European Modular Course System for Massive Online Open Course (MOOC) to optimize and extend the existing GEOTRAINET training framework

Milestone 9

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1. Executive Summary

This document presents the development of a European Modular Course System for a Massive Open Online Course (MOOC) designed to optimize and extend the existing GEOTRAINET training framework. Despite substantial European efforts to promote knowledge dissemination and professional training in shallow geothermal and Ground Source Heat Pump (GSHP) technologies, significant gaps remain in terms of harmonization, accessibility, and adaptation to national market needs. This deliverable addresses these gaps through the systematic compilation and structuring of existing European and national training materials, resulting in a coherent, modular, and scalable EU-wide online training system that ensures homogeneous coverage of core technological aspects while allowing flexibility for country- and profile-specific requirements.

The training system is structured into two complementary layers. The first layer focuses on awareness-raising, primarily targeting municipal-level stakeholders such as policymakers, planners, permitting authorities, and regulatory agents, and is implemented through an open-access MOOC format. The second layer is oriented toward professional certification, targeting technical profiles including GSHP installers and drillers. In this context, the deliverable establishes a training framework aligned with EQF levels 1–3, supporting the harmonization of learning outcomes, competencies, and quality standards across Europe, and enabling future recognition and professional mobility through instruments such as EUROPASS.

In addition, this document assesses the current status and potential routes for the establishment of a European professional certification scheme for GSHP drillers and installers. This assessment provides a comparative analysis of national certification systems, identifies regulatory, training, and market-related barriers, and outlines strategic roadmaps for extending and aligning existing qualifications across partner countries. Within this framework, the developed MOOC is positioned as a common foundational training component, supporting the long-term objective of a harmonized, high-quality European certification system that strengthens workforce competence, installation quality, and the overall deployment of shallow geothermal technologies across the EU.

2. Introduction

As the designated leader of WP5 Technology and business solutions and Task T5.2, UPV, undertook the development of the European Modular Course System for Massive Online Open Course (MOOC), aimed at optimizing and extending the established GEOTRAINET training framework. The initial deadline for this deliverable was Month 24; however, recognition of the extensive and intricate scope required for a high-quality, impactful outcome necessitated a formal extension to the project's end date. This strategic decision was made to ensure the final product, a comprehensive MOOC, was as promising as possible.

This deliverable addresses a significant need within the geothermal sector. Despite considerable European investment in knowledge dissemination and professional qualification frameworks (including projects such as GEOTRAINET, REGEOCITIES, Cheap-GSHPs, GEO4CIVHIC, and more recent initiatives like Geo2Spain or "leergang Bodemenergie"), a demonstrable potential for improvement exists in the popularization and effective dissemination of Geothermal Heat Pump (GHP) technologies. The core objective of T5.2 was the comprehensive compilation and synthesis of this existing material to construct an EU-wide modular system of online teaching courses. This system was explicitly designed to offer both homogenous, qualified coverage of essential common technological aspects, and the adaptability required to meet the specific country and skill-level requirements of various trainees, leveraging the credibility of the GEOTRAINET label and network.

3. MOOC Design

The resultant training framework was structured into two distinct layers. The first layer focused on awareness, targeting key municipal stakeholders, including decision-makers, planners, regulatory compliance agents, and thermal installation certification authorities. The Massive Open Online Course (MOOC) was the primary output designed for this audience.

The second layer focused on establishing a certification framework for technicians (installers, drillers, etc.) and defining the extension of professional qualifications at EQF levels 1-3 for the "Shallow Geothermal Installer" qualification, with content harmonization to facilitate professional mobility via systems like EUROPASS. The aim was the establishment of Roadmaps for the extension of already existing qualifications to the rest of partner countries, the elaboration of guidelines and materials, and the organization of seminars and courses with the relevant officials belonging to the countries and with key competences in their National Qualification Systems.

3.1 Preliminary Table of Contents

The initial stage of development involved the UPV team proposing a preliminary Table of Contents for the MOOC. This draft served as the basis for a series of multilateral online meetings involving all contributing partners, a crucial step undertaken to solicit feedback, integrate expert opinion, and ensure eventual agreement on the foundational course structure.

Draft of Table of Contents for Massive Online Open Course (MOOC)	Related Project	Partner(s) in Charge	Contact Person(s)	Contributing Person(s)
1. Introduction to Geothermal Fundamentals	"GEOPLASMA-CE", "ISSO 39, 72, 73"			
a. Overview of geothermal energy		GEK	schnabl@geoenergie-konzept.de	henk.witte@groenholland.nl
b. Types of geothermal systems		GEK	schnabl@geoenergie-konzept.de	henk.witte@groenholland.nl
c. Principles of heat transfer in geothermal systems		GEK	schnabl@geoenergie-konzept.de	henk.witte@groenholland.nl
d. Short introduction to GSHP systems		GEK	schnabl@geoenergie-konzept.de	henk.witte@groenholland.nl
2. Ground Source Heat Pumps (GSHP) Systems	"GEOCOOL"			
a. HP technology				henk.witte@groenholland.nl
b. GSHP systems (e.g., closed-loop, open-loop)		GEK	schnabl@geoenergie-konzept.de	
c. Water to water heat pump systems				
d. Aquifer thermal energy storage (ATES)				
e. Borehole thermal energy storage (BTES)				
f. Components and operation of GSHPs				
g. Efficiency and performance metrics				henk.witte@groenholland.nl
h. Technical aspects relating to GSHPs				
3. GSHP System Sizing and Installation	"GEO4CIVHIC", "GEOTRAINET", "CHEAP-GSHPS", "QQI 6N5646 Component Award in Domestic Heat Pump Systems Level"			
a. Designing and sizing considerations for GSHP systems		UPV	hjavadi@upv.es	henk.witte@groenholland.nl
b. Planning and thermal interference management				
c. Installation procedures and best practices				
4. Ground Heat Exchangers (GHE)	"GEOPLASMA-CE", "GEO4CIVHIC", "GEO2SPAIN", "CHEAP-GSHPS"			
a. Types of ground heat exchangers (e.g., vertical, horizontal)		UPV	hjavadi@upv.es	rpasquali@geoservsolutions.com; henk.witte@groenholland.n
b. Design and installation of ground heat exchangers		UPV	hjavadi@upv.es	henk.witte@groenholland.nl
c. Thermal conductivity and heat transfer in the ground		UPV	hjavadi@upv.es	henk.witte@groenholland.nl
5. Geology and Mapping Techniques	"GEO4CIVHIC", "GEOPLASMA-CE", "MUSE", "CHEAP-GSHPS", "GEOCOND"			
a. Geological formations relevant to shallow geothermal energy		GSA	cornelia.steiner@geosphere.at	schnabl@geoenergie-konzept.de
b. Techniques for site characterization and geological mapping				schnabl@geoenergie-konzept.de
c. Identifying suitable locations for GSHP installations				schnabl@geoenergie-konzept.de
6. Drilling Techniques and Training for Shallow Geothermal Systems	"GEO4CIVHIC", "GEO2SPAIN", "CHEAP-GSHPS", "GEOTRAINET", "Level 6 Higher Certificate qualification - GEODRILLING", "Leergang Bodemenergie (NL)", "GEOTECH"			
a. Overview of drilling methods, equipment, and safety protocols				schnabl@geoenergie-konzept.de;guus.van.gelder@groenholland
b. Practical considerations for successful drilling projects				rpasquali@geosrevsolutions.com; guus.van.gelder@groenhollan
c. Training for drillers on GSHP system installation and completion				guus.van.gelder@groenholland.nl
7. Environmental Impact Assessment in Shallow Geothermal Energy	"GEO4CIVHIC", "CHEAP-GSHPS", "GEOPLASMA-CE"			
a. Environmental considerations in shallow geothermal projects		GSA	marlon.brancher@geosphere.at	rpasquali@geoservsolutions.com
b. Assessing and mitigating potential environmental impacts		GEOSERV	rpasquali@geoservsolutions.com	acunnigham@geoservsolutions.com;henk.witte@groenholland.
8. Regulatory Compliance and Permitting (for each country)	"GEO4CIVHIC", "CHEAP-GSHPS", "GEOPLASMA-CE", "GEO2SPAIN", "BRL 11000 / Protocol 11001", "BUM/HUM Bodemenergie", "REGEOCITIES"			
a. Permitting processes for shallow geothermal installations				schnabl@geoenergie-konzept.de; henk.witte@groenholland.n
b. Compliance with local, municipal, and national regulations				schnabl@geoenergie-konzept.de
c. Codes and standards relevant to shallow geothermal systems				schnabl@geoenergie-konzept.de;henk.witte@groenholland.n
d. Administrative Procedures, Legislation & Regulation				schnabl@geoenergie-konzept.de;henk.witte@groenholland.n
e. Guidelines for regulators and policy makers		UPV	hjavadi@upv.es	schnabl@geoenergie-konzept.de
9. Monitoring and Maintenance of Shallow Geothermal Systems	"GEOPLASMA-CE"			
a. Monitoring equipment and techniques for system performance		UPV	hjavadi@upv.es	schnabl@geoenergie-konzept.de;henk.witte@groenholland.n
b. Regular maintenance procedures for GSHP systems				henk.witte@groenholland.nl
c. Troubleshooting common issues and optimizing system performance				henk.witte@groenholland.nl
10. Energy Efficiency Strategies for Buildings with GSHP Systems	"GEO4CIVHIC", "CHEAP-GSHPS", "GEOFIT", "ISSO 39, 72, 73", "IEA HPT Annex 52 - long term monitoring GSHP systems", "GROUND-MED"			
a. Integrating GSHP systems into building design				henk.witte@groenholland.nl
b. Energy-saving measures and technologies for efficient operation				henk.witte@groenholland.nl
c. Case studies highlighting energy-efficient buildings with GSHP systems				rpasquali@geoservsolutions.com
d. Historical and World Heritage Buildings			rpasquali@geoservsolutions.com	acunningham@geoservsolutions.com
11. Integration and Innovation in Shallow Geothermal Energy	ALL?			
a. Integration of shallow geothermal energy systems with other technologies (e.g., solar, hybrid systems)				schnabl@geoenergie-konzept.de
b. Emerging trends and innovations in the field of geothermal energy				schnabl@geoenergie-konzept.de

