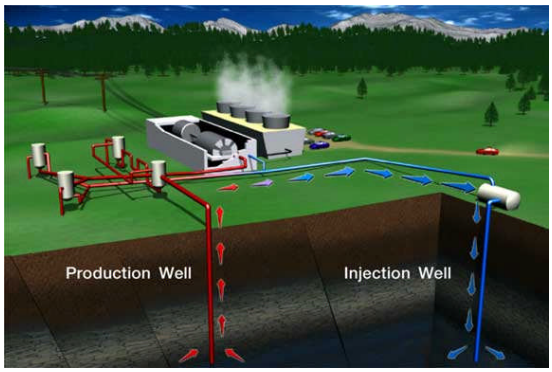
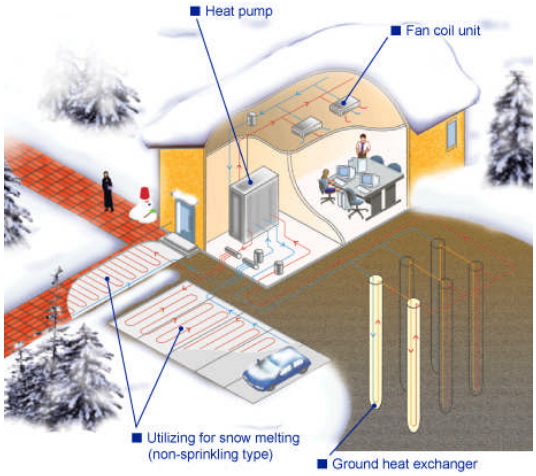
Bifluid Geothermal System – New Generation

The Geothermal Energy - from the Greek roots geo, meaning earth, and thermos, meaning heat - ie the thermal energy stored in the underground of our planet, and that the Earth's crust increases in proportion as we descend depth. It is an inexhaustible source of energy, constantly available and above all “renewable energy”.

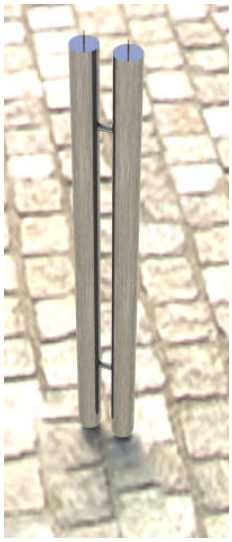
Types of geothermal energy currently in use:



• **Classical:** Geothermal power is power extracted from heat stored in the earth . It has been used for space heating and bathing since ancient roman times, but is now better known for generating electricity



- **Low Enthalpy** *: geothermal energy used for air-conditioning (Hot and cold)



- GEO COMPACT easy system :The **new Enthalpy geothermal system,** created by Modutech for air conditioning (hot and cold and hot water) with double-acting fluid.

* *In thermodynamics and molecular chemistry, the enthalpy (denoted as H, or specific enthalpy denoted as h) is a thermodynamic property of a fluid. It can be used to calculate the heat transfer during a quasistatic process taking place in a closed thermodynamic system under constant pressure. Enthalpy H is an arbitrary concept but the enthalpy change ΔH is more useful because it is equal to the change in the internal energy of the system, plus the work that the system has done on its surroundings.*

The term enthalpy was composed of the prefix en-, meaning "to put into" and the Greek word -thalpein, meaning "to heat", although the original definition is thought to have stemmed from the word "enthalpos" (ένθάλπος) .

