GEOTHERMAL ENERGY ASSOCIATION

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UPDATE ON US GEOTHERMAL POWER PRODUCTION AND DEVELOPMENT, JANUARY 16, 2008

INSTALLED CAPACITY/GENERATION

The United States continues to be the world leader in online capacity of geothermal energy and the generation of electric power from geothermal energy. According to state energy data, in 2005, geothermal energy provided approximately 16 billion kilowatt hours (kWh) – 0.37% of the electricity consumed in the U.S. As of January 10, 2008, geothermal electric power was generated in 6 U.S. states: Alaska, California, Hawaii, Nevada, Utah, and Idaho, with New Mexico and Wyoming soon to be added to the list.

States generating geothermal energy and existing capacity:
Total installed capacity: 2936.5 Megawatts (MW) 1/10/08
Total generation: 16,010 GWh (2005)

Table 1: January 2008 Geothermal Power Capacity On-Line

Alaska	California	Hawaii	Idaho	Nevada	Utah	Total US
0.4 MW	2541.3 MW	35 MW	13 MW	309.8 MW	37 MW	2936.5 MW

Alaska
The first geothermal power plant in Alaska was installed in 2006 at Chena Hot Springs. It is a small-scale unit, using organic rankine cycle (ORC) technology to produce 200 kW from a low-temperature resource (165°F). A subsequent 200 kW unit has been installed, bringing total production to 400 kW.

California
In 2006, 4.7 % of California's electric energy generation came from geothermal power plants. This amounted to a net-total of 13,708 GWh. In 2005, California's geothermal capacity exceeded that of every country in the world. California currently has 2541.3 MW of installed capacity**.

Hawaii
Currently, Hawaii has one power plant operating on the big island of Hawaii. This plant delivers an average of 25-30 MW (35 MW name-plate capacity) of firm energy on a continuous basis, supplying approximately 20% of the total electricity needs of the Big Island and its over 162 thousand residents.

Idaho
As of January 7, 2008, construction of the first geothermal power plant in Idaho has been completed and commercial sale of the produced electricity has begun. Raft River, a binary plant that uses a 300°F resource, has a nameplate production capacity of 13 MW. An expansion to this plant, as well as several other projects around the state, is currently underway.

Nevada
In 2006, Nevada had 16 power plants, with a capacity of 296.81 MW. Together, these 16 plants produced a net-total of 1,333 GWh during the year. Galena 2, an expansion to the Richard Burdett plant, went online in 2007. Nevada capacity is now increased to 309.8 MW.

Utah
There is currently one power plant in operation in Utah. In 2007, 11 MW was added to the Blundell Plant through a bottoming cycle which increased the plant capacity from 26 MW to 37 MW. Cove-Fort II was decommissioned in June of 2003 and Cove-Fort I was decommissioned in June of 2004 – Cove Fort is currently under re-development. Before the decommissioning of Cove Fort I, Utah geothermal plants generated 202 GWh. With only the Blundell plant running in 2005, that number had likely dropped by between 20-30 GWh. Blundell alone generated 184 GWh in 2002.

*New Mexico at Burgett has a 750 kilowatt (kW) binary plant that is off-grid; additionally it is no longer online. It is located in the Lightning Dock geothermal resource area – with a 235°F resource. This 0.75 MW is included in the total MW figure above.
**California had 2030.47 MW of net-capacity producing power in 2005. There is approximately 461 MW of power in California on standby (not producing power in 2005).
SOURCES: Geothermal Energy Association: http://www.geo-energy.org/information/plants.asp; California Energy Commission: http://www.energy.ca.gov/; and Nevada Commission on Mineral Resources Division of Minerals: http://minerals.state.nv.us/

NOTE: Power production figures used in this document largely refer to the capacity of the facility, and not its actual output. To compare the output of geothermal facilities with other technologies, please refer to the chart below. In general, capacity needs to be adjusted by the expected capacity factor shown to provide comparable electric generation.

