



## Direct Use of Geothermal Energy

*The direct use of geothermal resources is a proven, economic, and clean energy option that saves money and reduces pollution. The U.S. Department of Energy facilitates the development of low- and intermediate-temperature resources for direct use by supporting the Geo-Heat Center at the Oregon Institute of Technology in Klamath Falls, Oregon.*

### **Heat That Comes Directly from the Earth**

Geothermal reservoirs of low to moderate temperature 68°–302°F (20°–150°C) are used for heating homes, offices, and greenhouses; in aquaculture and food-processing plants; and a variety of other applications. These applications provide a savings in energy costs to the consumer, and produce only a small percentage of the air pollutants emitted by burning fossil fuels.

People at more than 120 locations (some of which include as many as 500 wells) are using geothermal energy for space and district heating, including a few locations where waste heat is used for snow melting. These space and district heating systems are developed

and owned by individuals, small businesses, and municipalities and are located mainly in the western United States. Vegetables, flowers, houseplants, and tree seedlings are raised in nearly 40 greenhouse complexes heated by geothermal energy. Approximately 30 aquaculture projects raise catfish, tilapia, shrimp, alligators, tropical fish, and other aquatic species. Industrial applications include food dehydration, laundries, gold mining, grain drying, mushroom culture, and sludge digestion. Dehydration, the drying of onions and garlic, is the largest industrial use of geothermal energy. In addition, there are approximately 220 geothermal resorts and spas throughout the United States.

### **Research Supported by the U.S. Department of Energy**

Through its support of the Geo-Heat Center, the U.S. Department of Energy conducts research, provides technical assistance, and distributes general information on a wide range of geothermal direct-use applications. The Geo-Heat Center's most recent projects include development of a greenhouse information package, cost comparisons of heat pumps, low-temperature resource assessment, cost analysis for homeowners, engineering model specifications, and creation of an information package for aquaculture developers.

### **Greenhouse Information Package**

The Geo-Heat Center recently developed a greenhouse information package that provides background information for developers of geothermal greenhouses. The package includes crop market prices for vegetables and flowers, greenhouse operating costs, crop culture information (tomato, cucumber, hydroponic lettuce, carnations, roses), greenhouse heating system specifications, a greenhouse heating equipment selection spreadsheet, and vendor information.

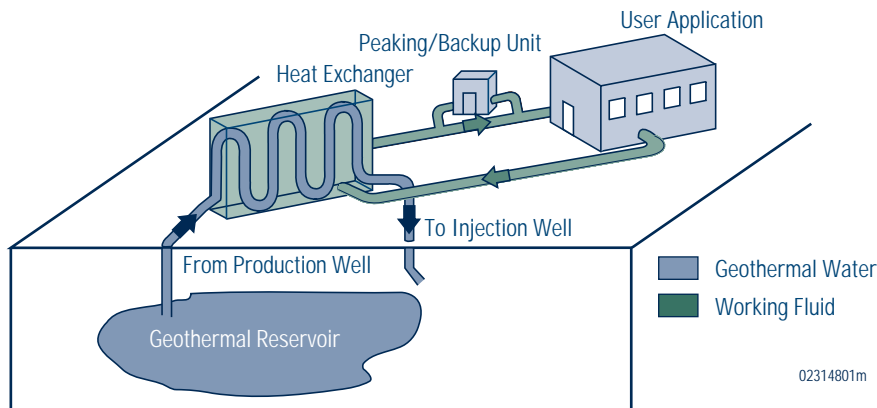
### **Groundwater Heat Pumps**

Researchers have identified groundwater heat pump systems as offering substantial capital cost savings over other types of geothermal heat pump systems. The Geo-Heat Center compared the capital cost of commercial ground-source heat pump systems, including ground-coupled, groundwater, and hybrid systems (using a cooling tower). They also investigated well pumps for commercial groundwater heat pump systems, including the optimum pumping rates for a range of well pump total-dynamic head and groundwater temperatures, and the impact on overall system energy efficiency rating and coefficient of performance. An information survival kit has been prepared for the prospective residential geothermal heat pump owner that answers some of the more frequently



Geo-Heat Center, Oregon  
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Milgro Nurseries in southwestern Utah, is one of approximately 40 greenhouses in the United States saving energy and costs by using geothermal energy.



Most geothermal direct-use systems use a heat exchanger to keep the geothermal water separate from the working fluid that carries heat to the application.

to engineers. These items include injection and production wells with open-hole and screened completions, line-shaft well pumps, submersible well pumps, and plate and frame heat exchangers. These model specifications will help ensure that the intent of the designer is reflected in the installed system by improving communication between the designer and the contractor, providing the owner with the expected level of reliability and performance.

asked questions concerning the application and use of geothermal heat pumps.

### ***Low-Temperature Resource Assessment***

Completed in 1996, this program assessed low-temperature geothermal resources in 10 western states (Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, and Washington). The program identified 271 cities and communities with a total population of 7.4 million that potentially could use geothermal energy for district heating and other applications. More than 1,900 thermal wells were identified by state teams as having temperatures greater than 122°F (50°C) and 1,469 are collocated with communities. The data are available on a Paradox database at the Geo-Heat Center.

### ***Selected Cost Considerations for Geothermal District Heating in Existing Single-Family Residences***

This study by the Geo-Heat Center examines the costs associated with installation of a district heating system for the single-family residential sector. Cost-saving areas discussed include installation in unpaved areas, uninsulated return lines, and installation in areas unencumbered by existing buried utilities.

### ***Model Specifications***

Recently, the Geo-Heat Center began developing model specifications for items specific to low- and medium-temperature projects that are most unfamiliar

### ***Aquaculture Developer Package***

Aquaculture is one of the fastest growing segments of the U.S. agriculture market and is drawing many into the aquaculture business who have little exposure to the technology. Researchers are developing a comprehensive aquaculture developer package to meet the needs of this expanding market. The package will include pond-heating requirements (indoor and outdoor), information on intensive and extensive culture, information on the culture of common species, current market prices for common species, and typical operating costs for a geothermal aquaculture operation. This broad base of information will permit more informed decision-making and lead to more successful projects.

### ***The Future***

The future of geothermal direct-use applications is bright: aquaculture and greenhouse operations are continuing to expand; district heating is being planned for a major area south of Reno, Nevada; industrial processes continue to grow; and geothermal heat pumps are an emerging market, nourished by the non-polluting and sustainable geothermal energy resource.

For more information on geothermal technologies, call the Office of Geothermal Technologies: (202) 586-5340

or visit the Web site:

<http://www.eren.doe.gov/geothermal>



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