GEO POWER

Geothermal energy to address energy performance strategies in residential and industrial buildings

INTERREG IVC
INNOVATION & ENVIRONMENT
REGIONS OF EUROPE SHARING SOLUTIONS

European Union
European Regional Development Fund

INTRODUCTION

Geothermal energy is one of the most environmental-friendly & cost-effective energy resources in use and has the potential to help mitigate global warming if widely deployed in place of fossil fuels. Recent technological progress, the variability of the cost and the difficult of oil &gas supply, the need to reduce the use of fossil fuels to cut pollution and our reliance on supplies from foreign countries have made the exploitation of geothermal energy, especially low-enthalpy power generation utilizing GCHP (Ground Coupled Heat Pumps) an attractive and viable alternative.

Technological advances have dramatically expanded the range and size of viable resources, especially for applications such as home heating and cooling, opening a potential for widespread exploitation (e.g. GE application to curb energy consumption of industries and SMEs).

The GEO.POWER partners, being aware of energy challenges, decided to develop a capitalization project on geothermal energy under the IVC Programme's environmental sub-theme on the energy and sustainable transport, to fill their legislation gaps and in that way actively contribute to the EU "20-20- 20" objective as well as to international climate agreements like Kyoto and Copenhagen protocols.

The general objective of the 2-year GEO.POWER project is to exchange best practices related to low enthalpy energy supply and - after a technical and cost/benefit assessment to evaluate the potential of reproducibility - to prepare the ground to the transfer some of the selected best practices within the Mainstreaming Programmes of the regions participating into the project by addressing applications mainly during the current programming period 2007-2013 as well as in the future regional framework instruments.

This will be achieved through the development of one action plan per each involved region where technical guidelines, potential regional legislation and financing schemes will be communicated to the Managing Authority / Intermediate Body responsible of the EU Structural Funds mainstreaming programmes: according to these action plans, every MA could subsequently shape their political endorsement and address call for the concession of grants or negotiating procedures between local authorities and public-private stakeholders for spreading GCHP (Ground Coupled Heat Pumps) within its administrative boundaries.

PARTNERS

Province of Ferrara

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Ministry of Regional Development and Public Works

ENEREA Észak-Alföld Regional Energy Agency

Reading Borough Council

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'Energy Centre' Energy Efficiency, Environment and Energy Information Agency

Royal Institute of Technology

Regione Emilia-Romagna

Institute of Geology at Tallinn University of Technology

VITO Flemish Institute for Technology Research

Geological Survey of Slovenia

Province of Ferrara, Italy

The whole Ferrara territory is located in the south-eastern sector of the wide sedimentary Po basin in Emilia Romagna Region. This sector is characterized by a complex geological structure called "Ferrara Folds" which was formed in the late Tertiary and influenced the stratigraphic architecture of the Quaternary deposits.

Recent geo-structural and geothermal investigations carried out by HERA Group (Energy Resources Environment Holdings) in collaboration with the University of Ferrara and the Emilia-Romagna Region, confirm the presence of geothermal reservoirs in the east part of Ferrara. Three hydrothermal systems have been identified: G1 G2 and G3. Each reservoir can be considered hydraulically separated from the others by aquitards that prevent significant leakages.

Shallow system G1 not show thermal anomalies except for small positive thermal anomalies recorded in proximity of the top of anticline rock formations of G2 and G3 reservoirs. Hydrothermal system G2 consists of fine and medium sand intercalated with Early Miocene marl layers. The reservoir top is 650-800 m deep and the system is characterized by an average temperature of 45°- 60°C. Hydrothermal system G3 is composed of fractured dolomites and limestone. The reservoir is 700-1000 m thick with the reservoir top at 600-1700 m deep. The average temperature recorded in this reservoir is approximately 85°- 95°C.

In the Ferrara Province, there is no case of exploitation of geothermal energy for power production purpose.

At the beginning of the 80's, the Municipality of Ferrara developed a Geothermal Project in order to exploit the geothermal resource as a primary source for an urban heating system and to reduce, in a solid way, the environmental impact created by the traditional energy sources (coke, oil and methane gas, etc…).

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Centre for Renewable Energy Sources and Saving, Greece

The geological structure of Greece favours the presence of hot water or steam in economic exploitable depths in many regions characterized by geological recent volcanic activity. Indicatively such areas are Milos, Nisyros and the northern region of the Greek territory.

