Cheap and efficient application of reliable Ground Source Heat exchangers and Pumps

Cheap GSHPs

Training Workshop
Brussels, 26th April 2019

The European project Horizon 2020 "Cheap and efficient application of reliable Ground Source Heat exchangers and Pumps" Cheap-GSHPs

Project number: 657982
Star: 01/06/2015
Duration: 48 mesi
Coordinator: CNR-ISAC
Website: www.cheap-gshp.eu
Total Budget: 5.804,847,50 €
Founded Budget: 4.844.652,00 €

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RED srl

Dr. Adriana Bernardi

Coordinator

Cheap GSHPs Project

No.	PARTICIPANT ORGANISATION NAME	SHORT NAME	COUNTRY
1	Consiglio Nazionale delle Ricerche	CNR	IT
2	UNIPD	UNIPD	IT
3	Fundacion Tecnalia Research & Innovation	TECNALIA	ES
4	ENERGESIS	ENERGESIS	ES
5	Research and Environmental Devices SRL	RED	IT
6	Galletti Belgium NV	GALLETTI	BE
7	Romanian Geoexchange Society	RGS	RO
8	ANER SERVICIOS INFORMATICOS	ANER	ES
9	REHAU AG&Co	REHAU	DE
10	Friedrich-Alexander Universitaet Erlangen-Nuernberg	FAU	DE
11	CENTRE FOR RENEWABLE ENERGY SOURCES AND SAVING	CRES	GR
12	Scuola univ. professionale della Svizzera italiana (SUPSI)	SUPSI	CH
13	SLR Environmental Consulting (Ireland) Ltd.	SLR	IR
14	Hydrahammer	HYDRA	IT
15	Geo-Green sprl	GEO-GREEN	BE
16	UNESCO	UNESCO	FR
17	PIETRE Edil	PIETRE	RO

General objectives

- To **reduce total cost of ownership** of shallow geothermal systems by 20-30% compared to actual state of art
- To **increase** the deployment of this technology by 10% versus current estimates
- To **contribute to the environment** with an additional CO_2 emission reduction of 1800 T/y and **to increase the safety**
- To **demonstrate the new technologies in** civil and historical buildings (6 real sites and 10 virtual cases)

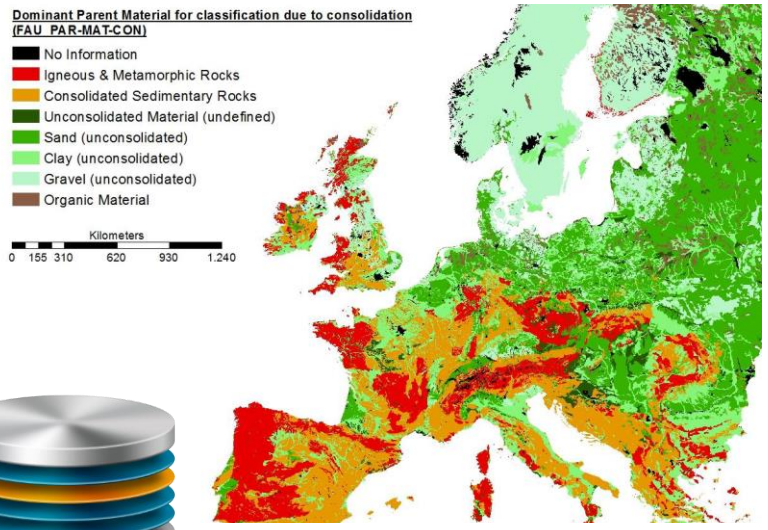
Project approach

- **Thematic geothermal mapping at local scale** for better planning of geothermal systems
- **Drilling machine developments** combined with **new Ground Source Heat Exchanger (GSHE) designs of co-axial and heat basket type** to reduce installation time, increase yield, increase safety, reduce permit needs
- **Design tools and Decision Support System (DSS)** for optimum selection, design and implementation of complete systems across different applications and soil conditions
- **Novel heat pump with improved performance at higher temperatures** to avoid having to change heating terminals in retrofitting of existing/historical buildings and to increase efficiency

