Graz 5th October 2018

MOST EASY AND LOW COST GEOTHERMAL SYSTEMS FOR RETROFITTING CIVIL AND HISTORICAL BUILDINGS

Project number: 723916
Project duration: 4 years
Total project budget: 8,141,120.97 €
Project budget financed: 6,841,960.75 €

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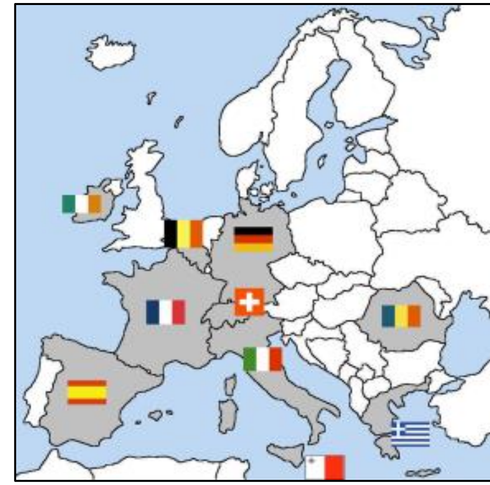
CONSORTIUM

No.	PARTICIPANT ORGANISATION NAME		COUNTRY
1	Consiglio Nazionale delle Ricerche ISAC (Coord) & ITC	CNR	Italy
2	Università degli Studi di Padova – DG&DII	UNIPD	Italy
3	Universidad Politécnica de Valencia	UPV	Spain
4	R.E.D. srl Research and environmental devices	RED	Italy
5	Terra GeoServ Ltd	GEOSERV	Ireland
6	Galletti Belgium NV (HiRef as affiliated partner)	GALLETTI	Belgium
7	FUNDACIÓN TECNALIA RESEARCH AND INNOVATION	TECNALIA	Spain
8	ThyssenKrupp Infrastructure GmbH	TKI	Germany
9	UNESCO Regional Bureau for Science and Culture in Europe	UNESCO	France
10	Friedrich-Alexander Universitaet Erlangen-Nuernberg	FAU	Germany
11	Romanian Geoexchange Society	RGS	Romania
12	Centrefor Renewable Energy Sourcesand Saving	CRES	Greece
13	Hydra srl	HYDRA	Italy
14	UBEG DR ERICH MANDS U MARC SAUER GBR	UBeG	Germany
15	Geo-Green sprl	GEOGREEN	Belgium
16	Pietre Edil srl	PIETRE	Romania
17	Solintel	SOLINTEL	Spain
18	Din l-Art Helwa	DLH	Malta
19	Scuola universitaria professionale della Svizzera italiana	SUPSI	Switzerland



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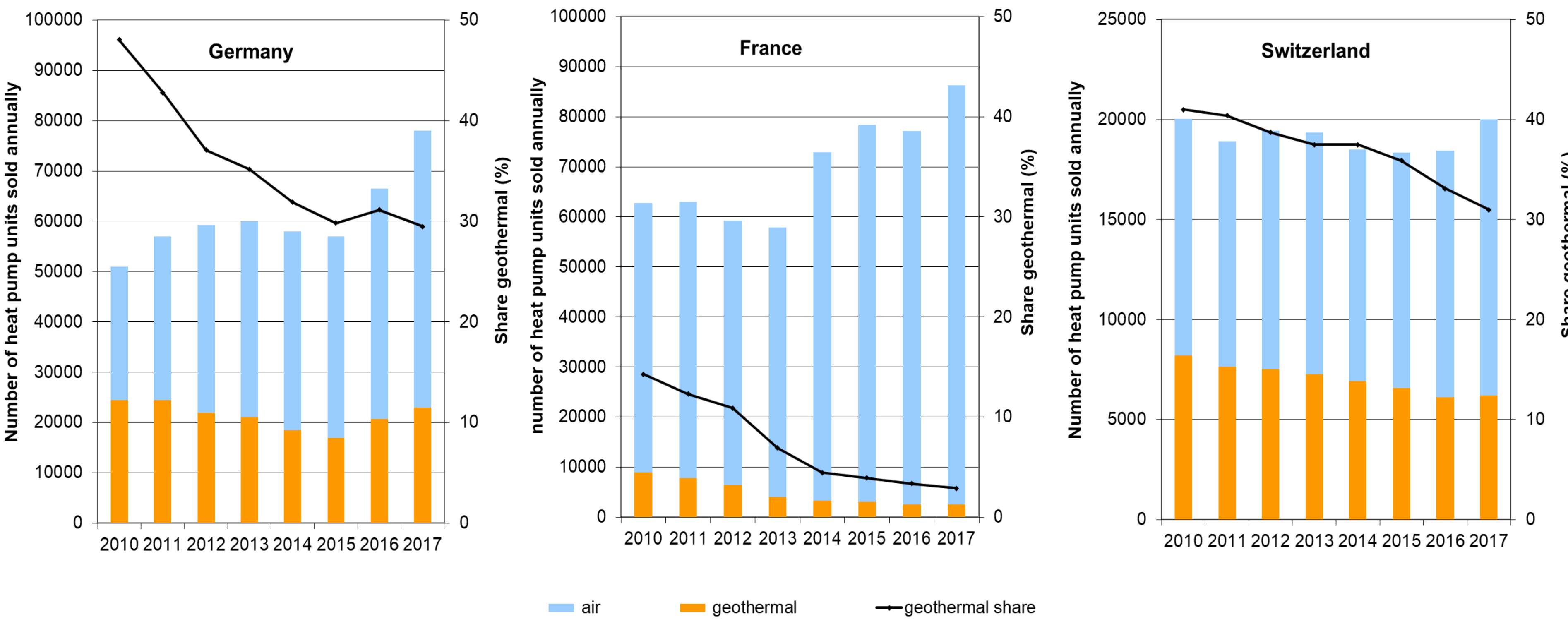
MARKET STATUS

