



GEA Issue Brief

Geothermal Energy and Jobs

A. Current Employment

According to an employment survey conducted by Geothermal Energy Association (GEA), the total number of jobs supported by the existing geothermal industry in 2004 was 11,460. This includes direct, indirect, and induced employment. Power plant or direct employment was estimated to be 4,583 full-time positions. This corresponds to 1.7 permanent jobs per megawatt (MW) of capacity installed. As the report notes, "Employment in the industry is probably at a historic low since power plant construction has been minimal between 1993 and 2004 as state and federal policies underwent significant changes. Also, because federal research support is at a historically low level, associated research employment is low."

Based upon our 2004 analysis, GEA estimated that the geothermal industry employed about 18,000 people in 2008. This is roughly 5,000 direct jobs in operating, construction, and manufacturing and an additional 13,000 supporting jobs. Employment is expected to increase in coming years as geothermal plant development and research expands. According to the US Department of Energy, building geothermal power plants creates 11 times the number of jobs as building a comparable natural gas power plant.¹

B. Job Quality

Not only does geothermal provide more jobs than a traditional power plant, it also provides quality, long-term jobs. According to the proposed Telephone Flat geothermal development project EIS/EIR located in the Glass Mountain Known Geothermal Resource Area, the average wage at the facility will be more than double the average wage in surrounding counties. According to the California census bureau, the average per capita income in 1998 in the closest counties was around \$20,000, with the average California per capita income nearly \$8,000 higher.² The average projected wage related to operation at the Telephone Flat facility would be higher than both the county and state averages, totaling between \$40,000 and \$50,000 (1998 \$).³

¹ U.S. DOE (Jan 2006). *Employment Benefits of Using Geothermal Energy*, Geothermal Technologies Program. DOE estimates total job creation for a 500MW geothermal plant at 27,050 person-years and a comparable natural gas plant at 2,460 person-years.

² Bureau of Economic Analysis (BEA). *Table 3.—Personal Income and Per Capita Personal Income by County*. Retrieved September 6, 2006, from www.bea.gov/bea/regional/articles/0700lap/tab3b.html.

³ Calpine Corporation (February 1999). *Telephone Flat Geothermal Development Project Final Environmental Impact Statement Environmental Impact Report*. California State Clearinghouse Number 97052078. pg 3.12-16.

GEA's employment survey found that the overwhelming majority of geothermal jobs are permanent (95%), and most are also full time. At The Geysers in California, 425 full-time and 225 part-time residents of the community are employed.⁴

1. Geothermal Employment and Rural America

Geothermal resources tend to be located in rural areas with few employment opportunities. Because geothermal energy must be developed where the resource is located, geothermal power plants tend to benefit these economically depressed areas by providing jobs, stability, and tax revenue. Geothermal developers, who typically negotiate 20- to 30-year agreements with purchasers, provide jobs that can be guaranteed for decades.

Rural communities tend to focus on a single source of revenue, such as manufacturing or agriculture, and this can contribute to unemployment and economic instability. Geothermal offers an important means of diversifying the economic base and simultaneously adopting an "innovative income-generating [strategy] to build on . . . assets, diversify . . . economies, attract new businesses, and sustain . . . successes."⁵ Such diversification, according to the Sonoran Institute, is a direct indicator of economic stability.⁶

Jobs at a geothermal facility cover a broad spectrum of skills and draw from a diverse selection of applicants. People employed by the sector include: welders, mechanics, pipe fitters, plumbers, machinists, electricians, carpenters, construction and drilling equipment operators and excavators, surveyors, architects and designers, geologists, hydrologists; electrical, mechanical, and structural engineers; HVAC technicians, food processing specialists, aquaculture and horticulture specialists, managers, attorneys, regulatory and environmental consultants, accountants, computer techs, resort managers, spa developers, researchers, and government employees.

C. Projected Employment

Looking to the future, geothermal employment should expand significantly. In 2009, the GEA verified over 5000 MW of geothermal projects under development. If only a fifth (1000 MW) of this development comes on line within the next few years (a conservative estimate), these new facilities will support 6400 person-year (p-*y) manufacturing and construction jobs and 740 power plant operation and maintenance (O&M) jobs.⁷ If these 1000 MW last 30 years – another

⁴ National Geothermal Collaborative (NGC). *Geothermal Energy and Economic Development*. Retrieved March 14, 2006, from http://www.geocollaborative.org/publications/Geothermal_Energy_and_Economic_Development.pdf.

⁵ Whitener, Leslie and David McGranahan (February 2003). *Rural America: Opportunities and Challenges*. AmberWaves, United States Department of Agriculture, Economic Research Service. Retrieved April 6, 2006, from <http://www.ers.usda.gov/Amberwaves/Feb03/features/ruralamerica.htm>.

⁶ Sonoran Institute (2005). "A socioeconomic profile, Josephine County, Oregon." *Economic profile system (EPS)*. Sonoran Institute. Tuscan, Arizona.

⁷ Hance, Cedric Nethanael (GEA). *Geothermal Industry Employment: Survey Results and Analysis*. September 2005. Research and analysis conducted by GEA for its employment survey indicated that once a power plant was built, employment directly related to operation and maintenance corresponded to 0.74 jobs/MW.

conservative estimate – new production will create 28,600 p*-y jobs. This employment estimate increases if the additional jobs brought on by research, direct use applications, and other geothermal activities are considered. The number also excludes indirect employment impacts.

