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GEOTRAINET: Training for ground-source heat pump designers and installers

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Abstract

Further success of Ground Source Heat Pump (GSHP) systems relies on adequate ground coupling installations, designed and constructed with good knowledge and workmanship. Training activities have been started in a number of countries, reacting either to quality concerns of industry or authorities, or to EU-Directive 2009/28/EU which called for such schemes. Coordination and harmonisation on the European level is needed, as well as providing training opportunities for countries without existing schemes. For installation, maintenance, etc. of the heat pump as such, a scheme called EUCERT and operated by the European Heat Pump Association (EHPA) already exists since several years. For the ground side, the association GEOTRAINET became operational in 2014, founded by the European Geothermal Energy Council (EGEC), the European Federation of Geologists (EFG), and a number of national associations.
GEOTRAINET is based on the results of EU-project Geotrainet (2008-2011) and provides the international roof for coordination activities. A European Training Committee (ETC) has been created inside GEOTRAINET, to oversee the revision of the original curricula from the EU-project, and to co-ordinate the national training activities. The ETC is defining the contents of the curricula, the approach how these contents will be transformed into practical training, and how a meaningful, fair and verifiable examination can be ensured. A modular approach seems to be the most appropriate, allowing for different levels of pre-education, various technological sub-sectors, and national requirements. The paper explains the structure of GEOTRAINET and reports on the results achieved by the time of HPC 2017.

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1. Training and certification needs

Quality in installation of ground source heat pumps (GSHP), in particular when drilling for borehole heat exchangers, raised concerns already more than a decade ago [1]. Since 2009, Article 14, 3 of Directive 2009/28/EC obliges the EU member states to provide certification or qualification for installers of those renewable energy technologies that already have a consumer market. The relevant text reads:

> *"Member States shall ensure that certification schemes or equivalent qualification schemes become or are available by 31 December 2012 for installers of small-scale biomass boilers and stoves, solar photovoltaic and solar thermal systems, shallow geothermal systems and heat pumps. Those schemes may take into account existing schemes and structures as appropriate, and shall be based on the criteria laid down in Annex IV. Each Member State shall recognise certification awarded by other Member States in accordance with those criteria."*

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For shallow geothermal installation, Annex IV of the directive does not provide much information. However, the curricula from the Geotrainet project (see below) can serve as a reference here.

Also the relevant industry, as well as national authorities are asking for training and certification of shallow geothermal designers and drillers, in order to guarantee the quality of planning, drilling and installation work, and to guarantee protection of soil and groundwater.

2. The reason for GEOTRAINET

Further success of Shallow Geothermal energy systems relies on adequate ground coupling installations, designed and constructed with good knowledge and workmanship. Opportunities for the necessary education, training, and eventually certification of persons for both the design and the construction (drilling, installation) of the ground side for shallow geothermal systems in the past only existed in a few countries. These countries are those with an early and strong ground source heat pump (GSHP) market. The same skills and technologies for ground coupling are required for underground thermal energy storage (UTES).

The legal requirement for certification in Europe is varying by country. In most cases, there is basically no such requirement for starting activities in shallow geothermal, even in countries with a well-developed training structure for drillers like in Germany, Sweden or the UK. The need for certification usually arises from administrative decisions, as in the following fields:

- Environmental issues, where certificates are made mandatory e.g. by water authorities when granting licenses for individual installations (like in Germany); however, it should be noted that not even all countries ask for such licenses for shallow geothermal drilling at all!
- Energy efficiency issues, where certificates are mandatory to comply with rules for grants or incentives paid to project owners, in order to guarantee the desired efficiency, energy saving and emission reduction the grants are intended for.
- Safety issues, where knowledge of and compliance with work and safety rules can be subject to mandatory certification by the relevant authorities.

Furthermore, it is in the very interest of the industry to have a clearly structured and harmonised training and certification landscape, in order to avoid market drawbacks due to inadequate workmanship, as experienced in some countries in the 1980s [2]. Accordingly, in recent years, several independent training activities have been started in a number of countries, on a national or even regional scale, reacting either to quality concerns of industry or authorities, or to EU-Directive 2009/28/EU.

Currently no transnational training scheme dedicated to the ground part of shallow geothermal systems exists in Europe. Coordination and harmonisation thus is needed on the European level. A task within GEOTRAINET is to keep track of the regional, national and international activities dedicated to shallow geothermal in Europe; alas, at this point of time, no list of some consistency can yet be given. Beside the goal to harmonise the different ongoing activities in the individual countries, there is also the need to help in providing training opportunities for countries without such schemes.

3. The GEOTRAINET-project 2008-2011

The aim of the project Geotrainet (full name: “Geo-Education for a sustainable geothermal heating and cooling market”) was to develop the training of professionals involved in Ground Source Heat Pump installations (GSHP); in practise this also included the related activities in Underground Thermal Energy Storage (UTES) [3].

The project was coordinated by EFG, in cooperation with EGEC; partners were Associations, Research Centers, and Universities (fig. 1). A good geographical coverage of the EU was achieved, and a network of further contacts from Portugal to Estonia and from Norway to Greece filled in the gaps. The project included the creation of an EU-wide certification scheme for both planners and installers of GSHP.

From the different groups of professionals involved in a GSHP or UTES project, Geotrainet is focused on two target groups:

- designers (who undertake feasibility studies including geology)
- drillers (who make the boreholes and insert the tubes).

The actual work was done mainly in 2 expert panels (drillers, designers). A total of 8 courses were held during the lifetime of the project. The courses were complemented and supported by an e-learning platform. Two course textbooks (“manuals”) have been written by a number of authors within the project; the covers are

presented in fig. 2, and pdf-versions are for download from the project website http://geotrainet.eu under "didactic material".