In pursuit of the accomplishment of the National Renewable Energy Action Plan and the “20-20-20” target, specific national energy policies have been developed establishing new financial incentives for building's energy saving including all the new technologies for heat production such as GSHP, biomass etc., that are described in the “Energy Performance of Buildings Regulation” (KENAK).

Hotel Amalia in Nea Tirintha, Peloponnesus

The hotel was totally renovated in 2007-2008. Supply of heating/cooling and hot water needs of the building is achieved by a heating/cooling system and an oil boiler. The heating/cooling system consists of an open-loop heat pump system and fan-coil units (floor standing type). GSHP system consists of 2 heat pumps of water-to-water type (352 kW each), 2 subsaline groundwater supplying wells and 2 re-injection wells (60m depth each), and 2 titanium heat exchangers.

Bioclimatic office building of CRES in Pikermi, Attiki

The bioclimatic and low-energy consuming office building of CRES was designed and constructed as a demonstration building for RES technologies and energy saving techniques.Among RES technologies used in the building, the geothermal water-to-water heat pump operates in bivalent mode and covers about 21% of heating and 15% of cooling needs of the building. The unit utilises groundwater from two wells ~80m deep each, located north and south of the building.

Two-family house in Pikermi, Attiki

The heating and cooling system consisting of geothermal heat pump with water wells (open loop) concerns a well insulated house with the use of synthetic windows with double glass and Argon gas in-between. The heat pump feeds the under-floor system with warm or cold water for heating or cooling accordingly. Two extra ceiling (built-in) dehumidifiers for cooling in the summer are placed in the two floors of the residence (each in every floor) and are commanded by a wall humidity sensor drying the air when needed, thus operating complementary to the floor-cooling.

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Ministry of Regional Development and Public Works, Bulgaria

Bulgaria has a sizable reserve of geothermal energy and is rich in low enthalpy geothermal waters.
The geothermal water is used for balneology sanatoriums (prevention, medical treatment and rehabilitation, in swimming pools), heating and cooling, conservatories, geothermal installations (GSHP), direct heat-supply and spa resorts and hotels.
The country has been utilizing approximately 37 percent of its total potential, or about 109.6 MWt producing some 1,671.5 TJ of energy per year, for use in space heating and air conditioning, greenhouses, drinking water, and for balneology purposes (IGA, 2004). Starting in 1999 geothermal heat pumps were installed in the capital, and around 50 percent of the pumps were used for cooling. At present there are no geothermal reserve sites that generate power (IEA, 2007).

Geothermal development in recent years has not made significant progress. The past few years, Bulgaria has been preparing and passing new legislation concerning geothermal energy and thermal waters. There are still many barriers that inhibit productive growth of geothermal energy in the country.

Good example for transition from fuel heating to geothermal heating is Sapareva banya municipality.
Sapareva banya is situated in the Southwestern region at the foot of Rila mountain and in the geothermal deposit of the town are the hottest geothermal springs in Bulgaria with temperature of 98 degrees C.
The warm mineral water is used for conservatory production development. 2 schools, 2 administrative buildings, the municipality building, a medical centre and the kindergarten are being heated with mineral water.
The municipality has also developed a project for building of a local geothermal plant which will supply the heating net of the buildings in the town and will replace the oil heating system.

Subsequently, a comparison of the price for oil heating with the expenditures for geothermal energy shows real high annual saving for heating in favour of the latter. The annual oil saving is 21 tons. The realization of the project will reduce the annual CO_2 emissions to 4 tons per year.

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ENEREA Észak-Alföld Regional Energy Agency, Hungary

Located in the Eastern part of Hungary, the North Great Plain Region has good potential for the use of geothermal, biomass and solar energy although the utilization of geothermal energy in the North Great Hungarian Plain is associated with thermal water usage. There are only a few large ground source heat pump systems in the region, which has no significant role in energy consumption. The estimated capacity of geothermal heat pumps in Hungary is about 40 MW (comparison: individual and district heating: 120 MW). We assume that the capacity of heat pumps of the region is lower than the 5 % of the national values.
Deep heat mining will be able to appear in the region, but the shallow depth of upper Pannonian sediments precludes the geothermal power production. Its perspective is the Engineered Geothermal Systems in the basement of the southern part of the region.

Renewable Energy Applying Centre, Debrecen

A large-scale monitoring system was set around a new building used as a warehouse and offices in the framework of the "Autonomous house" project supported by GVOP (Economic and Competitiveness Operative Programme) between 2005 and 2007.
16 BHEs were installed in the heating-cooling system of the logistic centre in the western margin of Debrecen. Near-surface stratification of the area is characterised by interdigiting loess and sandy layers with clay in some depth.

