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Deliverable D8.10

Report on activities of clustering and collaboration with other EU H2020 projects on shallow geothermal

WP8

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Publishable summary

The deliverable 8.10 “Report on activities of clustering and collaboration with other EU H2020 projects on shallow geothermal” is a public deliverable delivered in the context of WP8, Task 8.5 – Activities of clustering and collaboration with other EU H2020 projects on shallow geothermal, describes activities and meetings where key partners of other EU projects on geothermal were met during the development of GEO4CIVHIC.

The joint dissemination activities with other European projects during the development of the GEO4CIVHIC project are described as demonstrating extensive activity in the European context.

Abbreviations

GEO4CIVHIC	Most Easy, Efficient and Low Cost Geothermal Systems for Retrofitting Civil and Historical Buildings
EU	European Union
EC	European Commission
BHE	Borehole Heat Exchanger
GSHP	Ground Source Heat Pump
HP	Heat Pump

Introduction

The deliverable 8.10 “*Report on activities of clustering and collaboration with other EU H2020 projects on shallow geothermal*” is a public deliverable delivered in the context of WP8, Task 8.5 – Activities of clustering and collaboration with other EU H2020 projects on shallow geothermal.

Activities organised by INEA/CINEA where other European projects active in renewable Energy and in particular in shallow geothermal energy, were invited and other activities where key partners from other European geothermal projects were met during the development of GEO4CIVHIC are described.

Unfortunately, the COVID-19 pandemic crisis heavily influenced the course of the discussed activities.

The joint dissemination activities and useful meetings with other European projects during the development of the GEO4CIVHIC project are described as a demonstration of the extensive activity carried out in the European context at meetings with other European projects where there was an exchange of information and discussion of cooperation possibilities.

1 Activities of Clustering organised by INEA/CINEA

During the development of the project, three dissemination activities were organised by INEA/CINEA, in collaboration with partners from other European projects on the topic of shallow geothermal energy. The aim is to provide an opportunity to exchange information between the different projects with a view to possible collaborations and activities to help make renewable energies, including geothermal energy, a viable and cost-competitive source of energy for heating and cooling.

The aim was to find a common vision to increase the knowledge and also the commercial attractiveness of geothermal and other renewable energy sources for heating and cooling, to broaden awareness in particular of the shallow geothermal field and various technologies, and thus increase the penetration of renewable energy sources including geothermal.

The three activities were organised by INEA/CINEA, the first hosted at INEA headquarters, the other two at two workshops in Berlin and Reykjavik. Almost all the Commission-funded shallow geothermal projects were present on these occasions.

These three relevant moments are summarised below.

1.1 INEA H2020 workshop, Brussels (Belgium), October 8th, 2019

The 1st clustering meeting on H2020 projects in the area of renewables in buildings was organised in Brussels on the 8th of October 2019 by INEA (Innovation and Networks Executive Agency).

The first workshop joined together a certain number of H2020 research and innovation projects, with the purpose of creating synergies between all projects involved in renewable energy applied to Building.

The involved projects that accepted to be present were:

Be-Smart, BIPVBOOST, Pvadapt, PVSITES, RES4BUILD, SolBio-Rev, IDEAS, RECOGNITION, TRI-HP, GeoFit, GEO4CIVHIC, SWS-Heating, MakingCities, CityxChange, Hybrid-BioVGE

Prior to the meeting, INEA invited the coordinators to fill in a questionnaire including hyperlinks to the Cordis page of the other projects, useful for the preparation of the meeting.

The coordinator of Geo4CIVHIC sent the following completed questionnaire to the Commission:

Questionnaire for RES in Buildings Clustering event – 8th October 2019		
Please answer the questions with as many concrete, specific details as possible. This will allow us to prepare for the meeting in advance and better define the group sessions.		
1. Project Acronym: GEO4CIVHIC		
2. Project specific questions in table		
Project name/ hyperlink to project information	Are you aware of this project? What would you like to learn more about?	What can you offer to the other project? Do you see specific areas for collaboration?
Be-Smart	No, but it could be very interesting to know more about the capacities and costs of BIPV to reduce electricity costs for geothermal applications and because both Geo4CIVHIC and Be-Smart contribute to the complementary use of renewable energy sources, reduce CO2 emissions and increase environmental sustainability	Synergies and collaboration toward the same targets of sustainability and NEZB. The combination of Geothermal and PV technologies is a big opportunity to reduce the payback time of investments and raise the use of renewable energy in heating and cooling of buildings
BIPVBOOST	Yes. I'd like to be informed about the innovation progress and dissemination activities. BIPV can be very complementary with shallow geothermal plants with heat pumps	Synergies could be present between GEO4CIVHIC technologies and their association with PV technologies. Collaboration could lead to a combination of the 2 RES and raise the advantages for both.
PVAdapt	Yes. I'd like to be informed about the innovation progress and dissemination activities. BIPV can be very complementary with shallow geothermal plants with heat pumps	Synergies could be present between GEO4CIVHIC technologies and their association with PV technologies. Collaboration could lead to a combination of the 2 RES and raise the advantages for both.
PVSITES	Yes. I'd like to be informed about the innovation progress and dissemination	Synergies could be present between GEO4CIVHIC technologies and their
	with shallow geothermal plants with heat pumps	Collaboration could bring to an implementation of use of the 2 RES and raise the advantages for both.
RES4BUILD	No, but it could be interesting to know more because both Geo4CIVHIC and RE4BUILD contribute to the reduce CO2 and environmental sustainability	The analyses performed on LCA and impact on the environment inside GEO4CIVHIC could be merged with the results performed in this project. Moreover both are developing new Heat Pumps to reach a bigger market and reduce the pollution and the use of non-renewable sources
SolBio-Rev	Few. I'd like to know more being very near to the targets of GEO4CIVHIC	The synergy could be possible to associate different RES.
IDEAS	NO. I'd need to know more...	GEO4CIVHIC doesn't develop these special important aspects. Synergies could be important for the awareness of GEO4CIVHIC
RE-COGNITION	NO. I'd need to know more... It could be useful to overcome the limited awareness of geothermal energy	The knowledge of the barriers but not a lot on social point of view. The storage aspects could be very useful to combine with geothermal plants
TRI-HP	NO. I'd need to know more... It could be useful to overcome the low awareness of GEO4CIVHIC	The knowledge of the barriers but not a lot on social point of view. Applying geothermal to the absorption heat pumps could present additional synergies.
GeoFit	Yes. I'd like to be informed about the innovative progress and dissemination	It is possible to recognise a big area of collaboration between the 2 projects. GEO4CIVHIC is developing technologies and applications in the same field that needs to be more disseminate and furnish more awareness to the European Stakeholders
GEO4CIVHIC	/	/
SWS-Heating	NO. I'd need to know more...	It would be interesting to see if the storage solutions can be integrated with GEO4COVHIC
MAKING-CITY	Yes. I'd like to be informed about the innovative progress and dissemination	GEO4CIVHIC could furnish its solutions to be implemented in those offered in the project for higher and more complete smart cities applications
CityxChange	Yes. I'd like to be informed about the innovative progress and dissemination	GEO4CIVHIC could furnish its solutions to be implemented in those offered in the project for higher and more complete smart cities applications
Hybrid-BioVGE	No. I'd like to be informed about the innovative progress	Synergies could be present between GEO4CIVHIC technologies and their association with solar technologies. Collaboration could bring to an implementation of use of the 2 RES and rise the advantages for both.

Figure 1 – Questionnaire



European Commission


H2020 RES in Buildings Clustering meeting

Innovation and Networks Executive Agency (INEA)
Chaussée de Wavre 910, Brussels
Room: 041

8th October 2019

AGENDA

09.00-09.20	Arrival and registration
09.20-09.30	Welcome and introduction INEA
09.30-10.40	Project Presentations I (coordinators) <ol style="list-style-type: none"> 1. PVSITES 2. BIPVBOOST 3. Be-Smart 4. PVadapt 5. Hybrid-BioVGE 6. GeoFit 7. GEO4CIVHIC 8. MakingCities 9. CityxChange <p>5 minutes per project (45 minutes) + Q&A (25 minutes)</p>
10.40 – 11.00	Coffee Break
11.00-11.45	Project Presentations II (RIA coordinators) <ol style="list-style-type: none"> 1. SW5-Heating 2. TRI-HP 3. RES4BUILD 4. Ideas 5. Recognition 6. SolBioRev <p>5 minutes per project (30 minutes) + Q&A (15 minutes)</p>
11.45 - 12.25	Policy presentations (10 minutes each) + Q&A <ul style="list-style-type: none"> • Set Plan and Research priorities – European Commission DG RTD • RES Directive - European Commission DG ENER • Energy Efficiency in Buildings projects overview - EA5ME