Table 2: Comparing Power Technologies

Technology	Expected Capacity Factor (percent)
Coal	71
Nuclear	90
Geothermal	86-95
Wind	25-40
Solar	24-33
Natural Gas Combustion Turbine	30-35
Hydropower	30-35
Biomass	83

$$\text{Capacity Factor} = \frac{\text{Total Energy Produced}}{\text{Energy Produced if at Full Capacity}}$$

NEW ACTIVITY

This survey identifies up to 3313.8 MW of new geothermal power plant capacity currently under development in the United States (including projects in the initial development phase).* Up to 373 MW of capacity is currently under construction at 9 projects in 2 states. Unconfirmed projects (some of which are likely to be developed within the next few years) raise these numbers to 3368.8 MW of potential capacity currently under consideration. There are 12 states with projects currently under consideration or development, including: Alaska, Arizona, California, Hawaii, Idaho, Nevada, New Mexico, Oregon, Texas, Utah, Washington, and Wyoming.

The list below will show what projects are active in each of the 12 states. They explain which projects are in:

- **Phase I:** Identifying site, secured rights to resource, initial exploration drilling
- **Phase II:** Exploratory drilling and confirmation being done; PPA not secured
- **Phase III:** Securing PPA and final permits
- **Phase IV:** Production Drilling Underway/Facility Under Construction
- **Unconfirmed:** Proposed projects that may or may not have secured the rights to the resource, but some exploration has been done on the site

*The 3313.8 MW covers all projects that are Phase 1 through Phase 4.

Please Note: GEA is reporting information that is provided to us about these projects. We do not independently verify the data provided.

Alaska: 33-80 MW

Phase 1
• Chena Hot Springs – 5 MW – Received GRED III funding for Phase I – Chena Hot Springs • Naknek – 18 MW (plans to expand to 25 MW within two years) – Naknek Electric Association • Unalaska – 10 MW (resource potential expected to be 50 MW) – City of Unalaska

Arizona: 2-20 MW

Phase 1
• Clifton – 2 MW with 2 MW units added incrementally (20 MW potential resource) – ARIZONA PUBLIC SERVICE
Unconfirmed
• Northern Arizona University – unspecified – received GRED II money, preliminary studies completed

California: 663.2-1113.2 MW

Phase 1
• Fourmile Hill – 49.9 MW – Calpine Corporation • Telephone Flat – 49.9 MW – Calpine Corporation • North Geysers – 25-90 MW (up to three units) – Calpine Corporation
Phase 2
• Salton Sea – 25 MW with 200 MW potential (four 50 MW projects) – CalEnergy • Casa Diablo #4 – 25 MW – Ormat Technologies, Inc. • Surprise Valley – 27 MW – Enel North America

• Truckhaven – 100 MW – Iceland America, Esmeralda Truckhaven
Phase 3
• Northeast Side of Geysers (Bottlerock) – 38 MW – Bottlerock Power and ThermaSource, LLC • Geysers Unit 15 – 25.5 MW – Western GeoPower • North Brawley 2 – 50 MW – Ormat Technologies, Inc. • Juan Bautista de Anza Geothermal Project – 25 MW (Truckhaven) - Esmeralda Truckhaven Geothermal LLC • Northwest Military Pass – 30 MW (plans to expand to 120 MW) – Vulcan Power – The buyer of the power will be PG&E • Wister – 30-100 MW – Ormat Technologies, Inc. • Hudson Ranch I – 49.9 MW – CHAR, LLC • Truckhaven I – 49 MW – Iceland America
Phase 4
• North Brawley 1 – 50 MW (plans to expand to 100 MW) – Ormat Technologies, Inc. • Heber South – 14 MW – Ormat Technologies, Inc.
Unconfirmed
• Salton Sea – 20 MW – Sierra Geothermal Power

Hawaii: 30 MW

Phase 1
• Puna – 22 MW (*Ormat is permitted for 22 MW of additional capacity once the 8 MW unit is added to the existing Puna plant*) – Ormat Technologies, Inc.
Phase 3
• Puna – 8 MW – expansion to Puna plant – Ormat Technologies, Inc.