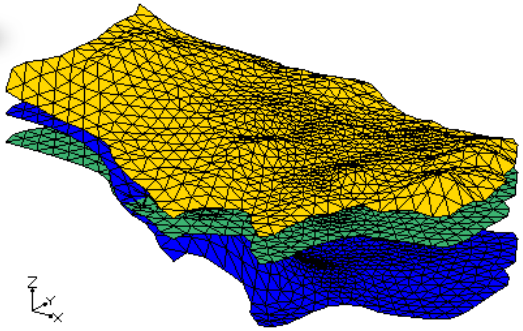
Geological Database

The geological database supports the software tool and the DSS for every EU location. It provides different information according to the user level of local geological knowledge.

The user only knows the coordinates	General database, based on FAU_PAR-MAT-CON	FAU_PAR-MAT-CON
The user knows the stratigraphy sequence	Thermal properties according to the stratigraphy	Geological db from analysis and literature
The user knows the stratigraphy and thermal properties	Thermal properties according to the user inputs	Only stratigraphy sequences input needed



New analysis method for gravel



Developments in drilling and heat exchangers

❖ Helicoidal GSHE and drilling machine developments

- ❑ Define the modifications to the drilling machine and tools drilling
- ❑ To develop machine capable of drilling reduced diameter holes at larger depths using the dry auger method
- ❑ Simulate, develop and produce heat basket type of GSHE for these boreholes

❖ Coaxial GSHE and installation machine development

- ❑ To develop, test and build new machine tools (drilling head, drill bit) and enhance the piling methodology
- ❑ To optimise the GSHE's design
- ❑ To study alternative materials and corrosion protection
- ❑ To study thermally enhancing fluids to be injected during the drilling process

Heat pump devlopments

- Develop a heat pump at high temperature with the environmental friendly CO_2 refrigerant and nanoparticles enhancing the geothermal fluid
- Evaluate the application of the new HP in Historical Buildings with high temperature terminals
- Scope:
  - ✓ To obtain higher COP
  - ✓ To reduce the environmental impact

Development of tools as holistic engineering approach

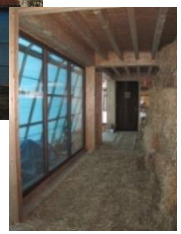
- To develop
  - DSS (decision Support System) engine for the assessment and selection of the safest and cost-optimal technologies for each geothermal installation
  - Information data models for a structured organization and generation of input data
  - user friendly web platform that gives access to the developed system and allows the 2D/3D visualization of data.
- To develop a freeware numerical model (Carm) for a dynamic simulation of GSHE and GSHP systems
- To define the configuration of shallow geothermal systems in combination with other renewable systems

Demonstrations

- To demonstrate the developed technology at 6 sites
- To evaluate
  - ✓ energy output of developed helicoidal and coaxial GHEs in different climatic conditions
  - ✓ high temperature HP performance: energy output, efficiency, reliability, temperature levels
- To predict performance of developed systems in the long run by computer simulations: 10 virtual cases
- To Compare with standard technology

