REGEOCITIES

D2.2: General Report of the current situation of the regulative framework for the SGE systems

SEPTEMBER 2013

# OVERVIEW OF SHALLOW GEOTHERMAL LEGISLATION IN EUROPE

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**AUTHORS** (in alphabetical order)

Florence Jaudin – BRGM, FR *(Lead Author)*

Luca Angelino – European Geothermal Energy Council, EU
Eleonora Annunziata – Institute of Management Scuola Superiore Sant'Anna, IT
Diane van Beek – IF Technologies, NL
Jessica Benson - SP Technical Research Institute of Sweden, SE
Sophie Bezelgues – Courtade – BRGM, FR-++++
Maximilien Croufer - 3E, BE
Doina Cucueteanu – Romanian Geoexchange Society, RO
José Cuevas, AIDICO, ES
Marco Frey - Institute of Management Scuola Superiore Sant'Anna, IT
Bas Godschalk - IF Technologies, NL
Angelos Goumas – CRES, EL
Åsa Jardeby - SP Technical Research Institute of Sweden, SE
Anne Mette Nielsen - GEUS, DK
Riccardo Pasquali – SLR, IE
Adeline Poux, BRGM, FR
Oskar Räftegård - SP Technical Research Institute of Sweden, SE
Francesco Rizzi - Institute of Management Scuola Superiore Sant'Anna, IT
Burkhard Sanner - UBeG GbR, DE

**EDITOR:**
Florence Jaudin – BRGM, FR
Alexandra Latham – European Geothermal Energy Council, EU
Sophie Bezelgues – Courtade – BRGM, FR
Adeline Poux, BRGM, FR
Luca Angelino - European Geothermal Energy Council, EU

# Preliminary remarks

## List of main abbreviations and acronyms used in the project

Technical:

| | |
|---|---|
| ATES | Aquifer Thermal Energy Storage |
| BHE | Borehole Heat Exchangers |
| BTES | Borehole Thermal Energy Storage |
| COP | Coefficient of Performance |
| GIS | Geographical Information System |
| GSHP | Ground Source Heat Pump |
| GW | Groundwater |
| H&C | Heating and Cooling |
| HVAC | Heating, Ventilating, and Air Conditioning |
| RES | Renewable Energy Sources |
| SGE | Shallow Geothermal Energy |
| SPF | Seasonal Performance Factor |
| TRT | Thermal Response Test |
| UTES | Underground Thermal Energy Storage |

Administrative (general or on European level):

| | |
|---|---|
| EED: | Energy Efficiency Directive |
| EPBD: | Energy Performance of Buildings Directive |
| LCC: | Life Cycle Cost |
| NREAPs: | National Renewable Energy Action Plans |
| PCM: | Project Cycle Management |
| RES Directive: | Directive on the promotion of the use of energy from renewable sources |
| SEAPs: | Sustainable Energy Action Plans (for cities) |
| WFD | Water Framework Directive |

The general term for all technologies addressed by the project is “shallow geothermal energy”. Geothermal Energy is defined in article 2 (c) of directive 2009/28/EC, and “shallow” refers normally to a depth until 400 m (in most practical cases about 100 m or less).
The technologies included under this general term are open and closed loops systems geothermal heat pump (GSHP)s, and Underground Thermal Energy Storage (UTES). Both technologies do not have a clear boundary when large installations are concerned (IEA ECES Annex 8 tried to establish a demarcation in 1998). UTES can be further divided into ATES (aquifer), BTES (boreholes), and possible other variations. For GSHP, several heat/cold sources are possible. In the project, shallow geothermal energy is used when referring to the technology in general, and GSHP or UTES when these distinct technologies are considered.

The present document (D2.2) is the General Report of the current situation of the regulative framework for the SGE systems. It has been created, using the 11 national reports (D2.1) produced by the REGEOCITIES partners and available on www.regeocities.eu. Its objective is to present reliable and up to date knowledge about the market conditions and barriers for SGE and analysis the current regulation and legislative framework in the partners’ countries.

**Regarding comparison of legal framework within the partner countries, we could have different definitions,** as below:

**1) Legal Definitions:**

License : '*certificate that proves one has been granted permission to do something under governmental authority'*

Permit: '*a license or other document given by an authorised public official or agency to allow a person or a firm to perform certain acts. The permit guarantees that laws and regulations that apply to the undertaken acts have been obeyed'*

Authorisation: '*the act of conferring legal authority'*

**2) Common Denominator**

In the case of the access to the geothermal resource or the works on the geothermal site, the terms license / permit / Authorisation are differently used according to States. Whatever is the used term, we can define a common meaning

- There is a written document / a certificate;
- Delivered by a person / agency holder of the public authority;
- To confer the right to undertake certain activities, whether it is the exploration / exploitation / the works;
- In the respect for the legality;

**3) Proposed definition**

**Licence / Permit / Authorisation** = '***A formal document provided by a Minister, an official or an agency under governmental or Regional or/and local authority to allow a person or a firm to perform (exploration/exploitation/work on the geothermal field) in compliance with the legal and regulatory framework'***. For the project, we used the word "License" and we specified the level provided (National, regional, local, city, … ).

**Declaration** = completed file (with all required information) simply send to local or regional authority before under taking activities (without permit implication)

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# 1 INTRODUCTION

Heating and cooling has the largest share of final energy demand in EU27. Heat is indeed a substantial part of the energy needs of modern society: for instance, in 2010, heat accounted for 47% of the final energy consumption in the EU (source: Strategic Research and Innovation Agenda (SRA) for the European Technology Platform on Renewable Heating and Cooling (RHC-Platform)).

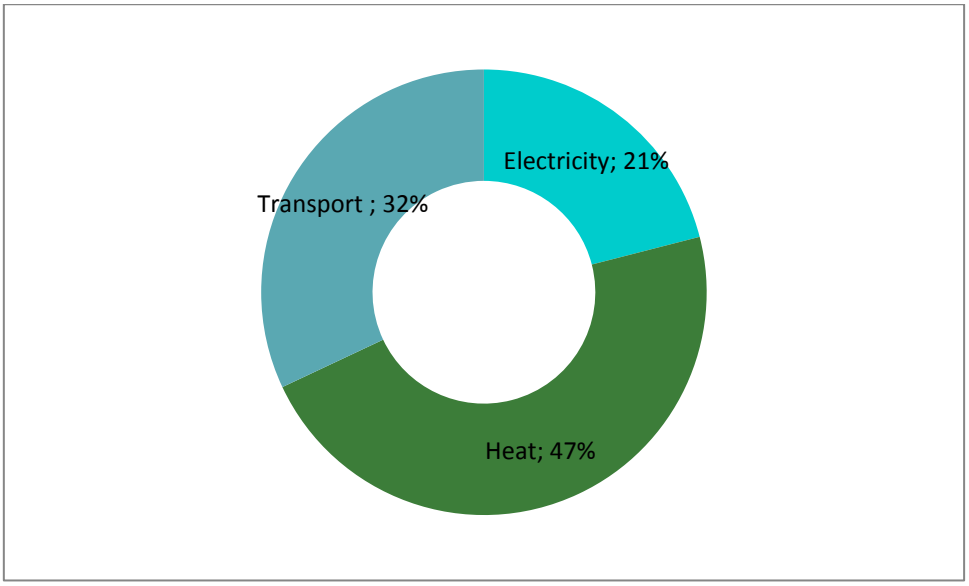



**Fig. 1: Final energy use in EU-27 by type of energy (SRA-RHC)**

Heat accounted for 86 % of the final energy consumption in households, 76 % in commerce, services and agriculture, and 55 % in industry (European Technology Platform on Renewable Heating and Cooling, 2011).

The vast majority (81%) of this energy is, however, being generated by burning fossil fuels. Therefore the current heating and cooling systems generally used in Europe are not only boosting costly imports of fossil fuels, such as gas and oil into Europe, but are also major contributors to the overall EU's greenhouse gas GHG emissions. Another general characteristic of the European landscape is that **H&C sector** is decentralised and very heterogeneous in its structure *(technologies, actors, demand, sources, costs etc.).*

In this context, Shallow Geothermal Energy (SGE) represents a renewable energy source (RES) with a large potential of energy savings, including the air conditioning of buildings for different applications (houses, commercial, industrial, etc.). SGE could achieve up to 70% energy saving with respect to traditional H&C systems (oil & gas), and it is therefore one of the possible technologies for decarbonising the heating sector. Moreover, SGE systems could supply not only heat but also cover the cooling demands, for example in commercial and office buildings, all over Europe. However, SGE sector is currently facing important challenges, some of those related to regulatory barriers at different levels which are affecting the implementation of those systems in cities.

The REGEOCITIES project's objectives are to help to reach the European targets for 2020 on energy efficiency and use of renewable energy by means of clarification of the non-technical administrative/ regulatory barriers at local and regional levels. It is focused in particular on the achievement of the National Renewable Energy Action Plans (NREAPs) of the EU member states, notably those with ambitious objectives regarding SGE. The partner countries, Belgium, Denmark, France, Germany, Greece, Ireland, Italy, the Netherlands, Romania, Spain, and Sweden have considered the SGE as an important energy technology for reaching 2020's targets.

# 2 CONTEXT OF DEVELOPMENT OF SGE

The European Union is committed to achieving the following goals by the year 2020:

- A reduction of at least 20% in greenhouse gas (GHG) emissions compared to 1990 levels;
- 20% of the final energy consumption to come from renewable sources;
- An improvement of energy efficiency by 20%.

Against this background, Shallow Geothermal Energy (SGE) represents a renewable energy source (RES) with a large potential of energy savings and GHG emissions reduction. Hence, it will be a key technology to achieving all major objectives of the EU's energy policy.

Additional benefits of using SGE technologies are:

. Reducing import dependency of fossil fuels and increasing security of energy supply

. Increasing local added value, creating jobs;

. Bringing innovation

. Empowering consumers and contributing to provide affordable energy as it is immune from price volatility common of fossil fuels;

## 2.1 What is geothermal energy?

A EU-wide definition of GEOTHERMAL ENERGY is given in Article 2 (c) of Directive 2009/28/EC: "geothermal energy means energy stored in the form of heat beneath the surface of solid earth".

In seven of the eleven targeted countries, a consistent legal definition exists for geothermal energy, but few of them have detailed legal definition for SGE (only the Netherlands and Italy). Practical (not legal) definitions are used in seven countries; they are based on heat capacity or/and temperature or/and depth threshold or on the associated use (heating and cooling). They always include open and closed systems.

We can say that SGE in Europe always refers to depths of less than 500m; even less in several countries.

Romania and Belgium have neither legal definition, nor practical definition for SGE.

| Legal definition for geothermal energy | Legal definition for SGE | Practical definition for SGE | No definition for SGE |
|---|---|---|---|
| 7 | 2 | 7 | 2 |

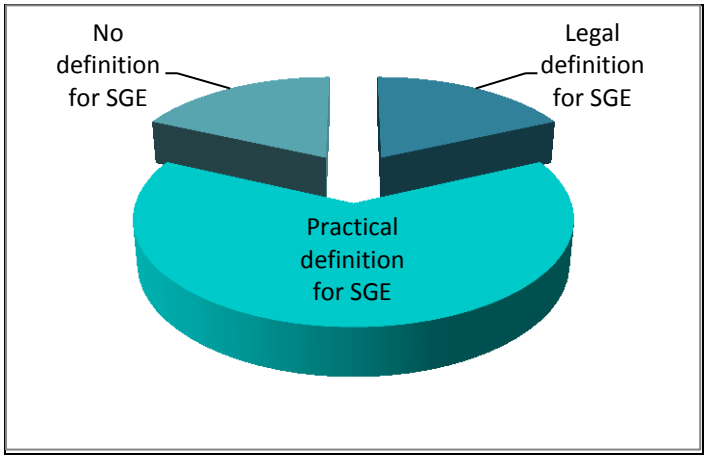



**Fig. 2: Definition of SGE systems in REGEOCITIES target countries**

## 2.2 Shallow geothermal energy in the target countries

In terms of number of installations, installed capacity and energy produced, Shallow Geothermal Energy is the largest sector of geothermal energy use in Europe.

