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Report on European Centers of Excellence (ECoE)

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Summary

The deliverable D8.11 “Report on European Centers of Excellence (ECoE)” delves into the establishment and operational framework of four distinguished Centres of Excellence (CoEs) in shallow geothermal energy across Europe. These centres, each located in a specific region, collectively contribute to advancing geothermal energy research and applications.

The four ECoE are: the ECoE for Southern Europe is based at the University of Padua (UniPD) in Italy. The Central European CoE is located at Friedrich-Alexander-Universität Erlangen-Nürnberg (FAU) in Germany, while the Western European CoE is situated at the Universitat Politècnica de València (UPV) in Spain. Lastly, the Eastern European CoE is hosted by the Romanian Geoexchange Society (RGS).

A brief report from each ECoE on their specific contributions to the field of shallow geothermal energy has been included, emphasising their approach and expertise. The report concludes with a highlight of their most notable joint activity: the organization of a comprehensive training course. This course represents a significant milestone in collaborative learning and knowledge sharing among these ECoEs, furthering the development and implementation of geothermal energy solutions across Europe.

1. INTRODUCTION

1.1 ECoE background and objectives

The European centers of excellence (ECoE) represent a group of people leading the organization and different structures, in a specific focus area, towards pre-determined goals. The aim of ECoE is the improvement of the expertise in a certain area, by exploiting the most of its resources to help business improvement. ECoE provide a focal point for knowledge management, by capturing new abilities and practices from inside and outside of the business. Therefore, the goal of the ECoE is to find the best practices and their dissemination to the other departments. Figure 1 shows the four locations of the ECoE.



Figure 1: European Centers of Excellence (ECoE)

More in detail, ECoE can have a wide range of purposes, depending on the focus area. The main goals and responsibilities of ECoE include providing research and support to the organization, by offering guidance, training, and oversight of the employees, and by governing the organization through appropriate resource allocation.

1.2 Organizational structure and framework

ECoE are built around a team of people, who can either be hired from outside the company or are already employees. The team members can continue to hold other positions in the business and therefore work in the role part-time or be full-time employed. In this sense, ECoE can be both an on-going part of the business or a temporary setup (see Figure 2). As an example, a business might choose to set up ECoE in the event of a new technology adaptation.

The tendency for ECoE is to be built around a specific focus area, which is relevant for the company and of particular importance for the business. The typical focus areas include:

- *Technology*: the adaptation of a new technology system or simply the study of a new technology to improve the business.
- *A business concept*: the introduction of a business concept such as BPM.

- *Skill*: improvement and utilization of a new skill such as certain management practices.
- *Other broad area of study*: for example, workplace equality.

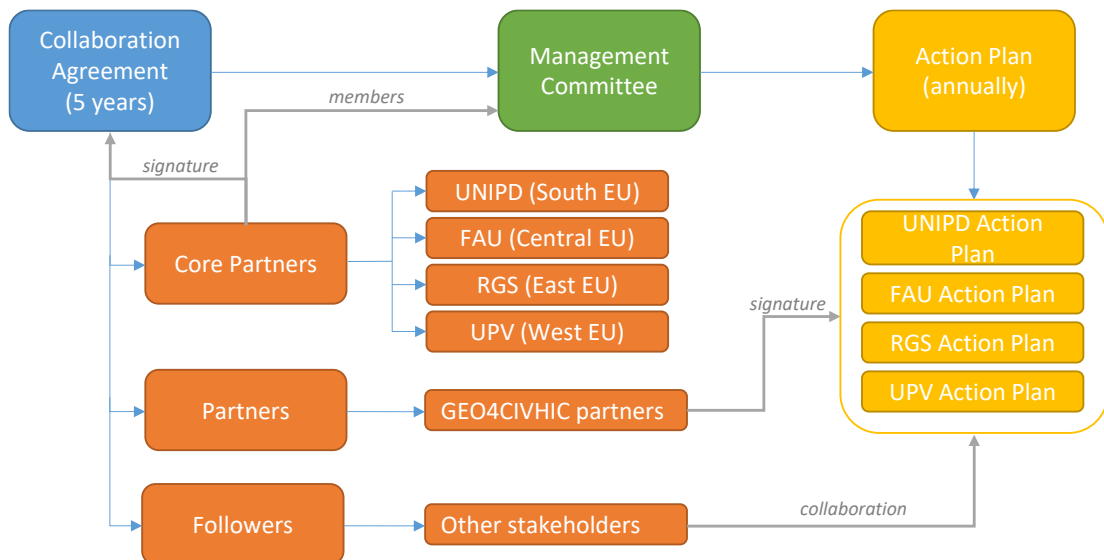


Figure 2: Layout of the European Centers of Excellence (ECoE)

The framework for establishing ECoE is explained in the present section, divided into three focal steps:

1. Define strategy and vision.

The first step regards the creation of a mission statement of the ECoE center, by thinking about its purpose (i.e., developing a technology, business concept, a certain skill, or else). In addition to that, it is also important to set some specific issues, such as budget requirements, number of employees needed.

2. Secure funding.

It is essential to secure the needed funding, after the initial planning part. It is important, for example, to recognize if an ECoE has been poorly designed, and therefore would cost more than bring an actual benefit to the business. While ECoE can contribute to reducing a business' operational expenses, it is also vital to acknowledge how establishing it successfully and operating it comes within cost. In particular, during the initial stages, a substantial amount of capital will be required, and in many cases, senior management within the organization might need to provide financial support. For this reason, it is crucial to decide if the ECoE requires external funding or not., and, depending on the specific objectives, it might be possible to secure public funding. For instance, if the ECoE is oriented towards environmental protection, government bodies or other environmental agencies, may offer additional funding. This is also possible for ECoE with specific academic and scientific purposes. Finally, ECoE can be established as joint ventures involving two or more companies.

3. Make the center operational.

Once the strategy and vision of the ECoE are defined, as well as the organization of the funding, it is possible to focus on the operational aspects of the center. The key areas that need to be sorted out are: staff, governance, marketing, performance measurements, and the role of the center within the community.

1.3 The Landmark ECoE's Agreement

The present section describes the collaboration agreement for the establishment of a network of European Centers of Excellence for shallow geothermal application in civil and historical buildings (GEO4CIVHIC), which can be found in the Annex of the present report, and a short part of it in Figure 3.


