Power Generation

Geothermal energy is heat from the Earth. It's clean and sustainable. Resources of geothermal energy range from the shallow ground to steam, hot water, and hot rock accessed by drilling wells up to thousands of feet beneath the Earth's surface. The extremely high temperatures in the deeper geothermal reservoirs are used for the generation of electricity.

Most power plants use steam to generate electricity. The high-pressure steam spins a turbine that rotates a generator, producing electricity. The largest source of carbon emissions in the U.S. are the many power plants still burning fossil fuels to boil water for steam. Geothermal power plants, however, do not burn fuels to heat water to steam. Instead, they use natural heat found below the Earth’s surface to generate electricity.

New geothermal power plants produce near-zero CO₂ and emit very little air pollution.

And unlike solar or wind energy, geothermal energy is available around the clock.

Discover the geothermal power generation potential in your state.

BENEFITS

Jobs Boost. Geothermal power plants employ about 1.17 persons per MW. Adding related governmental, administrative, and technical jobs, the number increases to 2.13.

Economy Boost. Over the course of 30 to 50 years an average 20 MW facility will pay nearly $6.3 to $11 million dollars in property taxes plus $12 to $22 million in annual royalties. Seventy-five percent of these royalties ($9.2 to $16.6M) go directly back to the state and county.

Locally Produced. Geothermal power can offset electricity currently imported into the state, keeping jobs and benefits in state and local communities.

Near-Zero Carbon Emissions. Geothermal flash plants emit about 5% of the carbon dioxide, 1% of the sulfur dioxide, and less than 1% of the nitrous oxide emitted by a coal-fired plant of equal size, and binary geothermal plants – the most common – produce near-zero emissions.

Small Footprint. Geothermal has among the smallest surface land footprint per kilowatt (kW) of any power generation technology.

Reliable. Geothermal power can provide consistent electricity throughout the day and year - continuous baseload power and flexible power to support the needs of variable renewable energy resources, such as wind and solar.

Sustainable Investment. Energy resource decisions made now for sources of electric power have 40-50 year consequences, or longer. Using renewables like geothermal resources avoids "price spikes" inherent in fossil fuel resource markets. Geothermal energy is an investment in stable, predictable costs. Investing in geothermal power now pays off for decades to come.
Colorado Geothermal Power Benefits

Reliable, baseload power:
1,105 MWe of geothermal potential

Total annual power production in Colorado for 2013 was 53,600 GWh. Geothermal potential in the state is as much as 8,900 GWh – 17% of the state’s energy demand, providing reliable baseload power.

Carbon emissions reduction:
7.2 Million metric tons

The EPA’s Clean Power Plan list 2013 emission levels for Colorado to be 41 MMtCO₂. 2030 target levels for the state are set at 30 MMtCO₂. Developing geothermal power in the state can help Colorado meet its target carbon emission levels, as new binary geothermal power plants will have no CO₂ emissions.

Locally produced power:
100% in-state electricity production

8% of Colorado’s electricity use comes from power produced outside of the state and imported for use. Developing the geothermal power could offset imports, allowing for 100% in-state electricity production, providing local jobs and increased revenue in the state – eliminating $420M spent on imports. Dollar amounts represent gross sales.

Policies & Incentives
Federal and state policies and incentives helped catapult renewable energy technologies, such as wind and solar, into the billion dollar industries they are today.

State incentive programs that help developers reduce upfront risk and secure power purchase agreements can help to incentivize geothermal power development in the state.

Geothermal Power Projects in Development in Colorado
- Poncha Hot Springs, Chaffee Co.
- Mt Princeton, Chaffee Co.
- Town of Rico, Dolores Co.
- Trinidad, Las Animas Co.
- Waunita Hot Springs, Gunnison Co.

Job Creation:
Construction: 3,400 person-years
Operation: 1,300 full-time jobs

Calculations in this flyer were based on the USGS 2008 Resource Assessment. Sources for other information in this flyer can be obtained by contacting the Geothermal Energy Association.
Direct Use

Geothermal energy is heat from the Earth. It’s clean and sustainable. Resources of geothermal energy range from the shallow ground to hot water and hot rock accessed by drilling wells up to thousands of feet beneath the Earth’s surface. The hottest reservoirs are used to produce electricity, and the more common moderately hot reservoirs are a ready source of natural heat, without burning fossil fuels.

Direct, or non-electric, use of geothermal energy refers to the use of the energy for both heating and cooling applications. Fluids with temperatures of <300°F, adequate for direct use, are available throughout much of the United States.

Direct use of geothermal energy in homes and commercial operations is much less expensive than using traditional fuels; savings can be as much as 80%! Furthermore, direct-use applications such as fish farms, greenhouses, microbreweries, fruit and vegetable drying, spas, pulp and paper processing, and lumber drying offer attractive and innovative opportunities for local businesses and entrepreneurs.

