addition to a thermal gradient drill-hole program. Drilling of the gradient holes started in November of 2005, and three had been completed by March 2006 (Nevada Geothermal Update, April 2006, Nevada Division of Minerals, http://minerals.state.nv.us/forms/ogg/ogg_NGU/NVGeothermalUpdate2006.04.pdf). Part of the exploration and geophysical work is being done in collaboration with the University of Nevada, Reno, Great Basin Center for Geothermal Energy.

Steamboat Hot Springs, Washoe County

On May 9, 2006, Sierra Pacific Resources and ORMAT Technologies Inc. jointly announced that Sierra Pacific Power Co., Sierra Pacific Resources northern Nevada utility, and ORNI 14 LLC, a subsidiary of ORMAT Nevada, Inc., signed a 20-year 20-MW Power Purchase Agreement (PPA) for Galena No. 3, a new binary geothermal power plant being built as part of the Galena Geothermal Project. This plant is expected to increase the output currently supplied from the Steamboat Hot Springs to Sierra Pacific Power Co. by between 15 and 25 MW. The design of the Galena No. 3 plant will be similar to the existing Richard Burdette Power Plant. This is the tenth PPA signed between ORMAT and Sierra Pacific Power in Nevada and the fourth signed since Nevada's renewable energy portfolio standard has been enacted by the Nevada State Legislature in 2001. (ORMAT press release, Reno, Nevada, May 9, 2006, and Bulletin Geothermal Resources Council, May/June 2006, v. 35, no. 3)

Steamboat Hot Springs - Redfield Campus, Washoe County

The Redfield Campus and the UNR Renewable Energy Center, a partnership between the University of Nevada, Reno, Truckee Meadows Community College, Desert Research Institute, the Regional Transportation Commission, Sierra Pacific Power, and Ormat Nevada, has the potential to become a world-class research facility in the field of renewable energy resources.

In 1995 the Nell J. Redfield Foundation donated land for the campus, southwest of the junction of the Mount Rose Highway and U.S. 395. A year later, the foundation pledged $5 million to help construct the inaugural building. In 1999 the Nevada Legislature allocated $5.2 million for the project.

The Redfield Campus is located at the south end of Reno, adjacent to the Steamboat Springs geothermal area. Ormat Nevada, which operates the geothermal power plants at Steamboat Springs, has agreed to contribute one megawatt of electricity from geothermal energy, 600 gallons per minute of 180ºF water (enough to heat the campus buildings), and 100 gallons per minute of 300ºF water at no cost, for research purposes.

In addition to geothermal energy research and education, the Redfield Campus will focus on other renewable energy technology including solar thermal energy, solar photovoltaic energy, wind energy, hydrogen energy, heat exchange development, and waste materials energy. (Great Basin Center for Geothermal Energy, UNR Renewable Energy Center: www.unr.edu/geothermal/UNRREC.htm)

Nevada Geothermal Resources Map

The map entitled *Nevada geothermal resources*, NBMG Map 141 (Second Edition), by Lisa Shevenell and Larry J. Garside, shows active direct-use applications and power plants as of 2005, and all known thermal springs and wells on a topographic base map. This map may be purchased at the Nevada Bureau of Mines and Geology publications office or on the Web at www.nbmg.unr.edu/sales.htm. An Acrobat pdf file of this map can also be viewed and downloaded for free from the Web at www.nbmg.unr.edu/dox/m141.pdf.

A Web-enabled interactive version of this map can be accessed at www.nbmg.unr.edu/geothermal/gtmap.pdf. You can pan around on the interactive map, click on a geothermal area, and it will present detailed information on the particular geothermal resource, with many sites having additional links to maps and photos.

Geothermal Bibliography

An online searchable bibliography of approximately 1,400 geothermal references can be accessed on the Nevada Bureau of Mines and Geology Web site at www.nbmg.unr.edu/geothermal/biblio/find.htm. The full list of references can also be downloaded as a Microsoft Word file.

The Geothermal Resources map and the online bibliography are just two of the many online resources and links that are available under the general geothermal information Web page at the Nevada Bureau of Mines and Geology Web site www.nbmg.unr.edu/geothermal/.

The U.S. Department of Energy (DOE) Geothermal Technologies Program and the DOE Office of Scientific and Technical Information (OSTI) have scanned approximately 3,300 agency and national lab technical reports. These files are in a PDF, full text searchable, format and accessible online at www.osti.gov/energycitations/.

Web Links to Other Geothermal Information

For further information on geothermal resources in Nevada, check the following Web sites or contact Ron Hess at 775-784-6692 or via Email at rhess@unr.edu:

- Nevada Commission on Minerals, Nevada Division of Minerals (http://minerals.state.nv.us/ or http://minerals.state.nv.us/programs/ogg.htm).
- Great Basin Center for Geothermal Energy at www.unr.edu/geothermal/index.html. This site contains geothermal exploration data, interactive maps, lease and incentive program information, and numerous geothermal digital data sets.
- GEO-HEAT CENTER, Oregon Institute of Technology, Klamath Falls, Oregon (http://geoheat.oit.edu/).
- DOE/INEEL Geothermal Resource Location Maps for 13 Western States (http://geothermal.id.doe.gov/maps-software).
- Geothermal biz.com (http://www.geothermal-biz.com/) is part of the U.S. Department of Energy-led GeoPowering the West (GPW) initiative to dramatically increase the use of geothermal energy in the western United States, Alaska, and Hawaii.
- GeoPowering the West Web site (www.eere.energy.gov/geopoweringthewest/).
- Southern Methodist University Geothermal (www.smu.edu/geothermal/).
- *Geothermal Site Identification and Qualification Report*, prepared for: California Energy Commission, Public Interest Energy Research (PIER) Program. Report prepared by GeothermEx, Inc. This report provides summary information on potential power producing geothermal resources within California and Western Nevada that could supply additional power to the California market. The report can be found at www.geothermex.com/CEC-PIER_Reports.htm.
- *Summary of Supporting Data for USGS Regional Heat-flow Studies of the Great Basin, 1970-1990*, by John H. Sass, Susan S. Priest, Arthur H. Lachenbruch, S. Peter Galanis, Jr., Thomas H. Moses, Jr., John P. Kennelly, Jr., Robert J. Munroe, Eugene P. Smith, Frederick V. Grubb, Robert H. Husk, Jr., and Charles W. Mase; USGS Open-File Report 2005-1207 online version 1.0 on the Web at http://pubs.usgs.gov/of/2005/1207/.