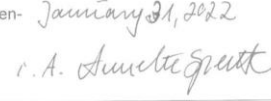



ENTITY	SIGNATURE AND DATE
FOR THE ENTITY N° 1 UNIVERSITAT POLITÈCNICA DE VALÈNCIA M ^{re} Belén Picó Sirvent Vice-Rector for Research	
FOR THE ENTITY N° 2 Friedrich-Alexander-Universität Nürnberg Annette Spletter Head of EU Grants and Contracts	Erlangen- January 31, 2022 
FOR THE ENTITY N° 3 Interdepartmental Centre Giorgio Levi Cases for Energy Economics and Technology Alberto Bertucco Director	
FOR THE ENTITY N° 4 Asociatia "Societatea Romana Geoexchange" (RO) / Romanian Geoexchange Society (EN) Gavriiliuc Robert President	 

Figure 3: Agreement between the European Centers of Excellence (ECoE)

As shown above, it is signed by all the founding partners, which are:

- Universitat Politècnica de València (UPV);
- Friedrich-Alexander-Universität Erlangen-Nürnberg (FAU);
- Interdepartmental Centre Giorgio Levi Cases for Energy Economics and Technology (UNIPD);
- Asociatia "Societatea Romana Geoexchange" (RO) / Romanian Geoexchange Society (RGS).

The aim of the agreement is the implementation by the Parties of a Network of "European Centers of Excellence for Shallow Geothermal Application in Civil and Historical Buildings" in different European countries in order to break down the barriers that shallow geothermal energy is still facing to transform the geothermal energy into a standard source of heating and cooling. In addition to that, the Parties commit to the pursuit of activities for dissemination and communication regarding the basic knowledge and the application of geothermal technologies through a collaborative approach. They are active parties of research and innovation actions in this field, with the common purpose of developing and supporting actions towards a large dissemination of the use of shallow geothermal systems, particularly in civil and historical buildings.

2. European Centers of Excellence in Shallow Geothermal Energy

2.1 CoE for Southern Europe

The Center of Excellence - Southern Europe is hosted at the "Giorgio Levi Cases Energy Economics and Techniques Study Center", established at the University of Padua. It is an interdepartmental center that deals with scientific and technological research of sources of energy, their transformation, distribution and

final use. Founded in 1969, this institution collects and coordinates the research activities in the energy field of 11 departments of the University of Padua and makes use of private and public funding. The objective of the Levi Cases fits perfectly with the objectives of the Center of Excellence, consisting in promoting interdisciplinary collaboration between researchers active in different scientific and technological sectors operating in the Energy sector, through the support of scientific and applied research, the organization of scientific and informative events, collaborations with national and international research bodies, and with private companies, and the establishment of university training courses. With its over 200 teachers organized in 54 research groups, this foundation intends to support the Southern European Center of Excellence in its role as a local, national and international reference in the regions of competence, on energy issues. The geothermal research group took part as project leader and coordinator of several European projects on the topic of geothermal research

2.2 CoE for Central Europe

The Central Europe CoE is located in the Friedrich-Alexander-Universität Erlangen-Nürnberg (FAU), that is now one of the largest research universities in Germany. Its five faculties cover the entire spectrum of modern academic disciplines, from the humanities, social sciences and theology to medicine, law, economics, sciences and engineering.

FAU is committed to interdisciplinary teaching and research that often crosses the boundaries of individual subjects.

Following the University's motto "Moving knowledge. FAU.", the various faculties and subjects work together to offer a range of interdisciplinary degree programs, the like of which is hard to find anywhere else. The Earth Science Group led and took part to vary European Project focused on Geothermal issues.

2.3 CoE for Western Europe

Western ECoE is located in the scientific park of the Universitat Politècnica de València (UPV), in Spain. Its high-precision laboratory for thermal tests is a fundamental part of the ECoE's activities in the field of the energy transition, going from being based on fossil fuels to renewable energies with less impact on the environment. The technological feature that makes this laboratory a unique thermal installation in Europe is that the injection (or extraction) of heat is evaluated right at the inlet of the exchanger, using an advanced control system to be constant and precise. In this way, much more precise results are obtained than using the traditional methodology, where no thermal injection control is carried out, limiting itself to the generation of a constant heat pulse in the generation source and that does not consider, for example, the thermal losses of the pipes or the thermal influence of the outside temperature. The laboratory currently has a borehole field with ten various borehole heat exchangers (BHEs): several Single-U tube (with different pipe and backfill materials), two coaxial BHE, a helix BHE and an energy pile from different European projects: GEOCOND, GEO4CIVHIC and CHEAP-GSHPs among others.

2.4 CoE for Eastern Europe

The Eastern Europe EoE is located at Romanian Geoexchange Society (RGS), that is dedicated to the Promotion of heating and cooling systems with geothermal heat pumps (H&C GSHP); to National and international lobby for H&C GSHP; to training and certification of personnel involved in H&C GSHP. RGS participates in national and international professional bodies; EU projects, and contribute to national strategies and policies. RGS is member of EGEC, Geoexchange AISBL, CNR-CME, and was partner in EU - IEE project GEOTRAINET (2008-2011); subcontractor in "Build-up-skills Romania - ROBUST" (2011-2013) and GeoDH project (2012 - 2015); partner in REGEOCITIES project (2012-2015); partner in Cheap-GSHPs project -Horizon 2020 (2015-2019); partner and WP leader in GEO4CIVHIC project - Horizon 2020 (2018-2022). RGS was winner of Energy Globe Award 2006 - National prize for the Project: "ROMANIA—a Clean Country in a Clean EUROPE—Geoexchange Technology"

Its Main EU target focuses on the promotion and regulative frame of shallow geothermal technology for heating and cooling at European level. training and certification of GSHP specialists according to European directives and national legislation.

RGS is active in the elaboration of the European regulative frame through EGEC and GEOTRAINET AISBL.

3. 2023 ECoE COURSE – 25-26 September

3.1 Phylosophy of the ECoE course

The main objectives of ECoE network and ECoE courses are the following:

- DISSEMINATION of the basic knowledge and most recent research results in GSHP technologies, equipment, applications management, standards, environmental impact, market aspects;
- INNOVATIVE development and research of improvement path for shallow geothermal domain across Europe;
- INCREASE of the visibility of shallow geothermal solutions / applications including civil and historical buildings.

These objectives were strictly followed by the first GEO4CIVHIC ECoE course organized on September 25-26th 2023, organized by the ECoE partners: UNIPD, UPV, FAU and RGS, and by all the other partners that cooperated with presentations in the 4 modules of the course.

3.2 Organizational aspects

There were 123 enrolled participants, coming from different countries as explained in Table 1. Of these, 88 were active participants, and attended at least one module. In order to obtain the attendance diploma, it was mandatory to attend all 4 modules.

Table 1: Detailed information about the ECoE course participants.