Idaho: 251-326 MW

Phase 1
• China Cap – 50-100 MW – Idatherm, LLC • Sulfur Springs – 25-50 MW – Idatherm, LLC • Preston Area Project – 50 MW – Idatherm, LLC
Phase 2
• Willow Springs – 100 MW – Idatherm, LLC
Phase 3
• Raft River expansion – 26 MW – US Geothermal

Nevada: 1046-1321 MW

Phase 1
• Black Warrior – 50 MW – Nevada Geothermal Power • Colado – 97 MW – Vulcan Power • Hazen – 20-30 MW – GRID LLC • New York Canyon – 20 MW – Vulcan Power • Pyramid Lake – 25 MW – Pyramid lake Paiute Tribe, Pyramid Lake Energy Project • Hawthorne Army Ammunition Depot – 10 MW – Geothermal Program Office (GPO) of U.S. Government • Gabbs Valley – 30 MW – Ormat Technologies, Inc. • McGinness Hills – 30 MW – Ormat Technologies, Inc. • Superstition Mountains – unspecified – Geothermal Program Office (GPO) of U.S.

Government
- Silver State Geothermal – 50-80 MW – US Renewables Group
- Gerlach – 5-10 MW – Sierra Geothermal Power
- Salt Wells & North Salt Wells – 10-20 MW – Sierra Geothermal Power
- Hawthorne – 10-15 MW – Sierra Geothermal Power
- Soda Lake – unspecified – Sierra Geothermal Power
- Spencer – unspecified – Sierra Geothermal Power
- Howard – unspecified – Sierra Geothermal Power
- Sulphur – unspecified – Sierra Geothermal Power
- Wells – unspecified – Sierra Geothermal Power

Phase 2

- Alum – 41-90 MW – Sierra Geothermal Power
- Silver Peak – 15-40 MW – Sierra Geothermal Power
- Wilson Hot Springs – 10-25 MW – Sierra Geothermal Power
- Blue Mountain – 24 MW – Nevada Geothermal Power
- Emigrant/Fish Lake Valley – 49-118MW – Esmerelda Energy Company & GeoEnergy Partners
- Trail Canyon No. 1 – 10 MW – Raser Technologies, Inc.
- Truckee No. 1 – 10 MW – Raser Technologies, Inc.
- Devils Canyon No. 1 – 10 MW – Raser Technologies, Inc.

Phase 3

- Aurora – 120MW – Vulcan Power
- Reese River – 13-30 MW – Sierra Geothermal Power
- Pumpernickel Valley – 16-40 MW – Sierra Geothermal Power/Nevada Geothermal Power joint venture
- Carson Lake – 30 MW – Ormat Technologies, Inc. & Geothermal Program Office (GPO) of U.S. Government
- Grass Valley – 24 MW – Ormat Technologies, Inc.
- Hot Sulphur Springs (Tuscarora) – 32 MW (plans to expand to 48 MW) – TG Power (nearing start of construction)
- Salt Wells – 26 MW – Enel North America

Phase 4

- Blue Mountain, Faulkner 1 – 35 MW – Nevada Geothermal Power
- Buffalo Valley – 24 MW – Ormat Technologies, Inc.
- Stillwater – 26 MW – Enel North America
- Jersey Valley – 24 MW – Ormat Technologies, Inc.
- Galena 3 – 17 MW – Ormat Technologies, Inc.
- Rye Patch – 13 MW (90% complete) – Presco Energy
- Salt Wells-Lee Allen - 120 MW – Vulcan Power

New Mexico: 21 MW

Phase 2

- AmeriCulture – 1 MW – (Distributed Generation project) – AmeriCulture
- Lightning Dock – 20 MW – Raser Technologies, Inc.

