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## The Economic, Environmental, and Social Benefits of Geothermal Use in Colorado

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Colorado has benefitted from its rich geothermal resources for centuries. Geothermal heat and hot water were used in the “Centennial State” long before it became a state in 1876. Native Americans valued the healing powers of hot springs often battling for possession. At various times, the Ute, Navajo, and U.S. Cavalry all soaked in geothermal hot springs.

Currently, geothermal heat or water is formally used in at least 30 resorts, small businesses, and communities across Colorado to heat pools and buildings, raise fish and alligators, and grow vegetables.

In addition, many informal, undeveloped hot springs attract hikers and hot springs aficionados. The Colorado Geological Survey lists 106 hot springs and 63 geothermal wells ranging in temperature from 68°F to 181°F across the state.

### *Economic benefits*

Geothermal resources benefit Colorado’s economy in several ways. Geothermal reduces energy usage, cuts operating costs, and offsets the burning of fossil fuels. Geothermal businesses create jobs, foster commercial growth, promote rural development, pay taxes, and are a major tourist attraction, bringing millions of visitors to the state annually.

Geothermal water or heat used by municipal entities cut heating costs, saving taxpayer money.

Since 1981, the Town of Pagosa (“water that has a strong smell” in Ute) Springs Geothermal District Heating System has delivered up to 13 million Btus of geothermal heat to its customers. With an annual operating budget of \$40,000, the system heats Pagosa Elementary, Junior High, and Senior High Schools; two churches; two large office buildings; five retail buildings; Pagosa Town Hall; two homes; a bank; and the Archuleta County Government Building. Geothermal hot water is also used to melt snow on sidewalks and driveways.



**Water from the Great Pagosa Hot Springs heats several customers in the Town of Pagosa Springs including the town square. (Photo: Governor’s Office of Energy Management and Conservation)**

In addition to the town, the Great Pagosa Hot Springs also heat several resorts and pools. Spa resorts have flourished since the 1950s, attracting over 160,000 visitors a year.

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Glenwood Springs is home to Hot Springs Lodge and Pool—the world’s largest, manmade outdoor mineral hot-springs swimming pool—as well as a number of spas, fitness centers, and health and beauty treatment centers.

Hot Springs Pool first opened in 1888; the adjacent 107-room Hot Springs Lodge in 1986. The pool and lodge employ 175 people year-round. In addition to melting snow, geothermal provides 60 percent of the facility’s heat.



**Hot Springs Lodge and Pool at night. (Photo: Hot Springs Lodge and Pool)**

Also in Glenwood Springs, Yampah (“big medicine” in Ute) Spa and Salon employs from 60 to 80 people. The building is well over 100 years old.

More than 2 million tourists travel to Glenwood Springs each year. Two-thirds of the town’s income comes from non-resident sales tax.

In Ouray, the city-owned Ouray Hot Springs Pool and Fitness Center uses about 48,000 billion Btus of geothermal water to heat the pool and five buildings totaling roughly 6,000 square feet. Built in 1927, the pool employs 20 people in the winter; 60 in the summer. In 2005, about 450,000 people visited the facilities. The pool is a

moneymaker for the town. Its total operating budget is approximately \$540,000 per year; revenues are \$660,000.

Wiesbaden Hot Springs Spa and Lodgings in Ouray was a hospital in the 1920s. Built in 1879, the original building was once called “Mother Buchanan’s Bathhouse.” The hotel currently employs nine permanent staff plus massage therapists on a contract basis. Geothermal provides 100 percent of the business’s heat in the winter. The owner calls geothermal “extremely valuable.”

Splashland in Alamosa is a community institution, turning 50 years old this year. The original owners created the pool after they hit water while drilling for oil in the mid-1950s. Splashland’s mission is “to provide a venue where children can learn to have fun and to connect in a positive way with their community.” Over the years, thousands of children from the Southern Colorado Migrant Program, Head Start, and local schools have learned to swim at Splashland.

Sand Dune Swimming Pool and RV Park also in Alamosa has used geothermal energy since 1995 to heat the entire facility. Organic tomatoes and English cucumbers are grown in a greenhouse for the onsite kitchen and sale to the public. From 7 to 20 people work at the pool and park depending on the season. Roughly 100,000 people visit the park annually.