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Figure 1: Preliminary table of contents.

3.2 Modules & Submodules

Following iterative consultation and refinement, the content was consolidated into a final, compact, and agreed-upon modular structure:

Welcome

- Welcome to the Specialization in Shallow Geothermal Energy: Skills Development and Training Across the EU
- Who is this MOOC for?
- Pre-Course Survey (highly encouraged)
- Course Structure & Schedule
- Learning Materials & Tools
- Discussions & Feedback
- Certificates

Module 1 (Part I): Introduction to Geothermal Fundamentals

1.1 Overview of Geothermal Energy

1.2 Types of Geothermal Systems and Principles of Heat Transfer

1.3 Geothermal Heat Pump (GHP) Technology

1.4 Ground Source Heat Pump - Systems

1.5 Combination of GHP Systems with other Renewables

1.6 Monitoring and Maintenance Procedures for System Performance

Final Evaluation - Module 1 (Part I) (13 Questions)

Module 1 (Part II): Introduction to Geothermal Fundamentals

1.7 Overview of Drilling Methods, Equipment, and Safety Protocols

1.8 Design Principles, Codes, and Standards

1.9 Environmental Considerations

1.10 Legal Framework and Permitting Processes

1.11 Troubleshooting General and Specific Issues of GHP Systems

Final Evaluation - Module 1 (Part II) (15 Questions)

Module 2: Energy Efficiency Strategies for Buildings with GHP Systems

2.1 Integrating GHP Systems into Building Design

2.2 Energy-Saving Measures and Technologies for Efficient Operation

2.3 Case Studies Highlighting Energy-Efficient Buildings with GHP Systems

Final Evaluation - Module 2 (15 Questions)

Module 3: Borehole Heat Exchangers (BHE)

3.1 Geological Parameters and Conditions

3.2 Site Characterization (Thermal Response Test)

3.3 Thermal Interference Management

3.4 Practical Considerations for Successful Drilling Projects

3.5 Guidelines of BHE for Regulators and Policy Makers

Final Evaluation - Module 3 (16 Questions)

Module 4: Groundwater Heat Exchangers (GWHE)

4.1 Geological and Hydrogeological Parameters and Conditions

4.2 Site Characterization (Pumping Tests)

4.3 Thermal Interference Management

4.4 Practical Considerations for Successful Drilling Projects

4.5 Guidelines of GWHP for Regulators and Policy Makers

Final Evaluation - Module 4 (16 Questions)

Module 5: Horizontal Collectors

5.1 Introduction to Horizontal Ground Heat Exchangers

5.2 Design of Horizontal Ground Heat Exchangers

5.3 Overview of Installation Methods, Equipment, and Safety Protocols

5.4 Guidelines of Horizontal Heat Collectors for Regulators and Policy Makers

Final Evaluation - Module 5 (18 Questions)

The final MOOC structure ensures full accessibility of all module and submodule content to participants, independent of their declared target group. The course follows a chronological learning path delivered over six weeks, with Module 1 spanning two weeks and subsequent modules each occupying one week.

3.3 Target Groups

Refinement of the course involved defining specialized target groups (Drillers, Decision Makers/Planners, Policy/Authority, Installers/Designers/Energy Consultants). Partners were instructed to utilize a shared online Excel file to adapt the content based on their expertise, past project involvement, and available resources, while also explicitly mapping specific subject matter to the corresponding target groups. The promotional outreach was broad, encompassing professionals, students, policy makers, and planners. The materials were designed to support both entry-level and technically inclined participants.