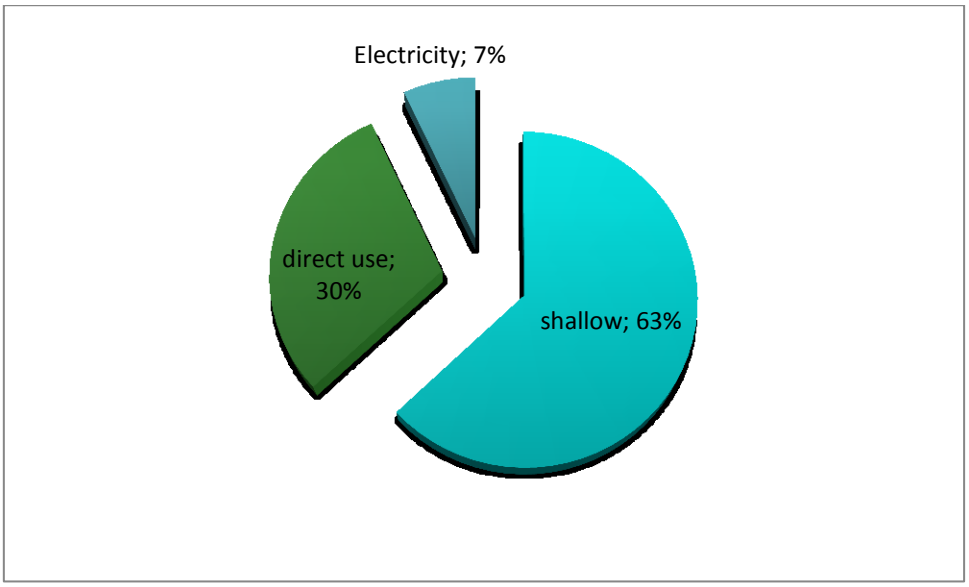



**Fig. 3: Share of installed capacity in the three geothermal sub-sectors in Europe as of 2012** (source: Antics, M., Bertani, R. & Sanner, B. (2013): Summary of EGC 2013 Country Update Reports on Geothermal Energy in Europe. - Proc. EGC 2013, paper keynote-1, 18 p., Pisa)

Eurobserv'ER shows in its Ground source heat pump barometer published in 2011, that the number of installed SGE units passed the one million mark in 2010 with about 100 000 units sold per year and a total installed capacity about 13 000 MWth.

The countries with the highest amount of geothermal heat pumps are Sweden, Germany, France and Switzerland (Figure 4 ). These four countries alone account for 64 % of all installed capacity for shallow geothermal energy in Europe.

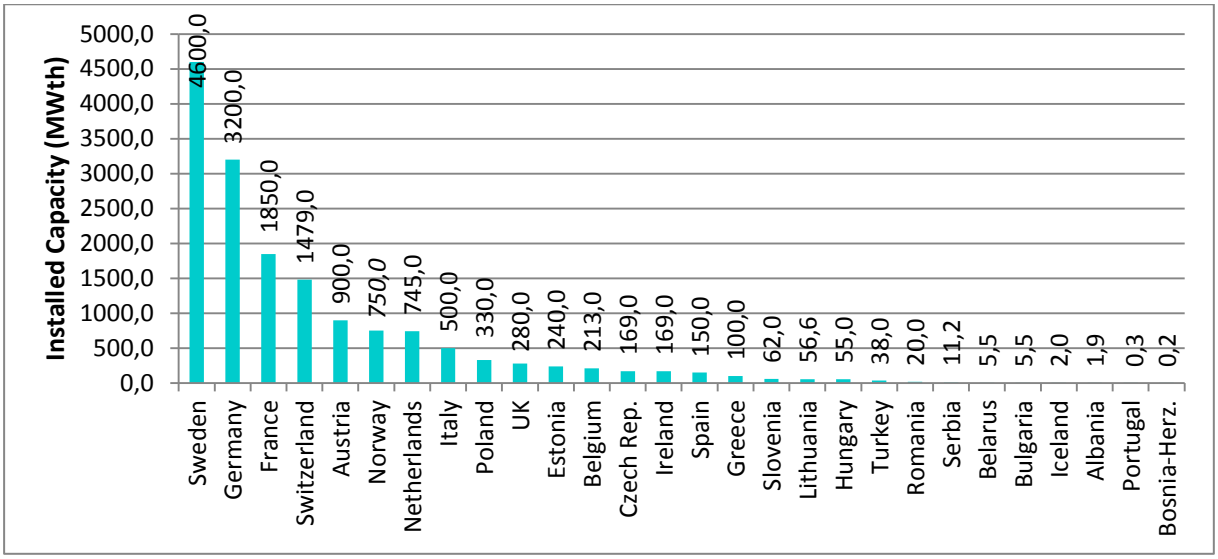



**Fig. 4: Shallow geothermal installed capacity in Europe 2012, after EGC 2013 country update reports**

After a period of strong growth between 2006–2008, the European SGE market is levelling since 2008, in part because of the economic and financial crisis. We see a strong decrease in some countries (Spain, Ireland, France, etc.), whilst others are less impacted. We can also observe that there is a decreasing number of new units but an increasing size of the units in mature markets.

| | Market |
|---|---|
| Belgium | In development , increasing slowly since 2009 |
| Denmark | In development , increasing since 2006 |
| France | Mature, increasing over 2006-2007. Stagnant for individual uses since 2007 |
| Germany | Mature, decreasing since 2009 |
| Greece | Juvenile, increasing since 2-3 years |
| Ireland | In development, increasing until 2009, decreasing or stable since 2009 |
| Italy | In development, increasing since 2006 |
| Netherland | Mature, increasing since 2006 |
| Romania | Juvenile, increasing slowly since 2006 |
| Spain | Juvenile, increasing over 2006-2007. Decreasing since 2008, especially since 3 years (recession and bursting of the housing burble) |
| Sweden | Mature, increasing |

**Tab. 1**: SGE's market recent evolution in REGEOCITIES's participant countries

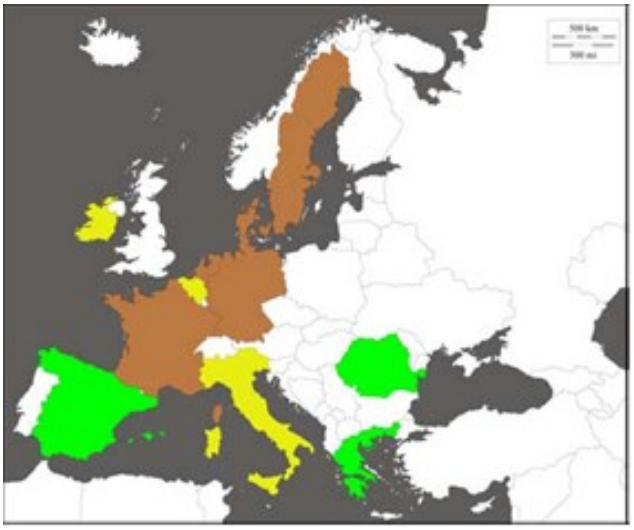


**Fig. 5: Market situation in REGEOCITIES's participant countries**
(brown : mature market, yellow : market in development, green : juvenile market)

The analysis of national elements provided by the countries participating in REGEOCITIES show a lack of official national statistics which allows us to understand the evolution of SGEs in each country. This is particularly evident in those countries where SGE are still poorly introduced like Greece, Ireland, Italy, Romania and Spain.

Except for some specific cases we can say that generally countries or regions have no good knowledge of the number of systems in operation, their characteristics or their energy contribution.

***Capacity of the total installed GSHP base in the EU in 2010 :*** **12 611 MWth**
*(From* HEAT PUMP BAROMET E R – EUROBSERV'ER – S E P T EMB E R 2011)

***GHSP sales in the EU in 2010 :*** **103 846 PACg**
*(From* HEAT PUMP BAROMET E R – EUROBSERV'ER – S E P T EMB E R 2011)

***With 100 000 units sold every year between 2000-2012, installed GSHP units reach the number of 1 200 000 in 2012.***

## 2.3 Operating technologies of Shallow geothermal energy (SGE)

Two basic techniques exist for the exploitation of shallow geothermal energy:

- *Installations which depend on the extraction of **groundwater**, so called **OPEN LOOP** systems. After thermal use, this groundwater is sent back (re-injected) to its origin.*

- *Installations which use a closed circuit buried in the shallow ground, so called **CLOSED LOOP** systems with two main sub-systems :*
  - *Horizontal closed loop (between 1 to 2 m deep) and variants like basket systems (1 to 10 m deep)*

- *Vertical closed loop also called borehole heat exchanger (BHE) (up to hundreds of meters deep ).*

*In most of the cases both systems could be used for heating and cooling purposes; it depends on the heating and cooling distribution system used in the building.*

When these systems are alternately used to produce heat or cold, we also speak of :

- Aquifer Thermal Energy Storage (ATES)
- Borehole thermal energy storage system (BTES system)

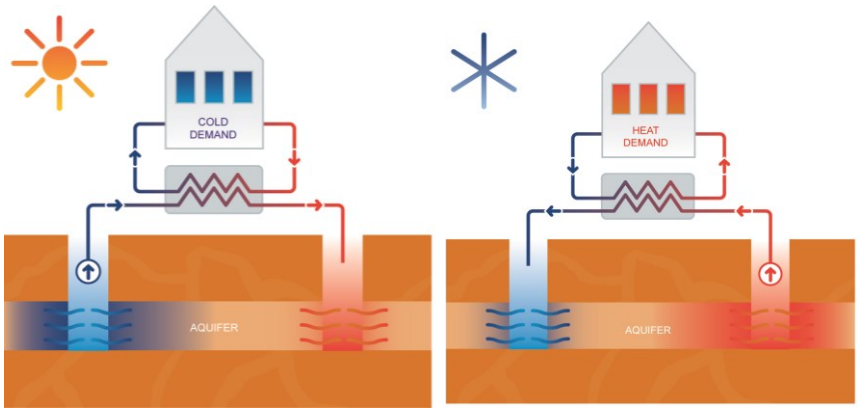



**Fig. 6: OPEN LOOP SYSTEM - ATES in the cooling and heating mode –**

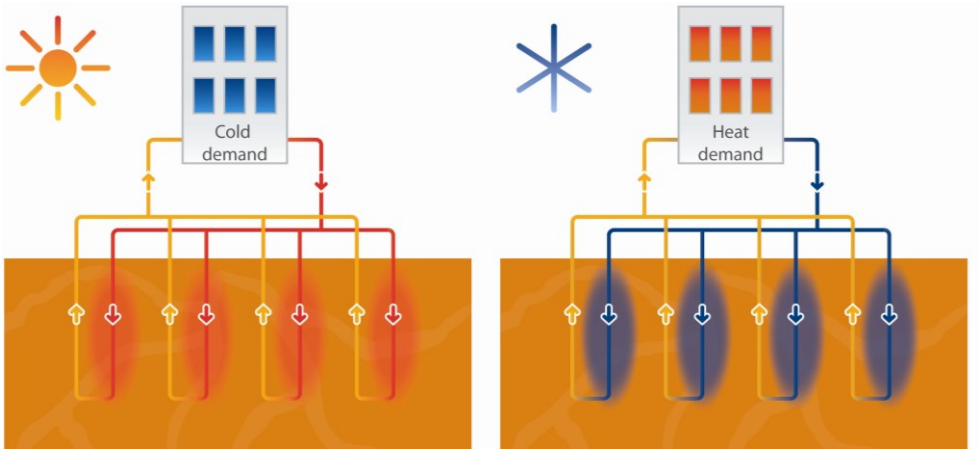



**Fig. 7: CLOSED LOOP SYSTEM -BTES in the cooling and heating mode –**

**Fig. 8: Very shallow CLOSED LOOP SYSTEMS**
(Left: horizontal closed loops, Right: basket system)

Information provided by REGEOCITIES's participant countries shows that:

- SGE systems are developed both for small (individual housing) or large systems (collective buildings, larges offices, commercial or industrial purposes, etc.), including water circulation loop - from groundwater or field of vertical heat exchanger - on which a heat pump can be linked to each building;
- Closed loop systems are prevailing (about 80% of all systems in EU) and mainly vertical heat exchangers. Horizontal systems are a niche market; while it is still used in Denmark, this kind of system is decreasing in France where it was an important part of the market for individuals few years ago.
- Open loop systems (ground water) are more or less important depending on the regulatory framework: it depends on how is applied the national environmental code and what are the specificity of ground water availability and uses in each country.
- SGE is also suitable for both off-grid systems and mini-District Heating (DH) systems, sizeable, for smart cities, covers dense urban areas and more isolated places.

| | Prevailing technology | Prevailing uses |
|---|---|---|
| Belgium | Closed loop | Individual and collective uses |
| Denmark | Closed loop | The closed loop are mainly horizontal and used for individuals |
| France | Both open and closed loop | BHE : 60 % Individual uses<br>GW : 92% collective uses<br>Heating, cooling and domestic hot water |
| Germany | Closed loop | Residential, changing to offices |
| Ireland | Mainly closed loop system with some open loop up to 2010 | Mainly residential before 2010, now mainly large commercial heating & cooling |
| Italy | Closed loop | Individual and collective uses |
| Netherlands | Both open and closed loop | Individual and collective uses<br>Heating, cooling and domestic hot water |
| Romania | Both open and closed loop | Individual and collective uses |
| Spain | Both open and closed loop | Individual or tertiary buildings |
| Sweden | Majority closed loop | Individual and collective uses |
| Greece | Mostly open loop systems | Domestic use. Progressive change in commercial use (swimming pools and sports centers) |

**Tab. 2: Main SGE's technologies and uses in REGEOCITIES's participant countries**

## 2.4 EU legislation and shallow geothermal energy

EU legislation on energy was based for many years on the EU authority in the area of the internal market and environment. However, with the inclusion of a dedicated title and legal basis in the 2009 Lisbon Treaty, energy has become an area of shared competence between the EU institutions and the member states.

As a matter of fact, Article 194 of the Treaty on the Functioning of the European Union (EU) states that «in the context of the establishment and functioning of the internal market and with regard for the need to preserve and improve the environment, European Union policy on energy shall aim, in a spirit of solidarity between Member States, to:

(a) ensure the functioning of the energy market;
(b) ensure security of energy supply in the Union;
(c) promote energy efficiency and energy saving and the development of new and renewable forms of energy »

Such a provision, therefore, entitles EU decision-makers to legislate on a number of issues that can directly or indirectly affect the shallow geothermal sector.

Hence, before going into the detail of the regulatory framework currently in force in the REGEOCITIES target regions, it is worth providing the reader with a general overview of the main EU legislation relevant to shallow geothermal energy and to the objectives of the REGEOCITIES project.

**KEY EU LEGISLATION FOR SHALLOW GEOTHERMAL ENERGY**

- ✓ Directive 2009/28/EC on the promotion of the use of energy from **renewable sources**
- ✓ Recast Directive 2010/31/EU on **energy performance of buildings**
- ✓ Directive 2012/27/EU on **energy efficiency**
- ✓ Recast Directive 2009/125/EC establishing a framework for the setting of **Ecodesign requirements** for energy-related products
- ✓ Recast Directive 2010/30/EC on the indication by **labelling** and standard product information of the consumption of energy and other resources by energy-related products
- ✓ Directive 2000/60/EC establishing a framework for Community action in the field of **water policy**
- ✓ Directive 2006/118/EC on the **protection of groundwater** against pollution and deterioration

*The EU climate and energy package*

Given its features, SGE technologies can benefit from the promotion of renewables and other policies to mitigate climate change. For this reason, one of the drivers for the market growth of SGE in the next few years will no doubt be the EU climate and energy package adopted in 2008 together with the so-called "20-20-20 by 2020 targets".

Along with EU-wide and binding national targets for greenhouse gas emissions and renewable energy, a number of measures have been adopted which aim to deliver the expected results by 2020.

*Simplification of administrative procedures*

Realising a geothermal project requires a variety of different permits. Complex, long, and sometimes unnecessary burdensome procedures can significantly delay project development and investment in the geothermal sector. Though having several competent administrative bodies to assess an application for geothermal licenses is fair, a one stop-shop process should be the rule for each phase of a project.

In this regard, Article 13 (1) of **Directive 2009/28/EC** *on the promotion of the use of energy from renewable sources* (RES Directive) requires member states to define and coordinate the respective responsibilities of national, regional and local administrative bodies for authorisation, certification and licensing procedures including spatial planning. In addition, timetables for determining planning and building applications should be transparent and comprehensive information and assistance to

applicants regarding the processing of authorisation, and licensing applications for shallow geothermal and other renewable energy installations should be made available at the appropriate administrative level.

It is worth highlighting that the RES Directive specifically requires that rules governing authorisation, certification and licensing fully take into account the particularities of individual renewable energy technologies. Further, this directive not only requires the simplification of administrative and authorisation procedures but also encourages, where applicable, the practice of "simple notification" for smaller projects and decentralised devices for energy from renewable sources.

*Planning*

The RES Directive also requires member states to recommend to all actors, in particular local and regional administrative bodies, to ensure equipment and systems are installed for the use heating and cooling from renewable energy sources when planning, designing, building and renovating residential (or industrial) areas. The directive specifies that governments should encourage local and regional administrative bodies in particular to include heating and cooling from renewable energy sources in the planning of city infrastructure, where appropriate.

*Technical specifications and support schemes*

Member states should clearly define any technical specifications which must be met by renewable energy equipment and systems, including SGE systems, in order to benefit from support schemes (Art. 13 (2) of the RES Directive). In addition, where European standards exist, including eco-labels, energy labels and other technical reference systems established by the European standardisation bodies, such technical specifications shall be expressed in terms of those standards.

*Information and training*

Lack of awareness and information as well as shortage of skilled workers is one of the market failures preventing the further market uptake of SGE. Article 14 of the RES Directive addresses these issues. According to the directive, member states have to ensure that information is made available to all relevant actors about support measures, net benefits, and cost, as well as guidance or training programmes.

Moreover, certification schemes or equivalent qualification schemes for installers of shallow geothermal systems needed to be available by the end of 2012, whilst certification awarded in a EU country have to be recognised by any other member state.

Finally, guidance should be made available to all relevant actors, notably for planners and architects so that they are able properly to consider the optimal combination of renewable energy sources and of high-efficiency technologies when planning, designing, building and renovating residential (or industrial) areas.

*Calculation of renewable energy from heat pumps*

A heat pump is a device allowing the transformation of heat from a lower temperature level to a higher one, by using external energy (e.g. to drive a compressor). The amount of this external energy input, be it electric power or, more rarely gas, has to be kept as low as possible to make the heat pump ecologically and economically desirable.

Against this background, the definition of appropriate methodologies for accounting for the contribution of heat pumps to the renewable energy targets was seen since the beginning as a significant implementation challenge given the diversity of heat pump applications and the current scarcity of statistical data.[1]

Lack of reliable statistics has also sometimes acted as a barrier for the development of the technology, notably as it was difficult to quantify the energy and thereby other impacts of the technology. Setting up a methodology was a long and complicated process but it should contribute to the removal of this "statistical barrier".

As explained by recital 31 of the RES Directive "the energy used to drive heat pumps should be deducted from the total usable heat. Only heat pumps with an output that significantly exceeds the primary energy needed to drive it should be taken into account"

Accordingly Article 5(4) provides that "aerothermal, geothermal and hydrothermal heat energy captured by heat pumps shall be taken into account for the purposes of paragraph 1(b) provided that the final energy output significantly exceeds the primary energy input required to drive the heat pumps. The quantity of heat to be considered as energy from renewable sources for the purposes of this Directive shall be calculated in accordance with the methodology laid down in Annex VII":

$E_{RES} = Q_{usable} * (1 - 1/SPF)$

where:

$Q_{usable}$ = the estimated total usable heat delivered by heat pumps fulfilling the primary energy efficiency criterion, and

*SPF* = the estimated average seasonal performance factor for those heat pumps

In line with Annex VII, on 1st March 2013 the European Commission adopted a decision (C(2013) 1082 final) establishing how Member States have to estimate the two parameters "Qusable" and the "seasonal performance factor" (SPF), taking into consideration differences in climatic conditions. The guidelines may be revised and complemented by the Commission by 2016, if statistical, technical or scientific progress necessitates it.

*Promotion of renewable energy and energy efficiency in buildings*

With buildings being responsible for nearly 40% of final energy consumption in the European Union (in residential homes, two thirds of this is for space heating)[2], a large potential for the use of renewables, cost-effective energy savings and CO2 emissions reductions exists and remains untapped in this sector. To this end, a series of several regulations have been adopted at EU level with a special focus on new buildings.

To begin with the RES Directive, Article 13(4)-(6) puts obligations on member states to introduce, where appropriate, measures in their building regulations and codes so as to use minimum levels of

[1] Hodson, P., Jones, C., Van Steen, H. eds., EU Volume III - Book One, Renewable Energy Law and Policy in the European Union, 2010, Leuven, Clayes & Casteels Publishing.
[2] COM(2011)109.

renewable energy in buildings (as of 2015)[3]. This directive also place specific requirements on public buildings to fulfil an exemplary role (from 2012 onwards) and requires member states to promote renewable energy technologies that contribute to a significant reduction of energy consumption, among which heat pumps fulfilling the minimum requirements of eco-labelling.

With regards to energy efficiency, SGE technologies can be crucial to meet the minimum requirements for energy performance that member states have to set in compliance with Directive 2010/31/EU *on energy performance of buildings* (EPBD). This directive, originally approved in 2002 and now replaced with effect from 1st February 2012 by a recast directive adopted in May 2010, is the main legislative instrument affecting energy use and efficiency in the building sector in the EU. The level of these requirements is not prescribed, except for the fact that they have to be cost-optimal, but is established at national level and reviewed every 5 years. What is mandatory is the adoption by member states of a methodology for calculating the energy performance of buildings which needs to take into account certain elements, including the thermal characteristics of a building.

The EPBD applies to new and those existing buildings undergoing major renovation[4]. For new buildings, high-efficiency alternative systems, including ground source heat pumps, need to be considered. To this end, their technical, environmental and economic feasibility should be assessed before construction starts. Finally, when new, replaced or upgraded technical building systems, such as heating systems, are installed, they have also comply with the energy performance requirements.

In addition, the EPBD looks at the future and introduces for the first time in EU law the concept of "nearly zero-energy building", i.e. a building that has a very high energy performance, whose amount of required energy should be covered to a very significant extent from energy from renewable sources. All new buildings owned or occupied by public authorities should become nearly zero-energy after the 31st December 2018, while this provision is extended to all new private buildings by the year 2020.

If the EPBD and the RES Directive contain key measures for the promotion of energy efficiency and for the integration of renewable energy in buildings, they are complemented by Directive 2012/27/EU on energy efficiency (EED) adopted in 2012. For instance, Article 5 of this directive sets out the obligation, as from 1st January 2014, to renovate 3%[5] of the total floor area of heated and/or cooled buildings owned or occupied by central government[6]. This is a step forward from the EPBD, although this target does not cover a large part of the public building stock (for instance public buildings owned by regional and local authorities), and does not address the private sector at all.

