

# Geoexchange Systems: Renewable and Ready

**Why Geoexchange systems:** Geoexchange (geothermal) heating and cooling systems are the most energy-efficient, environmentally clean, and cost-effective space conditioning systems available, according to the Environmental Protection Agency<sup>1</sup>. EPA found that geoexchange systems can reduce energy consumption--and corresponding emissions--by over 40% compared to air source heat pumps and by over 70% compared to electric resistance heating with standard air-conditioning equipment. Combining geoexchange with other energy-efficiency measures (such as window or insulation upgrades) can increase these savings synergistically.

**How Geoexchange works:** Geoexchange systems use the Earth's energy storage capability to heat and cool buildings, and to provide hot water. The earth is a huge energy storage device that absorbs 47% of the sun's energy--more than 500 times more energy than mankind needs every year--in the form of clean, renewable energy. Geoexchange takes this heat during the heating season at an efficiency approaching or exceeding 400%, and returns it during the cooling season. Geoexchange heating and cooling systems use conventional vapor compression heat pumps to extract the low-grade solar energy from the earth. In summer, the process reverses and the earth becomes a heat sink.

Heat exchanger designs include *closed loop* systems which use horizontal or vertical heat exchangers made of heat-fused high density polyethylene pipe. These systems usually circulate water with a biodegradable antifreeze added. *Open loop* systems generally draw ground water through the heat pump, and return it to the ground unaltered except for a all temperature change.

**Geoexchange is renewable:** Geoexchange is a renewable resource. In the heating mode, an efficient geoexchange system will move at least three units of solar energy from the ground for each unit of electricity used by the heat pump and its accessories. In the cooling mode, the same heat exchanger rejects heat to the surrounding ground, which equilibrates with the atmosphere. The energy flux attributable to the heat pumps is orders of magnitude lower than the solar energy received at the ground.

**Geoexchange synergies with building efficiency:** More efficient systems, better building envelopes, and art ventilation in commercial systems minimize the amount of geothermal heat exchanger required, giving geoexchange building designers strong incentives for more efficient building designs. In residential geoexchange applications, and improved shell efficiency also pay strong dividends in both first costs (by allowing equipment down-sizing), and operating costs, to a far greater extent than for conventional heating and cooling systems. Geoexchange domestic hot water, through "desuperheaters," shipped with about 80% of all units today, and through "full condensing" hot water systems, can save consumers several hundred dollars per year.

**Geoexchange synergies with other renewables:** Passive solar design strongly supports geoexchange heating and cooling efficiency and economics. For larger buildings, solar warming of ventilation air in winter also may have excellent economics for many owners. In the future, efficient buildings with ground-connected heating and cooling systems will meet peak or total loads with user-site photovoltaics, using the electric grid for efficient load management.

**Geoexchange: a great choice today.** EPA found that, even on a source fuel basis--accounting for all losses in the fuel cycle including electricity generation at power plants-- geoexchange systems are much more efficient than competing fuel technologies. They are an average of 48% more efficient than the best gas furnaces on a source fuel basis, and over 75% more efficient than oil furnaces. In fact, today's best geoexchange systems outperform the best gas technology, gas heat pumps, by an average of 36% in heating mode and 43% in cooling mode!

No alternative has such great opportunities to maximize savings by combining good design, good construction, and a system customers like. Surveys by utilities indicate a higher level of consumer satisfaction for geoexchange than for conventional systems: more than 95% of all geothermal heat and cooling customers would recommend geoexchange to a family member or friend.

**What about economics?** Geoexchange systems represent a savings to homeowners of 30% to 70% in the heating mode, and 20% to 50% in the cooling mode compared to conventional systems. Well-designed residential systems exhibit positive cash flows from the first month: the incremental cost of amortizing the geoexchange system is less than the cost of the fuel or electricity not used. Closed loop commercial and institutional systems today can cost less than alternative designs, and larger open loop systems may save hundreds of dollars per ton relative to conventional systems.

**Transforming the market:** Today there are 750,000 geoexchange installations in place. Success will show that the combination of government, utility, manufacturers, and other trade allies can accelerate acceptance of renewables as mainline design choices. This reinforces public understanding that renewable readily integrate into the fabric of life, and it accelerates understanding in the design and construction sectors that energy efficiency in buildings is an economic key for renewable energy successes.

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<sup>1</sup> Environmental Protection Agency, [Space Conditioning: The Next Frontier](#), Office of Air and Radiation, 430-R-93-004 (4/93).