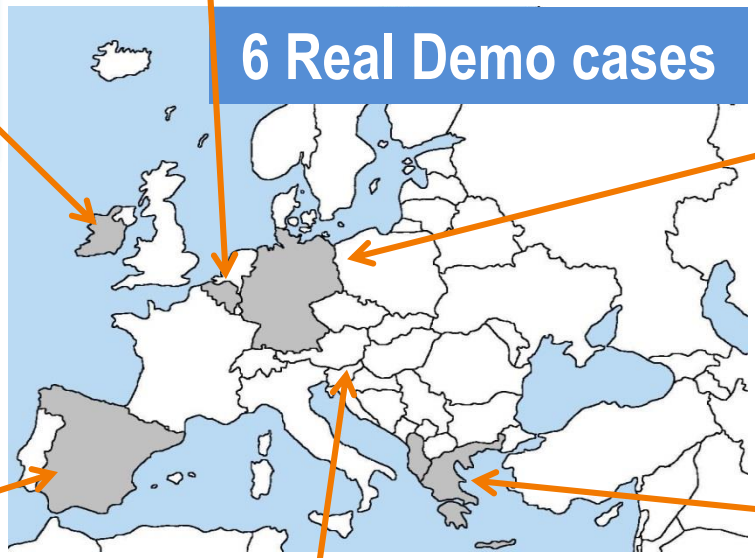
Cheap GSHPs Project

Cheap GSHPs



Private building, Putte - Mechelen, Belgium

The National Ecology Centre, Laytown – Co. Meath, Ireland



6 Real Demo cases

Demo room, Erlangen - Eltersdorf, Germany

Universidad Politécnica de Valencia, Spain

Technical Museum of Zagreb

Bioclimatic office building of CRES, Pikermi, Greece

Retrofit residenziale Glencree, Wicklow, Irlanda

Museo della rivoluzione, Sarajevo, Bosnia ed Erzegovina

Uffici doganali a Brogeda-Chiasso (Svizzera)

Bucarest, Romania , Slanic Street, no.2, 3rd sector.

Ballyoran Library, Dublino, Irlanda

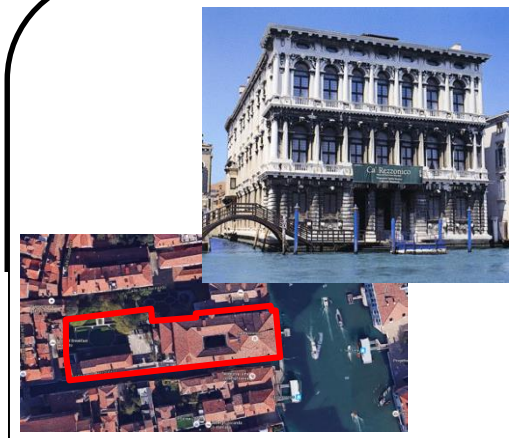
8 Virtual Demo cases buildings

Grupo Ortiz Office Buildings, Vallecas – Madrid, Spagna

Monastero serbo ortodosso di Bodjani, Village Bodjani, Serbia

Sede di Manens-Tifs S.p.A. Padova, Italia

2 Virtual Demo cases districts

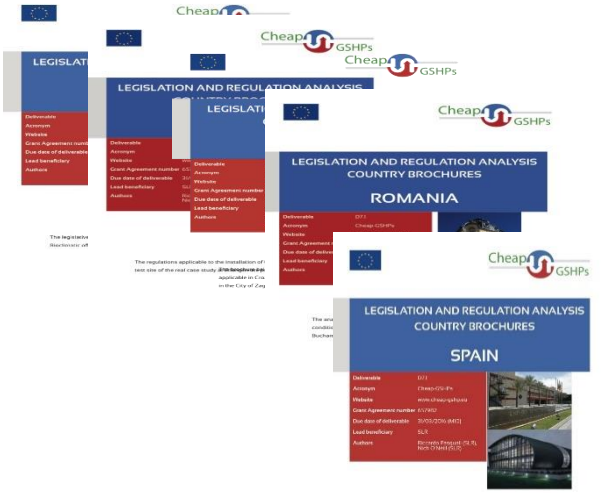


Complesso di Ca' Rezzonico, Venezia, Italia

Complesso di Santa Croce, Firenze, Italia

Environmental Impact, Risk, Standards & Regulations

- Legislative and Regulatory Impact Analysis for the deployments at each demo-site
- Recommendations to accomodate the new developments in standards and regulations
- Environmental Impact Assessment at case study locations
- LCA analysis and evaluation of the CO2 reduction