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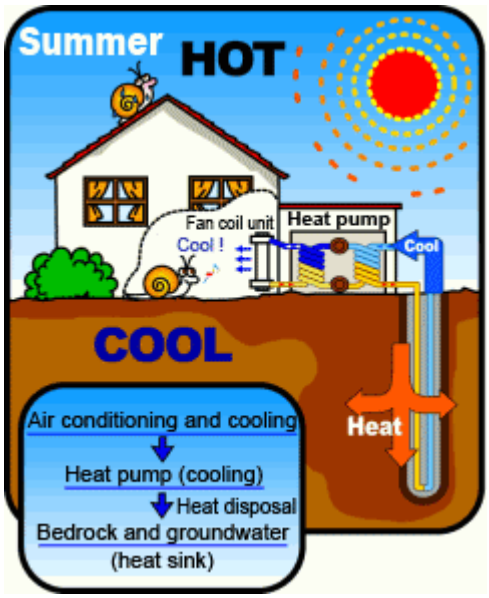
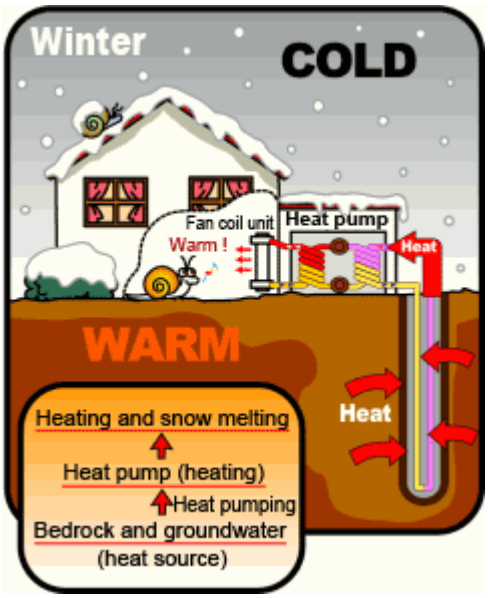


Process of heat exchange (in summer)



Process of heat exchange (in winter)

PRINCIPLE

A few meters depth from the surface of the Earth's underground temperature remains a constant throughout the year: this fact makes it possible to extract heat from the earth during the winter to heat homes, offices and sheds. Alternatively during the summer Earth's the same behaviour can reverse the process by disposing of heat needed to cool the same environments.

Exploiting this principle, the exchanging of heat is produced with heat pumps coupled with sensors that allow geothermal heating and cooling buildings with a single installation and ensure a high level of performance over the season.

The **need for electricity** is enormous compared to the thermal performance (about the performance of a GEO COMPACT system is equal to eight times that of a gas boiler condensing).

In addition the GEO COMPACT system is completely safe: **no flame, and therefore no risk of explosion, no toxic exhaust gases (like carbon monoxide), no polluting gases (like carbon dioxide CO_2), no liquid acid (as sulfuric acid H_2SO_4)**. The system can be easily integrated with Photovoltaic or Wind plant to meet the very low power consumption of the heat pump, this gives a substantially free energy needed to operate the GEO COMPACT system.

In addition, the GEO COMPACT system allows you to transform your house into a **zero-impact: Zero emission of CO_2!**

It should be noted that there is no need for external thermal input (for example, a gas boiler) for the periods of bad cold winters!

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WHAT IS GEOTHERMAL SYSTEM USED FOR

To Produce thermal renewable and clean energy that is used for:

- Heat any building
- to cool any building.
- to produce hot water.

HOW TO INSTALL A GEO COMPACT HEATING & COOLING SYSTEM

1- Check Your Property

First of all, you will need to take a close look at where you live. This is probably best done by someone who has experience in geothermal heating, since they will understand what to look for. You need to choose a geothermal pump that will fit with the topography and soil type of your property.

2- Install the System

Geothermal heating systems almost always require a professional for installation. There are many factors involved, including choosing the right system for you.

GEO COMPACT system works **in very little space** : the probes need to be deeply buried 26 feet (8 metres) depth and 1.31 ft (40 cm) wide to absorb sufficient heat that can be transferred to the house.

There are two options for using the heat collected by the system. It can be blown out into the home, much like a furnace would do, or you can have the tubes snake under the floor, providing radiant heating. Both methods are quite effective, though the blower will be more effective **if you plan to use your heating system as a cooling one in the summer, during hotter weather.**

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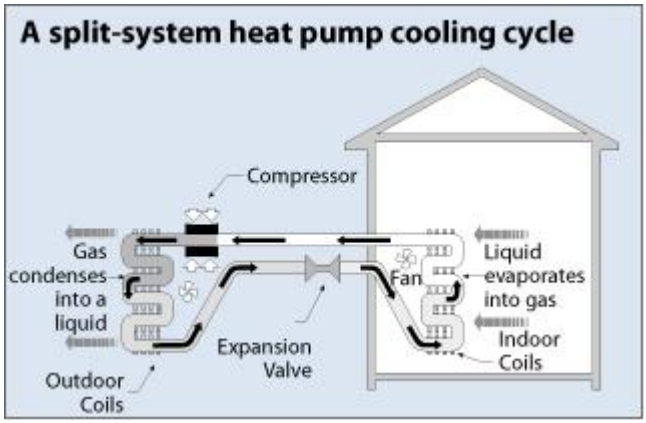
ENVIROMENTAL BENEFITS