Under the EED, however, member states have to set up an energy efficiency obligation scheme[7] to achieve new savings each year of 1,5 % of the annual energy sales to final customers. In that regard,

[3] The so-called "building obligation" is already in place in some countries and is widely recognised to be as an effective support measure renewable heating and cooling.
[4] Member states may choose to apply one of the following definitions of 'major renovation': (a) the total cost of the renovation relating to the building envelope or the technical building systems is higher than 25 % of the value of the building, excluding the value of the land upon which the building is situated; or (b) more than 25 % of the surface of the building envelope undergoes renovation;
[5]The directive specifies that the 3 % rate shall be calculated on the total floor area of buildings with a total useful floor area over 500 m2 and, as of 9 July 2015, over 250 m2.
[6] However, it is possible for member states to take alternative cost-efficient measures to achieve an equivalent improvement of the energy performance of the buildings within their central government estate.
[7] "Or other alternative policy measures that achieve the same amount of energy savings".

it is relevant measures that energy savings achieved with heat pumps can be counted, without any limitation, towards the 1.5% target.

*Eco-design and energy labelling*

Heat pumps (including GSHP) are covered under both Ecodesign and energy labelling legislation, which are two of the most effective policy tools in the area of energy efficiency. Ecodesign aims to improve the energy and environmental performance of products throughout their life cycle, while energy labelling requirements aim to providing citizens with information about environmental performance of products and thereby incentive industry in the development of further improved products and innovations beyond minimum levels.

Recast Directive 2009/125/EC establishing a framework for the setting of eco-design requirements for energy-related products (Ecodesign Directive) does not set binding requirements on products by itself, but through implementing measures adopted on a case by case basis for each product group (lot): Geothermal heat pumps are covered under ENER Lot1 "Boilers and combi-boilers" and ENER Lot 2 "Water heaters." After months of consultation, the new ecodesign requirements for space heaters and combination heaters were published on the Official Journal on 6th September 2013[8].

Recast Directive 2010/30/EC on the indication by labelling and standard product information of the consumption of energy and other resources by energy-related products (Energy Labelling Directive) extends the scope of its predecessors to also cover products in the commercial and industrial sectors. The Directive introduces new efficiency classes A+, A++ and A+++ on top of the existing A grade for the most energy-saving household products to reflect technological progress. The directive applies to "energy-related products which have a significant direct or indirect impact on the consumption of energy and, where relevant, on other essential resources during use". Energy classes and the specific products that must be labelled were determined by a Commission working group by means of delegated acts.

A Commission's Regulation published on 6th September 2013[9] established the introduction of an energy label for brine-to water heat pumps in two phases: the first to be introduced two years after the entry into force will range from A++ to G, while the other ranging from A+++ to D will be introduced in 2019.

| Date | Provision |
|---|---|
| By 9th July 2012 | Member states to transpose the 2010 version of the Energy Performance of Buildings Directive repealing an older version of 2002 |
| March 2013 | Commission issues guidelines on how to calculate renewable energy from heat pumps |
| As of 2014 | Member States to renovate each year an average 3% of the public building stock owned by central governments (EED) |
| As of 2015 | Member states to introduce, where appropriate, measures to set the minimum levels of RES which should be used in buildings (RES Directive) |
| 2015 | Energy label for brine-to water heat pumps A++ to G introduced (substituted by a new label ranging from A+++ to D in 2019) |
| 31st December 2018 | All new buildings owned or occupied by public authorities shall be nearly zero-energy buildings (EPBD) |

[8] Available at: http://eur-lex.europa.eu/JOHtml.do?uri=OJ:L:2013:239:SOM:EN:HTML
[9] Available at: http://eur-lex.europa.eu/JOHtml.do?uri=OJ:L:2013:239:SOM:EN:HTML

| | |
|---|---|
| 31st December 2020 | All new private buildings shall be nearly zero-energy buildings (EPBD) |

**Tab. 3: Timeline for the implementation of relevant EU legislation for SGE**

*Management of the resource and protection of the environment*

As well as measures promoting renewables or energy efficiency, regulations aiming to preserve and improve the environment can also affect the development of SGE systems. For instance, Directive 2000/60/EC establishing a framework for Community action in the field of water policy (WFD), requires member states to implement the necessary measures to prevent deterioration of the status of all bodies of surface water and to prevent or limit the input of pollutants in groundwater.

**A key element of the Directive is its river basin approach, following the natural geographical and hydrological unit - instead of according to administrative or political boundaries.** For each river basin district - some of which will traverse national frontiers - a "river basin management plan" needs to be established and updated every six years.

Regarding groundwater, as it is considered quantitatively much more significant than surface water and for which pollution prevention and quality monitoring and restoration are more difficult than for surface waters mostly due to its inaccessibility, the WFD takes a precautionary approach and establishes a prohibition on direct discharges to groundwater.

The application of water legislation to geothermal energy depends on whether a system is an open or closed-loop system. For the purpose of this report, it is relevant to highlight that Article 11 of the **WFD gives member states the option to authorise the reinjection into the same aquifer of water used for geothermal purposes provided it does not compromise the environmental objectives of the directive.** It is therefore within the competence of the national governments to decide as to whether reinjection of the geothermal fluids is allowed or required.

The WFD is complemented by Directive 2006/118/EC on the protection of groundwater against pollution and deterioration (Groundwater Directive). This Directive sets out specific measures to prevent pollution or limit the inputs of pollutants into groundwater, criteria for the assessment of good groundwater chemical status and criteria for the identification and reversal of significant and sustained upward trends and for the definition of starting points for trend reversal.

In other fields, however, EU legislation only sets the very general framework or just has a minor impact on SGE systems. This means that the major source of regulation is national and that, eventually, can vary from country to country. This is the case for instance of soil protection, which is not covered by EU legislation.

**It remains under national authority to determine whether and which geothermal drilling project should be subject to an assessment in accordance with codified Directive 2011/92/EC on the assessment of the effects of certain public and private projects on the environment (EIA Directive) However, for most SGE activities, an EIA seems not to be appropriate in accordance to their size and minor impact.**

Overall, as SGE systems can be more easily integrated in new and refurbished buildings, these technologies can benefit from regulations pushing up the renovation rate and promoting renewable

heating and cooling as well as energy efficiency in buildings[10]. Whilst the evolving EU legislation can increase the opportunity to implement SGE systems in Europe it is not possible to make a quantitative assessment of such an impact. The roll out of these technologies will largely depend on the case by case feasibility assessments. However, as we shall see, the way the EU law is adapted at the national and local circumstances, together with the existence (or lack) of other national and local regulations and codes, can also have significant major impact on the market development of SGE technologies.

## 2.5 Objectives of development in the target countries

### 2.5.1 National targets

Article 4 of the Renewable Energy Directive (2009/28/EC) required Member States to submit national renewable energy action plans by 30 June 2010. These plans were intended to provide detailed roadmaps of how each Member State expects to reach its legally binding 2020 target for renewable energy, including sectorial targets and the technology mix they expect to use.

[10] In order to be more precise, the compatibility between the concept of "nearly zero energy buildings and shallow geothermal systems" may be difficult particularly for individual buildings.

| Country | Final Energy Consumption in Heating and Cooling* (ktoe) | | Share of Renewables (ktoe) | |
|---|---|---|---|---|
| | 2010 | 2020 | 2010 | 2020 |
| Austria | 12007 | 12802 | 3657 | 4179 |
| Belgium | 21804 | 21804 | 766.4 | 2588.4 |
| Bulgaria | 4492 | 4638 | 741 | 1103 |
| Cyprus | 480 | 527 | 78 | 124 |
| Czech Republic | 17805 | 18680 | 1810.9 | 2672.2 |
| Denmark | 8042 | 7653 | 2480 | 3042 |
| Estonia | 1572 | 1579 | 612 | 607 |
| Finland | 14010 | 15300 | 5210 | 7270 |
| France | 67159 | 60000 | 11124 | 19732 |
| Germany | 111597 | 93139 | 10031 | 14431 |
| Greece | 8644 | 9674 | 1269 | 1908 |
| Hungary | 10347 | 9719 | 949 | 1863 |
| Ireland | 5160 | 4931 | 220 | 591 |
| Italy | 58976 | 61185 | 3851 | 10456 |
| Latvia | 2251 | 2612 | 1020 | 1395 |
| Lithuania | 2417 | 2684 | 666 | 1051 |
| Luxembourg | 1235 | 1268 | 25.5 | 107.8 |
| Malta | 44.76 | 72.73 | 3.5 | 4.5 |
| The Netherlands | 24612 | 24989 | 906 | 2179 |
| Poland | 32400 | 34700 | 3980 | 5921 |
| Portugal | 7286 | 8371 | 2240 | 2507 |
| Romania | 15788 | 18316 | 2819 | 4038 |
| Slovakia | 5971 | 5613 | 452 | 820 |
| Slovenia | 1996 | 2029 | 445 | 625 |
| Spain | 33340 | 29849 | 3764 | 5645 |
| Sweden | 14488 | 16964 | 8237 | 10543 |
| United Kingdom | 60000 | 51500 | 518 | 6199 |
| **EU-27** | **543923.8** | **520598.7** | **67875.3** | **111601.9** |
| **% of RES in final energy consumption** | | | **12.5%** | **21.4%** |

**Tab. 4: Total renewable heating and cooling (RES-H/C) energy targets for all 27 European Union Member States**

### 2.5.2 Local targets

A few provinces, regions or cities have defined local objectives for renewable energy in the near future, including for SGE. Some of them, signatories of the Covenant of Mayors[11], compiled their targets in Sustainable Energy Action Plans (SEAPs). In general, the SEAPs are an initiative lead by the Covenant of Mayors where the signatory cities prepare local plans for quantifying the energy savings that they want to achieve in accordance with the 2020 objectives. Nowadays, more than 2800 SEAP have been presented and approved under umbrellas of this initiative. The action plans, include basic information about the expecting savings related to H&C and even if the technologies for achieving the objectives are not described in the majority of the cases, it could be considered that the SGE, as renewable energy systems, could play a significant role in meeting the proposed targets.

Some of the cities with SEAP documents will be informed about the development of the REGEOCITIES project and the documentation and information (including the training programs) will be provided to them to facilitate the achievement of the SEAP objectives. We expect to have a positive response in this audience helping to promote the energy savings associated with SGE.

**THE STOCKHOLM ENERGY PLAN**

The Stockholm Energy plan from 2008, which is connected to the Stockholm master plan, says that focus should be on expanding district heating and cooling and in district cooling to use more free cooling. There is a dedicated section for SGE, solar and wind power. This section states that there are 1,600 applications for SGE systems each year and that this figure will remain stable in the next few years. The action whichis specified in this section is that the city shall continue to examine alternative energy sources and how to make public buildings more energy efficient.

Table 5 overleaf highlights the diversity of contexts in the partner countries.