Discover the geothermal direct-use potential in your state.
**Carbon emissions reduction:**

3 Million metric tons (MMtCO\(_2\))

Colorado CO\(_2\) emissions from heating are nearly 15 MMtCO\(_2\) per year. Developing geothermal direct-use in the state can reduce emissions by as much as 3 MMtCO\(_2\), while providing reliable energy at a low, stable price.

**Locally produced energy:**

As many as 1,880 Colorado jobs

Low-temperature hydrothermal potential exists throughout most of the state of Colorado with over 40 locations identified by the USGS as having potential for development.

**Reliable, stable heat:**

14.1 Trillion BTU

The total estimated annual heat consumption in Colorado is 217 Trillion BTU. Developing the hydrothermal direct-use resources in Colorado — as much as 14.1 Trillion BTU — could offset all of the electric heating and most of the coal-fired heat consumption in the state.
Geothermal energy is heat from the Earth. It's clean and sustainable. Resources of geothermal energy range from the shallow ground to hot water and hot rock accessed by drilling wells up to thousands of feet beneath the Earth's surface. Geothermal heat pumps use the natural insulating properties of the earth from just a few feet underground to as much as several hundred feet deep, offering a unique and highly efficient renewable energy technology for heating and cooling.

Most work by circulating water in a closed system through a “loop field” installed horizontally or vertically in the ground adjacent to or even beneath a building. Heat is taken from the building and transferred to the ground in the summer. The system is reversible, and heat is taken from the ground and used in the building in the winter. The system only moves heat, which is much more efficient than using a fuel or electricity to create heat.

Geothermal heat pumps can support space heating and cooling needs in almost any part of the country.

**BENEFITS**

**Economic.** On average, a typical home of 2000 square feet will require 4 tons of heating and cooling capacity with an average system installation cost between $5,000 and $7,500 per ton.

**Energy Efficient.** Geothermal heat pumps use 25% to 50% less energy than conventional heating or cooling systems.

**Carbon Emissions Reduction.** One ton (12,000 BTU/hr) of GHP capacity over a 20 year operating cycle avoids 21 metric tons of CO\(_2\) emissions. So a typical home system can avoid 80-100 metric tons of CO\(_2\) emissions.

**Improved Indoor Air Quality & Safety.** There is no combustion in a geothermal heat pump; therefore there is no chance of carbon-monoxide poisoning. By adding high-efficiency air cleaners with geothermal, these systems can improve inside air quality.

**Locally Produced. Everywhere.** Unlike other geothermal technologies, heat pumps are not limited by geography or geology. They can be installed in most locations in any of the 50 states or territories of the U.S.

**Sustainable Investment.** The lifespan of a geothermal system is usually greater than 24 years. A conventional furnace will last 7-10 years with regular maintenance. The ground loop of the geothermal system has a warranty of 50 years. These loops are made up of high-density polyethylene pipe, the same pipe which is used in city gas lines.

**Quiet Operation.** Unlike air conditioners, there is no outdoor unit. Geothermal units are very smooth and quiet in operation.
Colorado Geothermal Heat Pump Benefits

**Carbon emissions reduction:**
Over 50% for most systems

Percentage reduction of CO₂ emissions from a geothermal heat pump (GHP) retrofit for a typical home in the Western United States. For example, a retrofitting a fuel oil furnace with a GHP system will reduce CO₂ emissions by 62%.

**Household cost savings:**
$100s in cost savings each year

Average annual savings when replacing a household system with a geothermal heat pump. When multiple systems are replaced (e.g., space heating and cooling and water heating), savings are additive.

**Public & commercial buildings savings**

Public and commercial buildings, such as schools, universities, prisons, and hospitals, can be retrofitted with geothermal heat pumps and provide cost-savings to the state’s – and other utility rate payer’s – energy bills. Many Colorado school districts – such as Poudre Valley – have adopted policies/plans that require all new schools to be heated and cooled with GSHP systems.

**Geothermal Heat Pumps in Colorado**

Geothermal heat pumps are effective for all sizes of buildings from small homes to large buildings like the Colorado State Capital building, which was retrofitted with geothermal heat pumps. During 2013, the first year of operation, $95,000 in utility-bill savings was achieved. Savings are estimated to increase by about 3% annually, reaching $165,000 by 2029. Payback on the geothermal system is estimated to be 10 years.

**Policies & Incentives**

Federal and state policies and incentives helped catapult renewable energy technologies, such as wind and solar, into the billion dollar industries they are today.

States can use tax incentives, including property and sales tax incentives, and tax credits to provide an incremental motivation for geothermal development.

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