These figures shows the annually unit sold and the share of GHP in the total HP sales for 3 European Countries.



INTEGRATION OF GHP IN EXISTING BUILDINGS

HP PROBLEMS:

- Terminals and distribution often are designed for high temperatures, requiring heating supply
- temperatures in excess of 60-70 °C (this is almost always the case in the historical buildings), more thanmost heat pumps are able to achieve.
- Thermal peak load often is high compared to the average load (for most larger buildings).
- The demand of thermal energy for Domestic Hot Water (DHW) can be high (for residential, not for office applications).
- The existing electric power supply may pose constraints to electrically driven heat pumps.

GHE PROBLEMS:

- Site accessibility and space constraints.
- Existing underground infrastructure (gas and water supply piping, sewers, electrical power cables, etc.).
- Energy and material supply for drilling and BHE installation or for digging and installation of other ground heat exchangers (GHE), waste removal.
- Inconvenience for residents and neighbours due to noise, dirt, vibration, pollution during installation, or
- problems with structural weakness with older buildings.
- Permissions for the ground system.

AIM OF THE PROJECT

Today the **main barriers** in the application of shallow geothermal installations in the built environment are:

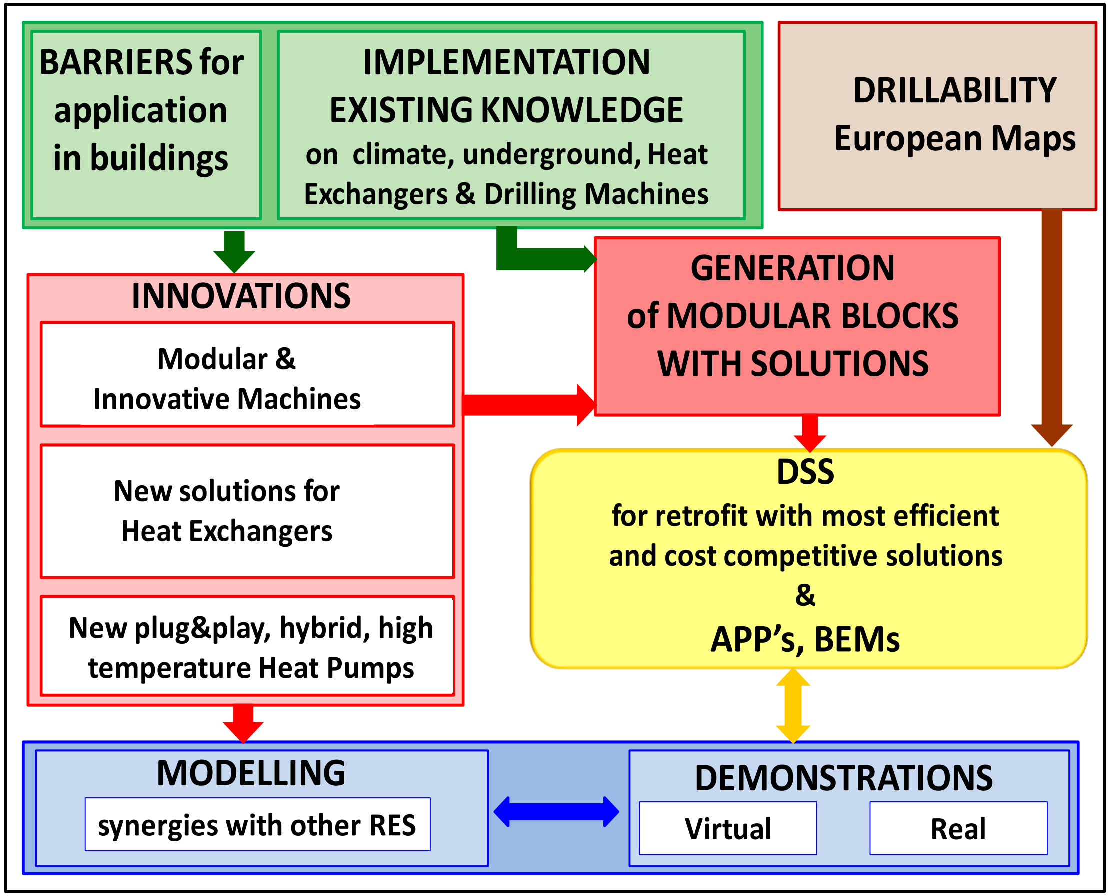
- **higher upfront investments** compared to other conventional solutions;
- **difficulties of cost effective and environmentally friendly drilling**;
- **need to change H&C terminals** in order to **adequate performance from heat pumps**, particularly in **historical buildings**;
- **low levels of awareness, reluctance to risks and/or lack of experience** amongst the designer and operators.