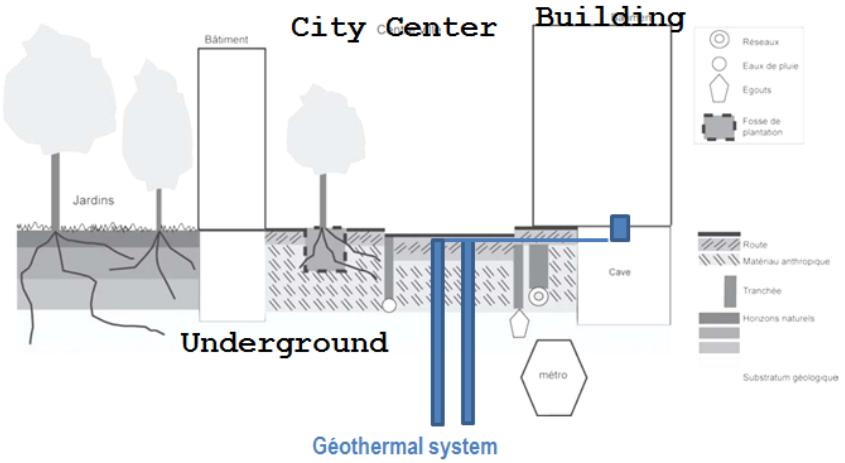
[11] The Covenant of Mayors is the mainstream European movement involving local and regional authorities in the fight against climate change. It is based on a voluntary commitment by signatories (regions, cities with different size) to meet and exceed the EU 20% $CO_2$ reduction objective through increased energy efficiency and development of renewable energy sources.

| | National | | Local | |
|---|---|---|---|---|
| | **Development plans** | **Comment/reference** | **Development plans** | **Comment/reference** |
| Belgium | - | | | |
| Denmark | NREAP | European level | | The municipalities in Denmark have a possibility to make strategic energy action plans. To facilitate this work, the Danish Energy Agency has prepared guidelines. It does not mention shallow geothermal energy, but gives a detailed description of deep geothermal energy as a potential local energy resource. |
| | | It is not clear whether the deep geothermal heat is included in the figures for geothermal heat pumps. | | |
| | | | | Climate Policy exists in some cities, but they doesn't mention SGE as a specific renewable energy source to be part of the future solution :<br>- Skanderborg Kommune : Climate Policy for 2011-2013<br>- Odense Kommune: climate plan for 2010-2012, but shallow geothermal energy is not mentioned as a specific renewable energy source to be part of the future solution. |
| France | NREAP | European level | SRCAE | The Targets vary a lot, SGE not always analysed.<br>Region Centre has actually targets for SGE (no SEAP)<br>Only 14 SEAP accepted In the Covenant of Mayors. |
| | SRCAE | Local Climate Energy Plans for regions, departments and big cities are mandatory when the population is more than 50 000 habitants. (Grenelle Law) | | |
| | PCET | | PCET | |
| Germany | NREAP | target in NREAP not very ambitious, looks like a shrinking annual market is envisaged from 2011, with annual increases becoming lower each year | 48 SEAPs | SEAPs of at least 5 cities in the Covenant of Mayors mention SGE, but no real targets |
| Greece | NREAP | European level | 49 SEAPs | 49 SEAPs have been published in total of 85 municipalities which signed the CoM. 12 out of these have been accepted from EU. Most of SEAPs do not include SGE systems. |

| | | | | |
|---|---|---|---|---|
| Ireland | NREAP | Targets set for GSHP to 84ktoe for 2020. 2012 interim values report GSHP ahead of the 2010 target. | SEAP | 3 published SEAPs for Ireland for cities and County local authorities. Two of these mention geothermal energy and to an extent recognise GSHP technology but no clear targets are included |
| | Strategy for Renewable Energy 2012-2020 | Mentions district heating but geothermal or GSHP are not mentioned | | |
| Italy | Legislative Decree 3rd March 2011 n. 28 | The decree introduces quantitative targets for integration of H&C systems with renewable energy concerning new buildings and major renovation of buildings. The decree does not consider specifically SGE systems. | | |
| Netherlands | NREAP | European level<br>The objective is to have a renewable heat production of 91 PJ in 2020. From this amount 10,1 PJ has to come from GSHP (11%). The documents distinguished deep geothermal energy, air HP, GSHP and air HP | SEAPs | Every (bigger) municipality has it´s climate and/or energy program. The targets vary a lot, because every municipality is free to fill in this program. Some municipalities are focusing on SGE. Examples are Amsterdam and Breda. |
| Romania | | | | |
| Spain | NREAP | Estimated potential in Spain for H&C by means of GSHP is defined in the document as 50.000 MWt whereas that the estimation of the current situation is only 100 MWt | PAER documents | No all cities have PAER documents and we have not found direct mentions to the Shallow geothermal energy in those that have been analysed. |
| Sweden | NREAP | | | The Stockholm Energy plan from 2008, which is connected to the Stockholm master plan, There is nothing specific mentioned about SGE in the SEAP from Stockholm<br>SEAP from Karlstad: there is nothing mentioned about SGE in and nothing specific about heating and cooling of buildings. |

**Tab. 5*:* Existing development plans for SGE in REGEOCITIES participant countries**

# 3 INTERACTIONS WITH THE URBAN ENVIRONMENT




The integration of SGE systems into cities will depend on a series of factors that should be taken into account to determine the feasibility of the installation. Different cities have different characteristics, concerning for example underground availability and building restrictions , which play a determinant role for the installation of this type of system. This interaction between the buildings, the city's framework , the underground infrastructures, and the SGE systems, will be analysed for determining the most plausible options for carrying out the installation.

Regarding historical buildings in old city centres, SGE could be an interesting solution when refurbishing heating/cooling installations, because there is no visual impact on the building.

## 3.1 The building

The EU has set ambitious targets to ensure that from 2020 all new buildings use very little energy and it has created the term 'nearly Zero-Energy Building' or 'nZEB'. But acknowledging the variations in building culture and climate throughout Europe, European building legislation (EPBD) does not prescribe a uniform approach to nZEBs.

> Directive 2010/31/EU (EPBD recast) Article 9 requires that "*Member States shall ensure that by 31 December 2020 all new buildings are nearly zero-energy buildings; and after 31 December 2018, new buildings occupied and owned by public authorities are nearly zero-energy buildings"*. Member States shall furthermore "*draw up national plans for increasing the number of nearly zero-energy buildings*" and "*following the leading example of the public sector, develop policies and take measures such as the setting of targets in order to stimulate the transformation of buildings that are refurbished into nearly zero-energy buildings*".

A

nearly zero-energy building is defined in Article 2of the EPBD recast as "*a building that has a very high energy performance. The nearly zero or very low amount of energy required should be covered to a very significant extent by energy from renewable sources, including energy from renewable sources produced on-site or nearby*".

Main National Building Codes, Labels and Incentives schemes only very rarely mention SGE. Nevertheless, the option to include SGE under 'other renewable systems' is generally accepted because those systems are considered in accordance with national legislation and regulation on renewable systems. The calculation methodologies of the energy savings could be performed with approved EU methodology.

A List of buildings codes, labels and incentives is given in appendix 1 from. **http://www.sustainablebuildingscentre.org/pages/beep**".

In several countries (France, Spain, Italy, Greece, Denmark, Sweden, and the Netherlands), new heat regulations and/ or building codes do not indicate clearly that the SGE systems could be considered as possible solution for reduce the need for purchased energy in buildings, as for example, the thermo-solar panels for hot water production which are clearly marked in the documents.

- In SPAIN : in the Technical Code of Construction there are requirements related to renewable energies, exclusively for the production of hot water, in most of the case the option for fulfilling the requirement (60% of the HDW must be provided by renewable systems) is achieved by means of installing thermo-solar panels which are generally regulated with local laws, as for example the "Ordenanza Municipal de Captación Solar para Usos Térmicos"

- In ITALY: The **Legislative Decree 3rd March 2011 n. 28** introduces quantitative targets for integration of H&C systems with renewable energy concerning new buildings and major renovation of buildings. The decree does not consider specifically SGE systems.

- In FRANCE: Thermal Regulation of 2012 for new constructions ( RT2012) give Maximal Consumption of primary energy for the heating, the domestic hot water, the cooling, the lighting and the auxiliaries;

- In The NETHERLANDS: SGE is not directly integrated in the legislation for heating and cooling in buildings, but is indirectly influenced by the Construction Resolution. This resolution contains rules about the energetic efficiency of buildings, e.g. the energy used for heating and cooling, hot tap water and light. The energy efficiency is expressed in the Energy Performance Coefficient (EPC). The EPC is only valid for new buildings and mentions the minimal energetic quality of a building, and is regulated by law. There are no rules about how to obtain the minimum EPC, the constructor is free to choose his own measures: extra insulation, better installation or the application of renewable energy, like SGE.

The main remarks concerning building codes and thermal regulations in REGEOCITIES participant countries are summarised in the table below

| | **Answer**<br>(extraction from National Report) | Comment/ reference |
|---|---|---|
| Belgium | - Nothing is imposed in this sector concerning H&C systems.<br>- Specific requirements are imposed for insulation in case of renovation | |
| Denmark | New energy agreement to reduce the energy consumption for heating and cooling of buildings (new or renovation). Switching to renewable energy, including ground source heating and cooling, can be one of the solutions, but no specific goals for this is formulated. | No specific goal for SGE |
| France | Since January, 2013, new thermal regulations for buildings came into effect (RT on 2012). It aims at lowering the energy consumption<br>At this time (first months of 2013) the professionals considered that used calculation are not favorable to the GSHP | No specific goal for SGE |
| Germany | Energy Performance of Buildings after EnEV 2009 | SGE is included in the calculation rules, offers opportunities to fulfil the required energy consumption limitation (primary energy use) |
| Greece | CMD D6/B/oik.5825/2010 (Regulation for the Energy Efficiency of Buildings – **REEB** –)<br>Law 3851/2010 (Accelerating the development of **RES**) | RES law (3851/2010):<br>– Up to 31/12/2014, the new buildings of public sector and up to 31/12/2019 the new buildings of private sector will cover the primary energy demands from RES.<br>– Obligatory installation of a RES system for heating, cooling & DHW demands (>60%) (incl. DH, CHP and Heat Pumps with SPF>3.3) in a building square scale.<br>REEB (5825/2010):<br>Specific minimum quantitative targets for buildings energy efficiency are given but SGE specific targets not clearly indicated. |
| Ireland | Part L - Conservation of Fuel and Energy - Dwellings (2011)<br>Part L - Conservation of Fuel and Energy - Buildings Other Than Dwellings (2008) | SGE systems are mentioned as an eligible technology with a performance |
| Italy | The **Legislative Decree 3rd March 2011 n. 28** introduces a quantitative targets for integration of H&C systems with renewable energy concerning new buildings and major renovation of buildings | The decree does not consider specifically SGE systems. |
| Netherlands | Energy Performance coefficient (EPC) only valid for new buildings in the Construction Resolution (Bouwbesluit) | SGE not clearly indicated as heating/cooling solutions, but it can be included in the calculation of the EPC |
| Romania | - No UNDERGROUND space planning in Romanian municipalities.<br>- No special RES plans in urban planning of Romanian municipalities | |
| Spain | - The lack of a clear specification in codes (RITE and CTE) to indicate that the SGE systems could be considered as possible solutions for reduce the energy demand in buildings associated to energy savings in H&C, triggered the increment of alternative solutions which were clearly marked in the documents<br>- It is important to remark that in the Technical Code of Construction there are requirements related to renewable | SGE not clearly indicated as heating/cooling solutions.<br>The Region of Valencia (Comunidad Valencia) submitted through the Valencian Energy agency a document for the incorporation of renewable energy systems in buildings. In this document the |

| | | |
|---|---|---|
| | energies, exclusively for the production of hot water | SGE systems were contemplated as one of those renewable sources to be incorporated in the buildings. |
| Sweden | National Building codes are not technology specific. But there are different numbers for the allowed energy use (kWh/$m^2$ year purchased energy) if you use electric heating or not electric heating. All heat pumps are considered electric heating. | |

**Tab. 6: barriers, building codes and thermal regulations in REGEOCITIES participant countries**

## 3.2 The city

Modern European cities could be divided into different categories, characterised by different aspects such as space availability, density of buildings and population, presence of historical buildings, special protection areas, parks, etc. All those aspects will determine the feasibility of the installation of shallow geothermal systems, due to their conventional instalation requirements. In general, a conventional medium/large city can be divided into different categories.

During WP3 some of the urban plans of the committed cities will be analysed to determine these categories and provide best practices guidelines for carrying out installations.

## 3.3 The underground

The underground of the cities is partially occupied by a vast amount of services including telecommunication systems and cables, electricity distribution systems, water supply pipes, sewage waters, as well as an important number of underground infrastructures such as garages and parking areas, cellars, and communication, and transport systems such as tunnels, Metros, and trains. The presence of these systems in the underground may interfere in the installation process of SGE because drilling is necessary. For this reason, it is essential to know the position and the dimensions of those systems to avoid undesirable interference and ensure that the systems can be installed in the planned position for a long period of time.

According to these issues, the underground planning of the cities is a powerful tool in carrying out subsurface installation; however, many cities have not developed this type of planning or do not have an updated plan of the underground.

# 4 SUPPORT TOOLS/FLANKING MEASURES, TO BOOST THE DEVELOPMENT OF GSHP

Incentives and tools existing to boost the development in sustainable ways

## 4.1 Information tools: dedicated Websites and GIS (general public)

Only one participating country has neither national site nor regional Websites about SGE. For the others countries, local and regional websites are predominant.