Strengths	SCORE	Weaknesses	SCORE
Constant source of energy independent of climate conditions	2,7	High investment cost	2,7
Ensure a steady performance throughout the year	2,6	Not well established regulatory procedures	2,7
Renewable energy source	2,4	Medium-high payback period	2,6
Can be installed almost everywhere	2,4	Poorly known renewable energy	2,6
Energy-efficient and low-emission system	2,4	Lack of design's standars	2,4
Covers heating/cooling/DHW needs (triple action system)	2,3	Difficult to integrate in building refurbishment	2,4
Very low visual impact	2,3	For proper operation, it's essential a good design	2,3
Low maintenance cost	2,1	The responsibility about the right operation of the installation is not defined properly	1,9
High profitability in the long term	2,0	Considered a complex installation for the most of technicians	1,9
Long useful life	2,0	Large variety of professions involved	1,7
Low noise level	1,9	Environmental consideration into projects	1,6
		Lack of visibility of the installation for the public	1,6
Opportunities	**SCORE**	**Threats**	**SCORE**
Development of technologies that will reduce the investments cost	2,7	Unclear legislation and regulation framework	2,6
Favourable policies for energy saving in buildings	2,6	Variety of energy efficiency alternatives on HVAC systems	2,6
New development of standards, regulations and legislation	2,4	Lack of quality control of the installations	2,4
Development of new technologies compatible with existing HVAC systems	2,3	Grants for conventional technologies (gas, fuel)	2,3
Large unexploited potential	2,3	Lack of training for the professionals	2,3
Contributes to both RES and EE targets	2,3	People unaccustomed to use public financing mechanisms	2,0
Growing awareness among the professionals to ensure quality	2,1	Few specialized companies in the sector	2,0
Local availability of additional resource for the local economy	2,0	Subsidy cuts	1,9
Financing mechanisms offered by the public sector	2,0	Falls of the market of new housing	1,9
Public-private partnerships to implement installations	1,4	Grants for other alternative technologies	1,7

Table 7 –SWOT Analysis of shallow geothermal systems

Exploitation and market deployment

- To analyze market penetration, potential, identifying barriers and business opportunities
- To make a SWOT analysis to support the exploitation of the new products and services
- To define a strategy with respect to the IPR

Thanks for your attention

Ir. Luc Pockelé
RED srl

http://cheap-gshp.eu/

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Enkele woorden over het Brugeo project

Pierre GERARD

Université Libre de Bruxelles – Service BATir – piergera@ulb.ac.be

L'Europe et la Région investissent dans votre avenir

REGION DE BRUXELLES-CAPITALE

BRUXELLES FEDER EFRO BRUSSEL

Union Européenne
Fonds Européen de Développement Régional

FEDER/EFRO programma 2014-2020

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Doelstellingen van de EFRO oproep voor projecten

- Versterken van de sociale en economische cohesie binnen de Europese Unie
- Terugdringen van onevenwichtigheden tussen de regio's

Specifieke doelstellingen EFRO in het Br[illegible]

- Ondersteunen van socio-economische ont[illegible] locale werkgelegenheid kan zorgen
- Ondersteunen van innovatie en activiteiter[illegible] Brusselse uitdagingen
- De economie herlokaliseren ten bate van d[illegible]
- Bevorderen van korte ketens
- Verbeteren van de leefomstandigheden va[illegible]

Bevorderen van geothermie in Brussel:

- Hernieuwbare energie voor verwarmen en koelen
- Korte ketens
- Steun aan KMO's (architecten, ingenieursbureaus, installeerders)
- Lokale werkgelegenheid

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REGION DE BRUXELLES-CAPITALE

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FEDER/EFRO programma 2014-2020

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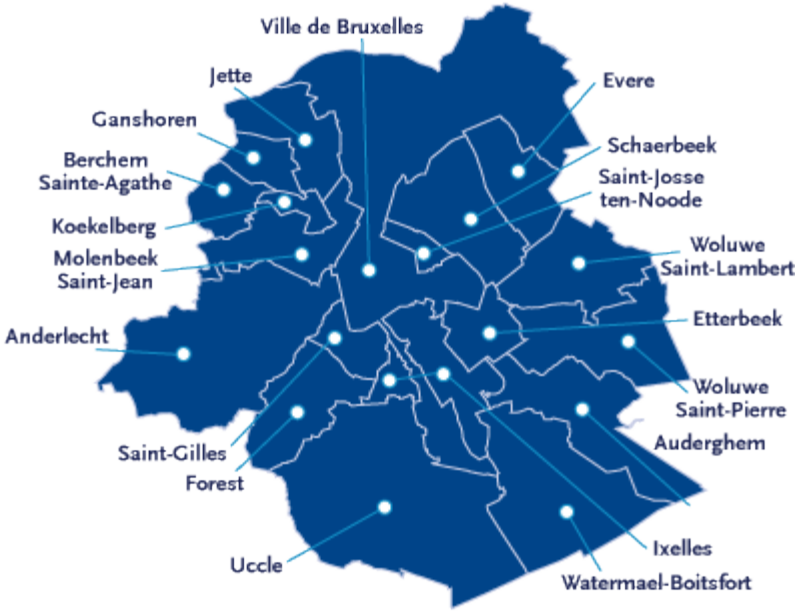
Bevorderen van geothermie in Brussel?

