Review of the Greek legislative framework for ground source heat pumps (GSHPs) and suggestions for its improvement

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Scope

- Presentation and analysis of the Greek legislative framework concerning GSHP systems;
- Study of legislative acts concerning:
  - geothermal potential
  - shallow geothermal energy
  - installation of heating/cooling energy systems
  - use of surface or ground water
  - heat pumps
  - renewable energy sources (RES) development
  - energy related products
  - energy efficiency of buildings;
- Report of the European Directives and Decisions;
- Specific recommendations for the improvement of the legislative framework.
Concerning shallow geothermal systems, Cheap-GSHPs project aims to:

✓ substantially reduce the total cost of ownership, composed out of investment and operating costs
✓ increase safety during installation and operation and
✓ increase awareness of this technology throughout Europe;

Overview assessment of the legislative and regulatory conditions;

Website: http://cheap-gshp.eu/
Ground source heat pump systems

- Ground source heat pump (GSHP) technology utilizes the relatively constant temperature of the ground or water to provide heating, cooling and DHW of buildings and other facilities throughout the year;
- GSHPs are the key to the exploitation of the unlimited shallow geothermal energy resources*, since they do not require the existence of geothermal resources (existence of hot water or steam);
- GSHP systems can be used from small residential buildings up to large individual buildings and complexes (offices, hotels, schools, shopping centers, etc.).

* Shallow geothermal energy: According to Greek legislation, geological formations and surface/ground waters with a temperature \( \leq 25 \, ^{\circ}C \).
GSHP system structure

A typical GSHP system is consisted of 3 main parts:

a) the ground heat exchanger or the water wells;
b) the water-cooled heat pump;
c) the heating / cooling system inside the building.
GSHP operation

- Heating period: During the winter, a GSHP carries thermal energy from the ground or groundwater to provide space heating.

- Cooling period: During the summer the energy transfer is reversed, with the ground or groundwater absorbing thermal energy from the building, in order to cool it.
GSHP systems types

System type selection criteria
- Available land surface;
- Ground characteristics;
- Possibility of water drilling in the area;
- Heating & cooling characteristics of the building/s.

Closed horizontal

Open vertical

Closed vertical

Most economical option
Main advantages of GSHP technology

- Mature and reliable
- Energy savings >50% compared to conventional heating/cooling/DHW systems
- Low operation and maintenance cost
- Small payback period
- Environmentally friendly (reduction of CO₂ and NOₓ emissions)
- Operation independent from weather conditions
- Noiseless operation and no visual impact
- Safe operation (no combustion or fuel storage)
GSHP market worldwide

- First installations of GSHP systems in the U.S.A. more than 60 years ago;
- First European countries systematically adopting the technology were Switzerland, Sweden, Germany and Austria;
- During the last 15 years the largest markets are the U.S.A and Canada in America; Germany, Switzerland, Austria, the Scandinavian countries and France in Europe; Japan, South Korea and China in Asia.
Greek GSHP market

- The first pilot residential GSHP vertical closed system in Greece was installed in 1993;
- Remarkable growth in the mid-2000s due to:
  - the increase of oil prices compared to the price of electricity
  - awareness of public and installers of heating/cooling systems
  - introduction of the licensing process for the installation of the systems (Law 3175/2003);
- The development path that the market followed during the mid-2000s peaked around 2010;
- Since then, the sector shows a decline due to:
  - the economic recession
  - the stagnation of the construction industry
  - strong competition by natural gas.

