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Clean and Diversified Energy Initiative

WESTERN GOVERNORS' ASSOCIATION

Geothermal Task Force Report

January 2006

WGA CDEAC PROCESS

- The Western Governors' Association's Clean and Diversified Energy Advisory Committee is set to consider an array of options for bringing on-line 30,000 Megawatts of clean energy by 2015, increasing energy efficiency 20 percent by 2020 and providing adequate transmission for the region.
- The CDEAC has released several task force reports that examine the feasibility of and options for reaching those goals. The Committee will meet this spring to develop recommendations for the Governors' annual meeting in June.
- Available at: www.westgov.org

Geothermal Task Force Report

- **The Western Governors' Association's Clean and Diversified Energy Advisory Committee (CDEAC) commissioned this task force report in February 2005. Members of the Task Force are listed below. This is one of several task force reports presented to the CDEAC on December 8, 2005 and accepted for further consideration as the CDEAC develops recommendations for the Governors. While this task force report represents the consensus views of the members, it does not represent the adopted policy of WGA or the CDEAC. At their Annual Meeting in June, 2006, Western Governors will consider and adopt a broad range of recommendations for increasing the development of clean and diverse energy, improving the efficient use of energy and ensuring adequate transmission. The CDEAC commends the Task Force for its thorough analysis and thoughtful recommendations.**

Members of the Geothermal Task Force

- Dan Schochet (Chair), Ormat (CEDEAC Member)
- Frank Barbera, Imperial Irrigation District Energy Division
- John Bebout, Bureau of Land Management (BLM)
- Peggy Duxbury, Calpine Corporation
- Troy Gagliano, Renewable Northwest Project
- Karl Gawell, Geothermal Energy Association
- Sean Hagerty, BLM California
- Roger Hill, Sandia National Laboratories
- Roy Mink, U.S. Department of Energy
- Bernie Smith, Alaska Energy Authority
- Jim States, Rocky Mountain Oilfield Testing Center
- Martin Vorum, National Renewable Energy Laboratory
- Jonathan Weisgall, MidAmerican Energy
- Charlene Wardlow, Calpine Corporation
- Workshop participants from over two dozen companies, universities, national laboratories, and federal and state agencies with expertise in geothermal resources.

Report Conclusion

- The Western States share a capacity of almost 13,000 megawatts of geothermal energy that can be developed on specific sites within a reasonable timeframe. Of these, 5,600 megawatts are considered by the geothermal industry to be viable for commercial development within the next 10 years, i.e. by about 2015. This is a commercially achievable capacity for new generation and does not include the much larger potential of unknown, undiscovered resources

Report Conclusion

- The 5,600 MW is estimated to be developable at busbar costs in a range of levelized costs of energy (LCOE) of about 5.3 to 7.9 cents per kilowatt-hour (kWh). This assumes commercial project financing conditions and the extension of a production tax credit (PTC) consistent with current federal energy law. Lacking a PTC to catalyze renewable energy development, LCOE values would be 2.3 cents a kilowatt (¢/kWh) higher.

- If actual future markets sustain energy costs up to 20 ¢/kWh or the risk and cost of development is reduced substantially, the Task Force estimates that known resources could support new capacity of about 13000 MW.

Summary of Western States' Near-Term
New Geothermal Power Capacity (in Megawatts)

	Near-Term/Near Market	Longer-Term/Higher Cost
Alaska	20	150
Arizona	20	50
Colorado	20	50
California	2,400	4,703
Hawaii	70	400
Idaho	860	1,670
Nevada	1,500	2,895
New Mexico	80	170
Oregon	380	1,250
Utah	230	620
Washington	50	600
Total	**5,630 MW**	**12,558 MW**

NOTE: The capacity of **Wyoming, Montana, Texas, Kansas, Nebraska, South Dakota, North Dakota** was not analyzed during the July 25 Geothermal Task Force Sub Group meeting on Supply. This information will be incorporated into this report once available.