Keywords of the Topics:

1. Geothermal Fundamentals
2. GSHP System Sizing and Installation
3. Ground Source Heat Pumps (GSHP)
4. Ground Heat Exchangers (GHE)
5. Geology and Mapping Techniques
6. Drilling Techniques
7. Environmental Impact Assessment
8. Regulatory Compliance
9. Monitoring and Maintenance
10. Energy Efficiency in Buildings
11. Others

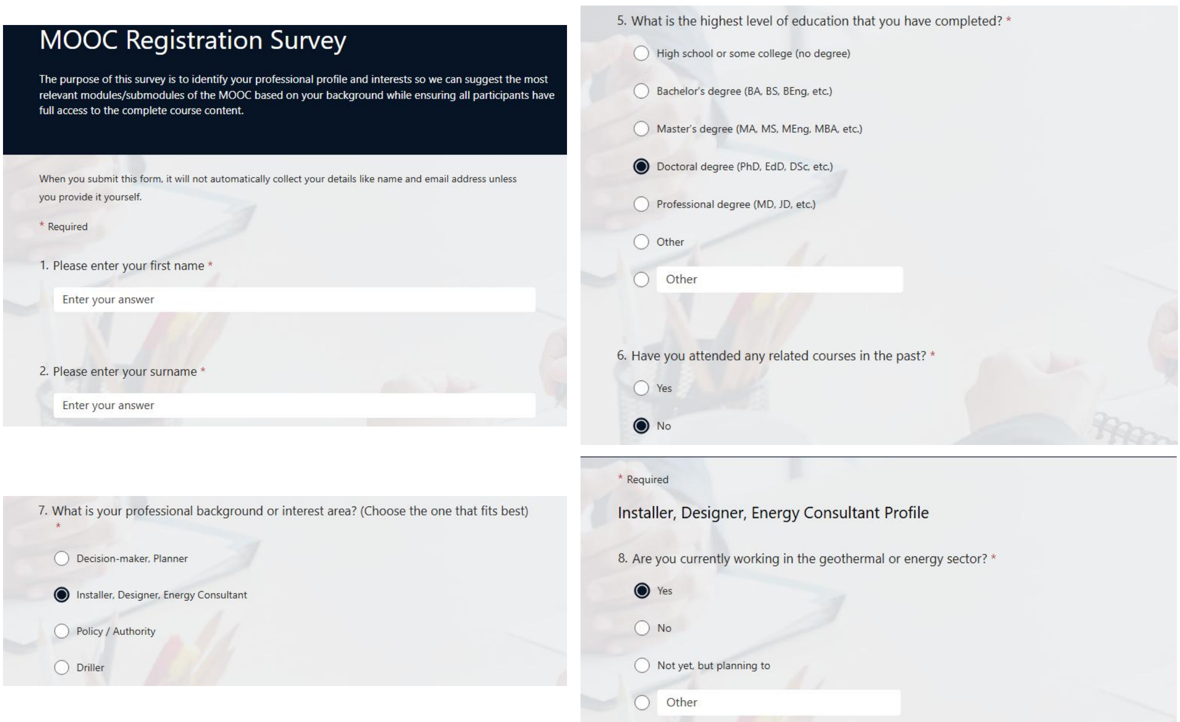
Project (SGE)	Checking the availability of the Training Material (Public/Private)	Topics Covered	Keywords Relevance	Uploading the PDF to the dropbox	Language of the Training material	Partner in Charge
GEO4CIVHIC	Public	Energy needs and technical solutions for efficient buildings	10	✓	English, French, German, Greek, Italian, Romanian, Spanish	UPV
		Geology and mapping	5			
		Drilling methodology, machines and heat exchangers	6,4			
		Geothermal heat pumps technology	3			
		Sizing GSHP and hybrid technologies	2			
		Environment and standards	7,8			
		Historical and World Heritage Buildings	10,11			
GeoPLASMA-CE	Public	Short introduction to GSHP systems	1	✓	English, Handbook also in German, Polish, Slovakian, Slovenian and Czech	GSA
		Methods and workflows how to estimate resources for BHEs and GWHEs	5			
		Monitoring and regulatory compliance	8, 9			
MUSE	Public	Methods and workflows how to estimate resources for BHEs and GWHEs	5	✓	English	GSA
Geo2Spain	Expired	Level 1 - geothermal borehole assistant	1, 4, 6, 11	✓ There is no material for the practical part of the course, and the online part has already expired. The topic list has been uploaded.	Spanish	GEK
		Level 2 - drillers in geothermal installations.	5, 6, 8, 11			
		Level 3 - dimensioning and supervision of geothermal installations	1, 2, 5, 8,			
Leergang Bodemenergie (NL)	Private/Commercial	Programme for training for certification (legal requirement) in teh netherlands. Covers all aspects of ATES and BTES design, construcion and operation on different levels (5 courses in total)	1,2,3,4,5,6,8,9, 10	Material is commercially available	Dutch	GROENHOL
ISSO 39, 72, 73	Commercial	Building side systems and shallwo geothermal systems	1, 2, 3, 4, 10	Material is commercially available (www.isso.nl)	Dutch	GROENHOL
BRL 11000 / Protocol 11001	Public (www.sikb.nl)	Protocols for ATES and BTES installation, not trainin material as such but provides practical information and requirements for shallwo geothermal energy	1,2,3,4,5,6,8,9, 10	✓	Dutch	GROENHOL
BUM/HUM Bodemenergie	Public (www.sikb.nl)	Guidelines for regulators and policy makers	8	✓	Dutch	GROENHOL
Cheap-GSHPs	Public	Energy needs and technical solutions for efficient buildings	10	✓	English, Italian, French, Romanian, German, Spanish,	GEOSERV
		Geology and mapping	5			
		Drilling methodology, machines and heat exchangers	6,4			
		Geothermal heat pumps technology	3			
		Environment and standards	7,8			
Component Award in Domestic Heat Pump	Commercial	Heat Pump Installation and Commissioning (not specific to GSHPs)	2,3,9	material available only to paid participants	English	GEOSERV
Geotrainet	Public	Drillers training on installation and completion of GSHP systems and boreholes	4, 5, 6	✓	English	GEOSERV
		Designers training on sizing ans installing gshps	1,2,3			
REGEOCITIES	Public	overview of GHSP systems	1,3	✓	English	GEOSERV
		Technical Aspects relating to GSHPs	2, 4,6			
		Administrative Procedures, Legislation & Regulation	8,11			
Level 6 Higher Certificate qualification - GeoDrilling	Commercial	practical training in the use of drilling equipment and operating procedures as well as classroom training in areas such as: geology; geo-informatics; drilling equipment and operations; sample retrieval and processing; environmental management and stakeholder engagement; health and safety; and communications (general - not gshp specific)	6	material only for participants	English	GEOSERV

Figure 2: Preparation of a database to combine training materials for shallow geothermal energy from various European and national projects.

		Target groups:	Drillers	Decision Makers/ Planners	Policy/ Authority	Installers/ Designers/ Energy Consultants
1	**Introduction to Geothermal Fundamentals**					
1.1	Overview of geothermal energy		x	x	x	x
1.2	Types of geothermal systems and principles of heat transfer in geothermal systems		x	x	x	x
1.3	HP technology		x	x	x	x
1.4	GSHP systems (e.g., groundwater heat exchangers, ATES, borehole heat exchangers, BTES, collectors)		x	x	x	x
1.5	Combination of GHP systems and with other renewables, integration of GHP in low temperature grids		x	x	x	x
1.6	Monitoring and Maintenance Procedures for System Performance (BHE, GWHE, Horizontal)			x	x	x
1.7	Overview of drilling methods, equipment, and safety protocols (BHE, GWHE)		x	x		
1.8	Designing (incl. Codes and Standards) (BHE, GWHE)			x		x
1.9	Environmental considerations (protection areas etc.) (BHE, GWHE)		x	x	x	x
1.10	Legal framework and permitting processes (BHE, GWHE, Horizontal)		x	x	x	x
1.11	Troubleshooting general and specific issues of GSHP systems (BHE, Horizontal, GWHE)			x		x

Figure 3: Creation of target groups for each submodule.

To personalize the learning journey, a pre-course survey was integrated into the MOOC's welcome material to suggest relevant submodules to participants based on their expressed interests, as illustrated below.



MOOC Registration Survey

The purpose of this survey is to identify your professional profile and interests so we can suggest the most relevant modules/submodules of the MOOC based on your background while ensuring all participants have full access to the complete course content.