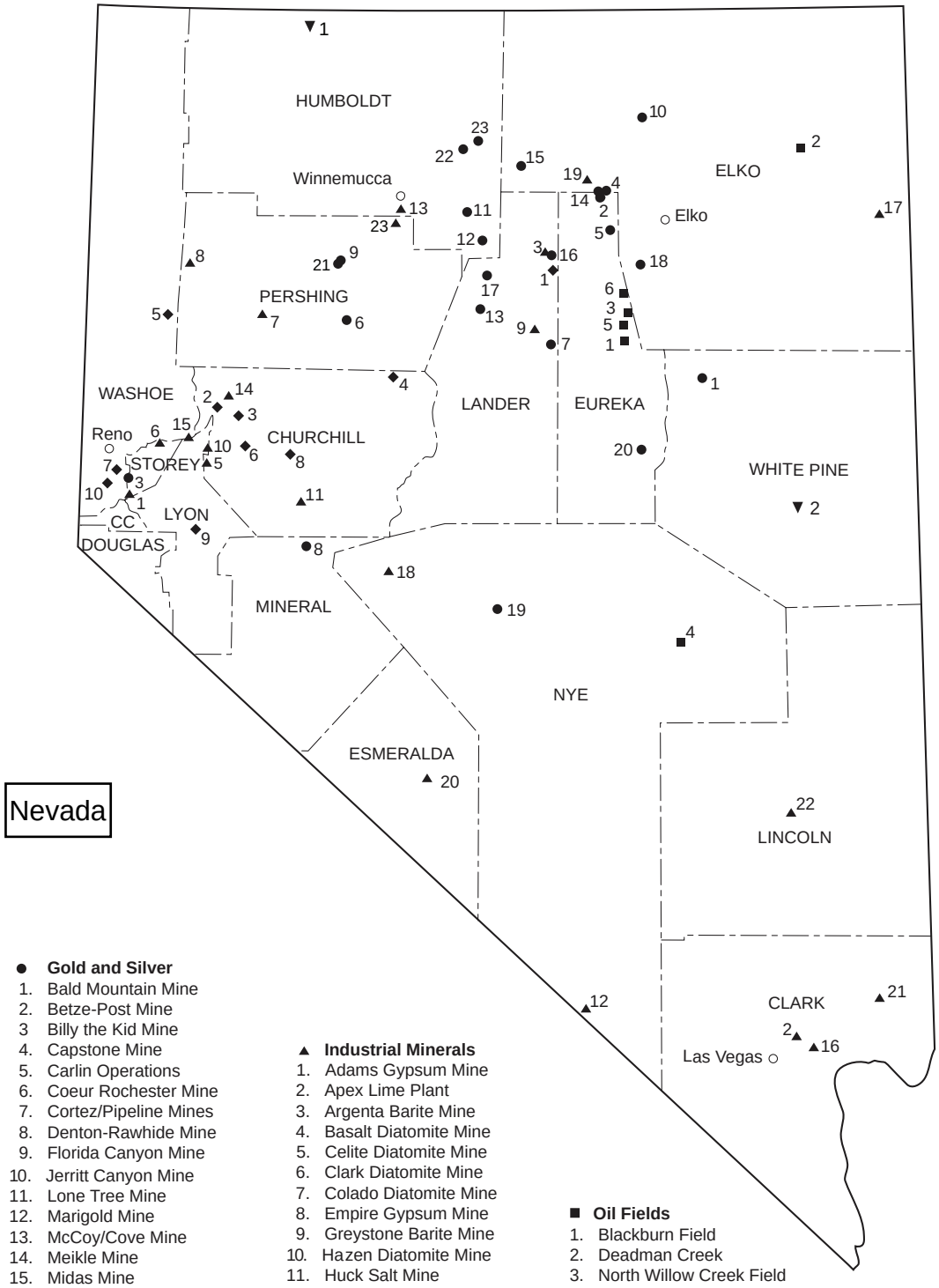
- *Geothermal Industry Temperature Profiles from the Great Basin*, by John H. Sass, Susan S. Priest, Arnold J. Blanton, Penelope C. Sackett, Stephanie L. Welch, and Mark A. Walters; USGS Open-File Report 99-425 online version 1.0 on the Web at http://wrgis.wr.usgs.gov/open-file/of99-425/webmaps/home.html.
- Nevada Public Utilities Commission (www.puc.state.nv.us/).
- The Bureau of Land Management Land and Mineral Records-LR2000 system (www.blm.gov/lr2000/).
- GeoCommunicator is the publication site for the Bureau of Land Management's National Integrated Land System (NILS). GeoCommunicator provides searching, accessing and dynamic mapping of data for federal land stewardship, land and mineral use records, and land survey information. GeoCommunicator provides spatial display for land and mineral cases from BLM's LR2000 system (www.geocommunicator.gov/).

NEVADA GEOTHERMAL POWER PLANTS 2006

Plant name (year on line)	Production capacity[1] (MW)	2006 Production (MWh) Gross	Net (sales)	Location	Operator
Beowawe (1985)	16.7 (16.6)	132,747	113,935	S13,T31N,R47E	Caithness Operating Beowawe Power, LLC 9790 Gateway Dr., Suite 200 Reno, NV 89521 (775) 850-2266
Bradys Hot Springs (1992)	26.1 (26.1)	179,464	119,842	S12,T22N,R26E	Brady Power Partners/ORMAT P.O. Box 649 Fernley, NV 89408 (775) 423-5800
Desert Peak (1985)/ Desert Peak II (2006)[2]	23 (23)	64,740	52,683	S21,T22N,R27E	Brady Power Partners/ORMAT P.O. Box 649 Fernley, NV 89408 (775) 423-5800
Dixie Valley (1988)	66.0 (62.0)	550,140	500,449	S7,T24N,R37E S33,T25N,R37E	Caithness Dixie Valley, LLC 9790 Gateway Dr., Suite 200 Reno, NV 89521 (775) 850-2266
Empire (1987)	4.6 (4.8)	35,571	25,604	S21,T29N,R23E	Empire Energy, LLC P.O. Box 40 Empire, NV 89405 (775) 557-2015
Soda Lake No. 1 (1987) and Soda Lake No. 2 (1991)	16.6 (26.1)	100,831	67,880	S33,T20N,R28E	AMOR IX 5500 Soda Lake Road Fallon, NV 89406 (775) 867-5093
Steamboat I, I-A (1986) and Steamboat II, III (1992) and Galena (2005)	83.0 (88.6)	455,225	334,867	S29,T18N,R20E	ORMAT Nevada 1010 Power Plant Road Reno, NV 89502 (775) 852-1444
Stillwater (1989)	13.0 (21.0)	84,727	49,352	S1,T19N,R30E S6,T19N,R31E	Amp Resources Stillwater Holdings, LLC 4785 Lawrence Lane Stillwater, NV 89406 (775) 329-0700
Wabuska (1984)	1.2 (2.2)	8,234	5,120	S15,16,T15N,R25E	Homestretch Geothermal 1147 N. Daybreak Dr. Washington, UT 84780 (435) 668-6003
Steamboat Hills formerly Yankee Caithness (1988)	14.5 (14.5)	71,906	63,265	S5,6,T17N,R20E	ORMAT Nevada 1010 Power Plant Road Reno, NV 89502 (775) 852-1444
TOTAL	264.7 (284.9)	1,683,585	1,332,997		