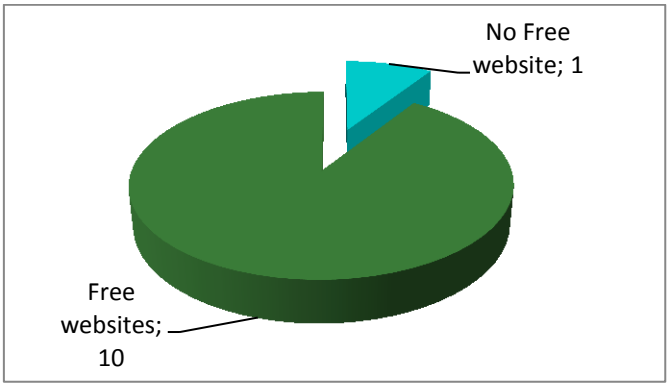



**Fig. 9: Distribution of countries having information web sites about SGE**

| Differents types of informations an tools on line | |
|---|---|
| **Info** | **Tools** |
| Available technologies | Geothermal ressource evaluation |
| Advices about the use of heat pump | Environment and groundwater protected areas |
| Advices for design | Database of wells (energy and water) |
| Drilling firms | Registers of SGE plants |
| Existing financial incentives | Tool to controle the presence of underground infrastructures |
| Legal framework and administratives procedures | Application for permission (e-service) |
| Risks guarantee systems | |
| National and local actors | |

**Tab. 7: Information websites and tools available on some websites**

**Support tool for SGE's development: the French GIS about SGE potential**

Since 2008, BRGM has, with financial support of the French Energy Agency and Regional Councils, created an atlas of shallow groundwater geothermal potential according to a national methodology. This atlas, also called "Decision-making tools" are in GIS format. They give information on the local shallow geothermal potential, regulation and technical aspects. New documents dedicated to vertical heat exchangers are in preparation.

## 4.2 Financial incentives

Most of the REGEOCITIES participant countries offer financial support for RES including SGE at national or local level (8 countries). However, these systems are not always very efficient for SGE. Only 4 countries have specific financial supports for SGE.

| | **Answer**(extraction from National Report) | **Comment/ reference** |
|---|---|---|
| Belgium | National tax reduction of 15,5% (2012) for companies<br>Regional level subsidies for residential, industrial and public sector | Wallonia: Residential and industrial sector, Public institutions<br>There is a position of HP Facilitator |
| Denmark | 2012-2015: incentive for the conversion of individual heating systems to heat pumps as a replacement for systems based on fossil fuels.<br>2013 and 2014: subsidy for energy renovation of existing buildings switching to renewable energy.<br>2013-2020: subsidy to promote energy-efficient use of renewables in industrial production processes.<br>Tax-deduction : for private houses (improving the house, use of RES,,,,) | None of the financial incentives have been or will be directed solely to SGE.<br>Another indirect incentive is the possibility to "sell" CO2 emission reductions in the form of energy savings to energy companies. |
| France | National Financial support + a few local | INDIVIDUAL: income-tax cut 26% rate, Zero rate eco-loan : for individuals<br>COLLECTIVE BUILDINGS: Heat fund (with specific par dedicated to geothermal and SGE)<br>For both OPEN or CLOSED LOOP |
| Germany | Marktanreizprogramm (MAP, market incentive program), since March 2012 only for refurbishment | High SPF threshold in MAP (lower one for air source!); no incentive in new houses, because there is an obligation for renewable energy use in new buildings as to EEWärmeG.<br>poor conditions for SGE |
| Greece | lack of particular subsidy schemes for GSHP | There are some financial incentives within specific programs co-financed by EU accessible for the GSHP: tax reduction, low interest loan |
| Ireland | Specific grant funding has been stopped as a result of budget cuts in 2010. | It is currently unclear if financial support specific to the deployment of GSHP will be made available again in the near future. |
| Italy | Since January 2013 the "Conto Energia Termica" allows to receive incentives for thermal retrofitting of buildings using geothermal heat pumps in 2 years (if P<35 kWth) or 5 years (if P> 35 kWth) up to 10% of the predicted cost.<br>Italian citizens, may deduct 50% of the investment costs of their SGE systems (and any other energy efficiency investment) from their tax bill. | INDIVIDUAL : tax cut (50% rate)<br>National and Local financial support from several Regions |

| | | |
|---|---|---|
| Netherlands | Because SGE is be considered as a successful technique, no subsidies are available in the Netherlands for individual housing owners or contractors. For energy contractors, investors and developers, there are some tax advantages | Energy Investing Allowance (Energie Investeringsaftrek (EIA)): net effect of 10 to 11%.<br>Environmental Investment Allowance (Milieu Investeringsaftrek (MIA)) and Vamil: tax arrangements<br>Green Mortgage (Groenbeleggen): interest reduction of about 1 to 2%.<br><br>Subsidy program renewable heat |
| Romania | - In some cases, Projects could be financed by Environment Fund Administration (EFA) and by the MINISTRY of ECONOMY, and the Operational Sectorial Environment Program<br>- The decision of the Ministry to exclude GSHP projects from Structural funds till the end of 2012 was based on the lack of a unitary European methodology for the calculation of the system efficiency in terms of primary energy produced through the thermal plant with GSHP. | Little effective and little used for GSHP<br>Not specific for GSHP but can take them into account , |
| Spain | - At National level is the GEOTCASA program<br>- Many of the Spanish autonomies have specific programs for subsidiaries support in the installation of SGE systems. | The company receive financial support to carry out the installation and the final user will pay to the company a monthly bill which should be 20 % cheaper that the bill based on conventional energy sources (electricity and gas). During the first 10 years, the company possess the ownership of the geothermal installation. This company should be confirmed as “recognised or certified” companies. |
| Sweden | There is a possibility for private individuals to get tax reduction for any refurbishment work, including also GSHP | There was a national incentives program between 2006 and 2010, supporting replacement of direct electrical heating in single family homes to any renewable heating system (heat pumps, biomass, district heating and so on). Since GSHP now is considered a mature technology there are no incentives directed towards the technology. |

**Tab. 8: Existing subsidies and financial incentives for SGE in REGEOCITIES participant countries**

## 4.3 Insurance schemes

In general, all stakeholders involved in the construction sector have their own civil damage insurance. This insurance could occasionally cover any damage or unsatisfactory work related to SGE installation.

It is common for heat pumps to have only a manufacturer's warranty, some of them may offer an extra insurance (extension of duration). Only France has a dedicated system to cover the geological risk of not finding the resource for the ground water heat pumps systems.

In partner countries, it is unusual to give a **performance guarantee** but some companies in charge of the operation and the maintenance of the SGE installations are beginning to propose a guarantee of results under the shape of a remuneration for their service modulated according to the performances of the installation (contractually by a value of COP or other)

**AQUAPAC : French geothermal risk guarantee system for SGE**

Dedicated to Ground Water Heat Pump projects with more than 30 kW heat capacity (not individual plants) and less than 100 m depth drillings.

Covers geological risks due to uncertainties of the drilling's results: flow rate and temperature of shallows groundwater.

Based on two complementary mechanisms:

- Research guarantee : cover the risk of insufficient resource with regard to the expected one and failure of injection
- Long time productivity guarantee (10 years) : cover the risk of decrease or deterioration of the resource during the exploitation

Maximum amount covered: 140 000 €

Duration of the guarantee: 10 years

Guarantee fund based on guarantee fees paid by each client and proportional to the cost of the system

196 projects have been accepted under the guarantee since 1983.

## 4.4 Professional structuring

The Professional structuring may be considered as a contribution to supporting qualitative development for SGE's sector. The most advanced countries for GSHP, and those with ambition of growth are the ones which set up gradually the structures and the actions necessary for the development of these systems (professional organisation for increasing quality, support schemes for investment and for knowledge dissemination, research programs to secure systems, …)

The Netherlands seems to be a good example, even if it is limited to the ATES.

**Why SGE (and mainly ATES) works in the Netherlands**

*In the past 25 years, there was only one year (1998) when SGE systems were subsidised. The success of SGE in the Netherlands is more the result of having the right people in the right place in the right time:*

*In the first phase (1980-1990) the new technique began:*

- *there were some people with ambition and courage;*
- *the government proposed a prohibition on the discharge of cooling water;*
- *the first example projects were made.*

*In the second phase (1990-2003) the first commercial projects were realised:*

- *The insecurity in the market of using a new kind of technique was taken away:*
- *there was a risk fund for the first couple of projects;*
- *Government supported research to the long term effects of SGE so that the market and government had a better idea of what they were actually doing.*
- *Some well running pilot projects were set up that gave a good example.*
- *Education of clients and consultants, courses and handbooks about SGE were set up.*
- *The Groundwater law was changed, so that ATES had a legal framework.*
- *There was a lot of marketing and promotion by means of information meetings, folders and websites for SGE.*
- *In this period the Kyoto Protocol was signed by the Netherlands so the urgency for energy saving and sustainable energy was even more clear. This resulted in the Building Act, which included regulations about energy saving for buildings.*

*In the third phase (2003 to present) there has been a real breakthrough for the technique:*

- *The government took more action to take away insecurities by doing more research on the effects in the subsurface and implementing a certification program for drillers.*
- *Also, other users of the subsurface (industry, drinking water) are been taking into account more and more and combinations between SGE and these other users are found.*
- *Clients, contractors and system operators are being educated as well.*
- *A process has been started for changing the law, so that also BTES systems will be included in the legal framework as well (paragraph 6.1). Also all parties (consultant, installers, contractors) have to be certified.*
- *The provinces include SGE in the provincial policies and more and more municipalities are incorporating SGE in the subsurface planning.*
- *Good working systems are guaranteed by a good control on permits and energy saving of a system.*

### 4.4.1 Certification of professionals & quality approach[12]

Member States had to implement the provision on certification of installers set out in the RES Directive by 31st December 2012.

[12] *Quality approach*: that includes all the actions led to reach a higher quality and certification as final target

Main certification approaches concern installers of surface installations and are managed at a national level (55% of REGEOCITIES participant countries adopt certification). In one case, the certification of installers is developed at regional level (Spain); this could constitute a barrier for SGE's development because the companies have to obtain the certification in each region.

Very few certification approaches are developed for drillers (BHE and water wells): only 4 participant countries have a quality approach for drillers. Almost no quality approach is developed in several countries.

Training initiatives were also developed (or will be developed) with the implementation of certification being implemented. We can note that the GEOTRAINET project was the opportunity for several countries to test (or introduce) training initiatives. Unfortunately the means are not always available to pursue these actions.

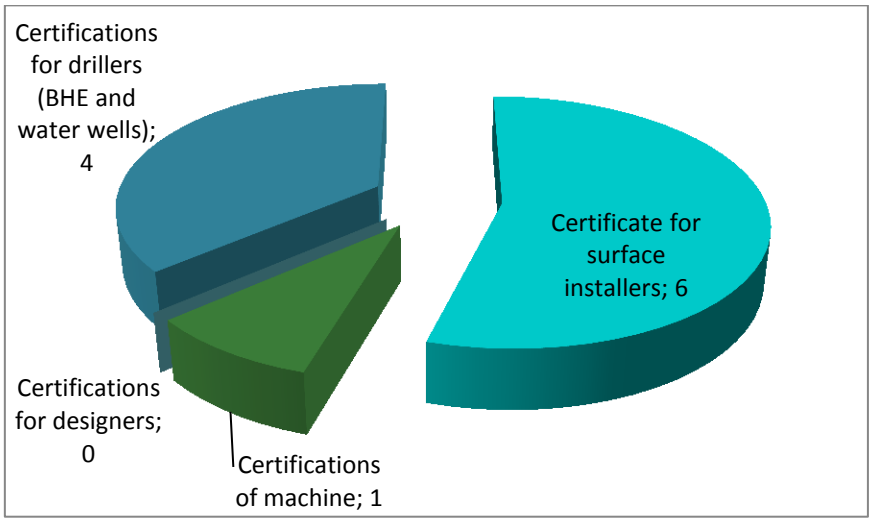



**Fig. 10: Distribution of countries with certification systems**

### 4.4.2 Training activities

The countries where professionals are certified have structured training activities.

