National GEOTHERMAL Collaborative

Geothermal Direct Use

The direct use of geothermal heat and water dates back thousands of years to when people used hot springs for cooking and for therapeutic purposes. Direct-use applications tap hot underground water and distribute the heat through pipes for various uses. These systems can replace traditional heating sources such as natural gas-fired boilers, furnaces or hot water heaters. Some cities and towns have installed large direct-use heating systems called district heating that heat many buildings from a common geothermal source. Geothermal energy can also be used to cool buildings. Geothermal direct use also has agricultural and industrial applications. The agricultural sector uses geothermal resources to provide a stable source of heat for raising fish and heating greenhouses; industrial uses include mineral extraction, drying timber and dyeing fabric. Resorts and spas also use geothermal water directly.

Technology

Direct-use systems use geothermal resources at temperatures between 70°F to 300°F; these temperatures are lower than those required for most geothermal power plants. Approximately 1,300 of these systems operate across the United States. Geothermal direct-use systems use a fairly simple and established technology that generally involves three basic elements:

- A production system that brings water up through a well to the surface;
- A delivery system that distributes hot water through pipes; and
- A disposal system where the cooled water is injected back into the reservoir.

Applications for Direct Use

Heating

Direct use of geothermal resources heating can save on energy costs compared to traditional natural gas or electric heating systems. Although direct-use applications often require a significant investment for drilling and installing equipment, they have lower operating and maintenance costs and do not require constant fuel purchases. Generally, space heating uses a single geothermal well to heat one building, whereas district heating uses one or more wells to heat several structures or even portions of entire cities and towns. District heating systems can save from 30 to 50 percent on heating costs, compared to heating systems that use natural gas, and even more compared to systems that use electricity, propane or fuel oil. These savings take into account the capital cost of equipment and efficiencies involved in converting the actual fuels into usable heat.

According to the Geo-Heat Center at the Oregon Institute of Technology, 18 locations in California, Colorado, Idaho, Nevada, New Mexico, Oregon and South Dakota use geothermal energy for district heating, and the potential exists to develop many more. More than 400 communities in 16 western states are located within five miles of a geothermal resource that is suitable for this purpose. Some examples follow of operational district heating projects.

- New Mexico State University heats approximately half the campus with geothermal heat. It is estimated that this system saves between $100,000 to $300,000 in heating costs each year, depending on the price of natural gas and the severity of the winter.

- The district heating system in Klamath Falls, Oregon, provides approximately 6 megawatts of heat to 20 commercial buildings and for melting snow over nearly 105,000 square-feet of sidewalks and bridges. A commercial greenhouse that covers three acres recently tapped into the city's system; it is using geothermal heat to grow tree seedlings.

(Con't.)

Heating *(Con't.)*

• The Oregon Institute of Technology in Klamath Falls, Oregon, uses a district heating system to heat nearly 700,000 square-feet of space in 11 different buildings. This operation saves approximately $300,000 per year on heating bills.

• Boise, Idaho, has four district heating systems. The Warm Springs System has operated since 1892 and is the oldest in the country. The other three systems supply heat to many buildings throughout the downtown area, including the State Capitol and the VA Hospital.

Agricultural Applications

Greenhouses and aquaculture (fish farming) are the two main agricultural uses for geothermal energy. Greenhouses typically use resources between 70°F and 220°F. Fish farms use even lower temperature resources of between 60°F and 90°F. Approximately 40 commercial greenhouses in eight western states grow plants such as vegetables, flowers and tree seedlings. In New Mexico, four large geothermal greenhouses currently employ approximately 200 people. In 2002 these operations saved a total of approximately $655,000 using geothermal resources for heating instead of natural gas. Nearly 50 aquaculture operations are located in 11 western states. In addition, geothermal resources can be used to pasteurize milk and dehydrate fruit and vegetables.

Industrial Processes

Geothermal resources also are used in mineral extraction, timber drying, fruit and vegetable dehydration and textile industries. In the United States, gold is extracted using a process called heap leaching in which a cyanide solution is sprayed over ore. Using the heat of geothermal resources allows the process to continue even in the winter, when the ore would otherwise be frozen solid. This method of mineral extraction, used primarily in Nevada, has resulted in higher rates of gold recovery. In Italy, geothermal energy has been used for centuries to process boron into boric acid. Geothermal heat also is used to dry lumber and to dye fabrics such as silk and wool.

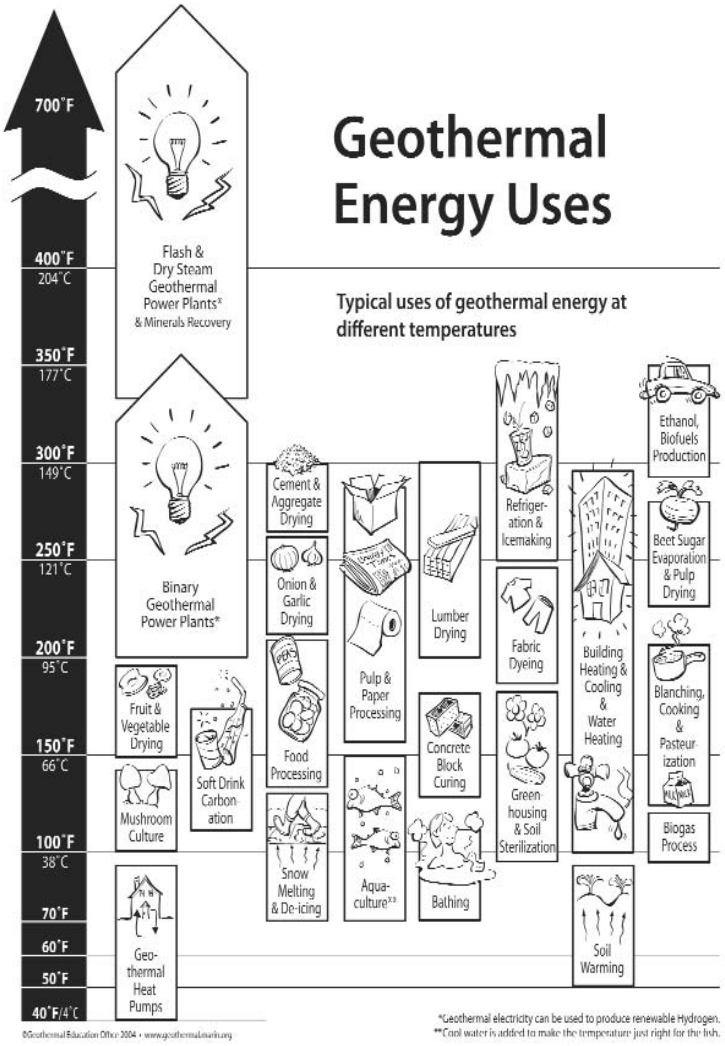

Fig.1
Source: Geothermal Education Office and the Geo-Heat Center, 2004.