Among the exchangers there are 9 pieces of 50m, 4 pieces of 100m with double U-pipes and one 100m with U-pipe ones, while two borehole heat exchangers installed with heat resistant double U-pipes system. The minimum distance between the boreholes is 7 m. Two WFP 13 type heat pumps (2*13 kW) operate based on the heat from vertical heat exchangers and a horizontal loop to produce sanitary hot water and heat (wall and floor heating).
The borehole heat exchangers are also used for passive cooling in summer. Temperature measuring devices were installed at different depths in the exchangers that measured soil temperature before and during operation. In the vicinity of three exchangers temperature sensors are installed at distances of 0.5, 1, 2, 3 and 5m in order to study the distance effect of the exchangers. In this way the data of 81 exchangers altogether, shell temperature and 82 soil temperature sensors are available.

GSHP in spa centre, Hajdúszoboszló

The city is one of the most significant spa centres in the region where a new ground source heat pump system was built in 2006 for a hotel. Although the heating potential of the thermal water of Hajdúszoboszló is high, the investor chose a geothermal based low temperature heating system.
The hotel has a significant heat demand, therefore 90 boreholes were drilled to 100 m depth consequently the total planned length of boreholes was 9000 m. The borehole-field has a quadratic grid with 5 m grid space. In each borehole double U-pipe construction was installed.
The distance of the system from the waterworks or from the thermal wells is enough to avoid temperature drop in addition unexpected events and drilling will not endanger the aquifers.

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Reading Borough Council, UK

The region the Reading partner works in is the Thames Valley.
There has been a dramatic increase in Ground Source Heat Pump installations in the last 10 years.
There were almost no installations at the turn of the century but there are now more than 50 recorded installations totalling over 3 MWth

Recent policy & market developments
Alongside Feed in Tariffs for small power generation, and the Carbon Reduction Commitment Energy efficiency scheme for commercial/ public sector organisations, the Renewable Heat Incentive is likely to have the greatest impact on the uptake of Ground Source Heat Pump technology.

The Renewable Heat Incentive pays 4.3pence per kWh for heat generated by heat pumps under 100kWth and 3 pence per kWh for systems over 100kWth

Reading Borough Council - Avenue Centre

Reading Borough Council has a state of the art building which is heated by ground source heat. It provides both office and school accommodation (the school being for young people with special learning needs)
At this particular site a combined installation of water source heat pumps (WSHP) links to a GSHP installation for primary heat generation which provides low cost, low maintenance and low CO2 generation without any local pollution from the flue gases that would have been the case if conventional gas boilers had been used. Both systems also provide summertime under floor cooling using borehole water via a plate heat exchanger. The installation is comprised of an array of 70 to 80m deep boreholes rather than a trenched system due to restrictions on space. The boreholes are then connected to two heat pump units which extract the available heat and circulate it through the building heating system.

University of Reading student services building

The Student Services building at the University of Reading, Berkshire, benefits from a ground source heat pump (GSHP).
The system, which was installed in 2007, comprises of twenty five bore holes spaced five metres apart and drilled 100m deep in an open area adjacent to the building. The geology comprises of a mixture of sand and gravel. Each bore hole was lined, into which the outward and return pipes were inserted. The borehole pipes were interconnected using a header manifold and pressure tested before each hole was filled in.
Two 'Geothermal International' installed 90 kW reversible heat pumps were installed in the plant room to provide space heating and/or cooling together with pumps and manifolds to supply various parts of the building. This building has no provisional back up heating system as the load can generally be met by just one of the two heat pumps.
Heating or cooling is provided for those rooms requiring mechanical air handling with cross flow heat exchangers to transfer heat from the exhaust air to the incoming air or vice versa.