Low-enthalpy geothermal energy can be generated from groundwater in gravels infilling buried valleys formed during the Pleistocene glaciation, when the sea level was significantly lower than at present. Where buried valleys underlie floodplains of present-day rivers, flowing through major cities, a 'heat island' effect can generate slightly enhanced temperatures in shallow groundwater. This groundwater can be utilised for space heating buildings by passing it through a heat pump, and the chilled water then used as a heat exchanger to satisfy cooling requirements of the building. For flow rates of 20 l s−1, and a temperature reduction of 8 °C in the heat pump, a 672 kW heating resource can be generated, sufficient to heat buildings of 11,000 m2 floor area. A cooling resource of 336 kW is also available. Potentially, this geothermal resource could be utilised without the 'heat island' effect. Cost of the development is minimal and long-term economic benefits are significant. (Department of Geology, University College Cork, Cork, Ireland)

The geothermal source can substantially reduce the amount of fossil fuels (by reducing emissions of climate gases from the production of energy). It also does not pollute the soil.

HOW DOES THE GEO COMPACT WORK

The geothermal system GEO COMPACT consists of a heat pump and a series of pairs of vertical geothermal probes (40 cm x 8 m). The pump sends circulating a refrigerant that exchanges heat with the ground and the building (a system of heat exchange between working fluid and fluid internal operating outside). As the temperature of the subsoil constant, this will mean that in summer raffrescante has an effect, while in winter you will have heat. In fact, at a depth of about 8 m can be seen throughout the year a constant temperature of about 15 / 17 ° C.



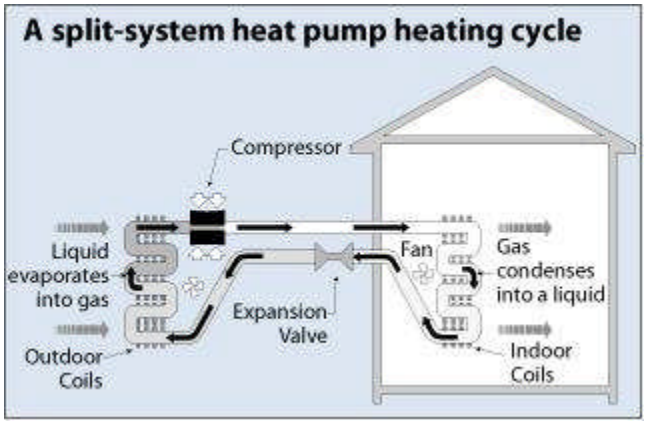
electrical energy it consumes. This is possible because a heat pump moves heat rather than converting it from a fuel, like in combustion heating systems.

How They Work

A heat pump's refrigeration system consists of a compressor and two coils made of copper tubing (one indoors and one outside), which are surrounded by aluminum fins to aid heat transfer. In the heating mode, liquid refrigerant extracts heat from the outside coils and air, and moves it inside as it evaporates into a gas. The indoor coils transfer heat from the refrigerant as it condenses back into a liquid. A reversing valve,

How Does a Heat Pump Work?

An air-source heat pump can provide very efficient heating and cooling for your home, especially in our hot humid climate. When properly installed, an air-source heat pump can deliver one-and-a-half to three times more heat energy to a home than the



near the compressor, can change the direction of the refrigerant flow for cooling as well as for defrosting the outdoor coils in winter.

Heat pump performance

The heat delivered by a heat pump is theoretically the sum of the heat extracted from the heat source and the energy needed to drive the cycle. The steady-state performance of an electric compression heat pump at a given set of temperature conditions is referred to as the **coefficient of performance (COP).** It is defined as the ratio of heat delivered by the heat pump and the electricity supplied to the compressor.

For engine and thermally driven heat pumps the performance is indicated by the primary energy ratio (PER). The energy supplied is then the higher heating value (HHV) of the fuel supplied. For electrically driven heat pumps a PER can also be defined, by multiplying the **COP** with the power generation efficiency.

The COP or PER of a heat pump is closely related to the temperature lift, i.e. the difference between the temperature of the heat source and the output temperature of the heat pump. The COP of an ideal heat pump is determined solely by the condensation temperature and the temperature lift (condensation - evaporation temperature).