1. Production capacity from currently developed geothermal resources (equipment capacity in parentheses).
Sources: Plant operators, Nevada Division of Minerals, and NBMG files.

2. Desert Peak II is a new binary power plant that was built to replace the original steam turbine power plant at Desert Peak, which was permanently shut down on May 1, 2006. The new power plant came on-line on August 1, 2006 with a generation capacity of 23 MW, twice that of the original power plant.



- **Gold and Silver**
1. Bald Mountain Mine
2. Betze-Post Mine
3 Billy the Kid Mine
4. Capstone Mine
5. Carlin Operations
6. Coeur Rochester Mine
7. Cortez/Pipeline Mines
8. Denton-Rawhide Mine
9. Florida Canyon Mine
10. Jerritt Canyon Mine
11. Lone Tree Mine
12. Marigold Mine
13. McCoy/Cove Mine
14. Meikle Mine
15. Midas Mine
16. Mule Canyon Mine
17. Phoenix Project
18. Rain Mine
19. Round Mountain Mine
20. Ruby Hill Mine
21. Standard Mine
22. Turquoise Ridge Joint Venture
23. Twin Creeks Mine

▼ **Copper and Molybdenum**
1. Ashdown Molybdenum Mine
2. Robinson Copper Mine

▲ **Industrial Minerals**
1. Adams Gypsum Mine
2. Apex Lime Plant
3. Argenta Barite Mine
4. Basalt Diatomite Mine
5. Celite Diatomite Mine
6. Clark Diatomite Mine
7. Colado Diatomite Mine
8. Empire Gypsum Mine
9. Greystone Barite Mine
10. Hazen Diatomite Mine
11. Huck Salt Mine
12. IMV Nevada Clay
13. MIN-AD Dolomite Mine
14. Moltan Diatomite Mine
15. NCC Limestone Quarry
16. PABCO Gypsum
17. Pilot Peak Limestone Quarry
18. Premier Magnesite Mine
19. Rossi Barite Mine
20. Silver Peak Lithium Carbonate
21. Simplot Silica Products
22. Tenacity Perlite Mine
23. W.Glen Sexton Dolomite Mine

■ **Oil Fields**
1. Blackburn Field
2. Deadman Creek
3. North Willow Creek Field
4. Railroad Valley (Eagle Springs, Trap Spring, Currant, Sand Dune, Grant Canyon, Bacon Flat, Kate Spring, Duckwater Creek, Sans Spring, and Ghost Ranch Fields)
5. Three Bar Field
6. Tomera Ranch Field

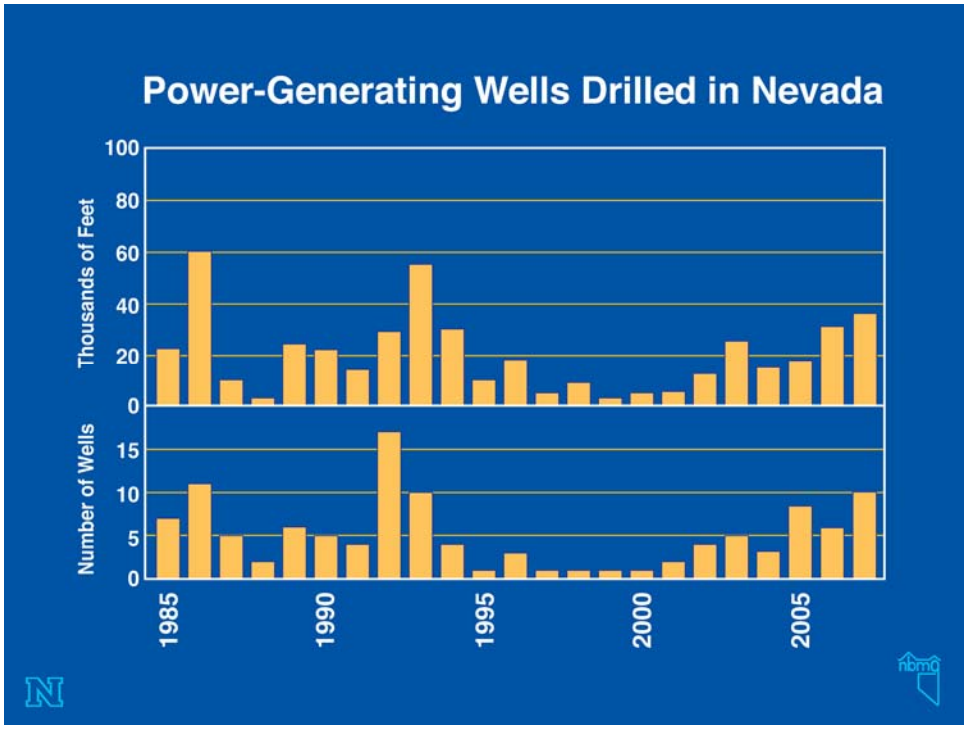
◆ **Geothermal Power Plants**
1. Beowawe
2. Bradys Hot Springs
3. Desert Peak
4. Dixie Valley
5. Empire
6. Soda Lake No. 1 and No. 2
7. Steamboat I, IA, II, and III
8. Stillwater
9. Wabuska
10. Steamboat Hills

Major mines, oil fields, and geothermal plants, 2006.