When you submit this form, it will not automatically collect your details like name and email address unless you provide it yourself.

* Required

1. Please enter your first name *

Enter your answer

2. Please enter your surname *

Enter your answer

5. What is the highest level of education that you have completed? *

- High school or some college (no degree)
- Bachelor's degree (BA, BS, BEng, etc.)
- Master's degree (MA, MS, MEng, MBA, etc.)
- Doctoral degree (PhD, EdD, DSc, etc.)
- Professional degree (MD, JD, etc.)
- Other
- Other

6. Have you attended any related courses in the past? *

- Yes
- No

7. What is your professional background or interest area? (Choose the one that fits best) *

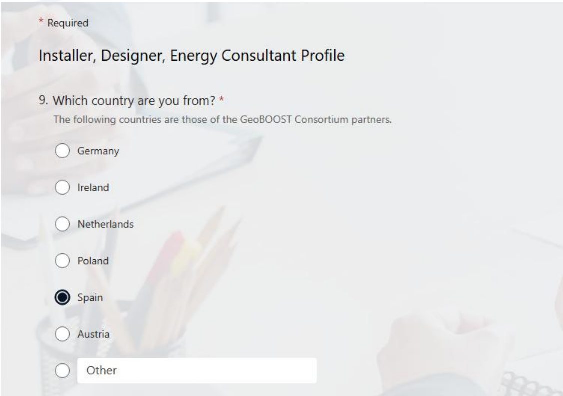
- Decision-maker, Planner
- Installer, Designer, Energy Consultant
- Policy / Authority
- Driller

* Required

Installer, Designer, Energy Consultant Profile

8. Are you currently working in the geothermal or energy sector? *

- Yes
- No
- Not yet, but planning to
- Other




Suggested (but not limited) Submodules for Installer, Designer, Energy Consultant - Spain

Module 1: Introduction to Geothermal Fundamentals
- Submodule 1.1 Overview of Geothermal Energy
- Submodule 1.2 Types of Geothermal Systems and Principles of Heat Transfer
- Submodule 1.3 Geothermal Heat Pump (GHP) Technology
- Submodule 1.4 Ground Source Heat Pump - Systems
- Submodule 1.5 Combination of GHP Systems with other Renewables
- Submodule 1.6 Monitoring and Maintenance Procedures for System Performance
- Submodule 1.7 Overview of Drilling Methods, Equipment, and Safety Protocols
- Submodule 1.8 Design Principles, Codes, and Standards
- Submodule 1.9 Environmental Considerations
- Submodule 1.10 Legal Framework and Permitting Processes
- Submodule 1.11 Troubleshooting General and Specific Issues of GHP Systems

Module 2: Energy Efficiency Strategies for Buildings with GHP Systems
- Submodule 2.1 Integrating GHP Systems into Building Design
- Submodule 2.2 Energy-Saving Measures and Technologies for Efficient Operation
- Submodule 2.3 Case Studies Highlighting Energy-Efficient Buildings with GHP Systems

Module 3: Borehole Heat Exchangers (BHE)
- Submodule 3.1 Geological Parameters and Conditions
- Submodule 3.2 Site Characterization (Thermal Response Test)
- Submodule 3.3 Thermal Interference Management
- Submodule 3.4 Practical Considerations for Successful Drilling Projects
- Submodule 3.5 Guidelines of BHE for Regulators and Policy Makers (Introduction & Spain)

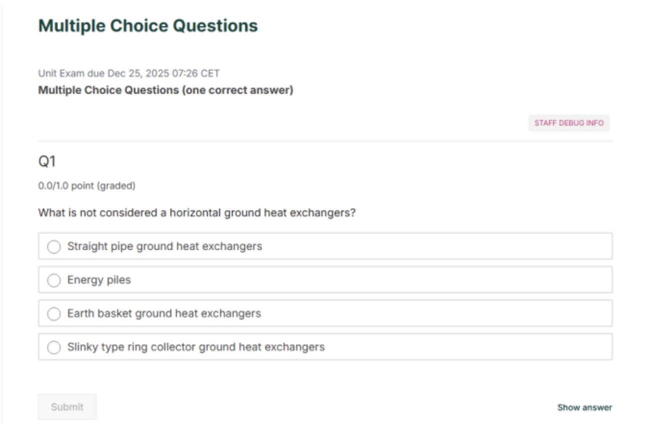
Module 4: Groundwater Heat Exchangers (GWHE)
- Submodule 4.1 Geological and Hydrogeological Parameters and Conditions
- Submodule 4.2 Site Characterization (Pumping Tests)
- Submodule 4.3 Thermal Interference Management
- Submodule 4.4 Practical Considerations for Successful Drilling Projects
- Submodule 4.5 Guidelines of GWHP for Regulators and Policy Makers

Module 5: Horizontal Collectors
- Submodule 5.1 Introduction to Horizontal Ground Heat Exchangers
- Submodule 5.2 Design of Horizontal Ground Heat Exchangers
- Submodule 5.3 Overview of Installation Methods, Equipment, and Safety Protocols
- Submodule 5.4 Guidelines of Horizontal Heat Collectors for Regulators and Policy Makers

Figure 4: MOOC pre-course survey and suggested submodules based on the chosen profile (as an example).

3.4 Learning Materials

The specialization's learning materials were standardized in consultation with the UPV[X] training center, featuring core content delivered via Video Lectures, supplemented by Reading Materials (PDFs/reports compiled from partners), and reinforced with Interactive Activities (quizzes and matching exercises) following each submodule. Professional presentation was ensured by hiring a video editor and graphic designer to develop standardized templates for all content. The course is free to audit, offering access to all core MOOC materials and submodule quizzes. However, the comprehensive exams following each module are only available to paid participants. Obtaining a verified certificate from edX requires an enrollment fee of approximately 42 EUR and achieving at least an 80% weighted grade across the entire course.



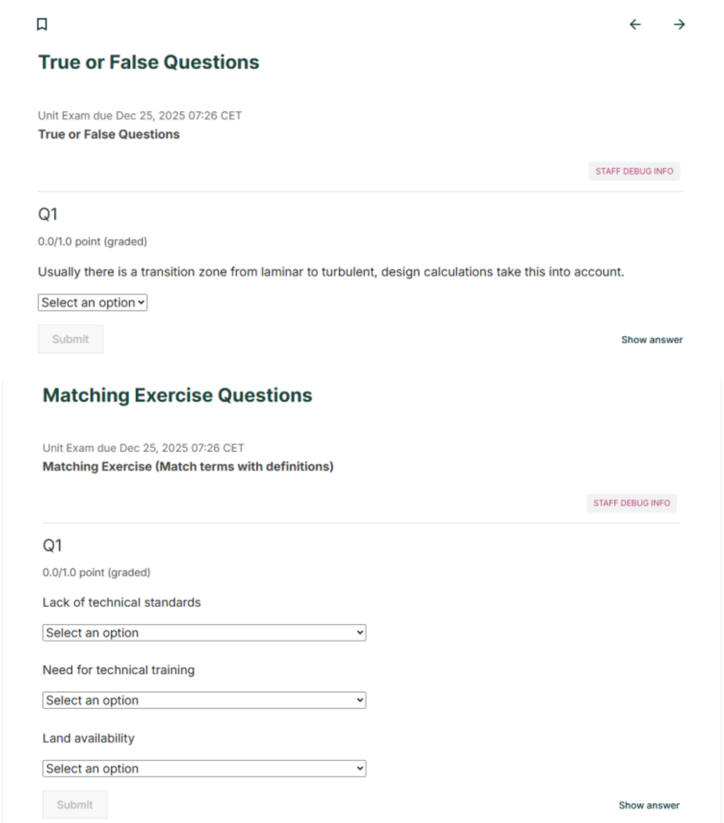


Figure 5: Three different types of MOOC questions.

