



Direct-use of geothermal energy in the USA

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Abstract

The direct utilization of geothermal energy in the United States includes the heating of pools and spas, greenhouses and aquaculture facilities, space heating and district heating, snow melting, agricultural drying, industrial applications and ground-source heat pumps. The installed capacity is 4200 MWt and the annual energy use is 21,700 TJ (6040 GWh). The largest application is ground-source (geothermal) heat pumps (59% of the energy use), and the largest direct-use for is in aquaculture. Direct utilization is increasing at about eight percent per year. A US Department of Energy program, *GeoPowering the West*, has been formulated to expand the production and use of geothermal electricity and heat in the western United States.

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1. Introduction

Geothermal energy is estimated to currently supply, for direct heat use and geothermal heat pumps, approximately 21,700 TJ/yr (6029 GWh/yr) of energy through direct-heat applications in the United States. The corresponding installed capacity is estimated at 4200 MWt. Of these values, direct-use is 8800 TJ/yr (2445 GWh/yr) and 600 MWt, and geothermal heat pumps the remainder. It should be noted that values for the capacity and the energy supplied by geothermal heat-pumps are only approximate, since, it is difficult to determine the exact number of units installed and most are sized for the cooling load. Thus they are oversized, in terms of capacity, for the heating load (except possibly in the northern US).

Most of the applications experienced some increase in use recently. However, the largest annual energy growth has been in the number of geothermal heat pumps. Aquaculture has the largest annual energy growth rate of the direct-use categories,

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increasing in annual use by 16.9% compound per year over the past 5 years. Resorts and spa use and development have actually remained fairly constant with only a slight growth—most of the increase is due to more comprehensive reporting of the data. There has been a major decrease in the industrial sector, as the gold and silver heap leaching-projects in Nevada are no longer using geothermal energy. In addition, the lithium-bromide chiller used on the Oregon Institute of Technology campus has been replaced with an electric chiller (due to the low efficiency of the geothermal system); thus, there is no direct-heat cooling in the US (except for geothermal heat pumps). Today, 35% of the annual energy use for direct-use is in the aquaculture industry, 28% is in bathing and swimming (resort and spa-pool heating), 18% in space heating (including district heating), 14% in greenhouse heating, and 5% in industrial processing, including agricultural drying and snow melting. If geothermal heat pumps are included, then they contribute 59% to the annual energy use, and direct-use contributes the remainder.

From 1990, the growth rate for direct-use was 6.0% annually and for geothermal heat pumps 8.5% annually, and an overall total of 7.4% annually. A summary of the apparent increase in direct-use in the USA over the past 25 years is shown in Table 1. Figs. 1 and 2 show the relative portions of direct-use capacity and energy use (without heat pumps) for the USA at the beginning of 2001. Figs. 3 and 4 show the apparent increases in geothermal direct-use.

2. Recent direct-use developments

There were 27 new projects identified in seven states, and 10 existing projects were expanded a significant amount, over the past 5 years. The new projects are mainly for aquaculture pond and raceway heating in the Imperial Valley of California and along the Snake River Plain in Idaho, and greenhouses in Oregon, Montana and Utah. The expanded projects include the Klamath Falls and Oregon Institute of Technology district-heating projects, six greenhouse projects in California, Idaho and New Mexico, and two aquaculture projects in the Imperial Valley of California. Two major industrial projects, both silver and gold heap-leaching in Nevada no longer use geothermal energy in their processes, due to the expense of royalty payments for geothermal energy use from federal lands.

During the past 5 years, the thermal capacity of the direct heat projects increased by 170 MWt, representing an annual energy utilization of 2792 TJ/yr (777 GWh/yr).

Table 1
Increase in known US direct-heat utilization (compounded annual % rate)

Period	Direct-use	Heat pumps	Total
1975–1985	3.0	19.7	5.9
1985–1995	4.1	17.6	10.0
1995–2000	7.9	8.1	8.0
(1975–2000)	4.6	16.5	8.0

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