Geothermal Energy - 2007

by Ronald H. Hess

Seventy-two geothermal well permits were issued during 2007 by the Nevada Division of Minerals: 6 project area permits, 22 industrial production well permits, 14 industrial injection well permits, three domestic well permits, 13 gradient well permits, and 14 observation well permits. A total of 41 geothermal wells of all types were reported as drilled during 2007. (Nevada Division of Minerals, 2008)

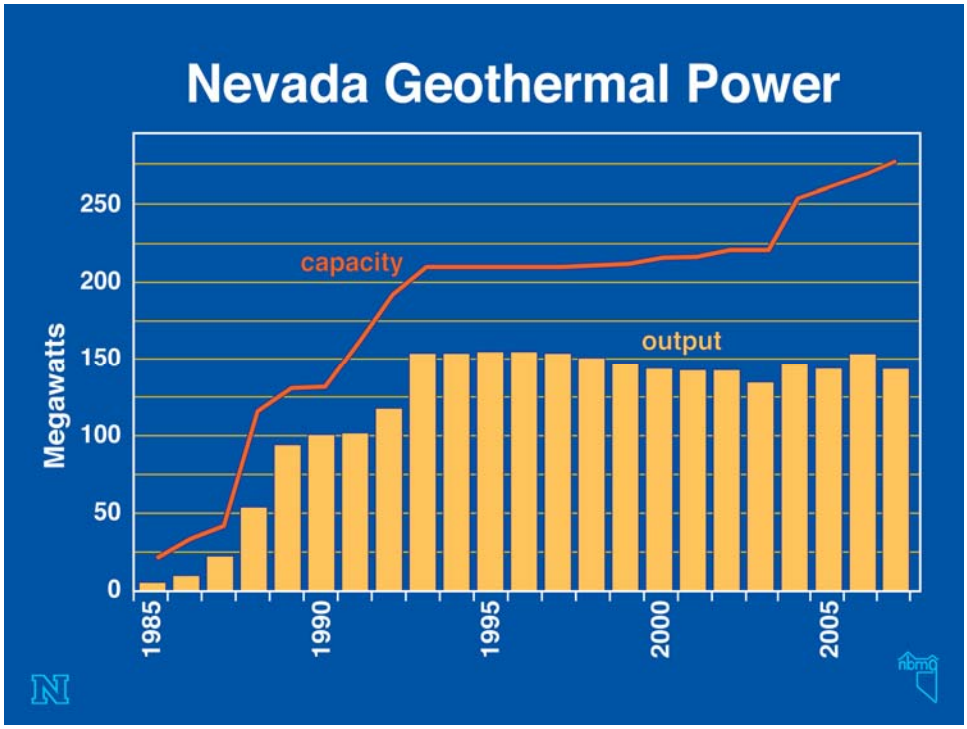


Industrial-class (power generating) wells drilled in Nevada, 1985–2007. Depth taken from original drilling permit.

In Nevada, during 2007, there were 353 federal leases covering approximately 561,780 acres, an increase from 2006 of 51 leases and 132,791 acres. Total lease rental revenue value for 2007 was $602,980, an increase from the previous year of $232,980. In comparison, during 2007, there were 753,056 acres of geothermal leases on federal lands nationwide with the acreage under lease in Nevada accounting for 75% of that total. During 2007, total lease sale income in Nevada was $11.7 million with $5.85 million going to the State of Nevada, $2.925 million going to the counties where the acreage is located, and $2.925 million going to the Department of Interior to help support the geothermal program. (Rich Hoops, BLM, oral commun., 2008)

Total gross electrical production during 2007 from Nevada geothermal resources on public lands was 1.2 million megawatt-hours (MWh), an increase of 40,000 MWh from 2006; net production was approximately 980,000 MWh, a decrease of 15,800 MWh over 2006. Gross electrical sales from federal lands in 2007 were $53.7 million, a decrease of $1.9 million from 2006. Geothermal production royalties for Nevada were $2 million in 2007. By regulation, half of all federal geothermal lease rental fees and production royalties are returned to the state. For 2007, $301,490 in lease rental fees and $1,000,000 in royalty production fees should be returned to Nevada. (Rich Hoops, BLM, oral commun., 2008)

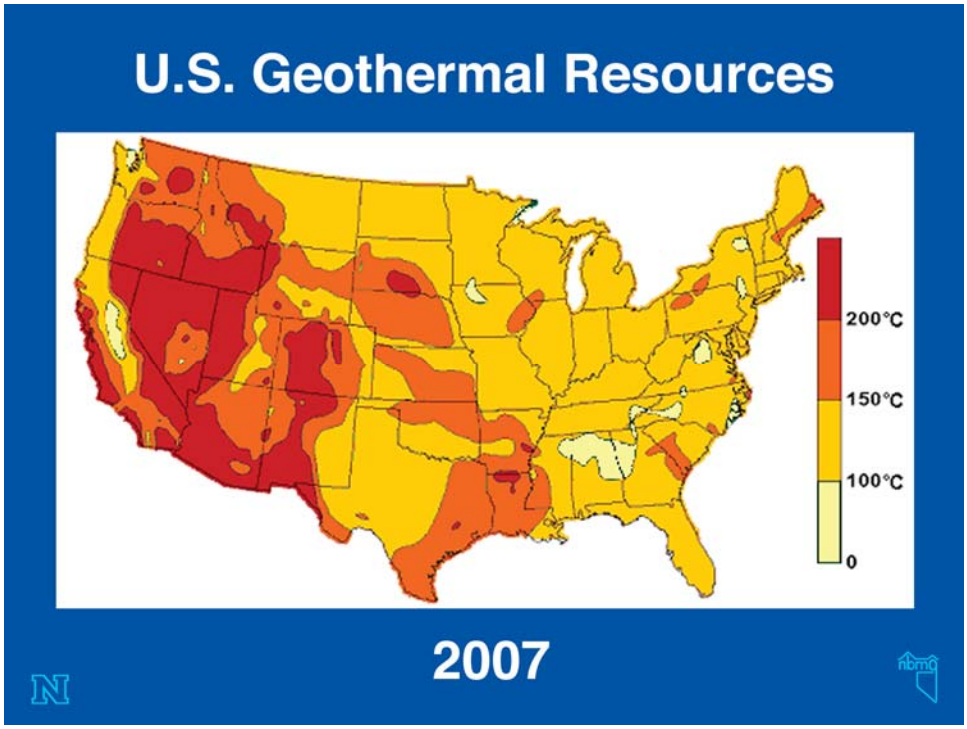
Total Nevada geothermal electrical production in 2007 from federal and fee lands combined was 1,585,138 MWh gross and 1,243,096 MWh net (Nevada Division of Minerals, 2008) with an approximate sales value of $69.4 million. This was a decrease in gross production of 98,447 MWh and in net production of 89,901 MWh from 2006. Production capacity from the currently developed geothermal resources at ten existing geothermal power production sites in Nevada is 277.1 megawatts (MW), a 12.4 MW increase from 2006. Currently installed equipment, or nameplate, capacity for the same sites totals 297.3 MW. The table of Nevada geothermal power plants lists operators,



Currently developed resource capacity and average net output of Nevada geothermal plants, 1985–2007. Average net output is annual sales in megawatt-hours divided by the number of hours in a year (8,760). No commercial geothermal power was produced in Nevada before 1985.

plant locations, and energy production for individual Nevada geothermal power producers at the end of 2007. Nevada is second only to California in total installed geothermal generating capacity.