4. Methodology

4.1 Partners' Responsibilities & Assignments

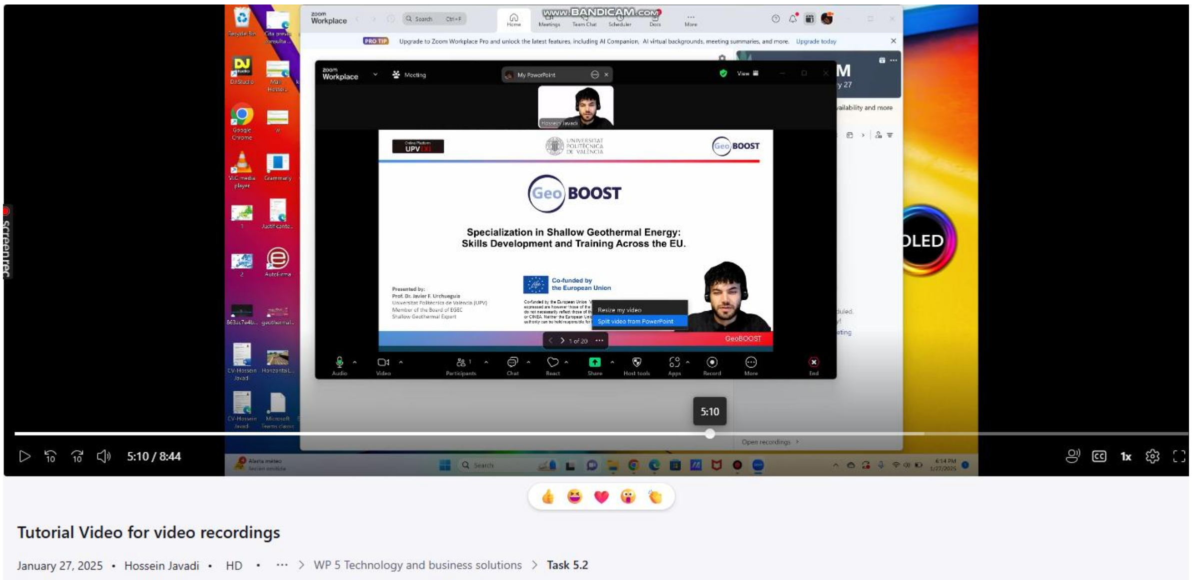
The assignment of content responsibility presented a significant challenge. While partners were initially invited to self-select submodules based on expertise, many cited the substantial anticipated workload and time constraints, often expressing doubt regarding feasibility and stating that the task was virtually impossible to accomplish. As the WP5 and Task T5.2 leader, the UPV team actively worked to find a solution, successfully pushing the partners forward. Eventually, the UPV team proactively intervened, assigning coordinator (main) and supporting partners for each submodule, basing these assignments on established partner specialty and area of work. This resolute approach, though demanding several months, secured final agreement on partner commitments, as presented in the final version of the table of contents.

		Partners in Charge (Please add your names relying on your past projects and expertise)						
1	Introduction to Geothermal Fundamentals	Partner 1 (Coordinator)	Partner 2	Partner 3	Partner 4	Partner 5	Partner 6	Partner 7
1.1	Overview of geothermal energy	UPV	GROENHOL/HW	Petr S. GEK				
1.2	Types of geothermal systems and principles of heat transfer in geothermal systems	GROENHOL/HW	Petr S. GEK					
1.3	HP technology	GROENHOL/HW	Petr S. GEK	Jakub K./PORTPC				
1.4	GSHP systems (e.g., groundwater heat exchangers, ATES, borehole heat exchangers, BTES, collectors)	K. Zosseder TUM	Petr S. GEK	GROENHOL/HW				
1.5	Combination of GHP systems and with other renewables, integration of GHP in low temperature grids	K. Zosseder TUM	Petr S. GEK					
1.6	Monitoring and Maintenance Procedures for System Performance (BHE, GWHE, Horizontal)	UPV	GROENHOL/HW					
1.7	Overview of drilling methods, equipment, and safety protocols (BHE, GWHE)	Ric Pasquali	ROTOTEC/Johnny, Björn					
1.8	Designing (incl. Codes and Standards) (BHE, GWHE)	Ric Pasquali, Aisling Cunningham	GROENHOL/HW					
1.9	Environmental considerations (protection areas etc.) (BHE, GWHE)	Ric Pasquali, Aisling Cunningham	K. Zosseder TUM					
1.10	Legal framework and permitting processes (BHE, GWHE, Horizontal)	Cornelia Steiner GSA	Ric Pasquali, Aisling Cunningham	GROENHOL/HW	K. Zosseder TUM			
1.11	Troubleshooting general and specific issues of GSHP systems (BHE, Horizontal, GWHE)	UPV						

Figure 6: Subjects assignment to the partners (as an example).

4.2 Tutorial and Pilot Videos

A major technical hurdle was standardizing the production of professional video recordings. A specific version of the ZOOM (version 6.2.11) software was identified as the only platform capable of simultaneously displaying the presenter's webcam (with a virtual background) and the presentation slides without completely blocking the view. The UPV team subsequently produced a comprehensive tutorial video demonstrating the precise recording procedure using this specific ZOOM version, followed by a post-processed pilot video to visually communicate the desired final product quality to the partners, helping them understand a process that was not initially straightforward.



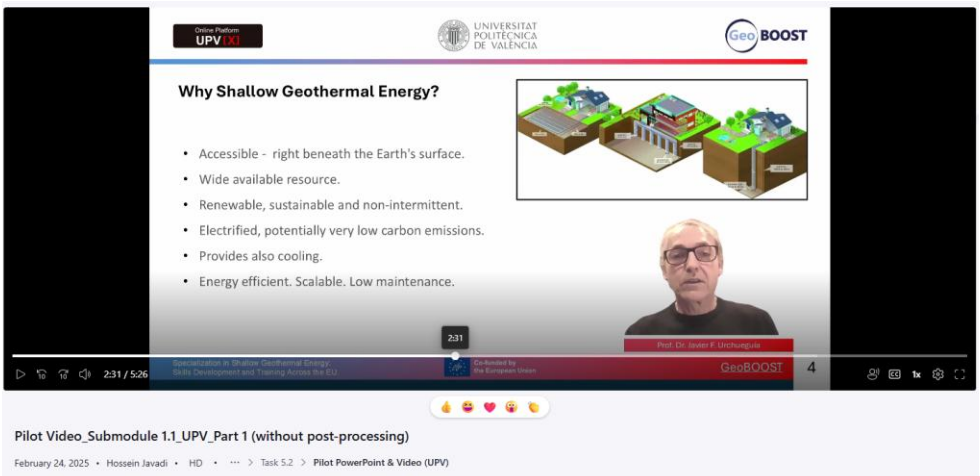


Figure 7: Tutorial and pilot videos made by UPV.