Built in the late 1960s, the Roaring Judy Fish Hatchery in Almont uses geothermal water to raise 3 million salmon; and 250,000 trout a year. The fish farm has five full-time employees, and one part-time.

Kerr Aqua Farms in Hooper, currently managed by Trinidad State Junior College, has been raising catfish, tilapia, lobster, and shrimp since 1979 using water found by

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another unsuccessful wildcatter. The 15-acre plus fish farm, called “one of the best there is” by its owner, provides “hands-on” education for 25 students per term.

Graduates of the aquaculture program have first choice of working for the Division of Wildlife. Geothermal water is also used to irrigate 30 acres.

Dunton Hot Springs in Dolores has been in business since 2002. Employing 25 people, the resort welcomes about 3,000 visitors a year.

“A wonderful combination of new comfort and old charm, spacious and cozy,” Waunita Hot Springs Ranch in Gunnison, 10 miles west of the Continental Divide, has been in business since about 1882. The Pringle family has run the resort since 1962.

Geothermal is used to heat about 20,000 square feet: a 35’ x 90’ swimming pool, spa pools, two lodges, a chicken house, large shop, a portion of a barn and recreation room, and two homes. Approximately 5,000 people visit the ranch each year.

Touted as “the only high-altitude alligator farm,” Colorado Gators in Mosca has been raising fish in geothermal water since 1977, and alligators since 1987. Thirteen people work in the business which raises 35,000 pounds of Rocky Mountain white tilapia per year. In addition, Colorado Gators buys tilapia from other sources, including Kerr Aqua Farms. It sells 100,000 pounds of fish each year.

The numerous geothermal small businesses described above as well as others in Colorado provide countless jobs, many located in rural areas. Using a standard multiplier of 2.5, geothermal businesses create an estimated 3,000 direct, indirect, and induced jobs in Colorado. In addition to jobs, the geothermal businesses pay local, state, and federal taxes.

### *Environmental benefits*

In addition to energy savings, the businesses and communities which use geothermal heat or water prevent the emissions of greenhouse gases (GHG) and air pollutants, helping to keep Colorado’s air clean and its sky clear.

If the geothermal spas, resort, pools, and communities had to use electricity to generate the heat that geothermal water naturally contains, not only would most shut down, but they would also emit at least 158,741 tons of carbon dioxide each year—the equivalent of 334,901 barrels of oil. In addition, they would emit 270 tons of nitrogen oxides and 286 tons of sulfur dioxides each year into Colorado’s air (see Table 1).

### *Social benefits*

Social benefits are difficult to measure quantitatively. One key social benefit from geothermal energy’s use in Colorado, however, is improved quality of life through recreation. Geothermal provides many unique recreational opportunities and attracts millions of tourists to the state each year.

### *The future*

According to a 1995 Colorado Geological Survey Low-Temperature Geothermal Assessment, 93 areas of concentrated geothermal energy in Colorado could provide hot water and heat for 100,000 homes.

In addition, Colorado may have the potential to generate electricity from high temperature geothermal resources, particularly in the Arkansas River and San Luis Valleys in western Colorado.

In 2006, the Western Governors' Association found that high-temperature geothermal resources in Colorado could generate up to 20 megawatts of electricity in the next 10 years.

Thus, there is significant potential for geothermal to contribute to Colorado economically, environmentally, and socially more than it already does.