Country	# of enrolled participants	# of actual participants	# of participants who attended 4/4 modules
Ethiopia	1	1	0
Germany	3	3	2
Greece	11	4	1
Ireland	3	1	1
Italy	25	19	10
Lithuania	1	1	0
Macedonia	1	1	1
Mexico	2	0	0
New Zealand	1	0	0
Norway	2	1	1
Peru	2	1	0

Portugal	2	1	0
Romania	31	28	19
Slovenia	1	1	1
Spain	26	18	14
Switzerland	2	1	1
Turkey	6	4	4
Ukraine	2	0	0
United Kingdom	2	2	1
Total	123	88	56

3.3 Format of the course – hybrid

The whole ECoE course took place both online and in presence, in three different locations, each one provided with an immersive environment tailored to deliver an optimal learning experience. More in detail, here are the venues details:

1. **Valencia, Spain:** Seminario 3, Tercera planta, ETS de Ingegneria Informatica. Universidad Politecnica de Valencia (UPV), Camino de Vera S/N 46022 Valencia.
2. **Padova, Italy:** Sala riunioni grande, Terzo Piano, Dipartimento di Ingegneria Industriale. Università degli Studi di Padova, Via Venezia 1, 35128 Padova.
3. **Oradea, Romania:** Renewable Energy Research Centre Termoline, Fabricilor Street 2F, 410032 Oradea.

3.4 Course timetable

The timetable was initially set in the management meeting in Athens – April 2023 and then refined in some iterations in the “ECoE course organization internal meetings”. The internal meetings were convened and conducted by UPV starting May 2023.

Each MODULE was coordinated by an ECoE partner.

- Organizers of **MODULE I: Buildings’ Energy Loads – September 25th 2023**

ECoE Eastern Europe - Romanian GeoExchange Society – RGS
ECoE South Europe - Consiglio Nazionale delle Ricerche – CNR
Università degli Studi di Padova – UNIPD

- Organizers of **MODULE II: Geology – September 25th 2023**

ECoE Central Europe – Friedrich-Alexander-Universität Erlangen Nürnberg (FAU)

Unweilt Baugrund Geothermie Geotechnik (UBeG)

GeoServ – Geothermal Energy Specialists

ECoE South Europe – Università degli Studi di Padova – UNIPD

RED s.r.l. – Renewable Energy Development

- Organizers of **MODULE III: Heat Pumps Technology and Drilling Techniques – September 26th 2023**

ECoE South Europe – RED s.r.l. – Renewable Energy Development

Consiglio Nazionale delle Ricerche (CNR)

HiRef s.p.a.

ECoE Central Europe – Terra Infrastructure

- Organizers of **MODULE IV: Sizing Ground Source Heat Pumps (GSHP) – September 26th 2023**

ECoE South Europe – Universidad Politècnica de València (UPV)

TECNALIA Research and Innovation

3.5 Course agenda

Hereby is presented the complete agenda of all the modules of the ECoE course.

- MODULE I: Buildings' Energy Loads**

	Lesson / Subject	Timing	Responsible / Trainer
PART I	nZEB	45 minutes	RGS – Horia Ban - President
	Course opening		Adriana BERNARDI – CNR Italy
	- The concept of Nearly Zero Energy Buildings (nZEB) 1. The reasons for developing low-energy consumption buildings; 2. Definition of nZEB.		Horia BAN – RGS / TERMOLINE Alexandra BAN – RGS / TERMOLINE
	- Energy performance and Cost-Optimization of Nearly Zero Energy Buildings (nZEB) 1. Energy performance of nZEB; 2. Cost-optimal and nZEB levels.		
	Relevant standards and regulations in the field of nZEB buildings		Alexandra BAN – RGS / TERMOLINE
	Strategies and technologies used in nZEB buildings 1. Renewable energy sources for nZEB; 2. New nZEB buildings; 3. Retrofit existing buildings to nZEB buildings.		Iulia PRODAN – RGS / Expert Project SRL
PART II	Thermal loads	25 minutes	RGS – Horia Ban - President
	- Thermal loads of buildings: Definition and importance 1. What are the thermal loads and why are they relevant in building design? 2. Factors influencing thermal loads.		Horia BAN – RGS / TERMOLINE
	- Methods and principles of calculating thermal loads of buildings 1. Calculation factors and coefficients relevant to determining thermal loads; 2. Standards and guidelines used for thermal load calculations.		
	- Concrete examples of applying calculation principles and methodologies in energy-efficient building design		

PART III	Application of geothermal to historical buildings	75 minutes	Adriana Bernardi / Michele De Carli
	Introduction: importance of retrofit of buildings and historical buildings <ol style="list-style-type: none"> 1. Definition of historical buildings and importance of retrofit of historical buildings; 2. Identification of the barriers in the refurbishment process of a historical building; 3. Legislation and permission process for refurbishment of historical buildings. 		Adriana BERNARDI – CNR Italy
	Retrofit of buildings <ol style="list-style-type: none"> 1. Consumptions across Europe: statistic data from Europe; 2. Types of buildings; 3. The options for the retrofit of buildings; 4. How to apply GSHP in existing buildings; 5. Case studies in particular historic buildings. 		Michele DE CARLI – UNIPD Italy

• **MODULE II: Geology**

	Lesson / Subject	Timing	Responsible / Trainer
PART I	Geology	60 minutes	FAU – David Bertemann / UBeg – Burkhard Sanner
	<ul style="list-style-type: none"> - Overview and components of shallow and very shallow geothermal systems; <ol style="list-style-type: none"> 1. Vertical systems shallow: BHE types, geometries, grouting process; 2. Horizontal systems very shallow: GHX types, special forms, installation process. - Heat transfer: what are the main parameters? <ol style="list-style-type: none"> 1. Soil & unconsolidated material context to physical parameters, pedological overview, measurement methods; 2. Rocks main overview of lithology, physical properties, measurement methods. - In situ thermal response tests (introduction): main overview of operating principles and applications, main components 		
PART II	Geothermal mapping	60 minutes	UNIPD – Antonio Galgaro / RED srl – Luck Pockelè, Giulia Mezzasalma, Silvia Contarini
	Drillability <ol style="list-style-type: none"> 1. Main drilling techniques; 2. Definition of the drillability concept; 3. Underground thermal properties; 4. European scale geothermal mapping; 5. Municipal scale geothermal mapping. 		Antonio GALGARO – UNIPD
	Geological databases <ol style="list-style-type: none"> 1. Rocks and unconsolidated sediments thermal properties data base; 2. On Site Ground Thermal Response Test Data base. 		Luck POCKELÉ – RED
	Field support application <ol style="list-style-type: none"> 1. Concept and Architecture of the Application; 2. Input sections with user interfaces (geolocalization, ground info, building info); 3. Output section. 		Silvia CONTINI – RED
	Exercise (Geological information and drilling information of some proposed locations using the tools explained)		Giulia MEZZASALMA – RED
PART III	Environmental impacts and regulation	60 minutes	GeoServ – Riccardo Pasquali
	Regulatory and environmental impacts of the integration of GSHPs in buildings covering the design, installation and operational aspects <ol style="list-style-type: none"> 1. Regulatory aspects around GSHP installation and buildings; 2. Environmental impact Assessment Methodologies and operational phases; 3. Standards applicable to GSHP systems. 		