- Welke types van geothermie in Brussel?
- Evaluatie van de huidige situatie in Brussel
- Welke bijdragen van een onderzoeksproject ? Welk hefboomeffect van een onderzoeksproject?



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Welke types van geothermie in Brussel?

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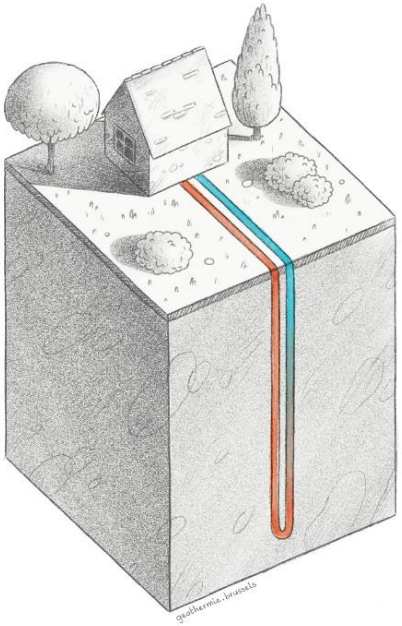
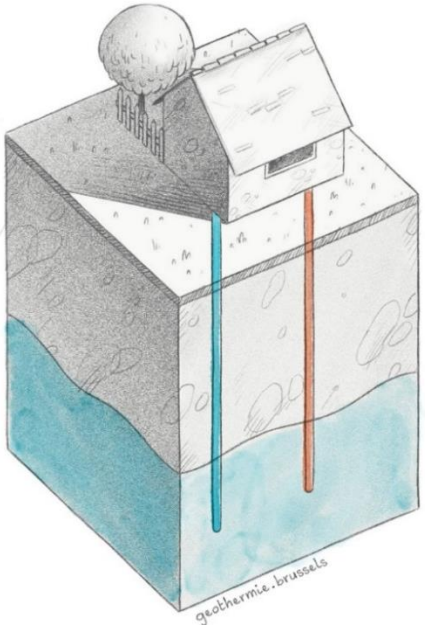
Gesloten systeem

Boorgat met U-vormige of coaxiale warmtewisselaar waarin een vloeistof circuleert



Open systeem



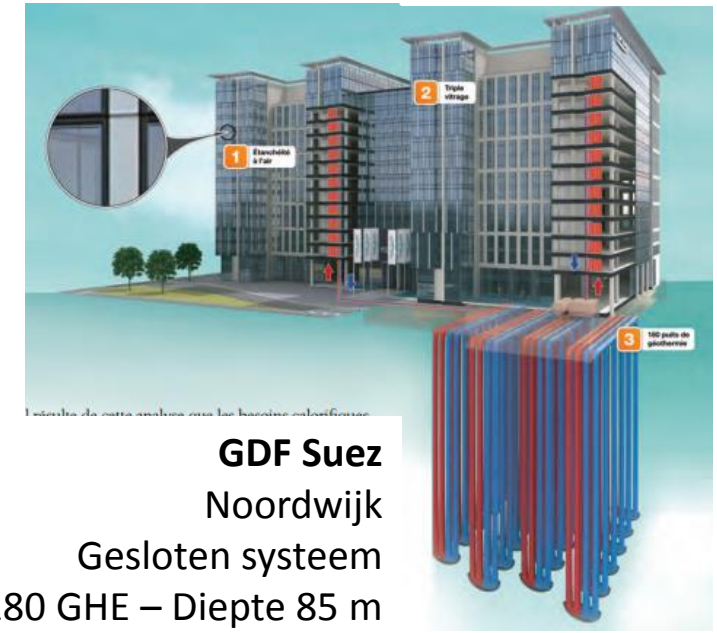
Twee putten (pompen/injectie in een aquifer)
→ **Grondwater warmtepomp**

