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Energy performance strategies for the large scale introduction of geothermal energy in residential and industrial buildings: The GEO.POWER project

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H I G H L I G H T S

- Potentiality of geothermal applications for heating and cooling in buildings.
- Description of the GEO.POWER project and its results.
- Local strategies for the large scale introduction of GCHPs.

A R T I C L E I N F O

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A B S T R A C T

Use of shallow geothermal energy, in terms of ground coupled heat pumps (GCHP) for heating and cooling purposes, is an environmentally-friendly and cost-effective alternative with potential to replace fossil fuels and help mitigate global warming. Focusing on the recent results of the GEO.POWER project, this paper aims at examining the energy performance strategies and the future regional and national financial instruments for large scale introduction of geothermal energy and GCHP systems in both residential and industrial buildings.

After a transferability assessment to evaluate the reproducibility of some outstanding examples of systems currently existing in Europe for the utilisation of shallow geothermal energy, a set of regulatory, economic and technical actions is proposed to encourage the GCHP market development and support geothermal energy investments in the frame of the existing European normative platforms. This analysis shows that many European markets are changing from a new GCHP market to growth market. However some interventions are still required, such as incentives, regulatory framework, certification schemes and training activities in order to accelerate the market uptake and achieve the main European energy and climate targets.

1. Introduction

Worldwide, the share of thermal energy use (both heating and cooling) accounts for about 47% of global consumer energy demand, much greater than final energy for transport (27%), electricity (17%) and non-energy use (9%) (IEA, 2011). Despite the importance of the heating and cooling sector, renewable energy technologies currently supply only a small percentage of global and European heat demand per year (Seyboth et al., 2008; EC, 2012).

The vast majority of heat is currently being generated by burning fossil fuels, whereas cooling is still predominantly produced from electricity-driven processes and, therefore, also largely relies on coal or gas (EGEC, 2012). Globally, in 2009 natural gas accounted for about 27% of the fuel mix for heating, combustible renewables and waste represented 26%, oil about 19% and coal and peat 20%. In the same year commercial heat provided 6.5% of heat production, while the share of geothermal and solar heat was 0.5% (IEA, 2012).

Renewable heat can be generated in a number of ways. In general, renewable heat policy support addresses technologies producing direct heat coming from solar energy, bioenergy, geothermal energy and ambient energy. Geothermal energy is one of the most environmentally-friendly and cost-effective energy sources with potential to replace fossil fuels and help mitigate global warming as well.

The IPCC Special Report on Renewable Energy Sources and Climate Change Mitigation (IPCC, 2012) predicts the annual global

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CO_2 savings from renewable energy technologies in four deployment Scenarios for 2030 and 2050, and highlights the good potential of the geothermal energy in reducing the greenhouse gas (GHG) emissions. Recent technological progress, the variability of the cost, the difficulty of oil and gas supply from foreign countries and the need to reduce the use of fossil fuel to cut pollution have made the exploitation of geothermal energy, especially ground coupled heat pumps (GCHP) for heating and cooling purposes, an attractive and viable energy alternative (Sanner et al., 2003). In fact, compared to other competitive technologies for heating, the environmental impact in terms of energy consumption and GHG emissions for the installation and operation work of modern GCHP systems is modest (Chiavetta et al., 2011).

Regarding the situation in Europe, a broad diffusion of geothermal energy could bring a concrete contribution to decarbonise the European economy and meet the targets of reducing GHG emissions by 20% by 2020 and by 80–95% by 2050 (compared to 1990 levels) as indicated by the EU Energy 2020 (EU, 2010b) and Energy Roadmap 2050 (EU, 2011), respectively. In the Renewable Energy Road Map (EU, 2006), the European Commission encourages member states and their local authorities to apply and implement concrete measures in order to improve energy production and distribution, to facilitate investment in the green sector, and to encourage and consolidate rational energy consumption behaviour with the final aim of making Europe the world leader in renewable energy and low-carbon technologies. However it is pointed out that the geothermal energy sector is not doing enough to exploit the potential of renewable energy sources (RES), emphasising that increased electricity and heat generation from geothermal resources will partially avoid the need for new fossil fuel power generation. Geothermal heating and cooling still require research and development over the next few years, notably to further improve the efficiency of the systems and to decrease installation and operational costs. However, the main barrier to augment geothermal deployment is a lack of appropriate financial incentives and legislation on both EU and local level. This could limit the achievement of European policy objectives in relation to EU "20/20/20 targets" (EU, 2010b), the Renewable Energy (2009/28/EC; EU, 2009) and the Recast Energy Performance of Buildings (2010/31/EU; EU, 2010a) directives, as well as the international climate agreements signed in Kyoto (UNFCCC, 1998) and Copenhagen (UNFCCC, 2009).