• **MODULE III: Heat Pumps technology and drilling techniques**

	Lesson / Subject	Timing	Responsible / Trainer
PART I	Innovative methods of geothermal drilling	75 minutes	RED – Luck Pockelé / TERRA Infrastructure – Arno J. Romanowski
	Basic of geothermal drilling methods and Borehole Heat Exchangers <ol style="list-style-type: none"> 1. State of art of vertical Borehole Heat Exchangers; 2. Drilling techniques for Borehole Heat Exchangers; 3. Drill rig anatomy and description of accessories; 4. Constraints for drilling in built environment. 		Luck POCKELÉ – RED
	A compact, rotating, and vibrating drilling head (RVD) for Urban Areas <ol style="list-style-type: none"> 1. Principles and advantages; 2. Technical description and configurations of the RVD head; 3. Overview of test and demonstration cases. 		Luck POCKELÉ – RED
	A compact, versatile drilling machine for innovative drilling methods in Urban Areas <ol style="list-style-type: none"> 1. Features of the versatile and compact drill rig and accessories; 2. The Terra-Infrastructure drilling method for co-axial Borehole Heat Exchangers; 3. The Hydra-RED drilling method for co-axial Borehole Heat Exchangers; 4. Cost and performance considerations based on Cheap-GSHPs and GEO4CIVHIC projects. 		Luck POCKELÉ – RED
PART II	Geothermal heat pumps	75 minutes	CNR – Sergio Bobbo / HIREF – Carlo Bissaro
	Basics <ol style="list-style-type: none"> 1. How heat pumps work. Why we are moving towards heat pumps and geothermal heat pumps. Definition of COP and EER; 2. Global environmental issues, i.e., ozone depletion, global warming, pollution, energy consumption. 		Sergio BOBBO – CNR
	Refrigerants <ol style="list-style-type: none"> 1. What is a refrigerant working fluid? 2. Characteristics of refrigerants; 3. Which are the possible alternative refrigerants of the future? 4. Some characteristics of the possible refrigerant cycles. 		Sergio BOBBO – CNR
	Innovation in HP <ol style="list-style-type: none"> 1. The heat pump market and the challenges for the heat-pumps manufacturers; 2. Standards defining the energy performance of heat pumps: current values and limits; 3. New development and technical features for the geothermal heat-pumps; 4. New types of geothermal heat pumps developed in the context of the European projects. 		Carlo BISSARO – Hiref
	Practical exercise: designing a thermodynamic cycle		Carlo BISSARO – Hiref

• **MODULE IV: Sizing Ground Source Heat Pumps (GSHP)**

	Lesson / Subject	Timing	Responsible / Trainer
PART I	Thermal response tests	75 minutes	UPV – Miguel A. Mateo, Borja Badenes
	<ul style="list-style-type: none"> - Thermal response test. Geothermal laboratory in UPV; - Workshop – Evaluation of TRT; - Exercise: evaluation of a proposed TRT. 		Miguel A. MATEO – UPV Borja Badenes – UPV
PART II	Decision support system for geothermal installation sizing	60 minutes	TECNALIA – Amaia Castelruiz
	Decision support system for geothermal installation sizing		Amaia Castelruiz – TECNALIA

3.6 Dissemination of the event

The ECoE course dissemination was conducted in different ways, starting with the use of LinkedIn and other social media, the different university websites, on H&C platforms, and in all the partner websites and contact lists.

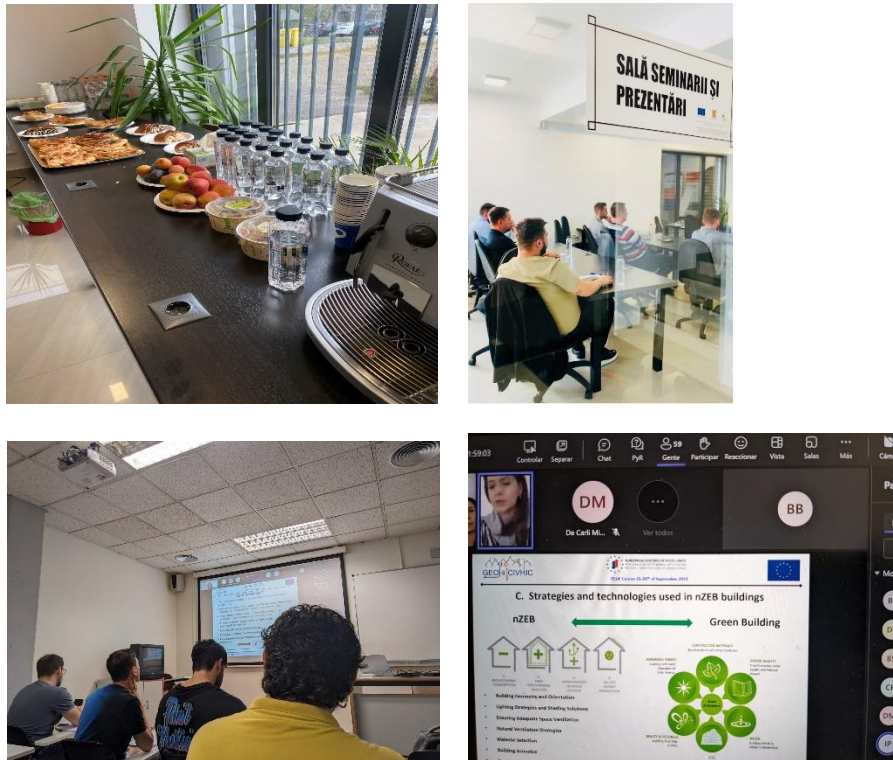


Figure 4: Pictures from the venues and online event.

3.7 Specific report from each venue

3.7.1 Participants. Number, structure, enrollment and acceptance procedure, communication organizers – trainees.

The participation and enrollment invitation were disseminated in Europe starting the end of July through the GEO4CIVHIC website and through the other dissemination ways presented above.

a) Valencia, Spain

In Spain, there were 25 enrolled participants, from different cities and universities, of which 8 attended the event in presence on both days of the course. More in detail, of the 25 participants, there were:

- 9 PhD students (from UPV, Universitat Autònoma de Barcelona, Universidad de Valladolid, Universidad de Ciencias Geológicas, Universidad Carlos III de Madrid);
- 9 Master students (from UPV; Universitat Politècnica de Catalunya, Universidad de Alcalá de Henares, Universidad de Valladolid);
- 6 university graduates.