Oregon: 128.4-213.4 MW

Phase 1

- City of Klamath Falls – 1 MW – (Distributed Generation project)

• Liskey Greenhouse – 1 MW – (Distributed Generation project) • Geoheat Cener at the Oregon Institute of Technology (OIT) – 1.2 MW – (Distributed Generation project) – OIT
Phase 2
• Neal Hot Springs – 25-30 MW – US Geothermal
Phase 3
• Crump Geyser – 40-60 MW – Nevada Geothermal • Newberry Volcano – 60-120 MW – Davenport Power – PPA with PG&E, who will sell the power to customers in California. • Geoheat Center at the Oregon Institute of Technology (OIT) – 0.2 MW – (Distributed Generation project) – OIT

Texas: Undefined

• Geothermal Lease Sale Completed

Utah: 156.6-189 MW

Phase 2
• Cove Fort – 36.6 MW (plans to expand to 69 MW) – The old Cove Fort units were shut down in 2003 and 2004. Cove Fort is being rebuilt and expanded. – Enel North America • Renaissance Geothermal – 100 MW – Idatherm, LLC
Phase 3
• Central Utah – 20 MW – Raser Technologies, Inc.
Unconfirmed
• Roosevelt Hot Springs (Blundell 3) – 35 MW – PacifiCorp

Washington: Undefined

Phase 1
• Mt. Baker – unspecified – Vulcan Power • Project on Oregon/Washington Border – unspecified – Raser Technologies, Inc.

Wyoming: 0.2 MW

Phase 2
• Rocky Mountain Oilfield Testing Center – 0.2 MW – Ormat Technologies, Inc. & USDOE

Tribal Land Projects

A number of Native American tribes have been considering the possibility of using geothermal for their energy needs, looking at resources like Pyramid Lake (listed above), Jemez Pueblo (NM), Walker River (NV), and Fort Bidwell (CA). Both private and governmental funds are being invested into some of these projects, most notably Fort Bidwell, which has received Department of Energy funding in the past.

DEVELOPING PROJECTS SUMMARIES

Table 3: Developing Projects by Phase

State	Unconfirmed		Phase I		Phase II		Phase III		Phase IV	
	#	MW	#	MW	#	MW	#	MW	#	MW
AK			3	33-80						
AZ	1	Unspecified	1	2-20.0						
CA	1	20	3	124.8-189.8	4	177-352	8	297.4-457.4	2	64-114
HI			1	22			1	8		
ID			3	125-200	1	100	1	26		
NV*			18	357-417	8	169-327	7	261-318	7	259
NM					2	21				
OR			3	3.2	1	25-30	3	100.2-180.2		
TX	Lease Sale Completed									
UT	1	35	2	136.6-169			1	20		
WA			2	Unspecified						
WY					1	0.2				
Totals	**3**	**55**	**36**	**803.6-1101**	**17**	**492.2-830.2**	**21**	**712.6-1009.6**	**9**	**323-373**

NV* - There are 18 projects in Phase I, but for six projects, developers did not disclose projected MW values

Phase I: Identifying site, secured rights to resource, initial exploration drilling
Phase II: Exploratory drilling and confirmation being done; PPA not secured
Phase III: Securing PPA and final permits
Phase IV: Production Drilling Underway/Facility Under Construction
Unconfirmed: Proposed projects that may or may not have secured the rights to the resource, but some exploration has been done on the site

Table 4: Developing Projects by State

State	Phase 1 to Phase 4	TOTAL (with unconfirmed)
AK	3/33-80 MW	3/33-80 MW
AZ	1/2-20 MW	2/2-20 MW
CA	17/713.2-1163.2 MW	18/683.2-1133.2 MW
HI	2/30 MW	2/30 MW
ID	5/251-326 MW	5/251-326 MW
NV	40/1046-1321 MW	40/1046-1321 MW
NM	2/21MW	2/21MW
OR	7/128.4-213.4 MW	7/128.4-213.4 MW
TX	Lease Sale Completed	Lease Sale Completed
UT	3/156.6-189 MW	4/191.6-224 MW
WA	2/unspecified	2/unspecified
WY	1/0.2 MW	1/0.2 MW
Total	**83 projects 2331.4-3313.8 MW**	**86 projects 2386.4-3368.8 MW**