European Commission

12.25 -13.15	Lunch break
13.15 – 13.30	Introduction to the afternoon session – INEA
13.30 – 15.00	Group or bilateral discussions This session is not structured or animated by INEA staff. Based on prior preparation (upon completion of questionnaire) and the information given in the morning session, the coordinators are expected to discuss in smaller groups or bilaterally to find areas of common interest and possible collaboration.
15.00 – 15.15	Coffee Break
15.15 – 16.00	Presentation of discussions in plenary
16.00 - 16.30	Wrap up and conclusions (INEA)

After the workshop Project Officers will be available for discussion on any grant implementation issues of the individual projects.

Figure 2 – Agenda for the INEA H2020 workshop

The aim of the meeting was to find areas of cooperation between projects. The event covered a variety of technological topics (building-integrated photovoltaics, other RES in buildings, heating and cooling, including shallow geothermal energy).

A second objective was to identify specific actions that projects could undertake jointly. The event provided an opportunity for project coordinators to meet each other, thus creating a network.

On that occasion, after a brief presentation of the specific projects, some common topics between the different projects were discussed during the meeting. Then, common activities were defined in some specific fields, not only in the direction of the dissemination of results.

Finally, sub-groups with closer objectives were created and a leader was identified.

GEO4CIVHIC was included in the subgroup called "Building Energy Horizons (BE-Horizons)"

The H2020 projects involved in this sub-group were: Hybrid-BioVGE, GEO4CIVHIC, Making city, SWS-Heating, Tri-HP, Res4Build, Ideas, Recognition, SolBioRev.

Cooperations in different fields were established in particular in:

- ✓ Data management
- ✓ Technical Cooperation (Automation, Control, Flexibility, Hybridization)
- ✓ Dissemination common material (Workshops, Social Media, Internet sites, Dissemination partners in contact, Common Dissemination material)



Figure 3 - Picture related to the formation of the collaboration group Be-Horizon

It was planned that future contacts would take place at other workshops or interactive activities. Activities started in the following months, but unfortunately the Covid-19 crisis interrupted all activities.

1.2 2nd Clustering organised by INEA: H2020 projects on Geothermal projects in occasion of WGC 2020- Reykjavik, April 2020/ 25th October 2021

A joint booth in occasion of World Geothermal Congress in April 2020, Iceland (WGC2020 - <https://www.wgc2020.com/>) was organised by INEA (actually CINEA).

This event was another very important opportunity to meet the partners of major European geothermal projects and to give the group high visibility and spread the European activities around the world, where the importance of H2020 for advancing the geothermal sector is often not sufficiently appreciated.

CINEA set up a large 'Horizon 2020' stand that will bring together all H2020 R&I projects and the ERANET (GEOTHERMICA) co-funding project to increase the visibility of H2020.

During the congress a parallel session on H2020 was organised and some high-level speakers from the Commission were present.

The projects that accepted to participate were:

DEEPEGS, DESTRESS, GECO, GEOSmart, MEET, CROWD THERMAL, Geo-Drill, GEMex, REFLECT, GEOPRO, GeoHex, SU-DG-IWG, GEOFIT, GEO4CIVHIC, Carbfix, cage, ZoDrEx, HEATSTORE, PERFORM, GeConnect, COSEISMIQ, GEO-URBAN, DEEP, DEEPEN, TEST-CEM, SPINE, RESULT, SEE4GEO, GRE-GEO. as shown in the figure 4.



Figure 4 – projects participating to CINEA 'Horizon 2020' stand

Unfortunately, Covid-19 started a couple of months before the scheduled date of the Congress, which was subject to constant shifts.

Finally, it was possible to organise the World Geothermal Congress in October 2021, but the pandemic situation was not completely over and many people had to participate via the web.

On that occasion GEO4CIVHIC was presented in Reykjavik and it was possible to meet and discuss with the other project partners physically present.



Figure 5 – Presentation of GEO4CIVHIC

1.3 3rd Clustering meeting organised by CINEA: H2020 projects on Geothermal projects - Berlin 17 October 2022

On 17 October - the first day of the European Geothermal Congress 2022 - CINEA organised a workshop on geothermal clustering on the premises of the Berlin Congress Centre.

The event brought together 12 EU financed projects in the geothermal domain.