Summary of Western States' Near-Term Geothermal Potential and New Jobs Created

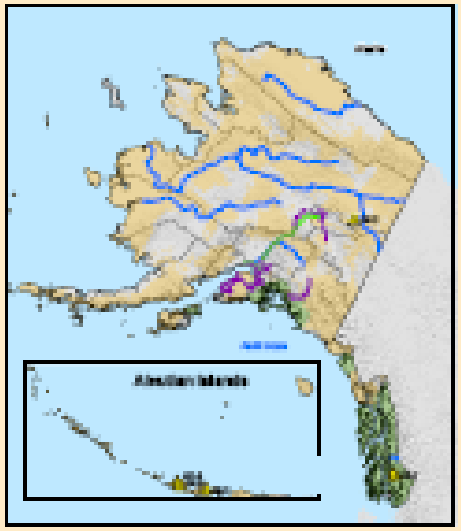
New Power Capacity		Direct and Indirect and Induced Employment (Power Plant, Construction, and Manufacturing Employment)
California	2,400 megawatts (MW)	10,200 ft jobs/38,400 person*yrs
Nevada	1,500 MW	6,375 ft jobs/24,000 person*yrs
Oregon	380 MW	1,615 ft jobs/6,080 person*yrs
Washington	50 MW	212 ft jobs/800 person*yrs
Alaska	25 MW	106 ft jobs/400 person*yrs
Arizona	20 MW	85 ft jobs/320 person*yrs
Colorado	20 MW	85 ft jobs/320 person*yrs
Hawaii	70 MW	298 ft jobs/1,120 person*yrs
Idaho	860 MW	3,655 ft jobs/13,760 person*yrs
New Mexico	80 MW	340 ft jobs/1,280 person*yrs
Utah	230 MW	978 ft jobs/3,680 person*yrs

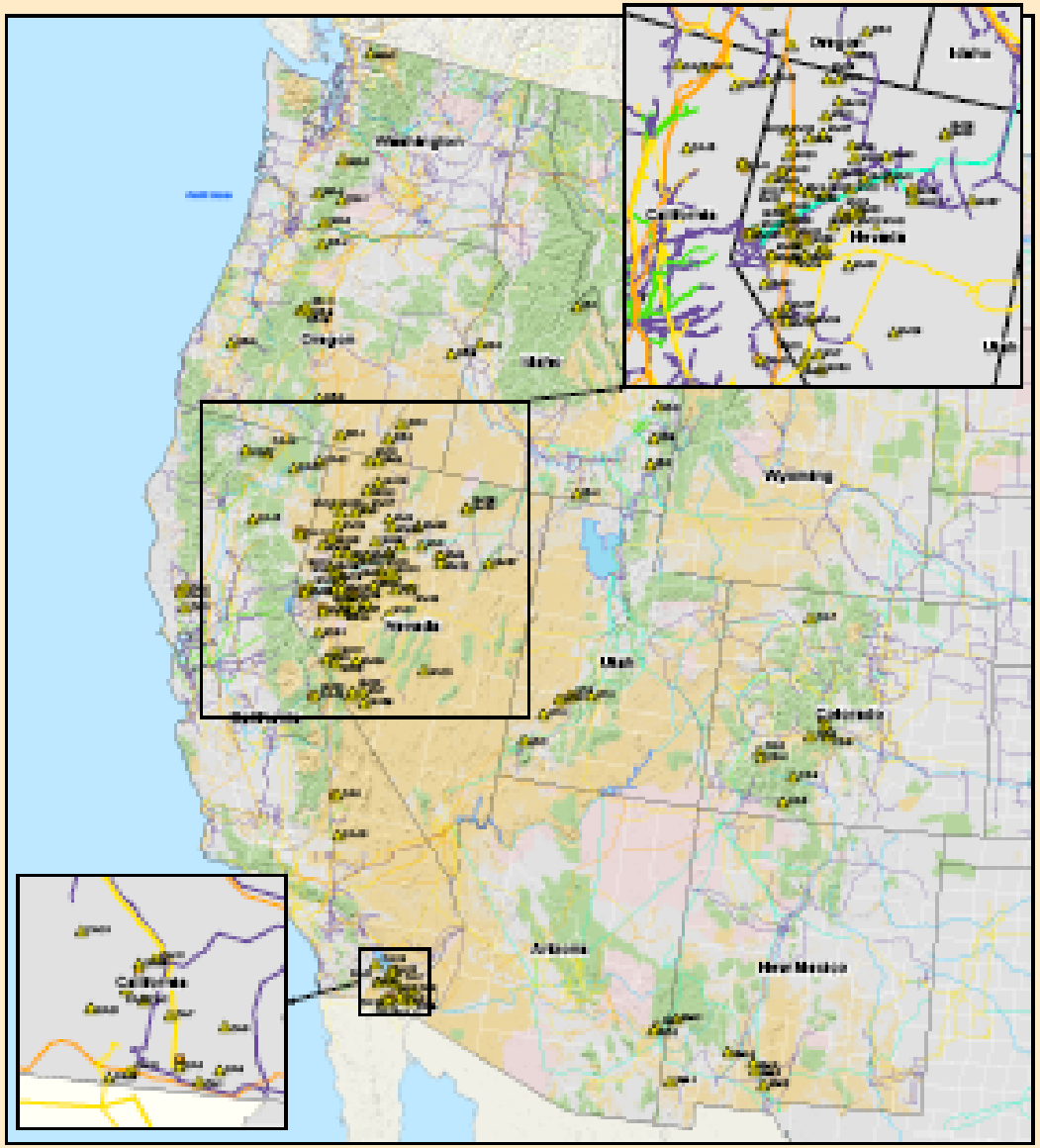
Wyoming, Montana, Texas, Kansas, Nebraska, South Dakota, North Dakota not estimated.