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<tbody>
<tr>
<td>Installed capacity (MWt)</td>
<td>0.4</td>
<td>4</td>
<td>14</td>
<td>50</td>
<td>100</td>
<td>135</td>
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<tr>
<td>Produced energy (TJ/yr)</td>
<td>3.1</td>
<td>39.1</td>
<td>80</td>
<td>270</td>
<td>486</td>
<td>648</td>
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<tr>
<td>Capacity factor</td>
<td>0.25</td>
<td>0.31</td>
<td>0.18</td>
<td>0.17</td>
<td>0.15</td>
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GSHPs diffusion barriers

- Financial
- Technical
- Institutional & legislative
- Awareness

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Geothermal energy & potential

- First mention of “geothermal energy” in the Greek legislation is made in Article 2(1) of Legislative Decree 210/1973 [Government Gazette (GG) 277 A'] "Mining Code", stating that natural steams (geothermal energy sources) are included in mineral resources that are considered mining minerals or ores;

- Definitions of "geothermal potential", "geothermal energy" and "hot waters" are given in Article 1 of Law 1474/1984 (GG 131 A') "Exploitation of geothermal potential".
Law 3175/2003 (GG 207 A')

- "Exploitation of geothermal potential, district heating and other provisions ";
- Article 2(1)(a): "Geothermal potential includes all indigenous natural steams, surface or ground hot waters and heat of geological formations that are over 25 °C. ";
- Article 11(1): "The installation, for own use, of energy systems for space heating/cooling through the exploitation of heat from geological formations and waters (surface or ground), which are not characterized according to the provisions of this law as geothermal potential, is allowed after permission granted to the owner of the property by the prefectural administration. ";
- Article 11(2): "The specific terms, conditions, required documentation and the licensing procedure are set by decision of the Minister of Development. ";
- Shallow geothermal energy, i.e. the type of geothermal energy which GSHPs utilize is not characterized as geothermal potential.
Ministerial Decree Δ9Β,Δ/Φ166/οικ.13068/ΓΔΦΠ2488 of 2009 (GG 1249 B')

- "Installation licenses for own use of energy systems for heating/cooling of spaces through the exploitation of heat from geological formations and waters (surface or ground), which are not characterized as geothermal potential";
- Article 1: The license is a unified license for the implementation/installation of the GSHP system and operation of the licensed installation;
- Article 2: The terms "system", "closed loop system", "open loop system", "productive well" and "reinjection well" are defined;
- Article 3: The license is issued by the Department of Development of the Prefectural Administration to which the property belongs to [responsibility of respective administrative region under Law 3852/2010 (GG 87 A') from now on] , in favor of the owner or usufructuary of the property;
- Article 4: The restrictions that must be taken into consideration regarding the installation and operation of the GSHP system are defined;
- Article 5: The required documentation that must be submitted for the licensing of the GSHP system is specified;
- Article 6: The licensing procedure is described;
- Article 8: Cases that can lead to penalty fees and license recall are mentioned.
Restrictions concern the cases of well drilling or trench opening, the use of surface or ground water and the certification of the pumps and systems;

Regarding the use of surface or ground water the relevant provisions of Law 3199/2003 (GG 280 A') "Water protection and management – Compliance with Directive 2000/60/EC of the European Parliament and Council of October 23, 2000“ and the Ministerial Decree οικ.150559 of 2011 (GG 1440 B') "Procedures, terms and conditions for the permit issuing of existing rights of water use“ have to be taken into account;

Specific restrictions state that in the case of a well drilling, this must be located at least:

- two meters from the property boundaries
- five meters from existing neighboring buildings of different ownership, the boundaries of the expropriated railway zone, main underground pipelines (water, sewerage, etc.) and medium voltage electricity distribution lines
- ten meters from main natural gas pipelines and high voltage electricity distribution lines.
Ministerial Decree Δ9Β,Δ/Φ166/οικ.13068/ΓΔΦΠ2488 of 2009 (GG 1249 B') – Article 6 “Licensing procedure”

Note: Ministerial Decree 1264/2012 (GG 230 B') specifies that in order to issue an installation license for GSHP systems, a €300 payment fee is required.
Other legislation involving use of GSHP systems

- Legislation involving definition of heat pump, definition of SPF values, energy calculations, energy needs and efficiency of buildings.