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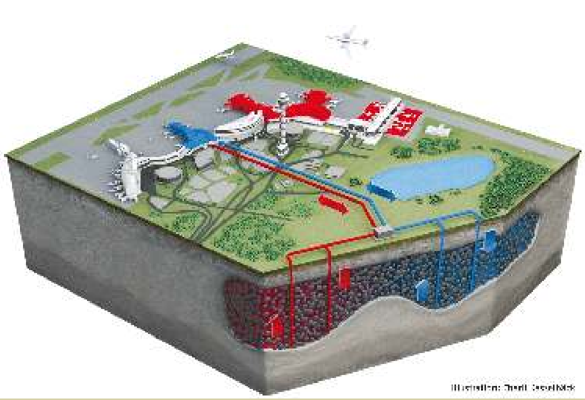
SP Technical Research Institute of Sweden, Sweden

Västra Götalandsregionen is located in western Sweden. There are about 280 000 detached houses and 400 000 apartments. About 5% of the multi family units are heated with heat pumps and for detached houses about 40% have a heat pump installed. Shallow and medium depth (1-250 meters) ground source heat pumps are common for detached single-family houses, with a market share of 15-20%. There are no deep wells in the region due to unsuitable geological conditions, i.e. the temperature rise is below 20°C per kilometer. There is neither any geothermal power production in Sweden.



The world's largest energy storage unit − the aquifer that supplies space cooling and heating for Stockholm-Arlanda Airport − has been in service since the summer of 2009. All cooling of airport buildings, including the terminals, comes from the aquifer.

During the summer, the aquifer supplies cooling to Stockholm-Arlanda's buildings while at the same time storing heat. In the winter, this stored heat will be used in the ground heating system at the airport's aircraft parking stands and to pre-heat ventilation air in buildings.

The aquifer will reduce the airport's annual electricity consumption by 4 GWh (no longer needed for operation of electrical chillers) and its district heating consumption by around 15 GWh making a total of 19 GWh. The system efficiency is world class. No heat pumps are used and electrical chillers less than 100 hours per year, gives a SPF closer to 100.

Ground source heat pumps are very common in the housing sector in Sweden. Most ground source heat pumps are used with borehole heat exchangers, ranging from small houses with one borehole to larger multi dwelling houses requiring several boreholes. The latter is an increasing market. The boreholes are typical 100-200 meters deep.

The market success is a result of a technology procurement in 1994-1995 by the Swedish National Board for Technical Development (NUTEK) on heat pumps. This got quite a lot of attention and the sales started to increase rapidly. There were two winners in this procurement and both were ground-source units.

As a consequence of the procurement, this type of heat pump began to dominate the market. The total sales in 2002 had increased more than 400 % from the technology procurement 7 years earlier. Since then has the annual sales stayed between 20 000 - 40 000 units.

300 000 installed ground source systems in Sweden:
- 10-12% of the residential heating
- Reduces the usage of fossil fuel (oil) by 1.2-1.5 million m³/year
- Reduces CO2 emission with 2.5-3.0 million tonnes/year

Source: GEOTEC

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‘Energy Centre’ Energy Efficiency, Environment and Energy Information Agency, Hungary

The Energy Centre was established in 1997 and owned by the Ministry of National Development. Basically it has three main activity areas:

- Manages most of the Hungarian statistical issues related to energy
- Manages subsidies and loans for energy efficiency and renewable energy
- Prepares documents for the government concerning energy efficiency and renewable energy sources and carries out energy agency activities

The geothermal features of the Carpathian Basin are very favourable because the Earth's crust is thinner and the average heat flow value is approximately 90-100 mW/m^2. The estimated volume of Hungary's thermal waters is 2500 cubic kilometres. The number of wells drilled in Hungary in the last 150 years is close to 100.000 and in 15-25% of these wells, temperature measurements of some kind were carried out.
In Hungary traditionally hot geothermal fluids have been exploited for balneological recuperative and recreational purposes. More recently the wide spread uses are the direct usage for direct heating purposes such as agricultural facilities (greenhouses), public and residential buildings (district heating) and the water supply of baths and swimming pools.
In the last decade the Hungarian heat pump market started to increase, and based on estimations, the gross final consumption of energy produced by heat pumps in Hungary was 250 TJ in 2010. Based on the Hungarian National Renewable Action Plan the energy which will be generated by heat pump is expected to increase approximately 23 times bigger than it was in 2010.
A couple of interesting investments had been carried out both in the private and public sector. In this brochure we would like to draw your attention for the following Hungarian best practises:

TELENOR Headquarter

Compared to a conventional building, the new headquarter will cut down on CO2 emissions equivalent to those generated by about 500 homes, making it one of Hungary's “greenest” office buildings. The building is equipped with environmentally-friendly engineering technology, based on renewable energy sources. The building draws its energy from geothermal heat pumps. The system uses 180 Borehole Heat Exchanger (BHE) drilled 100 meters deep (diameter 40 mm) to provide cold and hot water, therein regulating temperature in the building.