4.3 Development Steps & Progress Monitoring

The UPV team collaborated with the UPV[X] training center to outline a sequential, step-by-step process for material gathering and platform integration. This collaboration was key as the UPV[X] platform had a proven track record, especially among Spanish and Latin American audiences. The continuous monitoring of progress was managed through a dedicated Task Assignment document (shown below), consistently tracking the status of each submodule, as presented previously. During this phase, UPV[X] suggested leveraging their collaboration with edX, a leading global platform, to provide broader international visibility and significantly improve accessibility across the EU and worldwide.

Partner 1 (Coordinator)	Submodule	Status* Completed ✓, Ongoing ⌛				
		Video	Converted PPT into PDF	Additional PDF, Report…	Activities (Questions)	Post-Processed
Henk (GROENHOLLAND)	1.2	✓	✓		✓	✓✓
	1.3	✓	✓		✓	✓✓
	2.1	✓	✓		✓	✓✓
	2.3	✓	✓		✓	✓✓
	3.2	✓	✓		✓	✓✓
	3.3	✓	✓		✓	✓✓
	3.5	✓	✓		✓	✓✓
	5.1	✓	✓		✓	✓✓
	5.2	✓	✓		✓	✓✓
Petr, Zschoke (GEK)	3.1	✓	✓	✓	✓	✓✓
	5.3	✓	✓	✓	✓	✓✓
Kai & Javiera (TUM)	1.4	✓	✓	✓	✓	✓✓
	1.5	✓	✓	✓	✓	✓✓
	4.2	✓	✓	✓	✓	✓✓
	4.3	✓	✓	✓	✓	✓✓
	4.4	✓	✓	✓	✓	✓✓
	4.5	✓	✓	✓	✓	✓✓

RIC, Aisling, Joseph (GEOSERV)	1.7	✓	✓		✓	✓✓
	1.8	✓	✓		✓	✓✓
	1.9	✓	✓		✓	✓✓
	3.4	✓	✓		✓	✓✓
Cornelia, Marlon (GSA)	1.10	✓	✓		✓	✓✓
	4.1	✓	✓		✓	✓✓
Hossein, Borja, Javier (UPV)	1.1	✓	✓		✓	✓✓
	1.6	✓	✓		✓	✓✓
	1.11	✓	✓		✓	✓✓
	2.2	✓	✓		✓	✓✓

Figure 8: Partners' task assignment progress monitoring.

4.4 Material Collection

To enrich the course content, a shared repository on the GeoBOOST Sharepoint was created. Partners were formally requested to submit their available source materials (PDFs and reports) derived from previous relevant projects for inclusion in the MOOC database.

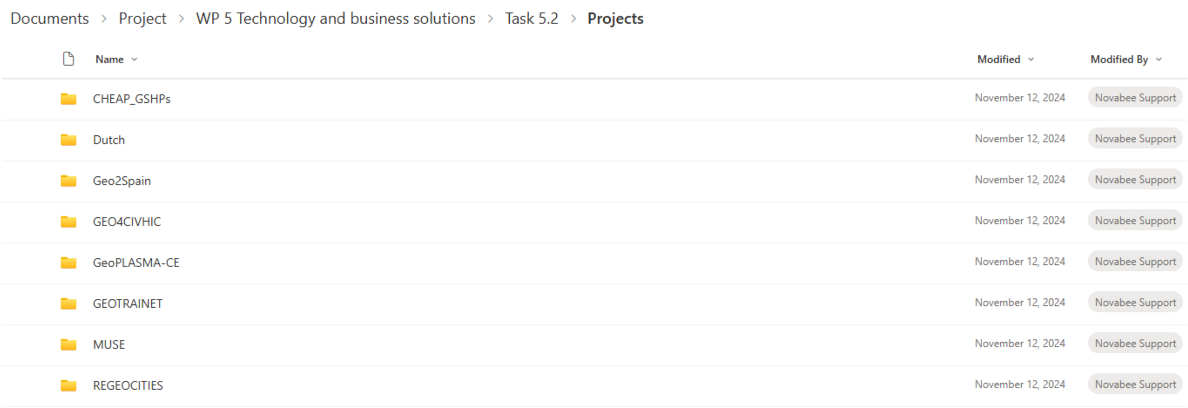


Figure 9: A shared repository to be served as MOOC database.

4.5 Video post-processing

The workflow for video post-processing was unexpectedly intensive. The UPV video editor was responsible for editing raw video submissions, incorporating professional intro/outro segments, and ensuring synchronization. However, the subsequent Quality Assurance (QA) review by both UPV[X] and edX personnel resulted in numerous, highly detailed technical and editorial comments on over 100 videos (e.g., deleting or adding zoom effects, addressing video length, sound clarity). This review effectively doubled the workload for the video editor and placed the UPV team under overwhelming pressure to address all issues. Although some comments about length or poor sound quality suggested re-recording, the UPV team successfully negotiated with the platforms to focus only on modifying the existing videos, as re-recording was deemed impossible given the elapsed time and the original D5.2 deadline. This critical negotiation allowed the project to move forward and secure the deadline extension from EGEC, the GeoBOOST coordinator, to the end of the project.

5. Launch and Dissemination

5.1 MOOC Launch in edX Platform

The MOOC, which represents a landmark achievement as the first comprehensive, compact course on Shallow Geothermal Energy in Europe at its time of release, was officially launched on the edX platform on October 1st. The UPV team collaborated closely with edX to transfer and adapt all materials for the MOOC format. The course parameters were defined as: 6 Weeks duration, English language, offered under a Free (Audit) or paid (Certificate, approx. 42€) cost model.

Figure 10: MOOC launch on edX platform.

Comprehensive learner support was provided via a continually monitored Support Forum (Q&A), with the UPV team continuously monitoring and interacting with the students.

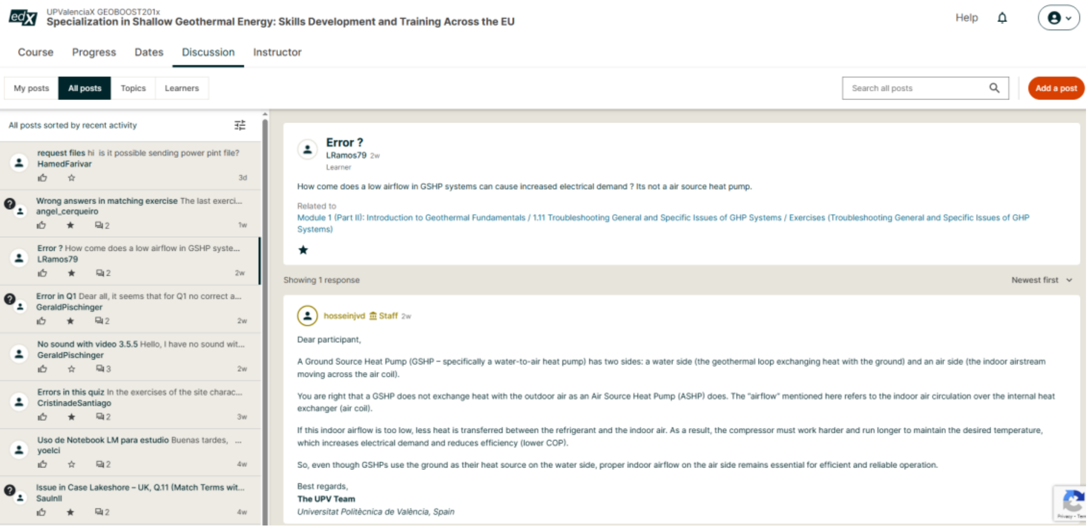
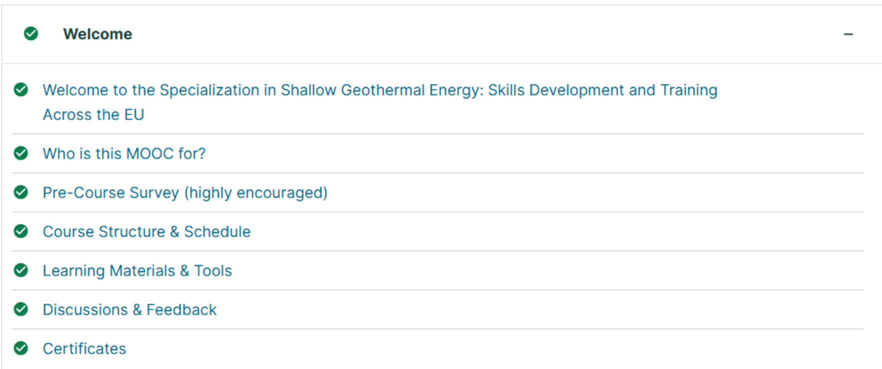


Figure 11: Discussion tab and communication with the participants in the edX platform.