In the period preceding the course, the trainees were informed by the professors of University of Padova, about directions for the location of the event, as well as instructions on how to obtain the online participation link.

b) Padova, Italy

In Italy, there were 24 participants enrolled for the event on both dates, enrolled through University of Padova, coming from different cities across Italy: 6 of them attended in presence on September 25th, 5 on September 26th; the remaining attended online. More information regarding the enrolled trainees below:

- 2 trainees are working engineers;
- 14 trainees are master students (from University of Padova, Università Sapienza di Roma);
- 8 trainees are PhD students (from University of Padova, Politecnico di Torino, Università degli Studi di Milano).

In the period preceding the course, the trainees were informed by the professors of University of Padova, about directions for the location of the event, as well as instructions on how to obtain the online participation link.

c) Oradea, Romania

In Romania, in addition to the presented ways, the RGS website and communication list were used including the RGS membership list and our own stakeholder list of contact. As a consequence, up to the enrollment deadline 20th of September 2023, 31 enrolled specialists were from Romania, 6 of them being doctoral students. All the enrolled people were eligible according the Enrollment form requests.

In 25-26th of September, the concrete participation of the Romanian trainees was the following:

- 9 trainees participated with physical presence in the RGS premises in Oradea and 1 participant out the 9 was a doctoral student;
- 16 trainees participated online and 4 of them were doctoral students.

Therefore, in the ECoE course the total Romanian trainees' participation was: 25 trainees and 5 out of the 25 were doctoral students.

In the period of time that preceded the course, the RGS team maintained a close and direct contact with the trainees, support them with information about the transport to and accommodation in Oradea, the concrete possibilities of obtaining training tools support, the possibilities to visit the most important local demo sites etc.

d) Erlangen, Germany

Finally, there were 3 participants enrolled from Germany, which all attended the course in the online format. All 3 are master students enrolled at FAU university.

3.7.2 Training tools distributed

a) Valencia, Spain

The organizers distributed and described the access ways (website addresses) to the GEO4CIVHIC Training Tools Package meaning:

- Training Manual containing 7 volumes;
- User Manuals containing the DSS and APP User Manuals;
- Brochures containing the Technical and the Historical ones;

b) Padova, Italy

The organizers distributed and described the access ways (website addresses) to the GEO4CIVHIC Training Tools Package meaning:

- Training Manual containing 7 volumes;
- User Manuals containing the DSS and APP User Manuals;
- Brochures containing the Technical and the Historical ones;

c) Oradea, Romania

The organizers distributed and described the access ways (website addresses) to the GEO4CIVHIC Training Tools Package meaning:

- Training Manual containing 7 volumes;
- User Manuals containing the DSS and APP User Manuals;
- Brochures containing the Technical and the Historical ones;
- GEOTRAINET Manual for drillers in shallow geothermal systems;
- GEOTRAINET Manual for designers in shallow geothermal.

The 2 last documents were disseminated as a “bonus”. They were published in 2011 within GEOTRAINET EU Project.

In the course coffee breaks, the GEO4CIVHIC movies were presented on the display.

c) Erlangen, Germany

The organizers distributed and described the access ways (website addresses) to the GEO4CIVHIC Training Tools Package meaning:

- Training Manual containing 7 volumes;
- User Manuals containing the DSS and APP User Manuals;
- Brochures containing the Technical and the Historical ones;

3.7.3 Graduation diplomas

As mentioned before, to the participants who attended all four modules of the ECoE course, was presented with an attendance diploma. 56 diplomas have been distributed, as Table 1 shows, while Figure 7 displays their format.



Figure 5:

the attendance diploma.

Format of

3.7.4 Budget aspects

- a) Valencia, Spain
- b) Padova, Italy
- c) Oradea, Romania
- d) Erlangen, Germany

For the coffee breaks and lunch in the 2 days of the course, the cost was almost 670 EUR (Oradea, Romania). The amount was covered from Other Direct Costs chapter.

For the physical participation of one organizer in Oradea the amount was covered from Travel chapter.

For the activity itself (interfaces, organization and management of the course, .ppt presentations preparation, teaching etc.) 2 persons worked pro-bono: Horia Ban – RGS President and Iulia Prodan – RGS Manager (both were trainers) and 4 persons worked based on an in-house consultant contract: Doina Cucueteanu, Alexandra Ban, Iulia Borse and Traian Copil, therefore their activity is covered from Staff cost.

No other costs were communicated by the other Centers of Excellence

3.8 Conclusions

3.8.1 Achieved objectives and positive aspects

Overall, the general impression of the course is very successful, as testified by the number of participants, both online and in presence. Despite a few minor technical difficulties of connection, unavoidable in the



context of the wide distribution in Europe of the 4 city cores (Valencia - Spain, Padova - Italy, Oradea - Romania, Erlangen - Germany) as well as of the trainees' locations (some of them from outside Europe), the course took place without any major difficulty and the reception of the presentations was impeccable.

4. Future ECoEs collaboration and events after the project end

New training and dissemination initiatives are being organized by the Centers of Excellence, aimed at both technical staff of the geothermal supply chain, public administrators and undergraduates and doctoral students from the various universities involved in the Geo4civhic project (UPV, UNIPD, FAU). These activities will be carried out for at least three years from the end of the project

5. Annexes

5.1 ECoE Agreement

GESEXCHANGE
ROMANIAN GEOTHERMAL SOCIETY
SOCIETATEA ROMANA GEOTHERMAL

Bd. Pache Protopopescu nr. 66 - CP 021414 - Bucuresti – Romania
Phone: +40 21 252 46 20; Fax: +40 21 252 68 80; Website: www.geocxchange.ro

UNIVERSITAT POLITECNICA DE VALENCIA

Camino de Vera s/n

Valencia – Kingdom of Spain

Ms. Belen Pico Sirvent – Vice-Rector for Research

GEO4CIVHIC – Agreement European Network of Centers of Excellence

Dear Mrs. Vice-Rector Belen Pico Sirvent,

Please, find enclosed one original copy of the Network Agreement, fully signed by all founding partners.

Similar copies have been sent to all the other founding partners.

Please do not hesitate to contact me if you have any questions

Kind regards,



Prof. Robert Gavriluc, Ph.D.
President of the Romanian Geoexchange Society

COLLABORATION AGREEMENT FOR THE ESTABLISHMENT OF A NETWORK OF EUROPEAN CENTRES OF EXCELLENCE FOR SHALLOW GEOTHERMAL APPLICATION IN CIVIL AND HISTORICAL BUILDINGS

BETWEEN

The UNIVERSITAT POLITÈCNICA DE VALÈNCIA (hereinafter referred to as the UPV) with CIF Q4618002B, created as university institution by virtue Decree 495/1971 of 11 March (BOE of March 26, 1971), with registered office in Camino de Vera, s/n, Valencia (Kingdom of Spain); and, in its name and representation, Ms. Belén Picó Sirvent, Vice-Rector for Research, with sufficient powers for the celebration of this act, by virtue of the Resolution of July 27, 2021 by the Rector of the UPV, in accordance with the provisions in articles 9 and 12 of Law 40/2015, of October 1, on the Legal Regime of the Public Sector and in articles 51 to 55 of the Statute of the UPV, approved by Decree 182/2011 of 25 November, the Consell.