↓

The **main goal of GEO4CIVHIC** is to **develop and demonstrate more easy to install** and **more efficient GSHEs,** using **drilling machine innovations tailored for the built environment** & **developing or adapting HPs** and **other hybrid solutions in combination with RES** for retrofits through a **holistic engineering and controls approach improving the return of investments**.

OBJECTIVES OF THE PROJECT

The GEO4CIVHIC block diagram for the overall technological approach



OBJECTIVES OF THE PROJECT

A) OBJECTIVES of the TECHNICAL BLOCK

Objective 1 – To identify the main gaps and barriers to deploying shallow geothermal systems in the built environment

- To set **the basis for the innovations to be developed, the indicators to measure the results** based on partners expertise and previous projects (THERMOMAP, GROUNDMED, REGEOCITIES, Cheap-GSHPs, GEOTeCH, GEOCOND, TESSE2b, VIGOR…).

- To identify the **main gaps and barriers** in the context of the **specific challenges of retrofitting of buildings.**
  Several building types will be modelled in different climates, with different levels of retrofit defining the applicability of the solutions and costs.

- To develop **new innovative maps of the drillability in EU** and the **scale of drillability** using knowledge (VIGOR, Cheap-GSHPs, GEOTeCH) and expertise of the consortium.

- **To perform guidelines and recommendations** to evaluate the efficiency of the solutions.

OBJECTIVES OF THE PROJECT

A) OBJECTIVES of the TECHNICAL BLOCK (cont)

Objective 2– To improve and develop innovative solutions regarding drilling methodologies and machine components as well as GSHEs for difficult and confined urban settings

- To improve **drilling methodologies** and **drilling machine components** and **GSHEs** **(design and materials used)**. The **drilling machines** need to **be flexible, of reduced dimensions** but still **powerful** to face the installation difficulties in urban settings with limited space availability.

- The **most promising methodology** is the **piling of steel co-axial GSHEs** at depths between 50 – 80 m and **improve** **the co-axial heat exchangers efficiencies** studied in Cheap-GSHPs, GEOTeCH and GEOCOND

Vibration/rotation drilling head mounted on drilling rig

- **The AIM is to progress increasing the drilling speed and extend the application to almost all soils types using a more compact drilling machine able to operate in confined and narrow spaces**

OBJECTIVES OF THE PROJECT

Objective 3 – To develop and demonstrate innovative heat pumps for both low and high temperature terminals suitable for all buildings (including historical) , climates and ground conditions

- To develop **(1) compact and easy to install heat pumps** for deeply retrofitted buildings with small energy load profiles (4 to 6 kW)
  These small capacity **plug and play geothermal heat pumps** will achieve **easy and low cost installations,** will have **reduced dimensions** with an **increased efficiency and flexibility**.