Total Western States

5,635 MW (additional to current 2,700MW)
23,949 fulltime jobs
90,160 person*years of construction and manufacturing employment

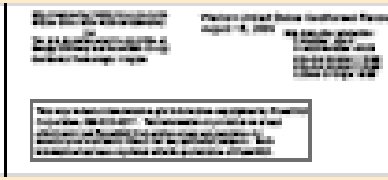
Geothermal Power Potential in the Western United States





Legend

Ownership



Limitations of Estimated Geothermal Potential

- Does not include direct uses of geothermal energy or small, off-grid power potential
- Does not include geothermal heat pump potential
- Does not include “EGS” technology
- Does not include oil and gas potential
- Does not include geopressured resource of Texas, Louisiana and Gulf of Mexico

Other Opportunities

Direct Use

In addition to generating electricity, the heat in geothermal fluids can be used directly for such purposes as growing flowers, raising fish and heating buildings. There are a number of basic types of direct use applications: aquaculture, greenhouses, industrial and agricultural processes, resorts and spas, space and district heating, and cooling. Generally, direct use projects use fluids with temperatures of between 70ºF and 300ºF. Direct use systems in the United States currently provide approximately 600 thermal megawatts of heat, enough to heat approximately 115,000 average homes.

Economic development potential from direct use is substantial. Four commercial greenhouses in southern New Mexico, which at times have employed up to 400 people, occupy more than 50 acres and use geothermal heat to grow plants. In 2002, these projects generated nearly $23 million in sales and paid more than $6 million in payroll. A large greenhouse in rural Utah that grows flowers employs between 80 and 120 people at different times throughout the year.

According to OIT, there are over 1300 direct use sites in Alabama, Alaska, Arizona, Arkansas, California, Colorado, Florida, Georgia, Hawaii, Idaho, Louisiana, Mississippi, Montana, Nevada, New Mexico, New York, North Carolina, Oregon, South Dakota, Texas, Utah, Virginia, Washington, West Virginia, and Wyoming.

Geothermal Heat Pumps

Another opportunity is offered by ground source heat pumps, taking advantage of the fact that subsurface temperatures at very shallow depths remain relatively constant year-round. Using closed-loop piping systems buried beneath the earth, these systems can be used almost anywhere to reduce heating costs in winter and cooling costs in summer.

The geothermal heat pump is a highly efficient renewable energy technology that is gaining wide acceptance for both residential and commercial buildings. Geothermal heat pumps are used for space heating and cooling, as well as water heating.

Engineered Geothermal Systems

Engineered geothermal systems (EGS) are reservoirs created to produce energy from geothermal resources deficient in economical amounts of water and/or permeability. Enhanced geothermal technology will increase the productivity and lifetime of those reservoirs. The U.S. Department of Energy (DOE) estimates that the application of enhanced geothermal technology can significantly expand the extent and amount of geothermal resources used in the West.

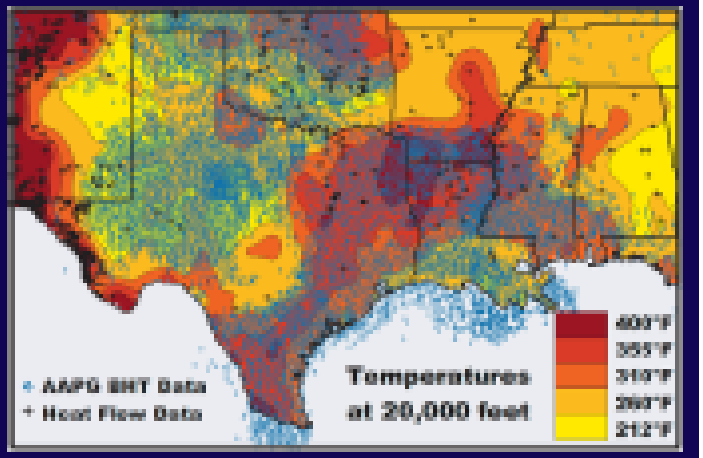
Using Oil and Gas Infrastructure to Enhance Geothermal Resources and Vice Versa.