The platform included a detailed Welcome section accompanying a welcoming video from UPV by Javier F. Urchueguía, as shown below, covering: Who is this MOOC for?, the highly encouraged Pre-Course Survey (above-mentioned in detail), Course Structure & Schedule, Learning Materials & Tools, Discussions & Feedback, and Certificates. The UPV team also prepared all necessary descriptions outlining what participants would learn and who the MOOC was for on the enrollment page.



Welcome to the Specialization in Shallow Geothermal Energy: Skills Development and Training Across the EU

Developed by a consortium of experts from across Europe, this MOOC brings together leading universities, research institutions, and companies in the geothermal sector. This EU-wide, modular online course offers standardized, high-quality education on **shallow Geothermal Heat Pump (GHP) systems**, while remaining adaptable to the diverse local needs of learners across Europe.

The course builds upon the lessons and outputs of several previous EU-funded projects, including **GEOTRAINET, REGEOCITIES, Cheap-GSHPs, GEO4CIVHIC, Geo2Spain, and Leergang Bodemenergie**, ensuring that learners benefit from the latest research, best practices, and practical insights in the field.

As a result, this MOOC represents the **first EU-level training initiative of this scale and structure** dedicated specifically to shallow geothermal energy.

We are delighted to welcome you to this European Massive Open Online Course (MOOC), developed within the **GEOBOOST Project** and funded by the **European Union**, and we hope it equips you with the knowledge and skills to advance sustainable geothermal solutions across Europe.

Please watch the following video from **Prof. Dr. Javier F. Urchueguía Schölzel**, Chairman of the **European Geothermal Panel** and faculty at **Universitat Politècnica de València**.

MOOC Welcome

Pre-Course Survey (highly encouraged)

Before you begin, we kindly invite you to participate in our **Pre-Course Survey**.

Your answers will help us:

- Understand your professional profile and interests.
- Recommend the most relevant modules and submodules for you (based on your role and country).
- Improve this course for future editions.

Participation is voluntary but **highly encouraged**.

Who is this MOOC for?

This MOOC is designed for a wide range of professional profiles:

- **Decision-Makers & Planners**
- **Policy / Authority Representatives**
- **Installers & Drillers**
- **Designers & Energy Consultants**
- Anyone interested in advancing **sustainable heating and cooling solutions** across Europe

Whether you are new to shallow geothermal energy or already experienced, this course offers both **introductory knowledge** and **applied training** through videos, readings, and interactive exercises.

Course Structure & Schedule

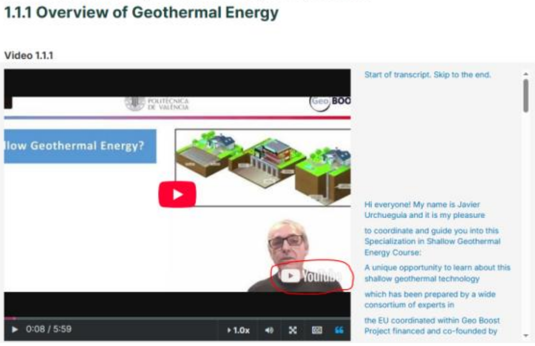
The MOOC consists of **5 modules** (with Module 1 divided into two parts):

- **Module 1 (Part I & II): Introduction to Geothermal Fundamentals**
  Recommended for the first two weeks (starting October 1, 2025, 4–5 hours/week).
- **Module 2 (Week 3): Energy Efficiency Strategies for Buildings with GHP Systems**
- **Modules 3–5 (Weeks 4–6):**
  - **Borehole Heat Exchangers**
  - **Groundwater Heat Exchangers**
  - **Horizontal Collectors**

Some submodules (**1.4, 1.5, 3.1, 4.2, 4.3, 4.4, 4.5, 5.3, and 5.4**) also include **additional PDF reading materials** alongside video lectures.

Learning Materials & Tools

- **Videos** are the **core of this course** and are available directly in edX with corrected English transcripts.
- If you want to watch the videos with **subtitles in your own language**, click on the **YouTube logo** in the corner of the video you are watching in the edX platform to go directly to YouTube.



Then, as shown in the screenshots below, follow the steps to activate auto-generated subtitles in the language of your choice. Once you are on **YouTube**, go to the **bottom-right corner** of the video and click on the **settings icon** (a small wheel).

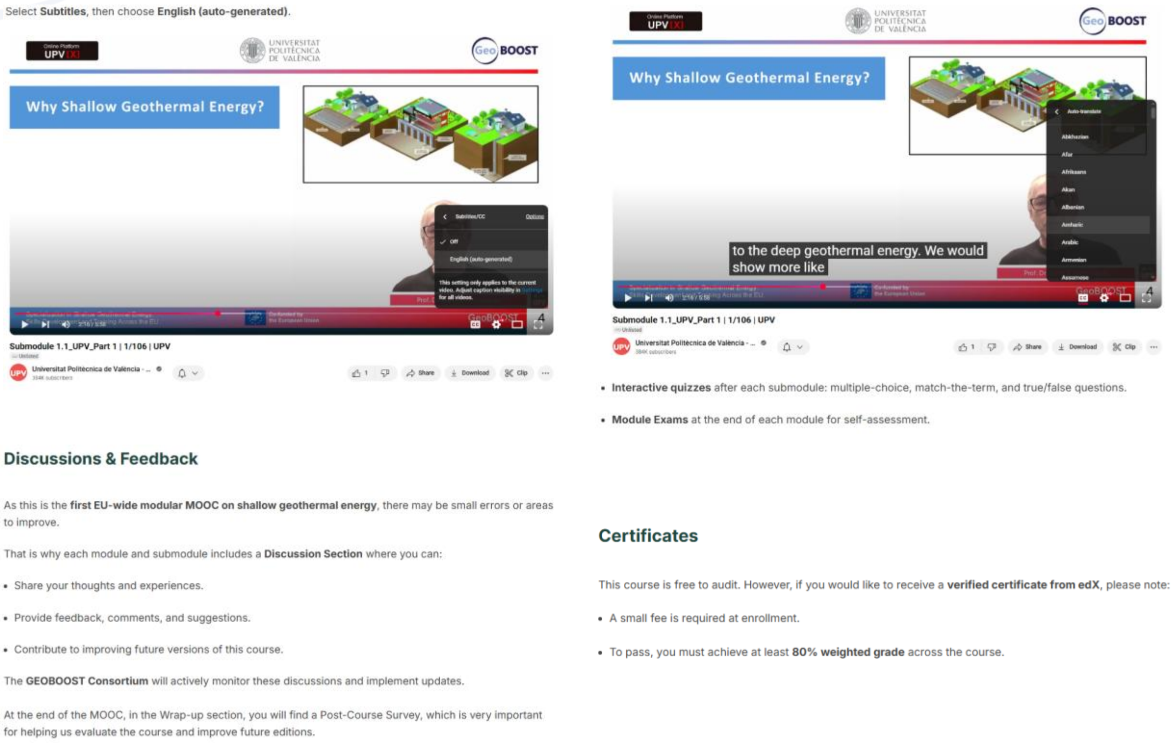


Figure 12: Welcome section of the MOOC and detailed info provided for the participants.