It is against this background that geothermal energy will play a much more important role in the future and will contribute to achieving all major objectives of the EU energy policy. This paper is based on the recent GEO.POWER project results. The 26 month project (Nov. 2010–Dec. 2012) aimed to evaluate the reproducibility and transferability of some of the most outstanding examples of Best Practices (BPs) currently existing in Europe for the utilisation of shallow and low-enthalpy geothermal energy, mainly related to the GCHP systems. The paper examines the energy strategies and the future regional and national financial instruments for the large scale introduction of GCHP in the Project members' regions. It explains how to fill in some legislation and financial gaps concerning energy and GCHP investments, illustrating some possible pathways towards low-carbon energy systems in Europe.

2. Methodology

2.1. GEO.POWER project

The GEO.POWER project ("Geothermal energy to address energy performance strategies in residential and industrial buildings") was co-financed by the European Regional Development Fund in the frame of the INTERREG IVC Programme. The partnership is composed of twelve partners (PPs) from nine EU countries under the coordination of the Province of Ferrara (Italy) (Fig. 1).

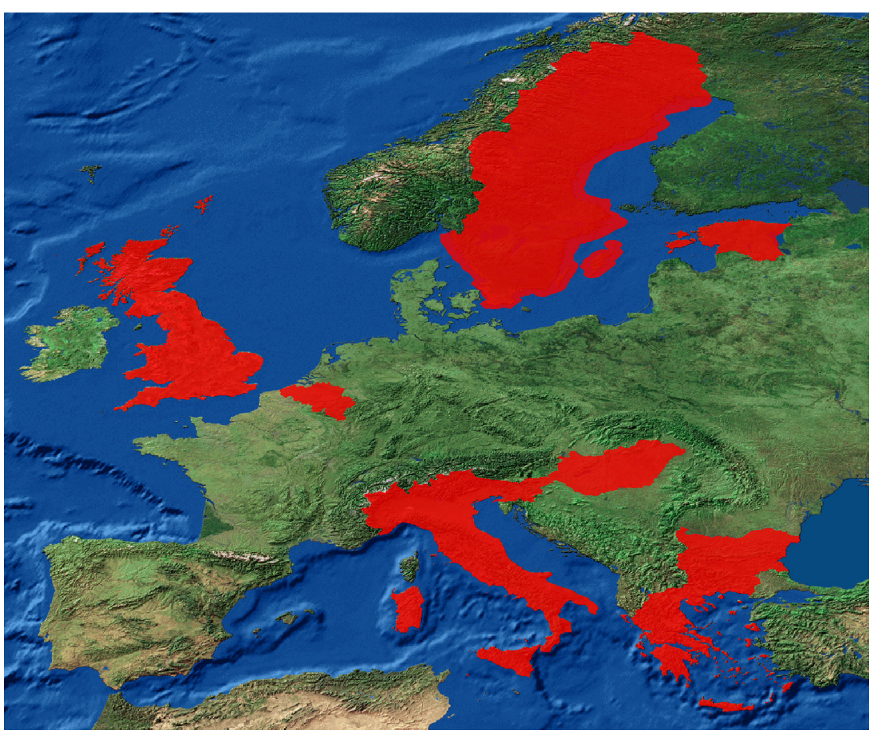

Fig. 1. The countries of GEO.POWER project partnership: Province of Ferrara, and Emilia-Romagna Region (Italy); VITO Flemish Institute for Technological Research (Belgium); Reading Borough Council (United Kingdom); SP Technical Research Institute, and KTH Royal Institute of Technology (Sweden); Institute of Geology—Tallinn University of Technology (Estonia); ENEREA—Èszak-Alföld Regional Agency, and Energy Centre (Hungary); Ministry of Regional Development and Public Works (Bulgaria); Centre for CRES—Renewable Energy Sources and Saving (Greece); GeoZS—Geological Survey of Slovenia (Slovenia).