In a new report titled “Update on Near-Term Geothermal Potential in Nevada,” Nevada’s near-term geothermal-energy generation potential is between 1,730 and 2,179 MW. It is believed that under suitable political, regulatory, and economic conditions this geothermal potential could be brought online using existing technology by 2015. If these resources are brought online by 2015, they would represent approximately 20% of Nevada’s demand in the year 2015. (Update on Near-Term Geothermal Potential in Nevada by Lisa Shevenell, Christy Morris, and David Blackwell, Geothermal Resources Council Bulletin, Vol. 37, No. 3, May/June 2008)



Geothermal resources map of the United States (2007) showing the estimated subterranean temperatures at a depth of 6 kilometers. To estimate the Earth’s internal temperature at any depth below the capabilities of normal well drilling, multiple data sets are synthesized. The data used for this figure are: thermal conductivity, thickness of sedimentary rock, geothermal gradient, heat flow, and surface temperature. (U.S. Department of Energy - Energy Efficiency and Renewable Energy Geothermal Technologies Program, original author SMU Geothermal Lab 2007, http://smu.edu/geothermal/).

To further encourage the production of renewable energy in Nevada, Governor Jim Gibbons established, by executive order, the Nevada Renewable Energy Transmission Access Advisory Committee (RETAAC) and named the 14 members that constitute the committee. The Advisory Committee recommends to the Governor those actions that are needed to improve Nevada's energy transmission infrastructure to insure available access and capacity for Nevada's future renewable energy producers. Its members work with the Governor's energy advisor, Dr. Hatice Gecol. The committee includes representatives from key renewable energy industries and interest groups that will work together to further that development. The 14 members are:

Daniel (Dan) Schochet, Vice President, Ormat (chair)
Carolyn Barbash, transmission executive, Sierra Pacific and Nevada Power (vice chair)
Jeneane Harter, president, HiTech Communications (vice chair)
Marion Barritt, director, American Solar Energy Society
Tim Carlson, president/CEO, Powered by Renewables
Gilbert Cohen, senior vice president, Acciona Solar Power
Thomas Fair, renewable energy executive, NVEnergy
Joseph Greco, vice president, western region, Terra-Gen
Erin Iping Kuo, director, Next Generation Etak and president of the Board of Directors, Nevada EcoNet
Dr. Raj Mehta, deputy director, Nevada State Office of Energy
Christy Morris, formerly Oil, Gas and Geothermal Program manager, Nevada Division of Minerals, currently Vice President of land & permitting with Ram Power, Inc.
Rebecca Wagner, commissioner, Public Utilities Commission of Nevada
Gary Wayne, director of strategic projects, SunPower Corporation
Brian Whalen, transmission planning manager, Nevada Power and Sierra Pacific.

In support of the RETAAC effort, the Nevada Division of Minerals and the Nevada Bureau of Mines and Geology have developed the Renewables of Nevada interactive map Web site showing geothermal, solar, wind, and biomass potential maps for Nevada along with a variety of other land-use, restricted lands, and base-map data sets. This Web site can be accessed at http://134.197.46.82/renewables/ .

Blue Mountain Geothermal Area, Humboldt County

The Nevada Geothermal Power, Inc. (NGP) Blue Mountain project area covers approximately 17.2 square miles in Humboldt County, Nevada. NGP signed a fixed-price, date-certain engineering, procurement, and construction (EPC) contract with Ormat Technologies Inc. to construct the Blue Mountain Faulkner I binary geothermal

power plant (phase 1, 35 MW gross) by December 31, 2009. As well field development drilling has moved forward, it now appears that the Blue Mountain geothermal resource should be able to support power production at the level of 49.5 MW gross. The contract for the construction of phase 1 was modified for a 49.5 MW power plant.

NGP has also received approval to construct a 20-mile long 120 kV overhead transmission line, which will connect to the existing electric grid just north of Mill City with an approved capacity for up to 75 MW of production. The path of the transmission line transverses a checker board of land ownership that is approximately 50% private land and 50% public land administered by the Bureau of Land Management. Power plant construction is expected to begin late in 2008. NGP has completed four production wells and expects to drill one to two more production wells and four injection wells in 2008. The Blue Mountain area is located at T36N, R34E in south-central Humboldt County, Nevada. (Blue Mountain Geothermal Project, Nevada Geothermal Power, Inc., Web site: http://www.nevadageothermal.com/s/BlueMountain.asp and Status of Resource Development at the Blue Mountain Geothermal Project, Humboldt County, Nevada, produced by GeothermEx, Inc., http://www.nevadageothermal.com/i/pdf/GeothermExBlueMtResourceReport_21Apr08_rev2.pdf)

Steamboat Hot Springs, Washoe County

The Galena No. 3 plant, Ormat's newest binary geothermal power plant at Steamboat Hot Springs, has come online. The addition of this new plant brings the gross power production from the Steamboat Hot Springs area up to approximately 100 MW. Sierra Pacific Power Co., Sierra Pacific Resources northern Nevada utility, and ORNI 14 LLC, a subsidiary of ORMAT Nevada, Inc., signed a 20-year 20-MW Power Purchase Agreement (PPA) for the Galena No. 3, project. At present, there are no new power plants planned for the Steamboat area.