1. California Potential

Geothermal provides 5% of California’s electricity, only a small percentage of the known, developable potential. This potential could contribute much-needed electricity to areas where the population is on the rise and blackouts have already occurred. In California, geothermal is expected to contribute more jobs to the state than any other renewable sector. Table 1 shows the number of both construction and operational person-years that will likely be generated over the lifetimes of the plants built in California, producing electricity for California, from 2003 to 2017.⁸

Table 1: Projected California Renewable Energy Job Opportunities, 2003-2017

Technology	Total CA Employment Growth for CA Electricity Production (person*years)
Geothermal	60,260
Biomass	38,610
Wind	20,420
Solar PV	2660
Solar Thermal	940

Source: Environment California Research and Policy Center

2. Direct and Indirect Potential, Western States

Most industries measure employment through both direct and indirect employment impacts. While indirect impacts are somewhat difficult to quantify, they help capture an industry’s overall

⁸ Source: Heavner, Brad and Bernadette Del Chiaro (July 2003). *Renewable Energy and Jobs: Employment Impacts of Developing Markets for Renewables in California*. Environment California Research and Policy Center. Accessed March 17, 2006, from http://www.environmentcalifornia.org/uploads/OW/aa/OWaa2RaedlfHwQOWbxKd5w/Renewable_Energy_and_Jobs.pdf.

employment. According to a report by the Western Governors' Association (WGA),⁹ development of the near-term geothermal potential of 5,600 MW of geothermal energy would result in the creation of almost 100,000 new power plant, manufacturing, and construction jobs. If the USGS estimate of 125,000 MW of geothermal potential is developed, millions of quality jobs will be created. Table 2 shows employment and resulting economic output estimates based on WGA's near-term estimates.

Table 2: Summary of Western States' Near-Term Geothermal Potential and Resulting Employment and Economic Contribution

	<u>New Power Capacity (MWs)</u>	<u>Direct and Indirect and Induced Employment (Power Plant Jobs/Construction & Manufacturing Employment)**</u>	<u>30 Year Economic Output (nominal)⁺</u>
California	2,400	10,200 ft jobs/38,400 person*yrs	\$36 billion
Nevada	1,500	6,375 ft jobs/24,000 person*yrs	\$22.5 billion
Oregon	380	1,615 ft jobs/6,080 person*yrs	\$5.7 billion
Washington	50	212 ft jobs/800 person*yrs	\$749 million
Alaska	25	106 ft jobs/400 person*yrs	\$375 million
Arizona	20	85 ft jobs/320 person*yrs	\$300 million
Colorado	20	85 ft jobs/320 person*yrs	\$300 million
Hawaii	70	298 ft jobs/1,120 person*yrs	\$1 billion
Idaho	860	3,655 ft jobs/13,760 person*yrs	\$12.9 billion
New Mexico	80	340 ft jobs/1,280 person*yrs	\$1.2 billion
Utah	230	978 ft jobs/3,680 person*yrs	\$3.4 billion
Wyoming, Montana, Texas, Kansas, Nebraska, South Dakota, North Dakota	Potential Exists; Resource not studied in WGA Report	Not Studied	Not Studied
Total Western States (additional to current)	5,635 MW	23,949 fulltime jobs/90,160 person*years of construction and manufacturing employment	84,410,046,000.00 Almost 85 billion dollars to the U.S. economy over 30 years!

** Power plant jobs are the direct, indirect, and induced full-time jobs (ft jobs) created by reaching the full power production capacity indicated. Construction and manufacturing jobs are the direct, indirect, and induced jobs necessary to build and supply the power plants at the full power capacity indicated. Construction and manufacturing jobs are expressed as full-time positions for one year (person*years), however, these jobs will be spread out over several years depending upon the development time frame for new projects. Direct employment results in 1.7 full-time positions and 6.4 person*years per megawatt. Induced and indirect impacts were calculated assuming a 2.5% multiplier; for a total direct, indirect, and induced employment impact of 4.25 full-time positions and 16 person*years per megawatt.

⁹ Western Governors' Association (WGA) (2005). *CDEAC - Geothermal Task Force*. Retrieved March 14, 2006, from <http://www.westgov.org/wga/initiatives/cdeac/geothermal.htm>.

+Economic Output measures gross power sales over 30 years, assuming power sells at \$.06/kWh and produces at a 95% capacity factor. Economic output is represented in nominal dollars, is not adjusted for inflation, and is rounded to the nearest million. Total economic output is not rounded.

D. Comparative Analysis

A "Geothermal Market Analysis" report, prepared by Deloitte Consulting for the US Department of Energy's Geothermal Technology Program, concluded:

The size of the geothermal power plant creates small economies of scale and requires a large amount of employees to produce a small amount of electricity.

- *Compared to Natural Gas, geothermal requires almost 11x as many employees to produce electricity*
- *Compared to other renewable energy alternatives, geothermal produces nearly 5x as many permanent jobs per 500 MW of capacity than Solar and Wind*

The report included the following chart:¹⁰

Jobs Created by Resource Type

Power Source	Construction Employment (jobs/MW)	O&M Employment (jobs/MW)	Factor Increase over Natural Gas
Wind	2.6	0.3	2.3
Geothermal	4.0	1.7	10.9
Solar Electric	7.1	0.1	2.2
Solar Thermal	5.7	0.2	2.5
Landfill Gas	3.7	2.3	14.7

¹⁰ *Market Analysis-Geothermal*, September 19, 2008, Deloitte Consulting LLP, prepared for the US Department of Energy, EERE, Geothermal Technologies Program.

Suggested Additional Reading (available at: <http://www.geo-energy.org/>):

- Geothermal 101: Basics of Geothermal Energy Production and Use. This 53-page booklet covers the basics of geothermal energy, from the types of power plants in use to common myths with numerous charts, graphs and pictures.
- A Handbook on the Externalities, Employment, and Economics of Geothermal Energy. This 65-page report covers economic, employment and other issues not examined, or not examined in depth, in the environmental guide.

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