Site	Location	Application	Annual Energy Use		Annual Emissions Offset (lbs)		
			Btu billion	Equivalent kWh	Nitrogen oxides	Sulfur dioxide	Carbon dioxide
4UR Guest Ranch	Creede	Resort/Pool	5.3	1,553,276	5,311	5,614	3,170,289
Best Western Twin Peaks Motel	Ouray	Space Heating	1.1	322,378	1,102	1,165	657,985
Box Canyon Lodge & Hot Springs	Ouray	Space Heating	1.1	322,378	1,102	1,165	657,985
Cement Creek Ranch	Crested Butte	Resort/Pool	0.4	117,228	401	424	239,266
Colorado Gators	Mosca	Aquaculture	56.0	16,411,976	56,115	59,318	33,497,404
Cottonwood Hot Springs Inn & Spa	Buena Vista	Space Heating	7.9	2,315,261	7,916	8,368	4,725,527
Dakota Hot Springs	Penrose	Resort/Pool	1.0	293,071	1,468	1,879	642,456
Desert Reef Beach Club	Florence	Resort/Pool	1.0	293,071	1,468	1,879	642,456
Dunton Hot Springs	Dolores	Resort/Pool	0.3	87,921	301	318	179,450
Hot Springs Lodge & Pool	Glenwood Springs	Resort/Pool Space Heating	69.2	20,280,513	69,342	73,301	41,393,221
Hot Sulphur Springs Resort	Hot Sulphur Springs	Space Heating Resort/Pool	39.9	11,693,533	39,982	42,264	23,866,901
Indian Springs Resort	Idaho Springs	Resort/Pool	4.3	1,260,205	4,309	4,555	2,572,122
Splashland Hot Springs	Alamosa	Resort/Pool	19.0	5,568,349	19,039	20,126	11,365,191

Site	Location	Application	Annual Energy Use		Annual Emissions Offset (lbs)		
			Btu billion	Equivalent kWh	Nitrogen oxides	Sulfur dioxide	Carbon dioxide
Joyful Journey Hot Springs Spa	Mineral Hot Springs	Resort/Pool	1.0	293,071	1,002	1,059	598,168
Kerr Aqua Farms	Hooper	Aquaculture	46.0	13,481,266	46,095	48,726	27,515,725
Mount Princeton Hot Springs Resort	Nathrop	Resort/Pool	1.8	527,528	1,804	1,907	1,076,703
Ouray Hot Springs Pool & Fitness Center	Ouray	Resort/Pool	48.0	14,067,408	48,099	50,844	24,111,958
Pagosa Springs Private Wells	Pagosa Springs	Space Heating	13.0	3,809,923	13,027	13,770	7,776,183
Roaring Judy Fish Hatchery	Almont	Aquaculture	50.1	14,682,857	50,203	53,069	29,968,213
Salida Hot Springs Aquatic Center	Salida	Resort/Pool	7.0	2,051,497	7,014	7,415	4,187,176
Sand Dunes Swimming Pool & RV Park	Alamosa	Aquaculture	81.2	23,797,365	81,367	86,012	48,571,236
Steamboat Springs Health & Rec. Assn	Steamboat Springs	Resort/Pool	11.8	3,458,238	11,824	12,499	7,058,382
The Spa at Pagosa Springs	Pagosa Springs	Resort/Pool	7.0	2,051,497	7,014	7,415	4,187,176
The Springs Resort	Pagosa Springs	Resort/Pool	1.0	293,071	1,002	1,059	598,168
Town of Pagosa Springs Geothermal Heating System	Pagosa Springs	District Heating	13.0	3,809,923	13,027	13,770	7,776,183
Trimble Hot Springs	Durango	Resort/Pool	7.0	2,051,497	7,014	7,415	4,187,176
Valley View Hot Springs	Villa Grove	Resort/Pool	5.7	1,670,505	5,712	6,038	3,409,558
Waunita Hot Springs Ranch	Gunnison	Resort/Pool Space Heating	20.0	5,861,420	20,041	21,185	11,963,359

Site	Location	Application	Annual Energy Use		Annual Emissions Offset (lbs)		
			Btu billion	Equivalent kWh	Nitrogen oxides	Sulfur dioxide	Carbon dioxide
Wiesbaden Hot Springs & Lodgings	Ouray	Resort/Pool Space Heating	10.8	3,165,167	10,822	11,440	6,460,214
Yampah Spa & Salon (Vapor Caves)	Glenwood Springs	Resort/Pool Space Heating	7.4	2,168,725	7,415	7,838	4,426,442
<b>Totals</b>			<b>538.30</b>	<b>157,760,119</b>	<b>540,338</b>	<b>571,837</b>	<b>317,482,273</b>
					<b>270</b>	<b>286</b>	<b>158,741</b>
					<b>Tons/year</b>		

**Table 1** – Greenhouse gas and air pollutant emissions offset by developed geothermal heat and hot water resources in Colorado (Source: Geo-Heat Center State Geothermal Databases).