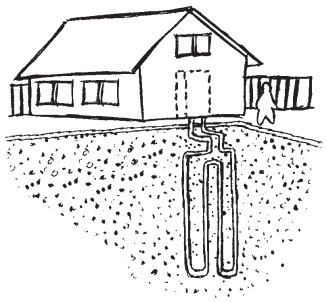
Geothermal Heat Pumps



EPA's State and Local Climate Change Program helps build awareness, expertise, and capacity to address the risk of climate change at the state and local levels. The program provides guidance and technical information to help state and local agencies prepare inventories of greenhouse gas emissions, develop action plans to reduce emissions, and educate their constituents. By emphasizing the many economic and environmental benefits of greenhouse gas reductions, the program encourages state and local decisionmakers to implement voluntary measures to reduce their greenhouse gas emissions.

Geothermal Heat Pumps

Geothermal heat pumps (GHPs), also known as ground-source heat pumps or "GeoExchange" systems, are among the most efficient and comfortable heating and cooling technologies currently available for homes and other buildings. GHPs take advantage of the nearly constant temperatures of the earth a few feet below the surface, collecting heat from the earth (or a body of water) during the heating season and transferring heat from the building to the earth (or a body of water) during the cooling season. They are appropriate for use in warm or cold climates, and are more efficient than traditional heat pumps that exchange heat between a building and the outside air.

Geothermal heat pumps are used in homes, stores, office buildings, and public buildings nationwide—including more than 450 schools in 30 states. GHPs may be installed in a variety of configurations. The main unit, located inside the building, is connected to a loop of durable piping that runs into the earth. In a horizontal loop system, the piping is buried in underground trenches. In a vertical system, piping is installed in boreholes similar to those drilled for water wells. Closed-loop GHPs circulate a water-antifreeze solution through the system, while open-loop systems go outside the loop to circulate groundwater or water from a pond or lake.

In addition to heating and cooling, GHPs can provide some or all of a home's hot water needs. Most GHPs are installed with "desuperheaters," which collect waste heat from the compressor and use it to pre-heat domestic hot water for free. During hot summers when there is much waste heat to reject, most of a home's hot water can be provided in this manner. Overall, desuperheaters have been known to provide 15-50 percent of a home's annual hot water needs, depending on the climate.

Commercial and residential customers also have the option of having all of their hot water needs met by GHP water heaters, which can be integrated into the same ground loop that services heating and cooling. This way of heating water is four times more efficient than standard electric water heating.

GHPs can handle a variety of additional loads in commercial buildings, such as freezers, walk-in and reach-in coolers, ice makers, hot water for laundry or dishes, and even snow removal and de-icing sidewalks and entry ways.

Other advantages: GHPs are quieter than conventional systems and have lower maintenance costs. Surveys show extraordinary levels of customer satisfaction, usually well over 90 percent.

In a 1993 EPA report titled *Space Conditioning: The Next Frontier*, the agency concluded that geothermal heat pump technologies represent a major opportunity for reducing national

BENEFITS OF GEOTHERMAL HEAT PUMPS

- Greatly reduced energy costs.
- Reduced emissions of greenhouse gases and other pollutants.
- Higher installation cost is paid for in just three to five years of energy savings.
- Quiet operation.
- Low maintenance costs.
- Suitable for warm or cold climates.

energy use and pollution, while delivering comfort, reliability, and savings to homeowners. Those conclusions remain valid today. EPA estimates that, on average, a properly sized and installed ENERGY STAR® -labeled geothermal heat pump can save consumers 30-40 percent on heating and cooling bills. Results will vary based on resident behavior, climate, and other factors such as abnormally hot or cold seasons.

Greenhouse gas emissions associated with the use of geothermal heat pumps are 55 to 60 percent lower than those from standard air-source heat pumps. In most areas of the United States, GHPs had the lowest CO_2 emissions and the lowest overall environmental impact of any space conditioning technology evaluated by EPA in its study.

Geothermal heat pumps cost more to install than conventional space conditioning systems, but the additional investment typically can be recovered in as little as three to five years through lower heating and cooling bills, low-interest loans, and rebates. If financed through a mortgage, loan, or lease, GHPs usually provide positive cash flow immediately, since the extra money in the monthly payment needed to cover the additional first cost is usually far outweighed by the energy and maintenance savings. For instance, a homeowner may pay $30 extra per month on her mortgage to cover the extra cost of a GHP system—but she will likely save $40 or more per month on energy and maintenance costs.