Belangrijkste voordelen

- Verwarmen en koelen met één installatie
- Hernieuwbare, locale en flexibele bron van energie
- Mogelijkheid van energie-stockage
- Continue en oneindige warmtebron
- Hoge COP (≈ 4) vergeleken met lucht warmtepomp

Bestaande installaties in Brussel

Hôpital Chirec
Delta
Gesloten systeem
176 GHE – Diepte 90 m



GDF Suez
Noordwijk
Gesloten systeem
180 GHE – Diepte 85 m

Bât Wilfried Martens
Belliardstraat
Gesloten systeem
33 GHE – Diepte 240 m

Bruxelles Environnement
Tour et Taxi
Open systeem
4 pair of wells – Diepte 80 m

Bestaande installaties in Brussel

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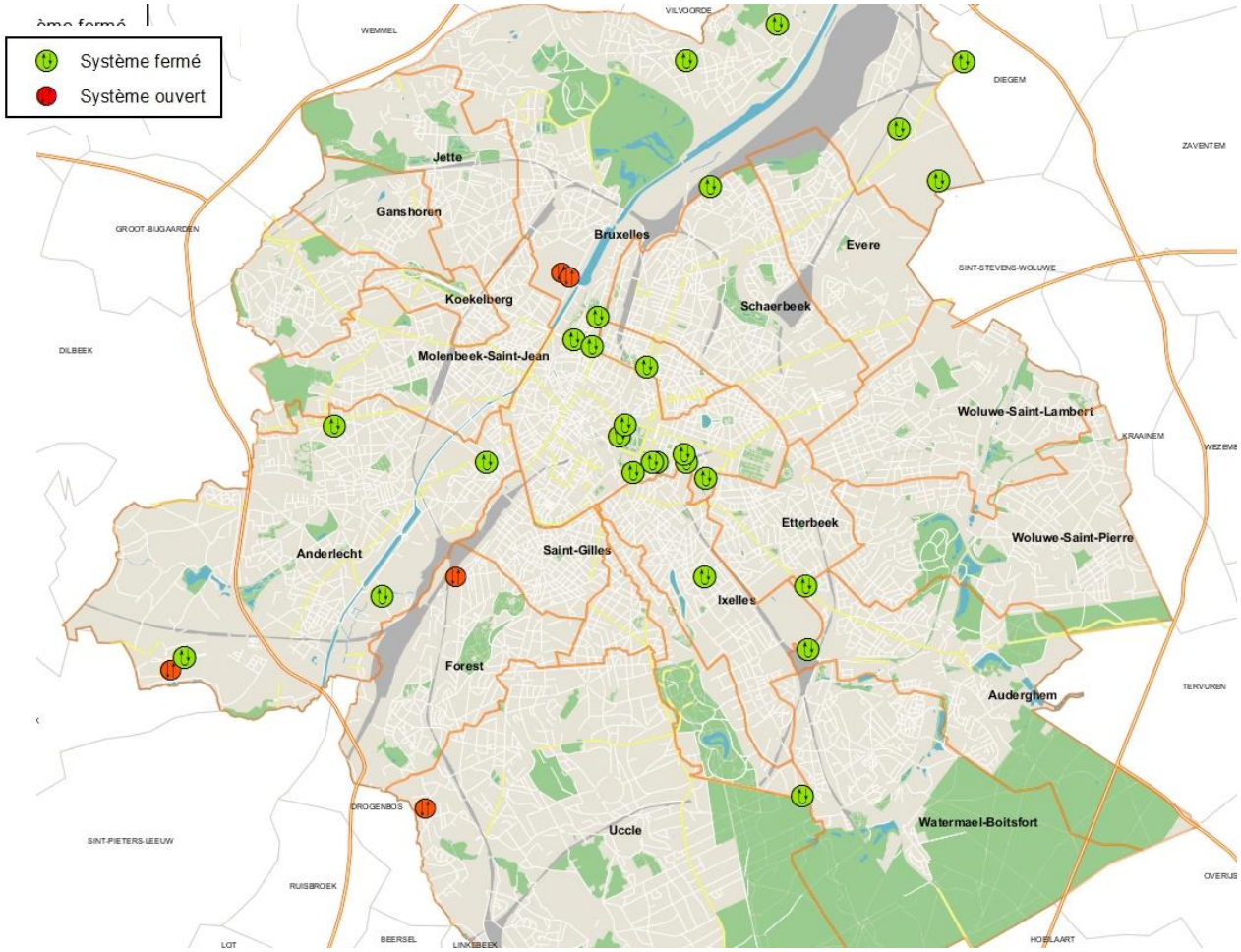
- Onvolledige inventaris van installaties (geen verplichte vergunning of registratie voor kleinschalige projecten)