Fig. 1. Geotrainet project partners (2008-2011) and their locations

To illustrate the scope of the GEOTRAINET training for designers and for drillers, summaries of the respective curricula as published in Deliverable 3 and 7 of the project, are given here as tables 1 and 2. The curricula are in a complete re-working currently and will have to be updated and kept in line with technological development and training needs, a task that a specific body shall oversee (the ETC, see below).



Fig. 2. Cover pages of Geotrainet drillers manual (left) and designers manual (right)

4. Status of GEOTRAINET

The results of EU-project Geotrainet (2008-2011) and the work done for transforming these results into a continuous training scheme had been reported in more detail in [4]. Meanwhile, the required legal entity to manage this scheme had been created end of 2013, and started is legal existence in spring 2014. The first courses after the end of the original project in January 2011 have been carried out in 2013 and 2014. In 2015, the European Training Committee (ETC) has been created, to oversee the revision of the curricula and to co-ordinate the national training activities. The European level (fig. 3) thus is fully operational, at least in theory.

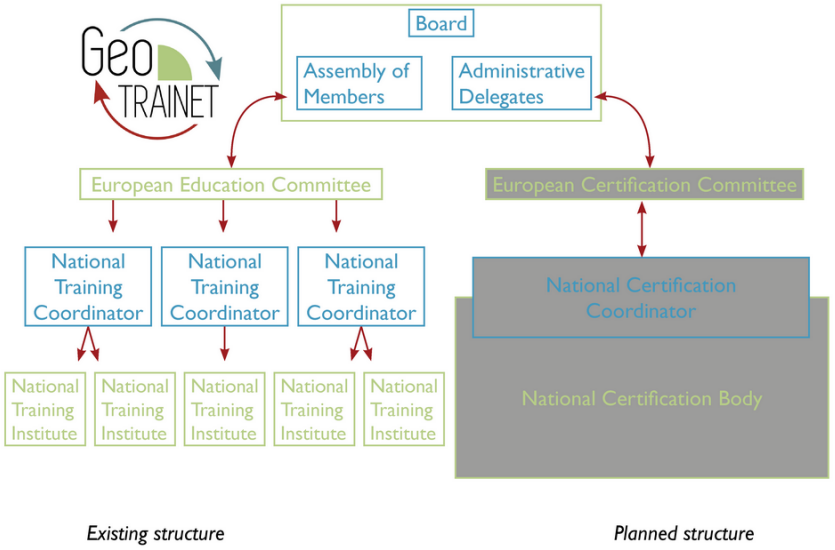


Fig. 1. Structure of Geotrainet; training side is operational in a preliminary status since 2014

The task of the ETC is to define the contents of the curricula, the approach how these contents will be transformed into practical training, and how a meaningful, fair and verifiable examination can be ensured. A modular approach seems to be the most appropriate, allowing for different levels of pre-education, various technological sub-sectors, and national requirements.

The revision of the curricula and didactic material could not be finished yet as planned, due to personnel reasons within the ETC. A new chairman will have to be appointed, and it is hoped that the important work of the ETC will have resumed by the time of IEA HPC 2017. Nevertheless, a short course was prepared for EGC 2016, and delivered on 19.9.2016 in Strasbourg, as update for trainers and other interested persons.

The most active country within Geotrainet currently is Spain, where the national coordinator Geoplat had organised a course already in November 2014 in Madrid, and a follow-up in November 2016 in Barcelona.

More information on the development and new events will be given through the Geotrainet website at: http://geotrainet.eu/

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Table 1. Summary of GEOTRAINET curriculum for designers as in the final project report 2011

Paragraph	Title
A	FUNDAMENTALS AND CONSTRAINTS
A1	Overview of shallow geothermal systems
A2	Limitations
A3	Concept and feasibility studies
B	INTRODUCTION TO DESIGN
B4	Ground heat transfer
B5	Design criteria
B6	Borehole heat exchangers
C	INTEGRATION WITH THE GROUND
C7	Geology
C8	Drilling
C9	Site investigation (ground conditions / licenses and permits)
D	INTEGRATION WITH THE BUILDING
D10	Heat pump technology
D11	Energy load
E	GSHP SYSTEM ALTERNATIVES
E12	Design of borehole heat exchangers (BHE)
E13	BHE design examples
E14	Design of horizontal collectors
F	GSHP INSTALLATION
F15	Installation and grouting
F16	Functional and quality control .
G	REGULATION
G17	European legal situation and standards
G18	Energy efficiency building codes
G19	Environmental issues

Table 2. Summary of GEOTRAINET curriculum for drillers as in the final project report 2011

Paragraph	Title
A	GENERAL TOPICS
A1	Overview of shallow geothermal systems
A2	Limitations
A3	Drilling methods
A4	Test drilling
A5	Environmental concerns
B	SPECIFIC TOPICS FOR CLOSED-LOOP SYSTEMS
B6	Performance of test drillings
B7	Performance of TRT (Thermal Response Test)
B8	Safety aspects
B9	Drilling an installation of BHE
B10	Connection plastic welding
B11	Filling with heat carrier and de-aeration
B12	Functional testing (procedure and documentation)
C	SPECIFIC TOPICS FOR OPEN-LOOP SYSTEMS
C13	Performance of test wells (MWD, geophysical logging, hydrochemical sampling):
C14	Performance of pumping test (data collection)
C15	Production wells – types and construction methods
C16	Tests after completion
C17	Well installations, well house, mains and fittings
C18	Functional tests of the total system
C19	Documentation, required documents
C20	Maintenance instruction and service