Black Warrior Geothermal Area, Washoe and Churchill Counties

The Nevada Geothermal Power, Inc. (NGP) Black Warrior project area is located southeast of Black Warrior Peak, Washoe and Churchill Counties (T23N, R25E). The project area covers seven square miles of leased private ground, including surface and

water rights, and one square mile of federal ground. Work done by Phillips Petroleum in the early 1980s indicated a potential for the discovery of a geothermal reservoir suitable for electric power generation based on temperature gradients found to be greater than 200°C/km throughout the leased area, as measured in ten widely spaced drill holes. Based on a 2005 GeothermEx Inc., report this area is estimated to have a potential of producing 37 MW. (Black Warrior Project, Nevada Geothermal Power, Inc., Web site: http://www.nevadageothermal.com/s/BlackWarrior.asp and Great Basin Center for Geothermal Energy, Current Geothermal Exploration Activity: http://www.unr.edu/geothermal/explactivity.htm)

Hot Sulphur Springs, Elko County (Tuscarora)

TG Power LLC is moving forward with the development of a 48-MW-net power plant at Hot Sulphur Springs. The plant will consist of six separate turbine generators using conventional water cooling towers instead of air-cooled condensers. To supply the water needed for the cooling towers TG Power has obtained a ground-water use permit for up to 6,400 gpm. TG Power has obtained financing to begin drilling a series of production and injection wells. The drilling program will also better define the existing resource potential for the project. Total cost of the project will be between $125 and $180 million. (Sparks Tribune, Saturday, Dec. 1, 2007, Vol. 98, No. 335)

Earlier exploration of this field, as described by F.E. Berkman (The Tuscarora, Nevada, Geothermal Prospect - a case history, November 17, 1980, NBMG geothermal files), identified this geothermal area as located on the west side of the Independence Mountains at the north end of the Independence Valley graben. The geothermal area includes “6 springs, one geyser and one fumarole. These occur in a narrow zone approximately 3 km long within the Midas fault zone. Waters from the hot springs were analyzed and subsurface temperatures of 228ºC and 167ºC (442ºF and 333ºF) were indicated by the Na-K-Ca and silica geothermometers.”

In an AMAX Exploration, Inc., Tuscarora Area, Nevada, Final Report, (August 1981, NBMG files), H.D. Pilkington reported that a test discovery well, with a total depth of 5,454 feet, encountered a low-temperature reservoir. There was some difficulty in completing the well due to some lost circulation zones. Drilling on the well had to be stopped short of target and before a high temperature reservoir was discovered. The

well was flow tested at approximately 1,200 barrels per hour with temperatures ranging from 69º to 108ºC (156º to 225ºF).

In 2003-2004 Earth Power Resources, which had the lease on the resource rights at that time, discovered a geothermal resource over 166ºC (330ºF) between the depths of 2,950 and 3,810 feet. Eventually this lease was transferred to TG Power LLC.

Desert Peak Geothermal Area, Churchill County

Ormat Nevada, Inc. announced that work has begun on an Enhanced Geothermal System (EGS) project using an existing sub-commercial well, DP 27-15, to demonstrate the technology's potential to generate substantial levels of additional electricity. This technology is intended to increase the production of a well by enhancing the permeability of the reservoir rocks in the well making it possible to extract additional heat from the reservoir. This project has been funded and developed by Ormat, the US Department of Energy (DOE), the Great Basin Center for Geothermal Energy, GeothermEx Inc., Idaho National Laboratory, Lawrence Berkeley National Laboratory, Sandia National Laboratory, University of Utah EGI, TerraTek, Pinnacle Technologies, and U.S. Geological Survey. Partial support for the project includes $1.6 million in direct DOE funding. (Nevada Geothermal Update, Nevada Division of Minerals, May 2008, http://minerals.state.nv.us/forms/ogg/ogg_NGU/NVGeothermalUpdate2008.05clm.pdf)

San Emidio and Granite Creek Geothermal Areas, Washoe County

U.S. Geothermal, Inc. announced the completion of a transaction with Michael Stewart and Empire Geothermal Power where it has acquired the Empire geothermal power plant and 28,358 acres of geothermal leases and ground water rights. The total purchase price for the power plant and acreage was $16.62 million. The transaction includes assets from two locations; San Emidio and Granite Creek. San Emidio includes the Empire power plant and approximately 22,944 acres of leases and ground-water rights. The Granite Creek assets are 5,414 acres of BLM leases about 6 miles north of Gerlach, Nevada. U.S. Geothermal plans to develop a 27-megawatt power project for the San Emidio resource with a drilling program to begin in 2008 and the plant to be online around 2011. This $75 to $85 million plan calls for the construction of twin binary cycle plants. It is anticipated that the current well field could provide approximately 75%

of the geothermal fluid requirement for one of the binary plants and an expanded production and injection well field could be drilled to provide the balance of the needed geothermal fluid for the second plant to make, in total, the 27-megawatt development. (U.S. Geothermal, Inc. http://www.usgeothermal.com and Nevada Geothermal Update, Nevada Division of Minerals, May 2008, http://minerals.state.nv.us/forms/ogg/ogg_NGU/NVGeothermalUpdate2008.05clm.pdf)

Grass Valley Area, Lander County

Ormat Technologies, Inc. announced that it had signed a 20-year Power Purchase Agreement (PPA) with Nevada Power Company for energy that will be produced from the Grass Valley Geothermal Power Plant to be built in Lander County Nevada. The plant will have a gross output of between 18 and 30 MW, (http://www.ormat.com/investor-relations/news-releases/). The site is in the vicinity of Hot Springs at Hot Springs Point, on the west side of Grass Valley. A series of gradient and observation well permits were issued, and some have been drilled. The wells are in Sections 15, 16, and 21 of Township 24 North, Range 47 East. In 2005 Ormat ran chemical analyses on 90.5ºC hot spring discharge that indicated a potential 177ºC reservoir temperature based on silica geothermometry. Ormat developed a geologic model that indicates a concealed fault may exist 760 meters northeast of the hot springs. It is probable that hot water circulating up this fault is providing the source fluids for the nearby hot springs. (Geothermal Resources of Nevada, Hot Springs at Hot Springs Point (Grass Valley) (updated Mar. 2006) on the web at http://www.nbmg.unr.edu/geothermal/site.php?sid=Hot%20Springs%20at%20Hot%20Springs%20Point)

Eight Mile Flat (Salt Wells), Churchill County

On March 20, 2007 Enel North America, Inc. purchased AMP Resources, LLC. from AMP Capital Partners and a minority investor. Enel North America, Inc. is a subsidiary of Enel S.p.A., Italy. The Nevada Division of Minerals has issued a geothermal project area permit (#698PA) to Enel Salt Wells, LLC to drill up to eight production wells with estimated depths of 1,000 feet, eight injection wells with estimated depths of 3,000 feet, and 10 observation wells. The project area is located in Sections 23, 24, 25, 26, 35, and

36 of Township 17 North, Range 30 East. A transmission line to the site of the proposed 26-MW power plant near Salt Wells has been completed. (Great Basin Center for Geothermal Energy, Current Geothermal Exploration Activity: http://www.unr.edu/geothermal/explactivity.htm)