- +/- 50 gesloten systemen
- 4 open systemen



Non actualized version

Evaluatie van de huidige situatie

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- **De ontwikkeling op het vlak van het gebruik van geothermie is beperkt in Brussel** vergeleken met omliggende regios (Vlaanderen, Frankrijk, Duitsland, Nederland, etc.)

- Vaak gebruikt in grote gebouwen als technologische showcase

- **Barrières**:
  - Gebrek aan **visibiliteit** van de technologie
  - **Gebrek aan kennis** bij architecten vergeleken met andere duurzame energietechnieken
  - **Stedelijke context**
  - **Gebrek aan ontwerptools** voor kleinschalige projecten
  - **Gebrek aan tools** om het financieel rendement en terugverdientijd te berekenen voor grootschalige projecten

Bevorderen van geothermie in Brussel

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- **Brugeo project – Europees Fonds voor Regionale Ontwikkeling (ERDF-FEDER-EFRO) 2014-2020 – Brussels Hoofdstedelijk Gewest**

Université Libre de Bruxelles
Service BATir
Profs. P. Gerard en B. Francois

Vrije Universiteit Brussel
Department of Hydrology and Hydraulic Engineering
Prof. M. Huysmans

Royal Belgian Institute of Natural Sciences
Geological Survey of Belgium
E. Petitclerc

Bruxelles-Environnement/Leefmilieu Brussel
Afdeling Vergunningen & Partnerschappen en Afdeling Water
M. Agniel, L. Gaudaré en R. Desgain

Belgian Building Research Institute
Department Geotechnical Engineering
N. Huybrechts en G. Van Lysebetten

Bevorderen van geothermie in Brussel

- **Brugeo project – Europees Fonds voor Regionale Ontwikkeling (ERDF-FEDER-EFRO) 2014-2020 – Brussels Hoofdstedelijk Gewest**
  - **Methodologie**
    - **Bestaande gegevens over de ondergrond samenbrengen**

      Beschikbare gegevens van de ondergrond in het Brussels Hoofdstedelijk Gewest
    - Verzamelen van data over de ondergrond, met een focus op de sokkel
    - Karteren van het geothermisch potentieel van Brussel
    - Herzien van de huidige wetgeving
    - Informatie en communicatie naar verschillende doelgroepen

Bevorderen van geothermie in Brussel

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    - **Verzamelen van data over de ondergrond, met een focus op de sokkel**

      In-situ proeven in Brussel – Naar een betere karakterisering van de Brusselse ondergrond

    - Karteren van het geothermisch potentieel van Brussel
    - Herzien van de huidige wetgeving
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Bevorderen van geothermie in Brussel

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    - Verzamelen van data over de ondergrond, met een focus op de sokkel
    - **Karteren van het geothermisch potentieel van Brussel**

      Cartografie van het geothermische potentieel en screeningstool voor geothermische installaties in Brussel – Bijdragen van het Brugeo-project

    - Herzien van de huidige wetgeving
    - Informatie en communicatie naar verschillende doelgroepen

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    - **Herzien van de huidige wetgeving**

      From 1st April 2019: new rules for open systems - Not presented today

    - Informatie en communicatie naar verschillende doelgroepen

Bevorderen van geothermie in Brussel

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http://geothermie.brussels

Bevorderen van geothermie in Brussel

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- **Brugeo project – Europees Fonds voor Regionale Ontwikkeling (ERDF-FEDER-EFRO) 2014-2020 – Brussels Hoofdstedelijk Gewest**
  - Project in uitvoering
  - Enkel voorlopige resultaten