Block of flats in the HUN street

This is a ten-story panel building with 256 flats, approximately 1 000 occupants. Before the investment the building had connected to the local district heating system. First of all the building envelope had been insulated, new energy efficient windows, and controllable heating (by occupants) were installed. After this investment it was worth to think about a renewable investment. A groundwater heat pumps system was installed. This system utilizes four wells and six injection wells. The wells are 14 meter deep. Three heat pumps were installed, with 434 kW nominal capacities for heating, 245 kW for domestic hot water supply. In Hungary this is the first building that was built of industrialized technology and utilizes geothermal energy via heat pumps.

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KTH Royal Institute of Technology, Sweden

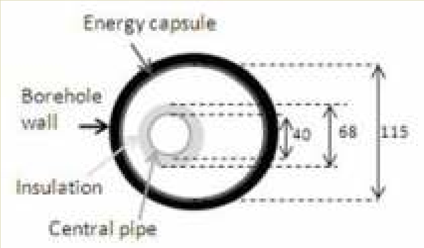
The Stockholm region is located in the east of Sweden and has a relatively mild climate. The daily temperature ranges during an average of 24 hours from about +25°C down to -10°C with a yearly average of about +7°C. The bedrock is mainly consisting of granite with good properties for drilling and with high thermal conductivity. In 2009, the building stock consisted of around 944 000 apartments of which 693 600 were multifamily-dwelling houses and 250 400 were small houses.

There are presently about 350 000 energy wells in Sweden and roughly 40 000 ground source heat pumps are sold yearly. They are estimated to produce around 9 TWh of energy and for a small house, the typical GHSP installation is a 132 m borehole with a capacity of 7.5 kW and a seasonal performance factor (SPF) of 2.9.

The government's main energy policy is the 20-20-20 EU climate goals where an increase from 44% to 50% energy from renewables is one of the primary goals. Ground source heat pumps are indirectly promoted through the ROT tax deduction where certain types of labor work paid by homeowners can be tax deducted.

Residential GSHP installation with a novel and innovative Borehole Heat Exchanger

The villa was built in 1955 and the living space is divided into a 110 m^2 primary area with an additional 60 m^2 basement. The borehole is 190 m deep and the diameter is 115 mm. The heat pump is frequency regulated and the heating capacity is in the range of 6 to 13 kW.



The thin energy capsule brings the secondary fluid to near direct contact with the rock and thus reduces the thermal resistance. Water circulates by traveling downwards in the central pipe and upwards in the annular channel. For each degree that temperature difference can be diminished, the COP increases with approximately 3%.

Results show that the temperature difference between the borehole wall and the annular flow is almost constant at about 0.4 °C. Also the heat injection is almost equal upwards and downwards which is often not the case for U-pipe BHE.

The Skåvsjöholm seabed collector heat pump

This heat pump installation utilizes heat from the sediments as it is sunk into the sea floor. The nominal heating power is 300 kW and the COP was at the time of installation around 3.0.

The collector consists of 42 collector tubes of about 400 m length each. These collector tubes are downloaded with concrete that weighs about 2 kg/m so they can't float up and get frozen stuck to the ice sheet above. The annual saving for heat only is estimated in the magnitude of 100 000 € per year.

The hotel is now also cooled by the seabed through free cooling. The heat pump cost was, recalculated for inflation and the Euro/SEK at present exchange rate, approximately 315 000 €.

The Vällingby Centre Bedrock Heat Pump with Storage

Under the shopping Centre in Vällingby a bedrock heat pump system is utilized for heating facilities in the area. There are totally 132 boreholes with a depth of around 200 m. The holes are drilled in the form of a fan for better storage capability. On the surface, the grid has just 7.5 m between the holes. The storage is used for both cooling and heating of the Centre. While cooling, free cooling can be used. The total cooling power of the heat pump machinery, except the peak power for cooling in summertime is around 3 MW and the total heating power wintertime is around 2-2.5 MW except peak district heating power. The total installation cost was around 4 M €. The payback period of the system is expected to be around 7 years. There are around 100 more similar large heat storing heat pumps in Sweden today and the company IKEA is a driving force behind this.