Stillwater Geothermal Area, Churchill County

AMP Resources, LLC. purchased the Stillwater Power Plant and associated geothermal resources from Stillwater Holdings, LLC., effective 12/31/2004. In August 2005 AMP Resources applied to the Nevada Public Utilities Commission (PUC) for a permit to construct a 37-MW binary geothermal power plant adjacent to the existing Stillwater power plant. In May 2006 the PUC approved a permit to build a 26-MW power plant. Upon completion, the new power plant will replace the existing Stillwater plant, online since 1989, which will be dismantled. When the new plant is completed, it will be known as Stillwater 2 Geothermal Power Plant. On November 16, 2007 Enel Stillwater, LLC received a special use permit from Churchill County to construct the Stillwater 2 power plant. Well level monitoring, to be reviewed annually, a hydraulic model to be supplied to the county that will show subsurface water dynamics, and noise restrictions were included as part of the approval conditions for the special use permit.

Geothermal Bibliography and Web Links to Other Geothermal Information

The U.S. Department of Energy (DOE) Geothermal Technologies Program and the DOE Office of Scientific and Technical Information (OSTI) have scanned approximately 3,300 agency and national lab technical reports. These files are in a PDF, full text searchable, format and accessible online at http://www.osti.gov/energycitations/ .

For further information on geothermal resources in Nevada check the following Web sites or contact Ron Hess at 775-784-6692 or via Email at rhess@unr.edu:

Map of Geothermal Resources in Nevada (second edition), NBMG Map 141, available online in pdf file format: http://www.nbmg.unr.edu/dox/m1412.pdf .

Nevada Commission on Minerals, Nevada Division of Minerals at http://minerals.state.nv.us/ .

Nevada Bureau of Mines and Geology Geothermal Resources of Nevada Web site at http://www.nbmg.unr.edu/geothermal/gthome.htm .

Great Basin Center for Geothermal Energy http://www.unr.edu/geothermal/. This site contains geothermal exploration data, interactive maps, lease and incentive program information, and numerous geothermal digital data sets.

GEO-HEAT CENTER, at http://geoheat.oit.edu/ , Oregon Institute of Technology, Klamath Falls, Oregon. This site focuses on direct use applications of geothermal energy.

DOE/INEEL Geothermal Resource Location Maps for 13 Western States in pdf, jpg, and e00 file formats at http://geothermal.id.doe.gov/maps/index.shtml .

The Nevada Geothermal Resources map in pdf file format is found at http://geothermal.id.doe.gov/maps/nv.pdf .

The Renewable Resource Data Center (RReDC) provides access to an extensive collection of renewable energy resource data, maps, and tools. Geothermal, biomass, solar, and wind resource data for locations throughout the United States can be found on the RReDC site at http://www.nrel.gov/rredc/ .

Geothermal biz.com http://www.geothermal-biz.com/ is part of the U.S. Department of Energy-led GeoPowering the West (GPW) initiative to dramatically increase the use of geothermal energy in the western United States, Alaska, and Hawaii.

Southern Methodist University Geothermal Lab, specializing in geothermal gradient data and maps of the entire country, post information at http://www.smu.edu/geothermal/.

Summary of Supporting Data for USGS Regional Heat-flow Studies of the Great Basin, 1970-1990, by John H. Sass, Susan S. Priest, Arthur H. Lachenbruch, S. Peter Galanis, Jr., Thomas H. Moses, Jr., John P. Kennelly, Jr., Robert J. Munroe, Eugene P. Smith, Frederick V. Grubb, Robert H. Husk, Jr., and Charles W. Mase; USGS Open-File Report 2005-1207 online version 1.0 on the Web at http://pubs.usgs.gov/of/2005/1207/ .

Geothermal Industry Temperature Profiles from the Great Basin, by John H. Sass, Susan S. Priest, Arnold J. Blanton, Penelope C. Sackett, Stephanie L. Welch, and Mark A. Walters; USGS Open-File Report 99-425 online version 1.0 on the Web at http://pubs.usgs.gov/of/1999/of99-425/webmaps/home.html

The Bureau of Land Management Land and Mineral Records-LR2000 system Web address is http://www.blm.gov/lr2000/

GeoCommunicator is the publication site for the Bureau of Land Management's National Integrated Land System (NILS). GeoCommunicator provides searching, accessing and dynamic mapping of data for federal land stewardship, land and mineral use records, and land survey information. GeoCommunicator provides spatial display for land and mineral cases from BLM's LR2000 system. The Web address for the GeoCommunicator is http://www.geocommunicator.gov/ .

NEVADA GEOTHERMAL POWER PLANTS 2007

Plant name (year on line)	Production capacity[1] (MW)	2007 Production (MWh) Gross	Net (sales)	Location	Operator
Beowawe (1985)	16.7 (16.6)	118,286	102,669	S13,T31N,R47E	Caithness Operating Beowawe Power, LLC 9590 Prototype Ct., #200 Reno, NV 89521 (775) 850-2266
Bradys Hot Springs (1992)	26.1 (26.1)	146,645	99,120	S12,T22N,R26E	Brady Power Partners/ Desert Peak P.O. Box 649 Fernley, NV 89408 (775) 423-5800
Desert Peak (1985) Desert Peak II (2006)[2]	23 (23)	112,424	86,064	S21,T22N,R27E	Brady Power Partners
Dixie Valley (1988)	66.0 (62.0)	529,295	480,600	S7,T24N,R37E S33,T25N,R37E	Caithness Dixie Valley, LLC 9590 Prototype Ct., #200 Reno, NV 89521 (775) 850-2266
Empire (1987)	4.6 (4.8)	27,482	18,887	S21,T29N,R23E	Empire Energy, LLC P.O. Box 152 Gerlach, NV 89412 (775) 557-2015
Soda Lake No. 1 (1987) Soda Lake No. 2 (1991)	16.6 (26.1)	97,460	64,152	S33,T20N,R28E	AMOR IX 5500 Soda Lake Road Fallon, NV 89406 (775) 867-5093
Steamboat I, I-A (1986) Steamboat II, III (1992) Galena (2005) Galena 2 (2007)	95.4 (101.0)	421,033	308,133	S29,T18N,R20E	ORMAT Nevada 1010 Power Plant Road Reno, NV 89502 (775) 852-1444
Steamboat Hills (1988, formerly Yankee Caithness)	14.5 (14.5)	37,760	27,878	S5,6,T17N,R20E	ORMAT Nevada
Stillwater (1989)	13.0 (21.0)	85,678	49,382	S1,T19N,R30E S6,T19N,R31E	Enel Stillwater 4785 Lawrence Lane Stillwater, NV 89406 (775) 329-0700
Wabuska (1984)	1.2 (2.2)	9,075	6,211	S15,16,T15N,R25E	Homestretch Geothermal 1147 N. Daybreak Dr. Washington, UT 84780 (435) 668-6003
TOTAL	**277.1 (297.3)**	**1,585,138**	**1,243,096**		

[1] Production capacity from currently developed geothermal resources (equipment capacity in parentheses). *Sources*: Plant operators, Nevada Division of Minerals, and NBMG files.