Certification and associated training activities are more developed for surface installers (fitters) than for ground operators (drillers, ground installers, etc.) and designers.

Within the countries covered by the project, only 4 countries have structured training schemes at a national level (Germany, Sweden, Netherlands and Denmark).

4 countries (France, Ireland, Italy and Spain) have training programmes in progress (connected with future certification schemes)

Even in countries without structured training activities, the GEOTRAINET project (2008-2011 EIE project), has allowed some progress. The partners of this project grouped together with other participants to continue the work which was began by GEOTRAINET. Finally, training initiatives seem essentially organised at a National level. Only Italy seems to want to trust regions and provinces with the responsibility of the organisation of training initiatives

# 5 MANAGEMENT OF THE RESOURCE

## 5.1 Legislation

The overview of the legal frameworks presented in national reports show:

- Only a few countries include horizontal systems in their regulations, whilst others have no regulation at all for these systems. For instance, in France where this technology was an important part of the market for individuals, they are neither regulated nor registered.
- That in most of the cases, regulations exist for BHE, although some countries don't have any regulation of those systems and some others have inappropriate regulations based on license procedures that are long and complicated for individuals. That a regulation exists for ground water in every country, and it is often based on licences.

| | **Horizontal systems** | **BHE** | **GW** |
|---|---|---|---|
| No regulation | France, Greece, Ireland, Netherland, Romania, Spain | Ireland, Netherland | 0 |
| Existing regulation | Belgium, Denmark, Germany, Italy, Sweden, Greece | Belgium, Denmark, France, Germany, Greece, Italy, Romania, Spain, Sweden | Belgium, Denmark, France, Germany, Greece, Ireland, Italy, Netherland, Romania, Spain, Sweden |
| Licence **or** declaration *(according to technical criterions)* | 0 | Belgium, France, Italy, Sweden | Belgium, France, Sweden |
| Licence | Belgium, Denmark, Germany, Sweden, Greece | Denmark, Germany, Greece, Romania, Spain | Denmark, Germany, Greece, Ireland, Italy, Netherland, Romania, Spain |
| Declaration | Italy | 0 | 0 |

**Tab. 9: Existing regulation for the main SGE technologies in REGEOCITIES participant countries**

Some countries developed systems of simplified regulations based on criteria of sizes of installations, for instance:

- in France, SGE less than 100 m and 230 kW only need declarations instead of licenses ;
- in Italy, in Lombardy region: a registration is required for horizontal systems and BHE < 150 m depth, a licence is mandatory for others.

But, this general overview also show that the regulative framework often constitute a barrier for the development of SGE: lack of regulation, complex procedures, long delay for procedures, expensive procedures, complex repartition between different authorities (national and local), and heterogeneous procedures from a region to another.

## 5.2 Tools for resource management

Various tools giving access to ground data and to its geothermal potential are developed in some countries. These tools are very useful for the management of SGE's development (design and management of different uses and users):

- The most basic are databases listing all the types of drilling and wells in a territory. These are relatively well developed, although they do not exist in Belgium, Greece, Italy, Romania and Spain. Most of the mature countries developed free accesses to these ground databases.
- Very few databases dedicated to SGE are available, only in some regions or cities (some German states, Italy, cities in Sweden).

Some cities, like Stockholm in Sweden, developed some tools to give information about existing plants and underground installations and to apply for legal permissions on line.

## Management of SGE's development : the Stockholm case

The City of Stockholm has since 2010 offered an e-service on their website to apply for a drilling permit for the installation of an SGE heat pumps. The service is open for vertical single bore hole closed loop systems used for single houses and heat pumps less than 20 kW and only if you are the land owner. If you do not comply with these points you have to apply by contacting the City of Stockholm and cannot use the e-service.

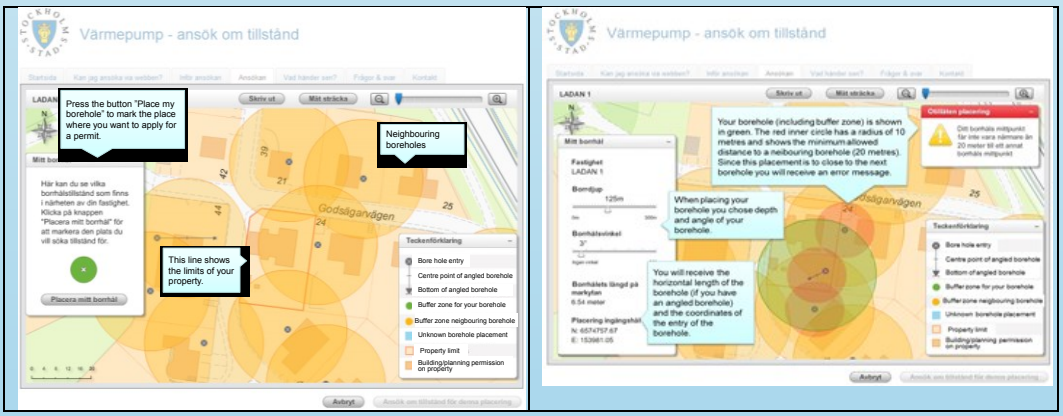
In order to get a permit to drill the City of Stockholm requires that:

- The driller is a certified driller according to the Swedish certification scheme.
- Drilling and installation complies with the guide "Normbrunn-07", a Swedish guide on how to perform the drilling correctly.
- The applicant has made an inquiry at www.ledningskollen.se, a website to locate any electric, telecom and communication cables.

The City of Stockholm will then send out inquiries to:

- Neighbours, if any, which can be affected by the installation. They have according to national law the right to express their opinion.
- Water company, the gas company, district heating company and the telecom company.

When applying, the applicant will be asked to place their borehole on an interactive map and then complete the application with the necessary details of the installation.



| | Answer | Comment/ reference |
|---|---|---|
| Belgium | | Geothermal resources evaluation Available on the GSB website but it's not free of charge |
| Denmark | There is no general inventory of shallow geothermal operations in Denmark. However, borehole heat exchangers and boreholes for groundwater based open loop systems can be identified in the public national borehole database Jupiter. | Reporting to the Jupiter database is **mandatory for groundwater** based open loop systems but voluntarily for borehole heat exchangers |
| France | National wells and boreholes database | Reporting to the BSS database is mandatory for wells a & boreholes more than 10 m deep |
| Germany | On the national level, there is just one geothermal database (GEOTIS), mainly for deep geothermal, with free access provided by the research institute LIAG in Hannover. Databases for boreholes, wells, geology exist in most states. | As the water resources management is a state task, there is no official federal inventory for groundwater or geothermal issues (only state inventories) |
| Greece | National Database is maintained by I.G.M.E. for the validated geothermal fields and reservoirs in Greece but it is not accessed free of charge for the public | |
| Ireland | - Geothermal Atlas of Ireland (SEAI, 2004)<br>- EPA/Teagasc Soils Map (2011) - Irish National Soils and Subsoils Database<br>- Bedrock Data and Bedrock Boreholes (ongoing) –<br>- Groundwater Web-Mapping (GSI, 2007-ongoing)<br>- Geotechnical Viewer (GSI, 2007 – on going) site investigation reports, borehole and trial pit records are included in a free national geotechnical borehole database. | lack of information on the potential for installing ground source heat pumps |
| Italy | Designers are predominantly national because detailed geo-hydrological information about underground geothermal resources is not publicly available and hardly achievable. | |
| Netherlands | - GIS web application that shows the possibilities for SGE for every location<br>- Dinoloket: is an archive that contains all geo-data and information of the Dutch subsurface<br>- Every province has a database of ATES systems. In the near future these databases will be connected to the WKO TOOL, so that the information is widely available for everyone. | |
| Romania | Lack of information regarding shallow geothermal potential<br>- No national/regional/local database of wells<br>- No public databases concerning all the uses of the underground | |
| Spain | General information of the geological setting of Spain can be consulted in the website of the Geological survey (www.igme.es) . Moreover, information about wells are available under petition in different organism depending on the regional councils.<br>No underground operation inventories | |
| Sweden | Geothermal operation inventories | |

| Free access to ground data | Well/Borehole data base | Specific data/ on potential for SGE | SGE dedicated data bases | Underground (space planning) data base |
|---|---|---|---|---|
| | **N** | Y | **N**<br>only a HP Database, not completed | |
| | Y | **N**<br>on project | **N**<br>on project | |
| Y | Y | Y | **N** | **N** |
| **N**<br>for SGE | Y<br>most states | Y<br>some states | Y<br>some states | N |
| N | N | N | N | N |
| Y | Y | N | N | Y<br>Cities level |
| N | Y<br>Region level | Y<br>Regional geothermal map | **Y**<br>Region level | Y/N Regional level |
| Y | Y | Y | Y<br>Currently only for ATES, per 1 July 2013 also for BTES | Y<br>In the near future municipalities can add every SGE underground plan to the WKO Tool |
| | N | **N** | N | N |
| Y | **N**<br>Only for wells identified by cadaster and mainly used for water supply. | **N** | **N** | N<br>if any in any cities, it is restricted document or almost unknown |
| | Y | | Y<br>Cities level | Y<br>Cities level |

**Tab. 10: Ground data/ Information access in REGEOCITIES participant countries**

Some countries developed and implement monitoring systems but this is still rare in other Member States as shown in the table below.

| | Answer | Comments/Projects |
|---|---|---|
| Belgium | | |
| Denmark | According to the statutory orders for open and closed loop ground source heating and cooling installations, respectively, yearly inspections by professionals are required. | No mandatory maintenance, except for the yearly inspections.<br>There is various performance guarantees on the market for ground source heating and cooling installations. |
| France | | |
| Germany | Monitoring for larger systems case by case (groundwater protection, thermal balance of the underground) | A general check (every 3 or 5 years) is going to be stipulated; nationally only in non-residential applications, some states (e.g. Hessen) want to include residential systems also. |
| Greece | | Installations subject to periodic monitoring/report based on performance indicators (SPF, COP etc.) exist and monitored either by institutes, research centres or installation companies but it's not the majority. |
| Ireland | N/A | |
| Italy | | |
| Netherlands | All ATES systems are monitored<br>Big BTES systems (> 70 kW) will be monitored after 1 July 2013 | Every permit contains certain requirements (maximum infiltration temperature, water quality measurements, ..), depending on the requirement and province. |
| Romania | | |
| Spain | - | - |
| Sweden | | |

**Tab. 11: Monitoring systems in REGEOCITIES participant countries**

## 5.3 Standards and guidelines documentation

Only 3 partner countries have developed national standards or Technical Guideline for SGE: Germany, Sweden and France, but several are planned (Italy, Netherlands).

Other European countries (but not project partners) have standards, we can report:

. the UK guideline MIS 3005

. The Swiss Standard SIA 384/6

**There are no existing standards at the European Union level**

Only the TRT-Thermal Response Test was on going; but at present it still on hold (the TC341/N525 is no longer the goal, CEN TC341 now targets a new EN ISO 17628 for release in 2015)

Several EU or International Associations or Agencies have also published standards or Guidelines, we can quote:

• Ground Source Heat Pump Association-GSHPA Standards
  - GSHPA Vertical Borehole Standard
  - GSHPA Thermal Pile Standard

• Environmental Agency ground source heating and cooling good practice guide.

**German standards**

VDI 4640-5, Thermal Response Test in Borehole Heat Exchangers, draft expected autumn 2013

VDI 4640-2, Ground Source Heat Pumps, September 2001 new edition, draft expected beginning of 2014

VDI 4640-1, Thermal Use of the Underground (shallow geothermal) / General, June 2010

# 6 CONCLUSION: SYNTHESIS ON THE "BARRIERS" FROM NATIONAL REPORTS

## 6.1 Barriers

Even though REGEOCITIES Project is dedicated to analysing the regulation of SGE systems; several types of “barriers” have been identified in the National Reports (D2.1).