The Federal Role

The EPA and Department of Energy's ENERGY STAR program helps draw consumer attention to the energy-saving and environmental qualities of geothermal heat pumps. In addition, the National Earth Comfort Program, established under the Department of Energy's Energy Partnerships for a Strong Economy, promotes the use of GHPs nationwide.

The program is a collaborative effort of the U.S. Department of Energy, EPA, and other public and private sector organizations, including 120 electric utilities. The goal is to increase annual sales of geothermal heat pumps in the United States from 40,000 per year in 1993 to 400,000 annually by the year 2005. Meeting this goal would reduce greenhouse gas emissions by more than 1 million metric tons of carbon compared to baseline market projections and save consumers more than $420 million per year in energy bills. A self-sustaining GHP industry would reduce carbon emissions by at least 5 million tons annually by the year 2010.

State Experiences with GHPs

A number of states provide incentives for the use of geothermal heat pumps and other geothermal energy technologies. Programs include property tax exemptions for the value of installed GHPs, income tax credits, and grant programs for public-private geothermal energy projects.

Idaho

Idaho allows an income tax deduction to taxpayers who install a solar, wind, or geothermal device used for heating or generating electricity (Idaho Tax Code 63-3022c). Geothermal heat pumps are eligible. The deduction starts at 40 percent of the cost of the system for the year in which it is installed, and drops to 20 percent for each of the following three years. The maximum deduction in any one year is $5,000.

In addition, the state's energy office offers a low-interest loan program for projects using geothermal heat, including GHPs. Loans are available for $1,000 to $10,000 for residential projects, and $1,000 to $100,000 for commercial projects. The interest rate is 4 percent, and the interest and principal must be repaid within five years. To qualify, the project must be located within the state, the savings must repay the installation costs within 10 years, and it must be the least-cost alternative when considering the installed cost and the projected costs of operation and maintenance over 20 years.

North Dakota

North Dakota has signed a memorandum of understanding with the Geothermal Heat Pump Consortium to facilitate the installation of GHPs in state facilities where the systems are feasible and cost-effective. The consortium will facilitate training, provide design assistance, and help with publicity, while the state agrees to recommend the installation of GHPs in buildings where it is cost-effective.

In addition, North Dakota provides tax incentives for geothermal heat pumps and other geothermal energy systems (North Dakota Tax Code 57-38-01.8). Any North Dakota taxpayer, whether an individual or corporation, who installs a geothermal, solar, or wind energy device may claim an income tax credit of 5 percent per year for three years for the actual cost of acquisition and installation. The three years during which the credit must be used are the year of installation and the two years immediately following installation.

Property owners in North Dakota may claim an exemption from property tax for a geothermal, solar, or wind energy system. The exemption is for the additional value that the energy system contributes to the total value of the property, as determined by a tax assessor. The exemption is valid for five years following the date when the system is installed.

For More Information

EPA's *ENERGY STAR Geothermal Heat Pumps* program lists heat pump models that meet ENERGY STAR guidelines.

Website: *http://www.epa.gov/appdstar/hvac/geothermal.html*

Information on the *National Earth Comfort Program* is available on the GeoExchange Information Center website. The site is operated by the Geothermal Heat Pump Consortium, a public-private partnership that is implementing the National Earth Comfort Program.

Website: *http://www.ghpc.org/*

The *Geothermal Information Office*, a collaborative effort between Alliant Utilities and the Electric Power Research Institute, provides basic information on geothermal energy, including heat pumps.

Website: *http://www.alliantgeo.com/*

The executive summary of EPA's report *Space Conditioning: The Next Frontier* may be viewed online at:

Website: *http://es.epa.gov/program/epaorgs/oar/spacecon.html*

EPA's State and Local Climate Change Program helps states and communities reduce emissions of greenhouse gases in a cost-effective manner while addressing other environmental problems.

Website: *http://www.epa.gov/globalwarming/ and click on "Public Decision Makers" under the "Visitors Center."*