AND

Friedrich-Alexander-Universität Erlangen-Nürnberg (hereinafter referred to as "FAU") with VAT DE132507686, a public university, with registered office in Schlossplatz 4, 91091 Erlangen, Germany, and on its behalf Annette Spletter, Head of EU Grants and Contracts.

AND

Interdepartmental Centre Giorgio Levi Cases for Energy Economics and Technology (hereinafter referred to as "UNIPD") with VAT 80006480281 created with University Centre status under year 1968 with registered office in Padua University - Italian Ministry of University and Research, and on its behalf Alberto Bertucco, acting as Director, who was appointed by directive council members and legal nomination act of the University Rector - 8.07.2018

AND

Asociatia "Societatea Romana Geoexchange" (RO) / Romanian Geoexchange Society (EN)] (hereinafter referred to as "RGS") with VAT 15258653 created with non-governmental organization (NGO) status under Judge decision from January 8th, 2003, in file no. 14/PJ/2003, Court of District 1 Bucharest with registered office in 66 Pache Protopopescu Boulevard, 021414 Bucharest - Romania, and on its behalf Gavriluc Robert, acting as President, who was appointed by Decision of the RGS general assembly from April 30th, 2020,

hereinafter referred to individually as "Party" or together as "Parties",

STATE

their common intention to collaborate in order to establish a Network of "European Centres of Excellence for Shallow Geothermal Application in Civil and Historical Buildings"

and hereby the Parties agree the following

CLAUSES

FIRST. PURPOSE OF THE AGREEMENT.

Within the framework of the European Horizon H2020 Project "Most easy, efficient and low cost geothermal systems for retrofitting civil and historical buildings - GEO4CIVHIC" a network of European Centres of Excellence in Shallow Geothermal Energy Research (ECoE) has been launched with the aim of connecting different European research, promoting geothermal energy as a standard source of heating and cooling, especially in the renovation of civil and historical buildings.

The aim of this agreement is the implementation by the Parties of a Network of "European Centres of Excellence for Shallow Geothermal Application in Civil and Historical Buildings" (hereinafter referred to "the Network") in different European countries in order to break down the barriers that shallow geothermal energy is still facing to transform the geothermal energy into a standard source of heating and cooling, especially in building renovation of civil and historical buildings. This agreement describes their understandings and commitments to this collaborative effort, taking into account the considerable experience of the Parties in the field concerned.

SECOND. SCOPE OF THE AGREEMENT.

The Parties intend to work together to create a Network of "European Centres of Excellence for Shallow Geothermal Application in Civil and Historical Buildings".

This agreement pursues to develop activities for dissemination and communication regarding the basic knowledge and the applications of geothermal technologies through a collaborative approach between different academic and industrial entities in European countries, leading to the creation of a Network in order to organize those activities.

The Parties committed to this agreement are Centres of Excellence for Shallow Geothermal Energies and are active partners of research and innovation actions in this field. Their purpose in the present agreement is to create a Network of centres to develop and support actions towards a large dissemination of the use of shallow geothermal systems, particularly in civil and historical buildings.

Each Party will be a centre of excellence of the Network and the centres shall be organized regionally in Europe: south EU (UNIPD), central and north EU (FAU), east EU (RGS) and west EU (UPV).

The main objectives of the Network shall be the exchange of knowledge, methods, and experiences between the Parties, the knowledge dissemination outside the Network, the training of future players/experts and the definition of policy-support objectives in shallow geothermal systems, among others.

The Network shall promote and develop joint actions between some or all the Parties. The actions shall include disseminations actions, training actions, experts exchange actions, etc.

The topics for the actions shall include geology, drillability and drilling methods, borehole heat exchangers, heat pumps, hybrid solutions, system controls, engineering tools, legislation issues, guidelines and standards, etc. The innovations from the most recent research and innovation projects on shallow geothermal (GEOTRAINET, CHEAP-GSHPS, GEOTECH, GEOCOND, GEO4CIVHIC) shall be included as well in order to communicate and disseminate the basic knowledge generated in different research and innovation actions.

The scope of the collaboration may be amended through the joint agreement of the Parties by means of amendments to this agreement, prior to its termination.

This agreement applies in full respect of the laws and regulations in force in the EU and the European Union.

THIRD. DURATION OF THE AGREEMENT.

The agreement will enter into force on the last day of signature of the Parties.

The duration of this agreement shall be for a maximum of 5 years, from the last date of signature of the Parties. After that period, the agreement will automatically end.

The duration of the collaboration may be extended through the joint agreement of the Parties by means of amendments to this agreement, prior to its termination.

FOURTH. GOVERNANCE STRUCTURE.

All significant decisions regarding the collaboration will require consent by all the Parties. Significant decisions will include decisions regarding suitability for actions under this collaboration, the nature of the actions to be taken and decisions regarding seeking and using funding to carry out collaboration activities.

The decision-making body regarding the collaboration shall be the Management Committee (MC) and shall be responsible for the operational management of collaborative activities and efforts in order to implement the purpose of this agreement.

Each Party shall appoint one person within their organization to serve to the MC. Each member of the MC shall be authorized to represent their organization in joint collaborative decision-making. Each organization shall be responsible for ensuring that the person granted authority to represent their organization is kept informed regarding the operation of the collaboration and the identification of issues for joint discussion.

The responsibilities of the MC shall include: general supervision of this agreement, formulation of proposals and taking of decisions, promotion of contacts with other entities and with relevant initiatives, preparation of an Action Plan, preparation of progress reports and annual reports, addition or termination of Parties, risk management, etc.

The MC shall have one coordination meeting per year at least and further meetings can be called at any moment upon request of a majority of one half (1/2) of the Parties.

FIFTH. ACTION PLAN.

Each Party shall identify activities and actions to perform in order to reach the purpose of the agreement. These activities must be aligned with the purpose and the scope of this agreement. These activities shall be compiled and approved by the Management Committee in an Action Plan annually.

SIXTH. OBLIGATIONS OF THE PARTIES.

This agreement does not lead direct funding to the Parties. All cooperation and exchanges will be conducted using the available resources of the Parties.

Each Party shall assign employees of their respective organizations to carry out the work of the collaboration subject to the availability of resources. Each employee assigned to work with the collaboration will continue to function as an employee of the organization making the assignment.