The projects represented at the meeting were: GEO4CIVHIC, GEOFIT, CRM-geothermal, CROWD THERMAL, EASYGO-ITN, GECO, GEOTHERM-FORA, GeoSmart, GEOTHERMICA, OPTIDRILL, ORCHYD and REFLECT.

The agenda is shown in figure 6.


European
Commission

GEOHERMAL CLUSTERING WORKSHOP
(Side event to the European Geothermal Congress)

17 October 2022

Venue: Berlin Congress Center, Alexanderstraße 11, 10178 Berlin, Germany

09.30 – 10:00	Welcome and introduction <i>Filipa Vieira Matias – Project Manager (CINEA)</i>
10:00 – 11:00	Presentations of CINEA's H2020 Geothermal Portfolio
11:00 – 11:30	Coffee Break
11:30 – 12:00	Presentations of CINEA's H2020 Geothermal Portfolio
12:00 – 12:45	Policy Context & Funding Opportunities <i>Luca Giovannelli – Policy Officer (DG RTD)</i>
12:45 – 14:00	Lunch Break
14:00 – 14:10	GEOTHERM-FORA project
14:10 – 15:40	Joint discussion <i>Moderators: Filipa Vieira Matias (CINEA) / Luca Giovannelli (DG RTD) / Philippe Dumas (GEOTHERM-FORA)</i> <ul style="list-style-type: none">• "H2020 geothermal portfolio contribution to the Clean Energy Transition and way forward"• "How can H2020 geothermal results contribute to the SET Plan update?"• "How to maximise impact and disseminate together"
15:40-16:00	Conclusions and take home messages <i>Filipa Vieira Matias – Project Manager (CINEA)</i>
16:00	End of the event



Figure 6 – Agenda of the Geothermal Clustering Workshop held in Berlin on 17 October 2022

The morning was dedicated to projects’ presentation and to setting the policy framework.



Figure 7 – Presentation of GEO4CIVHIC

In the second part of the event, participants took part in 3 consecutive discussion sessions on European project 'hot topics': Dissemination and Exploitation of Project Results and Policy Issues. The discussions were aimed at maximising impact and results and facilitating potential synergies between projects.



Figure 8 - Participants to the clustering event

Furthermore, a geothermal research and innovation stand was also organized at the Congress on 19 October 2022, where the GEO4CIVHIC consortium organized the 3rd international workshop. The event was hosted by the European Geothermal Research and Innovation Stand – a joint initiative between the Horizon 2020 and Horizon Europe projects to showcase the high level of cooperation in the field of geothermal energy in Europe and to attract interested parties coming from non-European countries that can contribute to the acceleration of geothermal developments.