Nearly 2/3 of all oil discovered in the U.S. is still in place. With conventional technology, that is all we can extract from most oil fields and still make a profit. Also, the cost of electricity to operate oil fields is the most important factor determining the economic life of those fields. New technologies, such as enhanced oil recovery techniques and drilling microholes with less expensive rigs, can be combined with measures to reduce electrical costs, like utilizing renewable resources (wind, solar, and geothermal), to significantly increase the percentage of oil recovered and proportionately reduce the need for foreign oil.

The cost of drilling to develop geothermal resources is often the most decisive factor in determining the economic viability of proposed geothermal power plants. Yet the thousands of oil and gas wells that are typically drilled to even greater depths (accessing even hotter zones) have scarcely been considered for use in geothermal systems. If only 5% of the 600,000 wells that have been drilled in Texas could be used for geothermal extraction, that would mean 30,000 wells available for electrical power generation. As a conservative estimate, if each well had an average production of 2 megawatts, we could have as much as 60,000 megawatts of electrical power generated out of Texas alone. This potential applies as well to the deep sedimentary basins of the western U.S.

Geothermal Energy Generation in Oil & Gas Settings

March 13-14, 2006
Southern Methodist University
James M. Collins Executive Education Center
Dallas, Texas



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Policy Recommendations

The Task Force recommends policy and regulatory initiatives that will

- (1) broadly strengthen and expand the renewable energy market;
- (2) facilitate timely leasing and permitting;
- (3) lead to the expansion of the transmission infrastructure; and
- (4) support key state and federal technology research to expand energy capacity.

Market Development Recommendations

The marketplace needs to support the continued development of geothermal resources.

- 1. Federal and state tax credits are important to reduce the risk and high capital cost of new projects. The federal production tax credit (and clean renewable bonding authority) should be made permanent, or at least extended ten years.
- 2. State laws and regulations should promote a continuing series of opportunities for power purchase agreements between developers and utilities. Whether generated through Renewable Portfolio Standards, Integrated Resource Planning, or other mechanisms, power purchase contracts are fundamental drivers of the market.
- 3. Federal and state laws and regulations should provide incentives for utilities and others to enter into long-term contracts for renewable power. Accounting and regulatory standards should treat renewable power contracts as benefits instead of liabilities, and power purchase contracts should have the backing of the government to ensure their credit worthiness.

Timely Permitting and Environmental Reviews

- Geothermal projects should be prioritized to ensure that permitting, leasing, and environmental reviews are completed in a timely and efficient manner.
  - 1. Federal, state, and local agencies should coordinate resources and requirements. Agencies should be designated to take the lead on specific issues to avoid duplication, and once issues are resolved they should not be revisited without cause.
  - 2. A critical path for new projects should be defined as part of this cooperative effort, and timeframes for key agency decisions along the pathway should be established.

Transmission Access and Adequacy

- The Western Governors should lead the process to ensure that adequate transmission is available for the identified resources.
  - 1. There should be consistent western state policies on inter-connection to the grid that facilitate new geothermal (and other renewable) power development.
  - 2. A fee to support the cost of new transmission could be set that would spread the cost across all states, parties and technologies on a capacity basis.
  - 3. Both inter- and intra- state transmission is needed to support the identified resources should be fast-tracked for permitting and environmental reviews.

Federal Program Support

- Continuing support from key federal programs is needed to achieve the 2015 goals. Federal programs should be coordinated with state agencies.
  - 1. As the National Research Council concluded (*Renewable Power Pathways, 2000*), given the enormous potential of the resource base, geothermal research by the US Department of Energy should be increased, particularly into technologies that can reduce risk, reduce costs, or expand the accessible resource base.
  - 2. Better resource information is needed. The USGS' new resource assessment and DOE's cost-shared drilling and exploration technology efforts should be priorities.
  - 3. The US Department of Energy's *GeoPowering the West* initiative should continue to support state and local governments, Indian Tribes, and others seeking to utilize the West's untapped geothermal resources.

Conclusion

- Geothermal power can be a major contributor to the power infrastructure and economic well-being of the Western States.
- New geothermal power capacity of 5,600 MW could add nearly 10,000 jobs, and also generate about 36,000 person-years of construction and manufacturing business.
- Geothermal power is a reliable, continuously available (24 hours per day – 7 days per week) baseload energy source that typically operates at 90 to 98 percent of the time.
- Insulated from conventional fossil fuel market volatility, geothermal power supports energy price stability and boosts energy security because it is a domestic resource.
- Geothermal power can help fulfill Renewable Portfolio Standards (RPS) that strive to diversify the states' and nation's energy supply.
- Geothermal energy is a clean electricity source, discharging far less emissions, including greenhouse gases, than equivalent fossil-fueled generation.