Total US Geothermal Projects Identified as Under Development – Confirmed and Unconfirmed – 1/8/08

86 Projects 12 States 2386.4-3368.8 MW

Some Benefits of Adding 3300 MW of New Geothermal Power

- Economic Growth Stimulus – $11 billion of new geothermal investment
- Employment Stimulus – 5,600 permanent new full time jobs and 21,120 person/years of construction/manufacturing employment (not including economic multiplier)
- Environmental Value – >25 million metric tons of carbon dioxide equivalent annually offset (equivalent to taking 5-1/2 million cars off the road annually according to the US EPA)

EMERGING TECHNOLOGIES

As geothermal technology progresses, resources that were once non-commercial are now being actively examined as feasible possibilities. Such resources might include the following:

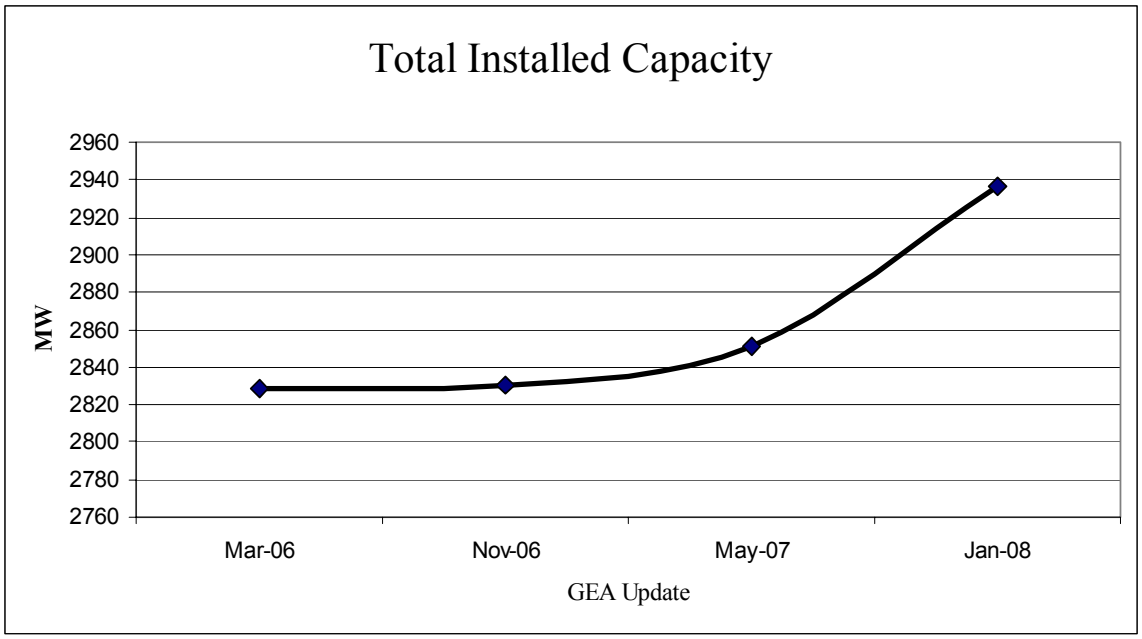
- **Enhanced Geothermal Systems (EGS)** – Often categorized under the antiquated term 'Hot Dry Rock,' EGS is thought by several experts to refer to any resource that requires artificial stimulation. This includes resources that have to be fully engineered, or ones that produce hydrothermal fluid, but sub-commercially. Regarding the latter, one expert states that, 'As we go further, there might be projects that require more and more stimulation.' Although EGS technology is still young and many aspects remain unproven, several projects are currently underway. If EGS technology proves commercially successful, it is expected to allow significantly increased extension of and production from existing fields, as well as utilization of geothermal energy in previously implausible locations.
- **Hydrocarbon/Geothermal Co-Production** – There is growing interest in producing electricity from the thermal fluid that flows from several oil & gas wells. One project is currently underway in Wyoming, with several more in the planning stages. Geothermal co-production has been predicted to be capable of providing 1000-5000 MW to the 7 states in the Texas Gulf Coast Plain alone (McKenna *et al.*, Oil & Gas Journal, September 5, 2005). Note that there is currently no geothermal electricity production in any of those states. Also, there appears to be renewed interest in production from the geopressured resources in Texas, Louisiana and the Gulf of Mexico.
- **Lower-Temperature/Flowrate Resources** – With recent and continuing advances in surface technology, new resources or those that were previously abandoned because of either sub-commercial temperatures or flow-rates are becoming increasingly viable options. Chena Hot Springs (Alaska) is currently producing 400 kW from a 165°F resource. Several projects aimed at utilizing similarly low-temperature or low-grade geothermal resources are currently in progress. Several in the industry predict that these advances will greatly increase the range of geothermal applications, some of which might include: waste heat stream recovery in industrial applications, small-scale electricity projects for communities or resorts (like Chena), and aquaculture.