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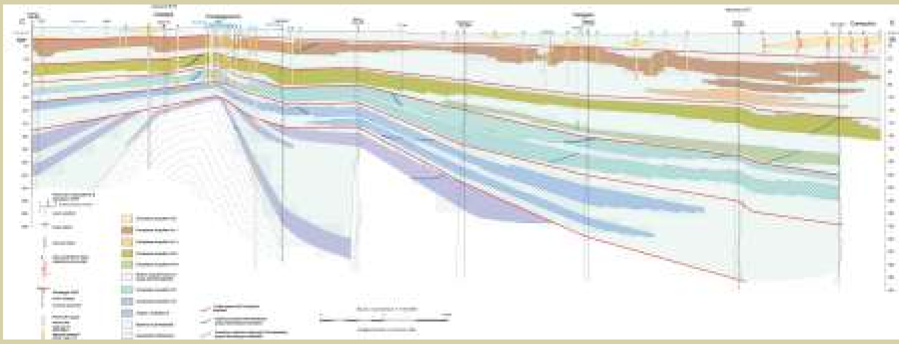
Emilia-Romagna Region, Italy

The Emilia-Romagna Region stretches from the Apenninic ridge to the Po River and the Adriatic Sea. The geological structure of Emilia-Romagna is very complex and for 30 years has been studied in depth by the Geological, Seismic and Soil Survey (GSSS).

A wide set of geological maps, at different level of detail, and a huge amount of data on the subsoil of its territory are today available.

Starting from this data set Emilia-Romagna defined a 3D model of the aquifers of the Emilia-Romagna alluvial plain and, in 2005, the hydrogeological maps related to the implementation of the Water Framework Directive were published. This set of maps represents the scientific reference for planning exploitation of low enthalpy geothermal energy (GCHP).

The geothermal gradients present in the Apennines are about 3°C/100 m. Some areas are characterized by thermal springs with temperatures of around 40°- 45°C due to hot water rising up along the main fractures. The geothermal gradient on the plain is normally around 2°-2.5°C/100 m; some sectors, however, coinciding with the presence of buried structural highs, present positive geothermal anomalies with gradients in the order of 6°-7°C/100 m.



Emilia-Romagna region, with the exception of one area near Ferrara, does not benefit from thermal anomalies conducive to electricity generation by means of geothermal fluids. In contrast, there are a number of areas with positive thermal anomalies and with geothermal reservoirs that can be harnessed for thermal purposes (heating and cooling). In recent years the use of very low enthalpy geothermal energy (14°-16°C) has been developed, above all through the creation of open and closed loop plants. To December 2010, the GSSS has documented 45 closed loop plants with vertical drills and 11 open loop plants with wells of extraction and re-injection; these data are organized in a dedicated GIS database.most plants deliver less than 20 Kwt of power in both heating and cooling regimes. There are also, however, plants which produce power in excess of 400-500 Kwt; in particular, they can deliver heating power of 2200 KWt and cooling power of 1600 KWt.

Since 2007, with the approval of Emilia-Romagna Energy Plan (REP), the Region outlined regulations and incentive programmes supporting geothermal exploitation.

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Institute of Geology at Tallinn University of Technology, Estonia

The Institute of Geology at Tallinn University of Technology (formerly an institute of the Estonian Academy of Sciences) is an independent research, development and teaching institution of the university.

Our aims are to advance Earth Sciences, offer competence for the university, governmental institutions and private sector, train MSc and PhD students jointly with other departments, and advocate for science and scientific thinking.

As a strategic partner for the Rebuplic of Estonia we hold a strong commitment in **researching and applying new technologies with the objective to provide a sustainable future for the national energy sector**.

Ground source heat pumps (GSHP) have been applied in Estonia since the beginning of 1990's. The current data states that there are about 5500 GSHP systems installed. The trend for applying this technology has shown rapid growth in recent years as today almost one out of three homeowners settles on a GSHP system as the main source for heating and cooling purposes.

In addition to the private sector also various industries (e.g. retail, cold-storages etc) have started to understand the vast advantages of these cost-effective solutions. Well planned ventilation and isolation accompanied with the GSHP systems and re-usage of residual heat **have provided heating cost savings up to 90 percent with payback time under 2 years** in some cases.

Currently it is our mission to communicate the benefits and the environment friendly nature of GSHP to individuals, companies and decision-makers for them to grasp the essence of geothermal energy, which will provide the sustainable future for heating and cooling.

For more local information visit **www.geopower.ee/eng**

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VITO Flemish Institute for Technological Research, Belgium

Although several geothermal pilot projects for direct heating were launched in the eighties and despite the successful development of the geothermal district heating system in the area of Mons since 1985, a further validation of the Belgian geothermal potential remained largely forthcoming. Greenhouse farmers recently expressed their interest in geothermal energy.
Green geothermal heating and cooling through heat pump applications is relatively new in Belgium, until recently mainly single housing applications were established. Both the Flemish and Walloon governments want to stimulate the use of green heating. Some successful geothermal projects that underline the benefit and high potential for more green energy in Belgium are presented below.