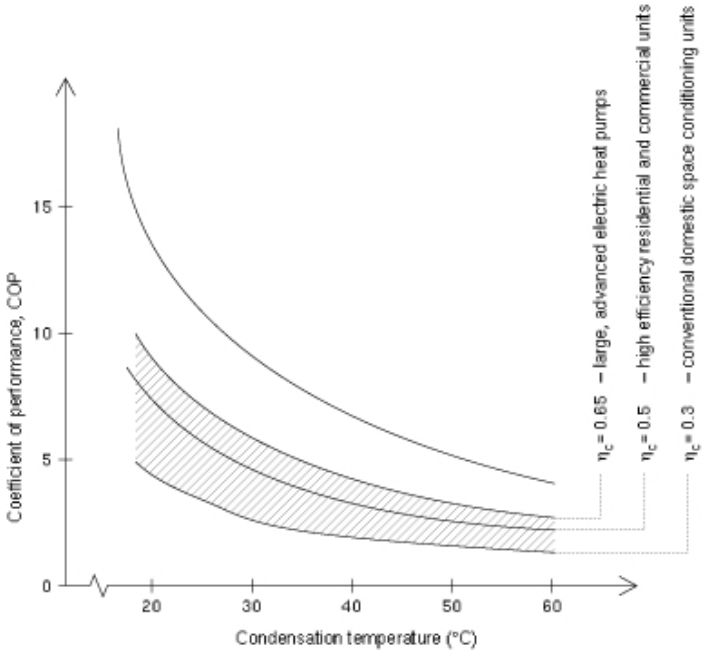


Figure 1 shows the COP for an ideal heat pump as a function of temperature lift, where the temperature of the heat source is 0°C. Also shown is the range of actual COPs for various types and sizes of real heat pumps at different temperature lifts.

The ratio of the actual COP of a heat pump and the ideal COP is defined as the Carnot-efficiency. The Carnot-efficiency varies from 0.30 to 0.5 for small electric heat pumps and 0.5 to 0.7 for large, very efficient electric heat pump systems.

←*Figure 1: COP for ideal heat pump*

An indication of achievable COP/PERs for different heat pump types at evaporation 0°C and condensing temperature 50°C is shown in Table 1.

Table 1: Typical COP/PER range for heat pumps with different drive energies.

Heat pump type	COP	PER
Electric (compression)	2.5 - 5.0	
Engine (compression)		0.8 - 2.0
Thermal (absorption)		1.0 - 1.8

The operating performance of an electric heat pump over the season is called the seasonal performance factor (SPF). It is defined as the ratio of the heat delivered and the total energy supplied over the season. It takes into account the variable heating and/or cooling demands, the variable heat source and sink temperatures over the year, and includes the energy demand, for example, for defrosting.

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The SPF can be used for comparing heat pumps with conventional heating systems (e.g. boilers), with regards to primary energy saving and reduced CO2 emissions. For evaluating electric heat pumps the power generation mix and the efficiencies of the power stations must be considered.

Factors affecting heat pump performance

The performance of heat pumps is affected by a large number of factors. For heat pumps in buildings these include:

1. the climate - annual heating and cooling demand and maximum peak loads;
2. the temperatures of the heat source and heat distribution system;
3. the auxiliary energy consumption (pumps, fans, supplementary heat for bivalent system etc.);
4. the technical standard of the heat pump;
5. the sizing of the heat pump in relation to the heat demand and the operating characteristics of the heat pump;
6. the heat pump control system.

Table 2: Typical COP/PER for heat pumps with different drive energies.

Heat pump type [1]	COP	PER
MVR	ott-30	
Closed cycle, electric	3.0 - 8.0	
Closed cycle, engine		1.0 - 2.0
Absorption (Type I)		1.1 - 1.8
Heat transformer (Type II)		0.45 - 0.48

Industrial heat pumps often have a higher COP/PER than heat pumps for buildings. This is mainly due to small temperature lifts and stable operating conditions. Typical COP/PER ranges for industrial heat pumps are given in Table 2.

BUILDING ENERGY SAVING: LEGISLATION & BACKGROUND

Building Energy Rating (BER) certificate, which is effectively an energy label, will be required at the point of sale or rental of a building, or on completion of a new building. The BER will be accompanied by an "Advisory Report" setting out recommendations for cost-effective improvements to the energy performance of the building. There will be no legal obligation on vendors or prospective purchasers to carry out the recommended improvements. SEI will publish BER certificates on a public BER Register.