As of January 2008, there are very few projects utilizing these new technologies that are currently on-line or in the later stages of development. Several industry developers, however, state that during the rest of 2008 efforts in each of these areas will be markedly increased with several new projects to be started – some of which are proposed to go on-line by the end of the year. For more information on these technologies, see *The State of Geothermal Technology: Parts I & II*, recently released by the Geothermal Energy Association (for electronic copies, please visit: *http://www.geo-energy.org/publications/reports.asp*).

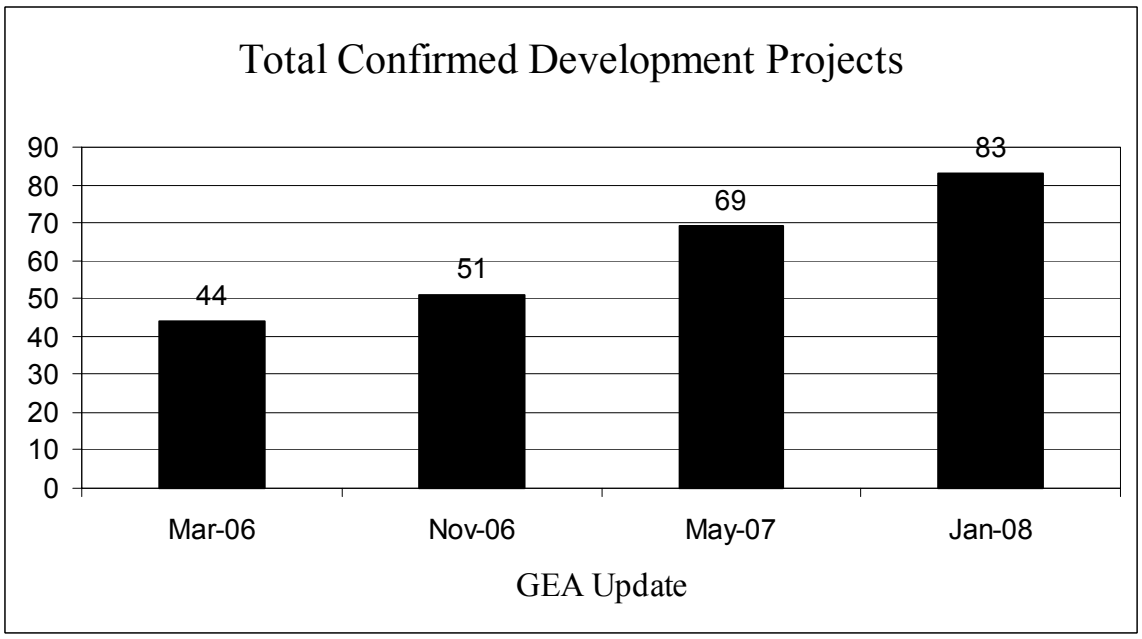
Comparison of Results from GEA Surveys
March 2006, November 2006, May 2007, January 2008