[2] Desert Peak II is a new binary power plant that was built to replace the original steam turbine power plant at Desert Peak, which was permanently shut down on May 1, 2006. The new power plant came on-line on August 1, 2006 with a generation capacity of 23 MW, more than twice that of the original power plant.

NONDOMESTIC GEOTHERMAL WELLS
REPORTED AS DRILLED, REDRILLED, OR COMPLETED DURING 2007

Area	Company Name	Well Type and Number	Permit Number	Location	Permitted Depth (ft)
Churchill County					
Eight Mile Flat Area	Carson Lake Basin Project	O 58-9	680	NW/4, NE/4, S. 16, T17N, R30E	2,500
	Carson Lake Basin Project	O 34-33	682	SE/4, NW/4, S. 33, T17N, R30E	2,500
	Carson Lake Basin Project	O 86-15	683	NE/4, SE/4, S. 15, T17N, R30E	2,500
	Carson Lake Basin Project	O 17-16	685	SW/4, SW/4, S. 16, T17N, R30E	2,500
	Enel Salt Wells, LLC	I 54-36	733	SE/4, NE/4, S. 36, T17N, R30E	1,500
	Enel Salt Wells, LLC	I 63-36	734	SW/4, NE/4, S. 36, T17N, R30E	1,500
Stillwater	Enel Stillwater, LLC	I 26-7	706	NW/4, SW/4, S. 7, T19N, R31E	1,400
	Enel Stillwater, LLC	I 63-7	707	SW/4, NE/4, S. 7, T19N, R31E	1,400
Elko County					
Hot Sulphur Springs	TG Power, LLC	O 87-5	674	SE/4, SE/4, S. 5, T41N, R52E	3,500
(Tuscarora	TG Power, LLC	P 65-8	675	NE/4, SE/4, S. 8, T41N, R52E	4,000
Geothermal Area)	TG Power, LLC	P 57-8	689	NW/4, SE/4, S. 8, T41N, R52E	4,000
	TG Power, LLC	P 72-8	690	NE/4, NE/4, S. 8, T41N, R52E	4,000
	TG Power, LLC	P 53-8	716	SW/4, NE/4, S. 8, T41N, R52E	5,000
Humboldt County					
Blue Mountain	Noramex Corp.(NV Geothermal Power)	P 23-14	635	SW/4, NW/4, S. 14, T36N, R34E	6,000
	Noramex Corp.(NV Geothermal Power)	P 25-14	637	NW/4, SW/4, S. 14, T36N, R34E	6,000
Lander County					
Buffalo Valley	Ormat Nevada Inc.	TG BV-1	644	SW/4, SW/4, S. 22, T29N, R41E	500
	Ormat Nevada Inc.	TG BV-2	645	SW/4, NW/4, S. 27, T29N, R41E	500
	Ormat Nevada Inc.	TG BV-3	646	NE/4, SE/4, S. 27, T29N, R41E	500
	Ormat Nevada Inc.	TG BV-4	647	SE/4, SE/4, S. 34, T29N, R41E	500
	Ormat Nevada Inc.	TG BV-5	648	NW/4, SE/4, S. 35, T29N, R41E	500
	Ormat Nevada Inc.	TG BV-6	649	NE/4, NW/4, S. 26, T29N, R41E	500
	Ormat Nevada Inc.	TG BV-7	650	SW/4, SW/4, S. 25, T29N, R41E	500
	Ormat Nevada Inc.	TG BV-8	651	NE/4, SE/4, S. 25, T29N, R41E	500
	Ormat Nevada Inc.	TG BV-10	653	NE/4, SE/4, S. 24, T29N, R41E	500
	Ormat Nevada Inc.	O 31-26 (42-26)	665	NE/4, NW/4, S. 26, T29N, R41E	3,000
	Ormat Nevada Inc.	TG BV-11	694	SE/4, NW/4, S. 25, T29N, R41E	1,000
Grass Valley	Ormat Nevada Inc.	O 67-16	660	SW/4, SE/4, S. 16, T24N, R47E	3,000
Reese River	Sierra Geothermal Power, Inc.	O 56-4	667	NW/4, SE/4, S. 4, T23N, R43E	4,000
	Sierra Geothermal Power, Inc.	TG 13-4(38-33)	711	SW/4, NW/4, S. 4, T23N, R43E	6,000
Pershing County					
Jersey Valley	Ormat Nevada Inc.	O 81-28	655	NE/4, NE/4, S. 28, T27N, R40E	3,000
	Ormat Nevada Inc.	O 18-27 (88-28)	656	SE/4, SE/4, S. 28, T27N, R40E	3,000
	Ormat Nevada Inc.	O 33-33	658	SE/4, NW/4, S. 33, T27N, R40E	3,000
Nye County					
Darroughs Hot Springs Area	Truckee Geothermal No. 1 SV-01, LLC	P 68-04	696	SW/4, SE/4, S. 4, T12N, R43E	4,000
Washoe County					
Steamboat Hot Springs	Ormat Nevada Inc.	P 44A-32	668	SE/4, NW/4, S. 32, T18N, R20E	1,000
	Ormat Nevada Inc.	P 14A-33	669	SE/4, NW/4, S. 33, T18N, R20E	1,000
	Ormat Nevada Inc.	PI 43-33	670	SE/4, NW/4, S. 33, T18N, R20E	1,000
	Ormat Nevada Inc.	I 14-33	708	SW/4, NW/4, S. 33, T18N, R20E	2,500
	Ormat Nevada Inc.	I 23-33	710	SW/4, NW/4, S. 33, T18N, R20E	2,500
Warm Springs Valley	Newcore Energy, LLC	O Marshall No. 1	744	NW/4, NE/4, S. 22, T23N, R20E	3,000

[1] I = injection well; O = observation well; P = production well; TG = thermal gradient well.