<https://geo4civhic.eu/events/>

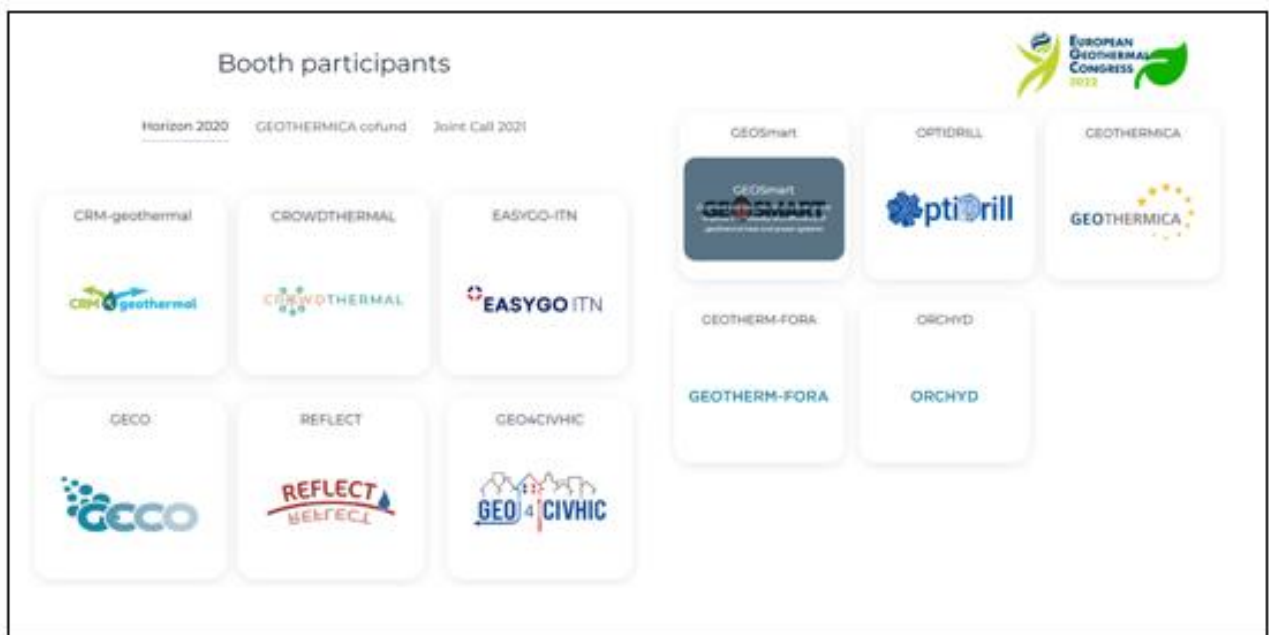


Figure 9 – Projects participating to the booth



Figure 10 – Poster of GEO4CIVHIC during the European booth event

2 Other activities to achieve clustering between EU projects

On the occasion of various events included in the dissemination events and also during the active participation in various European platforms, there were other opportunities to carry out clustering activities, information exchanges and collaboration with other European projects in the field of geothermal and renewable energy during the development of the GEO4CIVHIC project.

Below is a brief overview of these events where other EU projects were present and during which some interesting information exchanges and collaboration proposals took place.

2.1 ECTP Conference 2018 - Brussels on 13-14 November

<https://www.ectp.org/ectp-conferences/ectp-conference-2018>

During the ECTP (European Construction Technological Platform) 2018 conference organized in Brussels on 17-18 November, the GEO4CIVHIC project was exhibited through posters and flyers. The H2020 Cheap-GSHPs project was also presented at the same time. There was very close collaboration in the activities between the projects present.



Figure 11 - Posters exhibition during the ECTP Conference

2.2 International Sustainable Energy Conference 2018 – October 3rd-5th, 2018, Graz (Austria)

<https://solarthermalworld.org/news/isec-2018-working-across-technological-boundaries/>

On October 5th, 2018, during the ISEC held in Graz (Austria), a presentation of GEO4CIVHIC Project was performed.



Figure 12 – Brochures exposition of GEO4CIVHIC at ISEC

Furthermore, GEO4CIVHIC partners present at the event participated in the Geothermal Panel of the European Technology and Innovation Platform on Renewable Heating and Cooling (RHC-ETIP) where members of other EU Projects active within the Platform were present, allowing an exchange of results and ideas.

2.3 European Geothermal Congress – June 19th, 2019, The Hague (Netherland)

<https://europeangeothermalcongress.eu/proceedings-egc-2019/>

During the European Geothermal Congress organized by EGEC (European Geothermal Energy Council), 2 presentations were made on the GEO4CIVHIC project and its results to numerous members.



Figure 13 – Presentation of GEO4CIVHIC

Furthermore, the consortium partners present at the congress also participated in the RH&C-ETIP (European Platform for Renewable Heating Technology and Innovation) meeting. The meeting concluded with a collection of research topics included in various projects within EGEN in the field of surface geothermal energy, subsequently presented to the European Commission as proposals for future funding.

Other EU projects were present: GEOCOND, GeoTech, GEOPLASMA, MUSE, GRETA, SURE, DE-SCRAMBLE, DEEPEGS, CHPM2030, GEMEX .

2.4 REHVA 13th World Congress CLIMA, Bucharest (Romania), 26th and 29th May, 2019.

<https://www.rehva.eu/events/details/clima-2019>

During this great event, the GEO4CIVHIC project consortium partners presented two documents in specialized sections dedicated to renewable energy sources and discussions and connections took place with numerous participants.

Furthermore, on that occasion, the GEO4CIVHIC project partners participated in the “REHVA course on hybrid GEOTABS”, thus ensuring a link with the EU-funded GEOTABS.



Figure 14 – Presentation of GEO4CIVHIC at the REHVA 13th World Congress CLIMA

2.5 EVENT “SHALLOW GEOTHERMAL ENERGY DAYS” – Brussels 24th – 25th September, 2019

<https://www.egec.org/events/shallow-geothermal-energy-days-2019/>

EGEC and the GEOPLASMA project organized the “Surface Geothermal Energy Days” in Brussels. The results in GEO4CIVHIC were presented at the event by some partners.

A GEO4CIVHIC poster was also displayed during the event where other EU projects on shallow geothermal energy were presented.