Each Party shall commit the necessary resources to the collaboration subject to availability. The contribution from each Party shall include: the time and effort required for consistent representation and participation on the Management Committee and the resources of their organization required to ensure fulfillment of specific commitments described in this agreement.

Each Party shall notify to the Management Committee activities and actions to perform in order to reach the purpose of the agreement. This activities and actions will be incorporated to the Action Plan.

SEVENTH. ADDITION OF NEW PARTY.

The Management Committee can recommend the addition of other entities to the collaboration agreement. Upon the agreement of the Parties, additional entities may be invited to participate in the collaboration agreement. If the invited entities decide to participate, the Parties shall amend this collaboration agreement to include all participating organizations, with all Parties sharing equally in the rights and responsibilities described in this agreement.

EIGHTH. TERMINATION OF THE PARTICIPATION OF A PARTY.

Each Party retains the right to withdraw from this collaboration agreement upon giving the other Parties at least 30 days from a written notification of its decision to withdraw. The withdrawal of any Party from the agreement shall result in the termination of its participation in this collaboration agreement. The remaining Parties shall continue to work together under this agreement.

NINTH. EXTENSION OR AMENDMENT OF THIS AGREEMENT.

This agreement may be extended or amended only through unanimous agreement by the Parties. The decision to amend or extend the agreement, describing the agreed changes, shall be documented in writing, including the date of the amendment/extension, and the signatures of the Legal Representatives of each Party.

TENTH. LIABILITIES.

Each Party shall respect and abide by all applicable laws and regulations in force in the country where it is established and shall ensure that its personnel also respects and abides by all such laws and regulations. Each Party shall also comply with relevant rules concerning equal opportunities, protection of environment, financial management, branding, and EU and national public procurement rules.

Each Party shall be responsible for the liabilities towards third parties arising out of their own conduct and the conduct of their officers, employees and agents as related to the activities under this agreement.

No Party shall be responsible to any other Party for any indirect or consequential loss or similar damage such as, but not limited to, loss of profit, loss of revenue or loss of contracts, provided such damage was not caused by a wilful act.

For any remaining contractual liability, a Party's liability towards the other Parties shall be limited to damage caused by a wilful act or gross negligence.

ELEVENTH. CONFIDENTIALITY OF INFORMATION.

Each of the Parties undertakes not to disseminate, under any circumstances, scientific or technical information belonging to other Party to which it may have had access for the development of the work, notwithstanding the obligations in terms of active advertising and right of access to public information provided by national regulations. This paragraph shall not apply when:

- the receiving Party has evidences of previous knowledge of the information received;
- the information received is in the public domain;
- the receiving Party purchased this information from a third Party without confidentiality agreement.

The Parties agree that all the personnel participating in the assignment is aware and observe the confidentiality agreement specified in this clause.

The data and reports obtained during the implementation of joint works shall have a confidential character, unless otherwise stated. Where one of the Parties wish to use partial or final results, partly or wholly, for its publication as a paper, conference, etc, permission shall be requested to the other Party in writing and sent as registered mail to the Management Committee.

The other Party shall reply within thirty (30) days and report on its authorization, reservations or disagreement on the information included in the paper or conference. If no reply has been received after this period, silence shall be understood as the tacit authorization for its dissemination.

In publications as well as in patents, the authors of the work shall always be mentioned; in patents they will appear as inventors. In any type of dissemination of results this agreement shall always be referred to.

The provisions of this confidentiality clause shall remain during three (3) years after the termination of this agreement.

TWELFTH. PROPERTY RIGHTS.

The intellectual and industrial property rights that the Parties provide as prior knowledge for the development of the agreement will always be their property. Each Party grants the other Party access rights to its prior knowledge when this is necessary for the performance of the work of this agreement and during its duration.

If the results of the H2020 project above mentioned are used, it should be done in compliance with the regulations on property and exploitation rights contained in the signed consortium agreement between the partners.

The rights to the results of the agreement will belong to the Party that has carried out the work. When different Parties have jointly generated a result, on which it is not possible to determine the individual contributions of each of the Parties, or when it is not possible to separate such a joint result for the purpose of requesting, obtaining or maintaining intellectual property titles or industrial, the Parties will have joint ownership of the aforementioned result. The respective Parties shall agree upon the details of such joint ownership in a separate agreement.

THIRTEENTH. TERMINATION OF AGREEMENT.

This agreement, signed under the principles of collaboration and good faith, shall terminate in the following cases:

- the end of the duration period
- the mutual agreement of the Parties, expressed in writing
- failure to comply with the obligations contracted or with the provisions of the clauses established
- by judicial decision declaring the nullity of the agreement
- the general ones in force by the current legislation

If, during the term of this agreement, it is proved the existence of any of the causes of termination expressed above, the termination of the agreement shall be requested, for which, the Party that has detected such existence must notify it to the Management Committee, within a maximum period of ten (10) days since knowledge, in accordance with

the provisions of the legislation regulating the common administrative procedure and the rest of the regulations that may be applicable.

In each specific case, depending on the specific cause of termination, and in view of the situation of the actions in progress, the Parties shall establish the manner of termination of the actions.

The provisions set out in the confidentiality and property rights clauses shall remain in effect after the termination of this agreement.

FOURTEENTH. PERSONAL DATA PROTECTION AND SENSITIVE INFORMATION.

The Parties expressly agree to abide by the principles, provisions and security measures set forth in the General Data Protection Regulation UE 2016/679 and any other applicable regulations in force or that are promulgated in the future on personal protection data.

The purpose of the processing of personal data shall have the purpose that is stipulated in this agreement and the administrative management thereof. In the development of such purposes, each Party shall have the status of data controller.

The legal basis for the treatment of your personal data is the execution of this agreement, as well as its authorization to execute the same and the purposes described in it.

The data will be kept under the applicable legislation in commercial, criminal and civil law, as long as there is a relationship between the parties. In general, the personal data will not be communicated to third parties, nor transferred to third countries except for legal obligations and only subject to the applicable Data Protection Laws and Regulations.





FIFTEENTH. JURISDICTION.

All Parties will pursue the aims detailed here within in the spirit of friendship, mutual trust and respect.

For matters not expressly provided herein, this agreement shall be subject to the provisions of the Belgian laws.

The Parties agree to negotiate in good faith any dispute concerning a question of fact arising under this agreement.














In witness whereof, so that this may be officially recorded for the stipulated purposes, this agreement is signed in four copies, on the signature date by all the Parties.