- Information availability

Lack of knowledge about technologies and associated supporting incentives,

Lack of information on the potential for installing GSHP systems.

- Economic/Financial

The investment cost (quite high) and the pay-back time (too long) are mentioned in almost all the partner countries, as being a barrier for the development of SGE systems. However it is also said that the savings (financial and $CO_2$) in the operating phase are real and important (user feedback).

Also mentioned are the low dissemination of data from running operations (no best practice data base), the high electricity price, and the lack of financial incentives.

- Awareness and public acceptance

Public acceptance of SGE systems is mentioned several times:

- Complicated systems, due to the fact that several fields of expertise are necessary for the good realisation of an operation (ground knowledge, thermal operating of the building, the sizing and the installation of equipment, etc.),
- Negative image, due to bad references as a result of systems installed by incompetent installers (sometimes opportunist companies on a new market)

- National Macroeconomic situation

- Level-playing field

One of the main challenges for the sector is to design a future heat market with open and fair competition between all technologies so as to provide European citizens with affordable energy for heating.

Today, gas and home heating oil prices are often fixed by National authorities by means of social tariffs. The main consequence of these measures is that the final price of conventional sources of energy is always below its real cost. However, as the cost of fossil fuels increases and when we start to take into consideration their external costs, (CO2 tax, ETS etc.), renewable heating and cooling technologies, including geothermal, become more and more competitive.

- Regulative

Complexity delays and associated costs of the required procedures are often mentioned. The absence of regulative procedures or of good practice recommendations for GSHP systems could be a problem regarding the future development of the SGE sector (uses conflicts, space conflicts, and design defaults). A strong local involvement seems necessary in crowded areas (Stockholm case).

Heterogeneous regional regulations are difficult for installers and other professional to take into account.

Depending of the countries local authorities are more or less involved in regulative procedures for SGE.

The obligation to join existing or planned district heating system (DH), and the variability of RES tariff policy are also mentioned as barriers.

Lastly, in several countries the lack of training and certification procedures which could increase quality is mentioned even if most of the advanced countries have such certification or procedures on going.

## 6.2 Structuring elements

The following structuring elements have been notified in most of the advanced countries:

- Good example projects with good dissemination of knowledge
- Setting up adapted regulation
- Supporting financing tools (subsidies, insurance,…) at least during the first phase
- Research programs to secure systems and techniques
- Education, and documents
- Certification of parties
- Implementing control on energy saving
- Including SGE in local energy planning

But currently, even in the “advanced” countries efforts are still necessary to reach the goals (of RES in heating and cooling).

# Appendix 1


**BUILDING CODES, LABELS, INCENTIVES**[13] **f**rom **http://www.sustainablebuildingscentre.org/pages/beep**

| | Building codes (Mandatory) | | Labels ( voluntary) | | Incentive Schemes | |
|---|---|---|---|---|---|---|
| **BELGIUM** | **Wallonia** | | New residential | Brussels Capital Region: PEB Energy P... | New residential | Flanders: building renovation |
| | All buildings | Réglementation sur la Performance Ene... | Existing residential | Brussels Capital Region: PEB Energy P... | New buildings | Flanders: Property tax reduction |
| | **Flanders** | | Existing residential | Flanders: PEB Energy Performance Cert... | Residential buildings | Tax deduction for investments in ener... |
| | All buildings | EPB | Existing buildings | PEB Energy Performance Certificate | | |
| | **Brussels** | | All buildings | Walloon EPB | | |
| | All buildings | PEB | | | | |

[13] **Building energy code**: main regulatory instrument used by policy-makers to reduce the energy demand of the building sector. Building energy codes set minimum energy performances requirements regulating energy use in buildings. Mandatory building energy codes are advocated by the IEA 25 energy efficiency.
**Labels** : information instruments used by policy-makers to raise awareness. Labels provide information on a building's energy performance for end-users. Labeling schemes are advocated by the IEA 25 energy efficiency.
**Incentives**: financial instruments used by policy-makers as part of their market transformation programmes. Incentives drive improvements in the energy performance of new or existing buildings.

| | | | | | | |
|---|---|---|---|---|---|---|
| **DENMARK** | All buildings | Building Regulations | New non-residential | DGNB Denmark | All buildings | Tax reform 2010 |
| | | | Residential buildings | EBPD energy performance certificate | | |
| | | | Non-residential buildings | EBPD energy performance certificate | | |
| | | | New buildings | Passive House | | |
| | | | New buildings | Swan | | |
| **France** | Existing buildings | RT 2005 | All buildings | Bâtiment Basse Consommation BBC | Residential buildings | Crédit d'impôt Développement Durable |
| | New non-residential | RT2012 | | | New residential | Dispositif Scellier |
| | New residential | RT 2012 | | | Existing residential | Eco-Prêt à Taux Zéro |
| | | | | | Existing residential | Eco-prêt logement social |
| | | | | | New residential | Exonération de taxe sur la propriété ... |
| | | | | | Existing residential | Habiter mieux |
| **GERMANY** | All buildings | Energy Conservation Regulations (EnEV) | New buildings | Passivhaus | Existing non-residential | KfW Construction supervision for Ener... |
| | | | All buildings | Zukunft Haus: Energy performance cert... | Existing residential | KfW Grants for Energy-efficient Refur... |
| | | | | | New residential | KfW Loans for Energy Efficient Constr... |
| | | | | | Existing residential | KfW Loans for Energy-efficient Refurb... |
| | | | | | Existing non-residential | KfW Social Investment Programme - Ene... |

| | | | | | | |
|---|---|---|---|---|---|---|
| **GREECE** | Non-residential buildings | Regulation for Energy Performance of ... | All buildings | EPBD Energy Performance Certificate | Existing non-residential | Competitiveness and Enterpreneurship... |
| | New residential | Regulation for Energy Performance of ... | New residential | Passive House | Existing non-residential | Enviroment and Sustainable Growth (ΕΠ... |
| | | | | | Non-residential buildings | EXOIKONOMO KAT' OIKON (Energy Saving ... |
| **IRELAND** | Non-residential buildings | Building Regulations 2008: Part L - C... | Residential buildings | EBPD Building Energy Rating | Existing buildings | Better Energy: The National Upgrade P... |
| | Residential buildings | Building Regulations: Part L Conserva... | Non-residential buildings | EPBD Building Energy Rating | Existing residential | Better Energy Warmer Homes Scheme |
| | | | New buildings | Passive House | New residential | No current incentives for new residen... |
| **ITALY** | All buildings | National Code | Non-residential buildings | Energy Performance Building Certificate | Non-residential buildings | Energy Audits in Public Buildings |
| | | | New residential | EPBD Energy Performance Certificate | New residential | Energy Efficiency Titles scheme (TEE) |
| | | | New residential | Passive House - ZEPHIR | Non-residential buildings | Energy Efficiency Titles scheme (TEE) |
| | | | | | All buildings | ERDF funding 'renewable energy and e... |
| | | | | | All buildings | Law concerning anti-crisis measures: ... |
| **NETHERLANDS** | All buildings | Bouwbesluit 2012: Chapter 5 | All buildings | EPBD Energy Performance Certificate | New buildings | Lente-akkoord [Spring Agreement] |
| | | | | | Existing buildings | Meer mit Minder [More with less] |
| **ROMANIA** | | | | | | |
| | | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| **SPAIN** | All buildings | Código Técnico de la Edificación | All buildings | Certificado de Eficiencia Energética ... | All buildings | Grants for Energy Efficiency in Build... |
| | | | New buildings | Passivhaus | Existing buildings | Renove Tourism Plan 2009 |
| **SWEDEN** | Non-residential buildings | Building Regulations 2010 | All buildings | EPBD Energy Performance Certificate | All buildings | Energy Declaration of Buildings Act -... |
| | New residential | Building Regulations BBR10 | Non-residential buildings | Green Building | Existing buildings | Energy demonstrations |
| | | | All buildings | Miljöbyggnad (Environmental Building) | New buildings | Energy Demonstrations |
| | | | New buildings | Passive House | Existing residential | Technology procurement |
| | | | New buildings | Swan | | |

# Appendix 2

## Summary of General Barriers, such as mentioned in National Reports

| | Answer | Comment/ reference |
|---|---|---|
| Belgium | - **Information** : lack of knowledge- **Economi c**:<br>High investment costs<br>High Electricity price<br>- **Legal/Regulative** : long and unclear procedures<br>- **Organisational** : Different regional regulations are difficult for installers and other professionals to take into account | |
| Denmark | **- Economic :** economically attractive but installation cost and payback time remain barriers<br>- **organisational :** differences between various companies (differences of prices and dimensioning solutions<br>- **Legal/Regulation** : costly requirements for ground water permit and obligation to join existing or planned district heating system (existing exemptions) | (need of standardisation of advice and calculation ?) |
| France | - **Economic** : drilling costs (mainly for individual)<br>- **Legal/Regulation** :<br>Complex and long administrative files when authorisation requested<br>Administrative limit : simple or complex procedure depending on the depth of the project<br>- **organisational :** training and certification to increase quality | |

| | | |
|---|---|---|
| Germany | **- Informational barriers :**<br>Some information deficits today can still be seen with some installers of classical heating system (plumbers), and with persons in regulatory authorities.<br>**- Economic barriers :**<br>The most evident barrier in this group is the development of the price for electricity for the private consumer in Germany which went up steadily. But it is not only the general increase, which in a similar way affects all heat sources, but that the special heat pump tariffs are disappearing. Another economic barrier arises indirectly from the regulatory process. Limiting clauses (e.g. minimum permissible temperature, maximum drilling depth) and requirements for site investigations or monitoring are adding to the cost of the final system. In adition, fees and additional administrative cost can rise to the level of an economic barrier in individual cases. | |
| Greece | **- Economic :**<br>High investment cost **,**<br>Lack of economic and structural incentives,<br>The small market size,<br>- **Organisational** :<br>Lack of experienced professionals,<br>continuous modifications of the market rules,<br>The small market size,<br>Lack of Structural incentives<br>- **Information** : the higher complexity and the lack of knowledge on GSHP, not enough "know how" to design and construct these systems and the availability of supporting. The (low)knowledge of the market stakeholders<br>- **Legal/regulative** :<br>States energy policy which subsidises natural gas and the fossil fuels,<br>The destabilised RES tariff policy,<br>The complexity of the procedures and the time required to get the permits | |
| Ireland | - **Economic :** Present Irish economy, Lack of financial support<br>- **Legal/regulative :**<br>Lack of a regulatory of best practice for GSHP systems<br>**- Information** : Lack of information on the potential for installing GSHP systems<br>**- Training & Certification** | Specific grant funding has been stopped as a result of budget cuts in 2010 |
| Italy | - **Information** : The development of SGE systems in Italy is mainly hindered by information barriers<br>- **Legal/regulative** : delayed realisation of GSHP systems caused by the complexity of procedures and related costs. | |
| Netherlands | - **Legal/regulativ**e :<br>Permit Procedure ATES systems (too long)<br>BTES doesn't have a legal framework<br>- **Economic** : High Investment costs (mainly in renovation)<br>- **Information** :<br>Quality of systems (negative reputation)<br>Exploitation of systems to improve<br>Crowded subsurface & Interference | Many barriers have been overcome during the previous period but some remain |

| | | |
|---|---|---|
| Romania | Economic barriers<br>Organizational barriers<br>Information barriers<br>Legal / regulative barriers | Very strong in Romania |
| Spain | - **Economic** : General lack of knowledge around the national, regional or local schemes.<br>- **Organisational** : make more visible the options and promotion at the level of final users<br>- **Information** : potential stakeholders not sufficiently aware on GSHP<br>- **Legal/regulative** : permit for drilling having different criteria for every region | |
| Sweden | - **Priority in the District heating :** DH is the most common in most buildings.<br>- **Information** : In commercial buildings there is a lack of information/knowledge. | There are essentially no other barriers for ground source heat pumps in single family houses. |