At this stage all buildings, both residential and commercial require a BER when offered for sale or rent. This requirement was first introduced in 1 January 2007 and since that date all new dwellings that applied for planning permission on or after this date require a BER when they are offered for sale or rent. This requirement was extended to all new non-residential buildings in July 2008 and to existing buildings offered for sale or rent in January 2009.

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Building Energy Rating (BER)

EU Directive

An EU Directive is a piece of legislation that all Member States must enact. Directive 2002/91/EC aims to promote improvements in the energy performance of buildings.

What does the Directive cover?

The Directive covers both residential and tertiary (commercial and public) sector buildings.

The main elements in the Directive are:

1. The establishment of a framework for a common methodology for calculating the energy performance of all buildings.
2. The application of minimum standards of energy performance for new buildings, and existing buildings with a total surface area over 1000m², when they are renovated.
3. Certification schemes for new and existing buildings and the public display of these certificates.
4. Inspection and assessment of boilers and heating/cooling installations.

What timescale applies to the Directive?

Implementation of the EPBD in Ireland will be as follows:

BER of new dwellings commencing on or after 1 January 2007. The introduction of BER for new dwellings is subject to a transitional exemption period whereby a BER will only be required for dwellings constructed and offered for sale or rent for which planning applications are submitted as and from 1 January 2007 and which are substantially completed by 30 June 2008.

BER of new Non-Domestic Buildings commencing on or after 1 July 2008. A transitional BER exemption will apply to a new non-domestic building for which planning permission is applied for on or before 30 June 2008 provided the new non-domestic building involved is substantially completed by 30 June 2010.

BER of existing buildings when offered for sale or letting on or after 1 January 2009.

What benefits will the Directive bring?

The Directive will promote energy savings. Saving energy will help compliance with the emissions targets of the Kyoto Protocol. The EU recognised that energy efficiency is the single most cost-effective and publicly acceptable way of meeting our Kyoto objectives.

The EU Communication 'Energy Efficiency in the European Community - Towards a Strategy for the Rational Use of Energy' (29th April 1998) examined possibilities for saving energy. It identified improvements in the energy efficiency of buildings as a priority, due to the high energy consumption and high potential energy savings in buildings.

Buildings are the biggest users of energy in Europe, representing approximately 40% of energy consumption in the EU. Most of this energy is used for space heating. Significant energy savings can be made in buildings. The EU defined the saving potential as the energy that can be saved by investments in energy efficiency, which have a payback period of less than nine years. The savings potential for energy use in buildings is ~22% and can be realised by 2010.

How will the Directive affect the new build housing sector?

The EU Directive requires that a valid energy performance certificate be produced for all new dwellings.

In the Action Plan, the EPBD Working Group proposes to apply Building Energy Rating (BER) certificates from 1st January 2007.

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The Directive requires that all energy ratings on new build dwellings come from qualified and/or accredited experts, whose independence is to be guaranteed on the basis of objective criteria.

How will the Directive affect the rented sector?

The EU Directive requires that a valid energy performance certificate be produced for all dwellings when they are rented out. Building Energy Ratings will be valid for 10 years unless there is a change in the energy performance in the property due to measures implemented in the interim.

How will the Directive affect the non-domestic sector?

The Directive requires all new and existing buildings to have an energy certificate available when they are constructed, sold or rented out. The Directive also stipulates that all buildings over 1000m², with either public sector occupiers or frequent public access must prominently display an energy certificate. The only buildings exempt from the requirements of the EU Directive are:

- officially protected buildings and monuments
- places of worship
- temporary buildings with a planned time use of two years or less
- residential buildings which are intended to be used less than four months of the year
- stand-alone buildings with a total useful floor area of less than 50m²

As the Directive covers a vast range of buildings, implementing it in the non-domestic sector will be extremely complex.

What is the background to the EU Directive?

Saving energy will help compliance with the emissions targets of the Kyoto Protocol. The EU identified improvements in the energy efficiency of buildings as a priority, due to the high energy consumption and high potential energy savings in buildings.

The Directive provides a complementary legal instrument to Directive 93/76/EEC (September 1993), which required member states to develop, implement and report on energy efficiency programmes for buildings.

HOW MUCH IS THE COST OF THE GEO COMPACT easy system

The cost varies depending on the size of THE BUILDING. to heat, cool and hot water supply to a building of 100 square meters the cost is around **€ 16,000.00.** turnkey (including boiler, excavation and installation).

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