Figure 15 – participation to the event “SHALLOW GEOTHERMAL ENERGY DAYS”

Leaflets and brochures were also distributed.

In addition to the members of EGEC, the European projects GEOPLASMA, GEOTH, Cheap-GSHPs were also present at the event and fruitful contacts occurred between the partners of the different projects.

2.6 BRENET Conference in Aarau (Switzerland) – 3rd -4th September 2020

<https://www.brenet.ch/2020>

In this occasion a poster of GEO4CIVHIC was exposed.

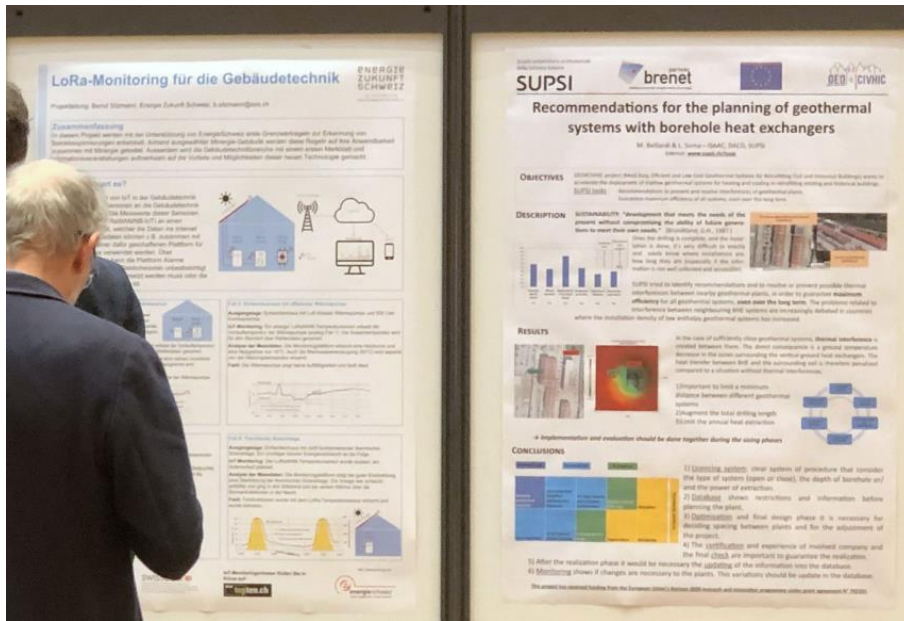


Figure 16 - Picture of the poster exposed at the BRENET Conference

Other EU projects present to the event were: BIPVBOOST, IEA task 60, IEA-EBC (energy in buildings and communities program), Alpenrhein-Bodensee-Hochrhein (Interreg) and interesting and fruitful exchanges took place with them.

Starting from 2020 until almost all of 2021, almost all events were either cancelled, postponed or organized online due to the Covid-19 pandemic situation so that the opportunities to meet partners from other EU projects to carry out cluster activities have become drastically reduced.

GEO4CIVHIC partners participated in various webinars just to disseminate the project.

2.7 EVENT EGEC, March 31ST 2022

GEO4CIVHIC members participated in a webinar organized by EGEC (European Geothermal Energy Council) within the framework of ETIP-DG (European Technology and Innovation Platform on Deep Geothermal).

Since it was a meeting within the platform, even if it was a webinar, the possibility of exchanging information and discussions for collaborations within the European Geothermal Platform was an important opportunity.