Ground source heat pump with borehole thermal energy storage (BTES) at headquarters INFRAX

Infrax is an electricity and gas distribution operator in Flanders. The project concerns a very sustainable office project with several eco-innovative technologies and won several prices in Belgium and abroad (a.o. Challenge 2020, Green Good Design Award). The combination of architectural finesse, high comfort requirements and sustainability resulted in a nice building that saves 174MWh yearly and reduces greenhouse gas emissions with 33 ton/y.

Every year thousands of new offices are constructed, but typically they act as big energy consumers. This example shows how ecology and economy can go together and that aiming for zero energy or even net positive energy buildings is perfectly possible.

Ground source heat pump with aquifer thermal energy storage (ATES) at Hospital St-Elisabeth
The project concerns a renovation project where the oldest hospital of the Campine region is converted into a modern energy-efficient complex with high comfort. A new approach is implemented by the architect by separating care and support functions of the hospital in order to optimally respond to the specific need of each function.

The energy bill in a hospital is increasing year by year. Hospitals want to focus the available resources on specific care matters and not on the energy bill. As the existing building park of Belgian hospitals is rather old, the transferability to comparable installations is high.

Geothermal district heating with energy cascade at St Ghislain
Since 1985 hot water (72°C) is extracted from 2400m depth in the area of Mons where it feeds a district heating system that answers the heating demands of 3 scolar complexes, 10 appartment blocks, a swimming pool and a hospital. The waste heat is further used to heat horticulture greenhouses and finally for fermentation in a purification station. The reservoir is under artesian pressure and hence does not require much additional pumping to produce the hot water. Reinjection is not needed as the reservoir pressure is well maintained through time and the chemical quality of the water is good.

The potential to scale-up the capacity of the geothermal system (estimated at about 208GWh) for the industrial and residential sector is huge.

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Geological Survey of Slovenia, Slovenia

Slovenia has quite a complex geological structure appertaining to Alps, Dinarides and Panonian basin. Geothermal conditions are in this respect rather variables.

The use of geothermal energy (852 TJ) in Slovenia was estimated to more than 2 % of the total energy consumption from Renewable Energy Sources in 2008. In 2009 the total geothermal capacity amounted to 116 MWt (total energy use 1016 TJ).

Actually prevailing type is water source GCHP installation (50%). Other types (horizonatal and vertical) are in the significant increment in last years. There are more than 4400 small GCHP units of about 49.9 MWt capacity (using 244 TJ). NREAP (2010-2020) envisages 480 M€ investments (84 M€ costs of support) and 1573 TJ increased use of geothermal RES. (NREAP = National Renewable Energy Action Plan 2010-2020)

Good practice is represented by Spa "Snovik" where up to 7.6 l/s (28°C) of geothermal water is exploited from three wells. The major part of water is used to fill the pools and minor part for drinking and other water supply. To lower operation costs for heating, a groundwater heat pumps system was installed. Water heat pumps are located before the drinking water supply system and after the wastewater discharge. The temperature of rejected water after the heat abstraction is 12 °C.

The system utilize a heat of waste water, collected from washing pool filters, showers and surplus in collecting pools in the day reservoir. The device consists of two independent units - heat pump water / water and a heat pump air / water, equipped with DDC regulation. In both cases water with input temperature 24 °C is heated to 40 °C.

Waste water in the reservoir daily oscillating from 80 to 120 m3 in summer months and from 50 to 80 m3 per day in winter months. The installed 73 kW heat pump water / water is heating indoor and outdoor pool, whirlpools and sanitary water. It operates 20 hours daily, pumping from 70 to 80 m3 of waste water and producing 400 MWh / year of energy.

Heat pump water / water

In the basement (technical) room next to the pool is the daily release excess heat, which arising from the refrigeration compressors in operation. Because the ambient temperature exceeds 30 °C there is approximately 5 to 7 kW surplus air energy that can be used to heat fresh thermal water. For space cooling and beneficial use of excess heat the air / water heat pump with 10 kW power was installed. Annual produced energy from a heat pump air / water is 60 MWh / year.