- To build **hybrid pumps (2)** that **combine air and geothermal sources** more efficient in certain climates than single air source or single geothermal source alone

- To improving the Coefficient Of Performance (in the order of 2.5 to 3.0) of the **pump for high temperature terminals (3)** developed in Cheap-GSHPs project useful for historical buildings normally equipped with high temperature terminals

- To build a **two source heat pump (4)** merging those developed in Cheap-GSHPs and GEOTeCH for realities that need low and high temperature

- A special research will study the possibility **to use at least in part natural fluids** with **lower Global Warming effects**, named mid-term low GWP refrigerant

OBJECTIVES OF THE PROJECT

A) OBJECTIVES of the TECHNICAL BLOCK (cont)

Objective 4 – Develop and make available different tools for preliminary feasibility assessment and analysis of different solution sets that will achieve user optimized energy management solutions

- To develop an **Application** for the user (drillers, owners, designers) to complete on site a **preliminary evaluation of the feasibility of the GSHP system in that specific underground**. The smart phone/tablet based application will be based on the drillability maps

- To realise a **repository of solution modules for drilling methodologies, GSHE types, building energy loads, HPs (**from activities of the objectives 1 to 3).
An **improved Cheap-GSHPs DSS including also the retrofit of the building, costs and urban setting** will identify the **technical and economic feasibility** and will **select the appropriate technology**.

- **To maximize the efficiency** other **RES** will be included, **control strategies** will be developed in an integrated **Building Energy Management System (BEMS)** associated to an **user friendly Application for end users to identify the different consumptions**

OBJECTIVES OF THE PROJECT

A) OBJECTIVES of the TECHNICAL BLOCK (cont)

Objective 5 – To demonstrate the project developments and innovation in a cascade at 4 different real case study sites and 12 virtual sites.

❖ To demonstrate the **feasibility** of the GEO4CIVHIC developments and solutions:

- ✓ **2 field test sites** to validate and improve the drilling methodology and machine components.
- ✓ **3 pilot facilities** in existing infrastructure, to check and validate the adapted well point technology, a novel high conductive plastic co-axial GSHE, two very shallow heat exchanger solution, the plug and play heat pump and the optimized controls.

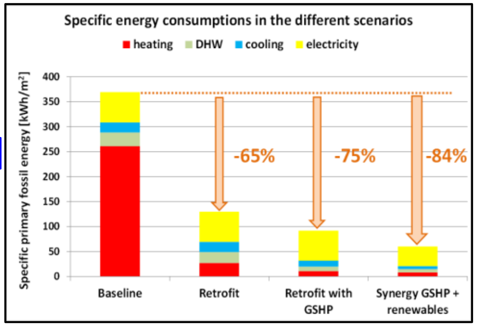
- ✓ **4 real demonstration facilities (1 civil and 3 historical) in different built environments, undergrounds and climatic conditions** will be used to test the shallow geothermal system with the innovative drilling machine, the improved GSHE's and the novel heat pumps

- ✓ **12 "virtual" demonstration facilities" where the DSS and design tools will be applied.**

OBJECTIVES OF THE PROJECT

B) OBJECTIVES of the ECONOMICAL& MARKET BLOCK

Objective 6 – To provide the building retrofit market with a solid economic value basis leading towards a general acceptance of the GSHPs s as a standard renewable energy source in Europe.



- To **reduce and possibly eliminate the investment gap** between conventional and geothermal heating/cooling in retrofitted buildings, **to reduce the costs with 30 %** and to **increase the overall efficiency using the demonstration sites**.
- To develop the **marketing and business plans** by the industries, SME's, architect and engineering studios within the consortium

Objective 7 – To organize intensive teaching, training and dissemination activities to convince stakeholders/users of the value and the performance achieved with the shallow geothermal systems using the GEO4CIVHIC innovations.

- To organise an extensive **training package to make aware and inform European and national associations of architects and engineers**
- To exchange information to built activities, … using the **common geothermal projects cluster**, supported by the EU withthe projects Cheap-GSHPs, GEOTeCH and GEOCOND
- To organise an **"European centers of excellence for shallow geothermal applications in civil and historical buildings"**

OBJECTIVES OF THE PROJECT

C) OBJECTIVES of the ENVIRONMENTAL& STANDARDISATION BLOCK

Objective 8 – To enhance the knowledge on recommendations towards common standards, regulations permits and the awareness of the contribution of the shallow geothermal systems to a more sustainable environment

- To provide **transferrable recommendations** for the **development of common European standards and regulations** for ground source heat pumps in the retrofitting scenarios and historical buildings.
- To **demonstrate the potential** in the context of the reduced environmental impact of the GSHE technologies and the smaller scale drilling plant equipment required for installation.
- **To transfer the knowledge during dedicated and specific training events organized for the local authorities at the case study site locations**

Objective 9 – To enhance the activity inside the committees generating European standards (CEN) for the use of shallow geothermal systems

- To provide recommendations to the **European Committee for Standardization (CEN**) where some partners of the consortium are active at both national and European level

Many thanks