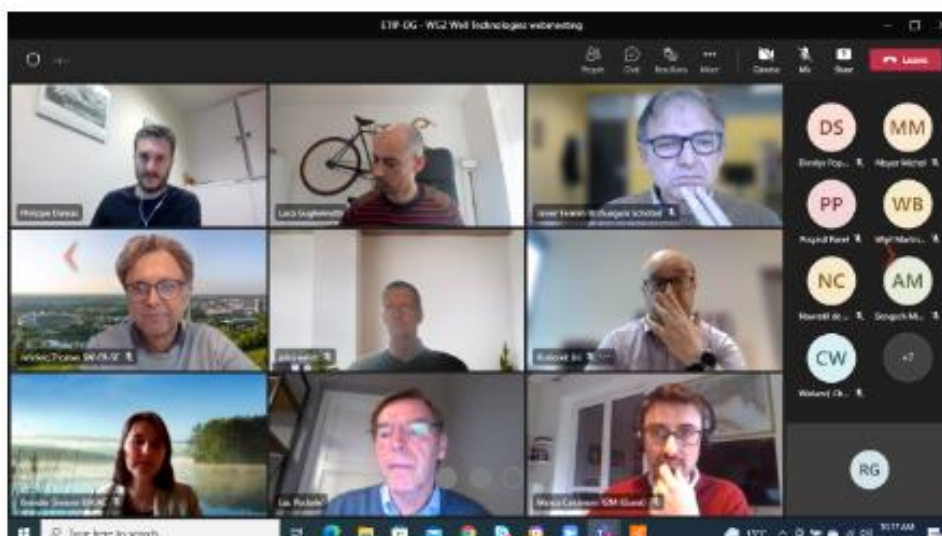


Figure 17 – screen shot of the participants where partners of GEO4CIVHIC are included

In fact, the webinar joined together several EU funded projects, such as: GEOFIT, GEOCOND, GEO4CIVHIC, Geo-US, HEATSTORE, GEO-URBAN and interesting discussions raised during the presentations of the present projects.

2.8 EVENT “GEOSCIENCES FOR A SUSTAINABLE FUTURE” - 19th - 21st September 2022, Torino (Italy)

<https://www.geoscienze.org/torino2022>

GEO4CIVHIC’s members participated to Workshop “organized by EGEN (European Geothermal Energy Council) in Torino between Società Geologica Italiana (SGI) e Società Italiana di Mineralogia e Petrologia.

In that occasion some results of GEO4CIVHIC were presented to the participants.



Figure 18 - Presentation of GEO4CIVHIC at the event “GEOSCIENCES FOR A SUSTAINABLE FUTURE”

Other European projects were present: HotLime, RES4LIVE, GECO, GEO-IN (interreg), A.M.AL.PI.18 (interreg), ReservAqua (interreg) and interesting future collaborations were discussed.

2.9 EVENT EGEC, EUROPEAN GEOTHERMAL CONGRESS, 17th – 21st October 2022, Berlin (Germany)

<https://europeangeothermalcongress.eu/wp-content/uploads/2023/03/Proceedings04.pdf>

GEO4CIVHIC’s members participated to Congress organized by EGEC (European Geothermal Energy Council) in Berlin.



Figure 19 – Vision of the EGEC Congress hall

The other projects represented at the meeting were: CRM-geothermal, CROWD THERMAL, EASYGO-ITN, GECO, REFLECT, GEOSmart, OPTIDRILL, GEOTHERMICA, GEOTHERM-FOR A, ORCHYD, REFLECT. On that important occasion, the partners of the various projects present had the opportunity to meet and discuss various issues related in particular to geothermal objectives.

2.10 EVENT RHC, May 25th, 2023 – Torino (Italy)

<https://www.rhc-platform.org/100rhc-event/100-rhc-event-2023/>

RHC (Renewable Heating & Cooling) organised: “100%RHC Event- Towards 100% renewable energy-based heating and cooling in Europe: A secure energy supply in time of crisis”.

The RHC brought together stakeholders from the geothermal, solar thermal and heat pump sectors – including related industries such as district heating and cooling, thermal energy stor-

age and hybrid systems – to continue to define a common strategy for the growing use of technologies related to renewable energy for heating and cooling.

A GEO4CIVHIC poster was shown and a lecture was given describing the activity within EGEC, including the GEO4CIVHIC project, as well as past and future activities of geothermal source use.



Figure 20 - Presentation of poster at the RHC event

In that occasion networking was performed with other EU projects (SENERGY NETS, SHAREs, HYPERGRYD, SHIP2FAIR, TS2, ...) present at the conference.

The participants at the workshop were very interested to collaborate in future with the objectives and the development of the present projects. Exchanges of information and possible future collaborations were discussed.

2.11 World Geothermal Congress 2023, Beijing, China, 15th – 17th September, 2023

<https://www.wgc2023.com/wgc2023/en/>

During the Congress, a poster of GEO4CIVHIC was exposed related to a paper submitted and accepted: Bernardi A. et al. “Ground Source Heat Pump Systems Applied To Historical Buildings To Improve Their Energy Efficiency”.

Other European projects were present on that occasion: DEEPU, GEOTHERM FORA, DEEP-STORE, ORCHYD, SILVERSTONE (Innovation funds), KEYGEOTHERMAL (special funds for Pologne).

GEO4CIVHIC members present at the Congress met and exchanged information with members of the other EU projects.