- Law 3468/2006 (GG 129 A') "Production of electricity from renewable energy sources and cogeneration of electricity and heat of high performance and other provisions";

- Law 3661/2008 (GG 89 A') "Measures for the reduction of energy consumption in buildings and other provisions";

- Law 3851/2010 (GG 85 A') "Acceleration of renewable energy sources development for the resolve of the climate change issue and other provisions on jurisdictional issues of the Ministry of Environment, Energy and Climate Change";

- Ministerial Decree Δ6/Β/οικ.5825 of 2010 (GG 407 B') "Approval of regulations of energy performance of buildings";

- Law 4122/2013 (GG 42 A') "Energy performance of buildings";

- Decree 2013/114/EU.
Legislation concerning the energy-related products (including heat pumps)

- Presidential Decree 7/2011 (GG 14 A'), harmonizes the national legislation with Directive 2009/125/EC "Establishing a framework for the setting of ecodesign requirements for energy-related products";

- Ministerial Decree 12400/1108 of 2011 (GG 2301 B') harmonizes the national legislation with Directive 2010/30/EU concerning "The indication by labeling and standard product information of the consumption of energy and other resources by energy-related products".
Recognition of heat pumps as RES

- Law 4062/2012 (GG 70 A') "Promotion of the use of energy from renewable sources" which harmonizes the national legislation with Directive 2009/28/EC;
- First time that heat pumps, utilizing geothermal, aerothermal or hydrothermal energy, are recognized officially as RES;
- Article 15(2)(b) states that geothermal energy is the energy stored in the form of heat beneath the solid surface of the earth;
- Article 16(3) defines what exactly is calculated as gross final energy consumption from renewable sources for heating and cooling. In the amount of this energy, among others, geothermal energy which is captured by heat pumps is taken into account.
Suggestions for improvement

Based on the principles of environmental protection, hygiene and safety rules, relevant technical parameters and best practices from countries with developed GSHP markets (e.g. Sweden, Germany, France, The Netherlands) the following revisions are proposed:

- **Reduction of the distance of the well from five meters to two meters from:**
  - existing neighboring buildings of different ownership
  - underground main pipelines (water supply, sewage, etc.)
  - medium voltage electricity distribution lines;

- **Reduction of the distance of the well from main natural gas pipelines, from ten meters to five meters;**

- **Clear separation between open and closed GSHP systems regarding their license issuing procedure;**

- **Replacement of license issuing with a simple approval procedure for execution of technical works for the installation of closed loop GSHPs up to a specific capacity (e.g. 20 kW\text{th} and/or 20 kW\text{c}) in all types of applications;**

- **Simplification of the license issuing of the installation of closed loop GSHPs (e.g. higher than 20 kW\text{th} and/or 20 kW\text{c}) in all types of applications;**

- **Provision of the possibility of inclined boreholes drilling.**
Suggestions for improvement II

- Revision of certain definitions concerning GSHPs in order to approach — to the greatest possible extent — the scientific truth;
- Certification procedure of contractors and drillers for the execution of the technical works (based on ANNEX IV of Directive 2009/28/EC);
- Possibility of exploiting surface water through GSHP systems (extraction from the sea, rivers, lakes, etc.) not only for public, commercial (hotels) and industrial uses or for other investments of strategic character, but for private [residential and commercial (apart from hotels)] use as well;
- Provision at a national and local level of an overall development master plan for GSHP systems, i.e. a common database of geothermal heat exchangers, wells and GSHPs with all required specifications;
- Creation of a development plan and database for all underground networks (water, sewage, natural gas, etc.) at a national and local level, which will be connected to the relevant abovementioned database concerning GSHPs.
Conclusion

- The Greek legislative framework for the development of GSHPs has been improved over time mainly due to the relevant European directives and decisions;

- Further improvements and developments are required, as the revision of the existing legislative framework is among the main actions that can facilitate the development and diffusion of GSHP systems in Greece;

- Changes regarding the legislative framework involving permission process for the installation of GSHP systems are recommended, concerning:
  - system definition
  - installation specifications
  - clarification of responsibilities of involved departments
  - technical issues
  - simplification of the process.
Thank you for your attention

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