ENTITY	SIGNATURE AND DATE
FOR THE ENTITY N° 1 UNIVERSITAT POLITÈCNICA DE VALÈNCIA M ^a Belèn Picó Sirvent Vice-Rector for Research	
FOR THE ENTITY N° 2 Friedrich-Alexander-Universität Nürnberg Annette Spletter Head of EU Grants and Contracts	Erlangen- <i>January 31, 2022</i> <i>r. A. Annette Spletter</i>
FOR THE ENTITY N° 3 Interdepartmental Centre Giorgio Levi Cases for Energy Economics and Technology Alberto Bertucco Director	
FOR THE ENTITY N° 4 Asociația "Societatea Română Geoexchange" (RO) / Romanian Geoexchange Society (EN) Gavriliuc Robert President	 

5.2 List of participants.

5.2.1 Valencia, Spain


List of people attending in presence:

		 			
European Centers of Excellence Advanced Shallow Geothermal Course [VALENCIA], [SPAIN] Dates from September 25 th , 2023 – to September 26 th 2023					
	Name	ID	Country	Signature Day 1 [25/09/2023]	Signature Day 2 [26/09/2023]
1	Rafael Vidal	48683867-C	Spain		
2	Alvaro Martínez	49573074-12	Spain		
3	Hossein Jevodi	48247506L	Spain		
4	Miguel A. MATEO PLA	52725242 L	Spain		
5	BORJA BARRALES	37471754-P	SPAIN		

		 			
Name	ID	Country	25/09/23	26/09/23	
6	JAVIER F. VECINOJA	19 846 90 8 R	Spain		
7	BERNO ARMEJUDT	21007441 T	SPAIN		
8	ADELA RAMOS ESCOBERO	23029300K	SPAIN		
9					



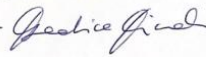


.....

Meeting Secretary
(Chair or local organiser)
Name + signature:




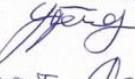
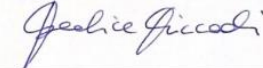

 BORJA BARRALES

5.2.2 Padova, Italy

- September 25th 2023 – Morning and afternoon:

1	MARKUS EDISON KEU -- MASTER STUDENT - 
2	DENISE MAKOURA GUILAVOGHI - MASTER STUDENT 
3	BEATRICE RICCARDI - MASTER STUDENT 
4	NICOLA BORGATO - PhD STUDENT 
5	GONCA GÖRMEZ - VISITING STUDENT 
6	DAN AZIMI MOHAMMAD - Ph.D Student dept of Geoscience




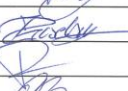





- September 26th 2023 – Morning and afternoon:

1	NICOLA BORGATO - PhD STUDENT 
2	MARKUS EDISON KEU - MASTER STUDENT. 
3	DENISE MAKOURA GUILAVOGHI MASTER STUDENT 
4	GONCA GÖRMEZ VISITING STUDENT 
5	BEATRICE RICCARDI - MASTER STUDENT 




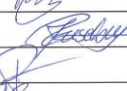





5.2.3 Oradea, Romania

List of people attending in presence:

ATTENDANCE LIST
Romanian ECoE - Oradea - TERMOLINE Company
25.09.2023

No.	Name	Signature
1	MAVĂȚĂ Ștefan-Flavin	
2	TIVĂDAR I. ADRIAN	
3	SPIN BOGDAN	
4	DRĂGAH SERGIU	
5	MINTENAS CSONCOR	
6	BAN SERGIU	
7	İRİNA PETRU ELISEBILĂ	
8	COPL TRAIAN	
9	OCTAVIAN BUȚOR	
10		
11		
12		

ATTENDANCE LIST
Romanian ECoE - Oradea - TERMOLINE Company
26.09.2023

No.	Name	Signature
1	MAVĂȚĂ Ștefan-Flavin	
2	TIVĂDAR I ADRIAN	
3	SPIN BOGDAN	
4	DRĂGAH SERGIU	
5	MINTENAS CSONCOR	
6	BAN SERGIU	
7	İRİNA PETRU ELISEBILĂ	
8	COPL TRAIAN	
9	OCTAVIAN BUȚOR	
10		
11		
12		

5.2.4 List of online participants

First name	Last name	Qualification
Agapi	Orfanoudaki	Undergraduate
Aisling	Cunningham	Final year of undergraduate
Alessandra	Insana	PhD student
Alessandro	Bortolin	-
Alina Mihaela	Nistor	Master student
Anastasis	Ladas	University degree
Andra	Ungureanu	University degree
Andreas	Koutelidakis	Master of Science in geothermal field
Anna Karina	Mureşan	Master student
Bahadir	Kivanc	PhD student
Bianca-Florina	Gliga	Master student
Calin	Alexandru	Master student
Cecilio	Morales	Geophysics Master degree
Cristina	de Santiago	PhD student
Cristina-Adina	Vasile	Master student
David	Sorrentino	University degree
Elife	Arpaci	Padova University
Enrico	Zampieri	-
Eva	Henneken	Master student
Fatemeh	Isania	PhD student
Fatemeh	Pazoki	PhD student
Fodor	Loredana	Master student
Francesco	Ottaviani	Master student
Francesco	Scuderi	PhD student
Hannes	Hagenauer	Master student
Hosam	Mohammed	Master student
Ignacio	Marzan	PhD student
Ionut Alexandru	Suciu	University degree
Iza	Martinez	University degree
Jan	Wagner	Master student
Joao	Figueira	PhD student
Jordi	Brunet Garcia	Master student
Josè	Salido	PhD student
Kire	Stavrov	Master student
Laura	Vallese	Master student
Lorenzo	Jardini	University degree
Maria Romana	Alvi	Master student
Marina	Facci	PhD student
Mattia	Chinello	University degree
Mélissa Fabiola	Yozy keptdib	Master student
Mert	Güner	PhD student

Mihailov	Florin Vladimir	PhD student
Milen	Perez	Master student
Montse	Colomer	University degree
Neculai	Negut	University degree
Nicola	Mutinelli	University degree
Norbert	Caldera	PhD student
Oliver	Suft	Early Career Academic
Pablo	Soler	University degree
Razvan-Silviu	Stefan	PhD student
Ruxandra	Ceausu	Undergraduate
Salvador	Martínez	Master student
Sandeep	Bandarwadkar	PhD student
Sara	Franzè	Master student
Sebastian	Toie	Master student
Sebastian	Parfene	Master student
Semra	Polat	Master student
Simona	Adrinek	Master student
Simone	De Feudis	PhD student
Sodiq	Oguntade	Master student
Stylianos	Karagkiozis	Master student
Tadele Dagne	Ewunetu	University degree
Tarlea	Gratiela	SRG member PhD Engineer
Tiberiu	Catalina	PhD student
Truia	Florin	University degree
Tugba	Gurler	Early Career Academic
ugur can	erginag	PhD student
Yuliaa	Demchuk	-