In particular, GEO4CIVHIC and DEEPU partners agreed on future collaboration, in particular within common European platforms.

ID: 1775

Ground Source Heat Pump Systems Applied To Historical Buildings To Improve Their Energy Efficiency

ABSTRACT

The project 2020 Co-funded project "Near Zero Efficient and Low Cost Geothermal Systems for Built-in and Historical Buildings (GEO4CIVHIC) and "Clean and Efficient Application of Shallow Ground Heat Exchangers and Pumps" (GEO4CIVHIC) developed innovative Ground Source Heat Exchangers (GSHEs) and drilling components to meet the shallow geothermal systems for heating and cooling in non-dwelling buildings, in particular the historical ones.

The innovation are focused on meeting the challenges in the drilling methods and heat exchangers, including the adaptations required in the built environment, including working in narrow space (1-2m long, small drilling technologies and compact drilling rigs).

In this article the latest progress, findings, approaches and procedures, as well as the application of the final of the geothermal application to historical buildings, including UNESCO World Heritage sites, are described. Some examples (with text and photos) of geothermal installation in historical buildings are presented. Analyzing how the use of geothermal energy systems facilitates the balancing effort between heritage significance and energy conservation.

The study demonstrates that the Ground Source Heat Pumps (GSHPs) are often among the best solution to match the requirements of sustainable energy with the integrity and sustainability of the cultural heritage and its buildings, both in their interior and exterior features. In addition, the GSHP systems applied during the site projects, as they include a large portion of underground elements, have minimal visual impact, compared to air source heat pumps and gas boilers (1, 2).

CHALLENGES

- Narrow space in urban context
- Constraints on retrofitting of historical buildings (no photovoltaic panels, no thermal insulation, no substitution of high temperature heating systems)
- Economic barriers (high costs of investments)

METHODOLOGICAL APPROACH

Reveal heat exchangers and drilling machines

- Reveal coaxial plastic and steel heat exchangers
- Compact drilling machines
- Water-air-water drilling head for efficient drilling in consolidated soils

Innovative Heat Pumps

- Two-stage high temperature Heat Pump
- Heat source (water to water and air to water) high temperature Heat Pump

Tools

- Decision Support System
- Methodology map
- App for feasibility study

REAL DEMONSTRATION CASE STUDIES

Site	Technical Museum Nikola Tesla, Zagreb (Croatia)	Angel's Gate, Ferrara (Italy) - UNESCO World Heritage
		
Project	Cheep-GSHPs	GEO4CIVHIC
GSHEs	3 plastic double-U, 3 coaxial - stainless steel external tube	4 coaxial - stainless steel external tube
Heat pumps	Two-stage high temperature	Dual source (ground and air) high temperature
SCOP	3.2 (with 100% CO ₂ capture and 100% CO ₂ capture)	3.40
SEER	3.29	3.76

VIRTUAL DEMONSTRATION CASE STUDY - NEW HUMANISTIC CENTER - UNIVERSITY OF PADOVA (ITALY)

Simulation of the performance of the geothermal solutions developed within GEO4CIVHIC project

- Dual source (Ground and Air) Heat Pumps
- Coaxial GSHEs with stainless steel external tube

Logos: Cheep GSHPs, European Union, GEO4CIVHIC, CNREC, SINOPEC, 中国石化 SINOPEC.

Figure 21 - Presentation of poster at theWGC23 event

Conclusion

The clustering activities with other European projects in the field of renewable energies and especially geothermal energy that took place despite the long pandemic period were important and positive occasions. This pandemic crisis gave an important break to this type of activity, which normally takes place on every occasion organised in Europe to present the results of European projects and where the partners of different projects can meet and discuss useful future collaborations and exchange results and ideas.

Numerous interesting discussions took place during conferences, workshops and, in particular, during the clustering events organised by CINEA/INEA.

These events gave participants the opportunity to learn about the development of innovation in the renewable energy sector within the framework of other Research and Innovations researches funded by the Commission.

These opportunities help to understand what is missing to push research and in particular the low-enthalpy geothermal sector to develop further and, in particular, how to achieve specific goals.

In conclusion, the various joint activities carried out allowed the institutions/SMEs and industries involved to learn about existing innovations, experiences and expertise and to receive information on the different efforts and results achieved during the development of the European projects.

Finally, in the future, those involved will be able to combine the results and knowledge achieved for the further development of technologies by trying to overcome existing barriers to greater awareness, particularly in shallow geothermal energy.