70.000 l LPG (45%) for the needs of the central unit operation with an indoor and outdoor pool are saved annually. Annual savings in energy costs provide a 42.000 €/a and reduction of CO_2 emissions for 117 t.

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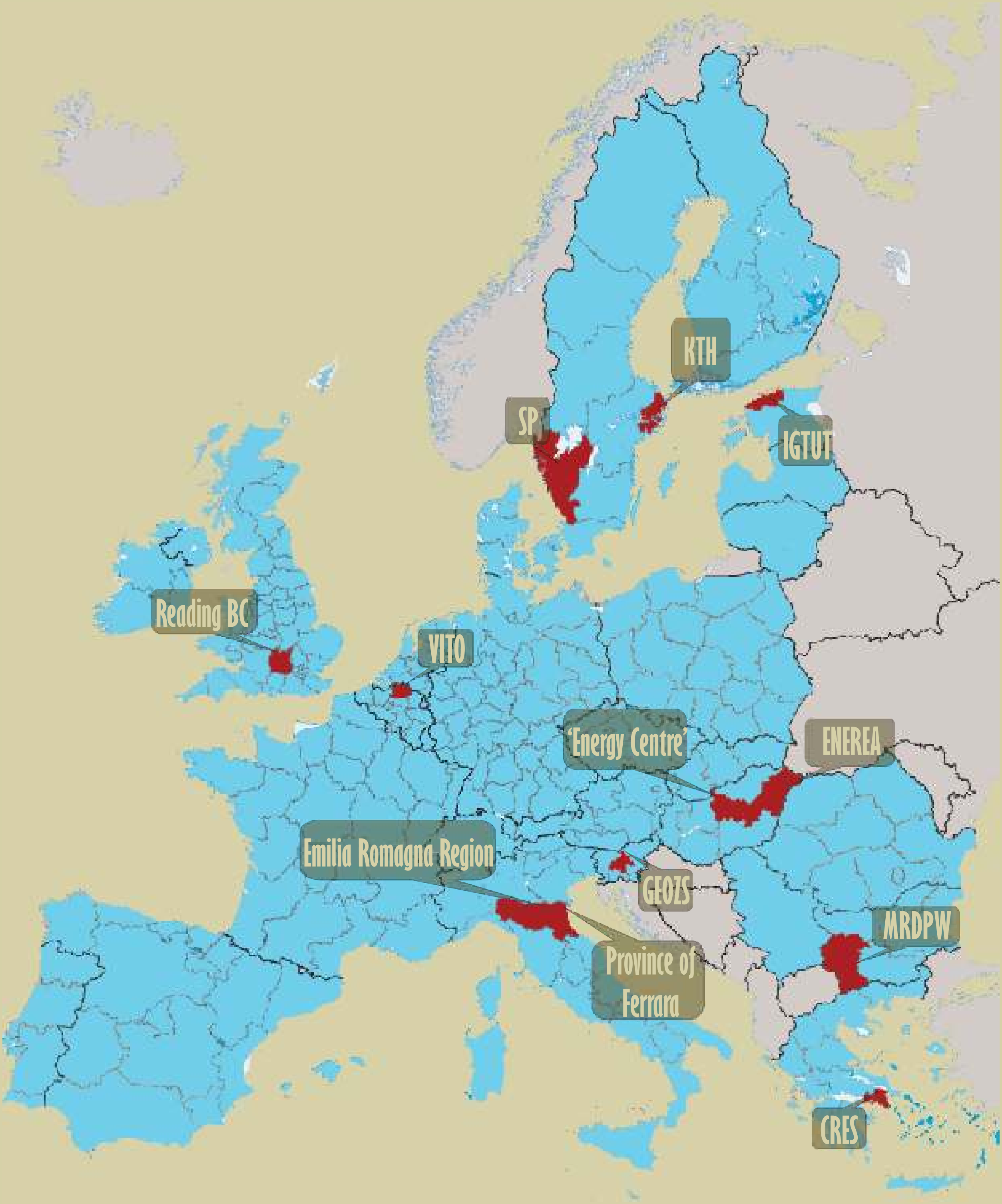
INTERREG IVC provides funding for interregional cooperation, its aim is to promote exchange and transfer of knowledge and best practices across Europe. It is implemented under the European Community's territorial co-operation objective and financed through the European Regional Development Fund (ERDF). The overall objective of the INTERREG IVC Programme is to improve the effectiveness of regional policies and instruments. A project builds on the exchange of experiences among partners who are ideally responsible for the development of their local and regional policies.



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