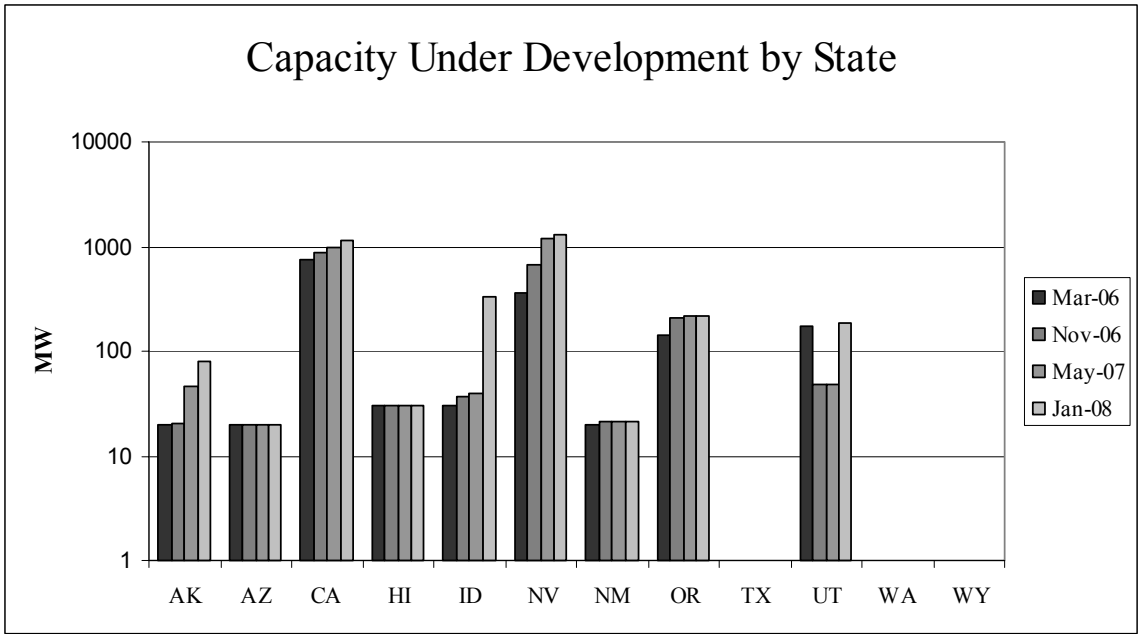
INDUSTRY GROWTH

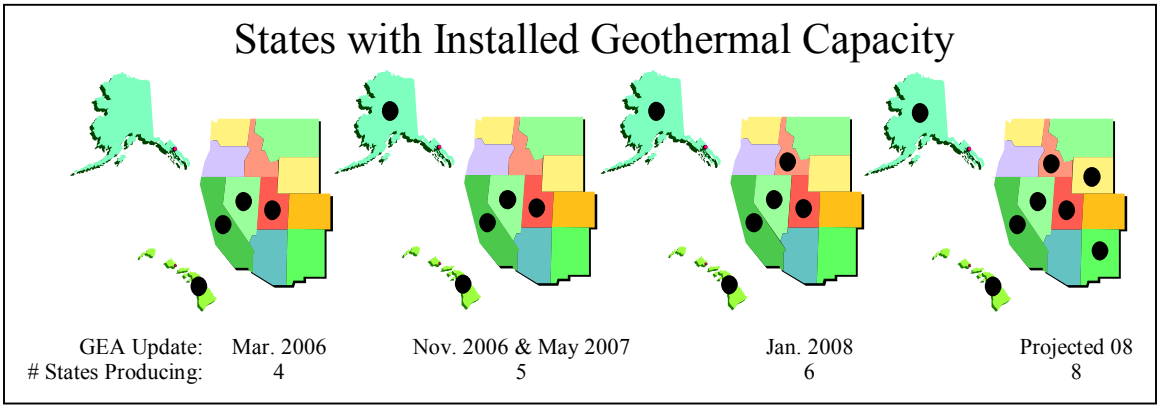
Installed Capacity:



New Activity:







Prepared by Mark A. Taylor, Geothermal Energy Association January 10, 2007