5.2 Promotion

A concerted promotional strategy was implemented to maximize visibility and enrollment. A promotional poster (presented below) was publicly debuted at the GeoBOOST meeting in Warsaw, Poland, followed by a presentation at the PORTPC congress, June 2025.

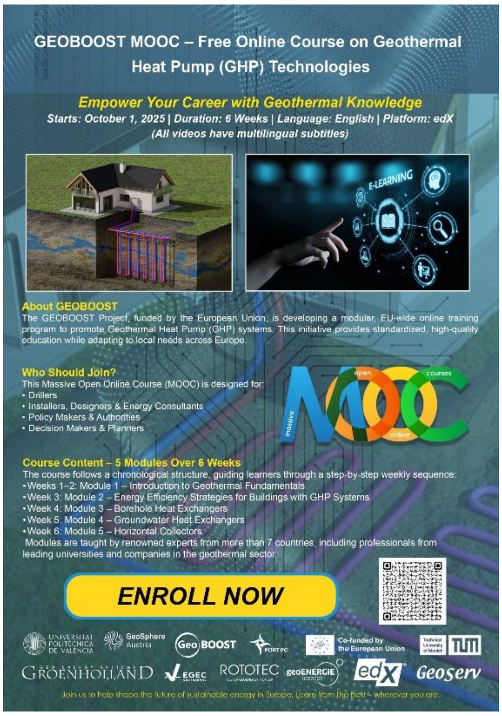


Figure 13: MOOC poster prepared for promoting.

This marked the first public introduction of the MOOC's content and value proposition. In addition to the GeoBOOST website (also EGEC social media and platform), the poster and materials were subsequently circulated among the entire GeoBOOST Consortium, urging broad promotion to companies, stakeholders, universities, and institutes. The MOOC enrollment page was supplemented with detailed descriptions and included short professional bios and profile pictures of the partners recorded videos for the MOOC, as can be seen below.

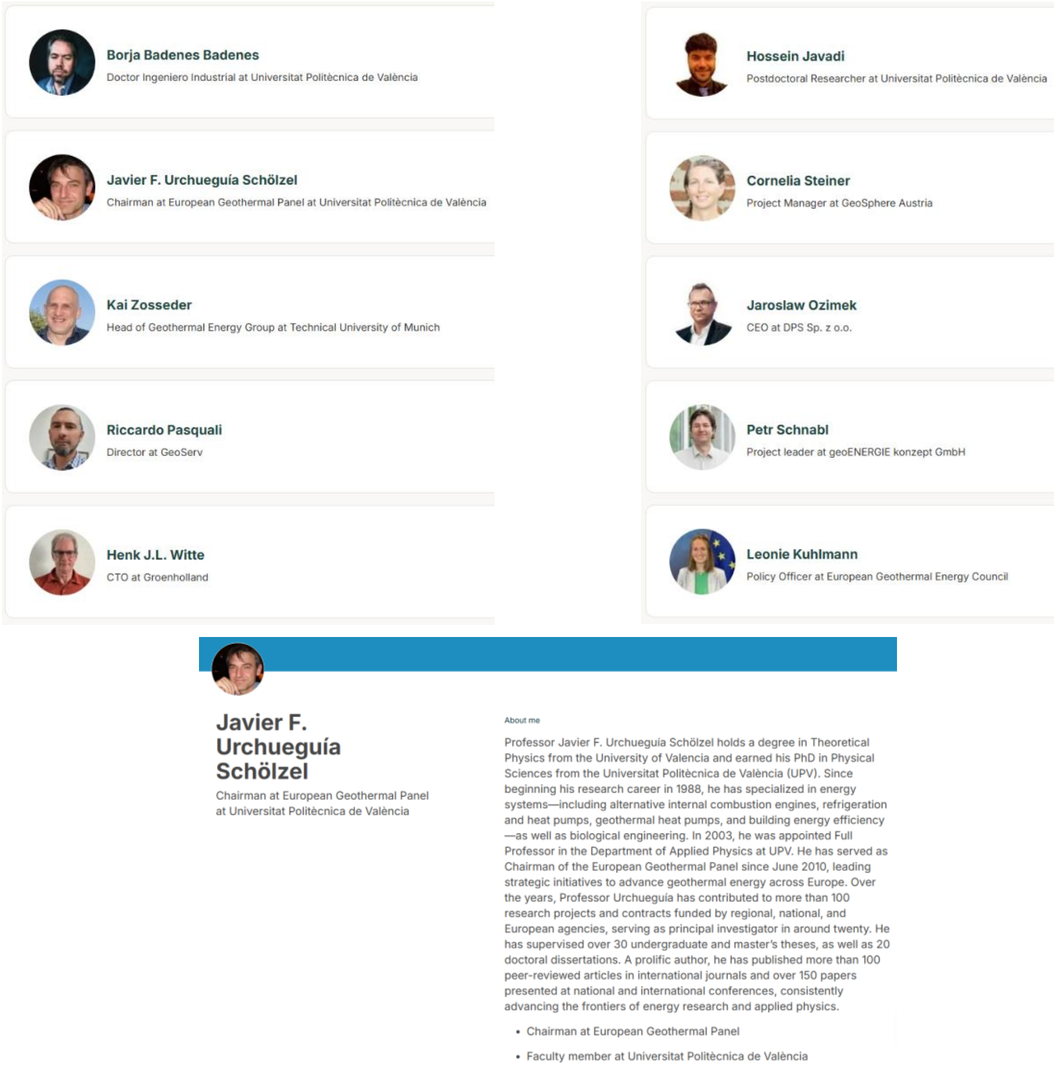


Figure 14: Introducing the partners recorded videos for the MOOC on edX platform.

6. Challenges & Recommendations

6.1 Technical & Organizational

Key technical challenges included the necessity of enforcing a specific software version (ZOOM) for consistent video production across geographically dispersed partners.

Organizationally, the sheer scale and minutiae of the external QA review process imposed a substantial, unexpected burden on the UPV coordination team and the video editor, requiring extensive time negotiation and adaptation.

6.2 Partner Coordination

The primary challenge in coordination was overcoming the initial reluctance from partners regarding the commitment required for content development, necessitating a firm yet collaborative assignment of responsibilities by the Task leader.

6.3 Recommendations

Based on the experience, future projects of this scale should allocate a more substantial and realistic timeframe dedicated specifically to collaborative content production, post-production quality control, and platform-level review cycles to mitigate unforeseen delays.

7. Enrollment & Participants

The MOOC launch on October 1st was a notable success. By November 11th (six weeks post-launch), the course achieved encouraging and promising participation figures, as confirmed by the screenshots showing the outcomes and enrollments:

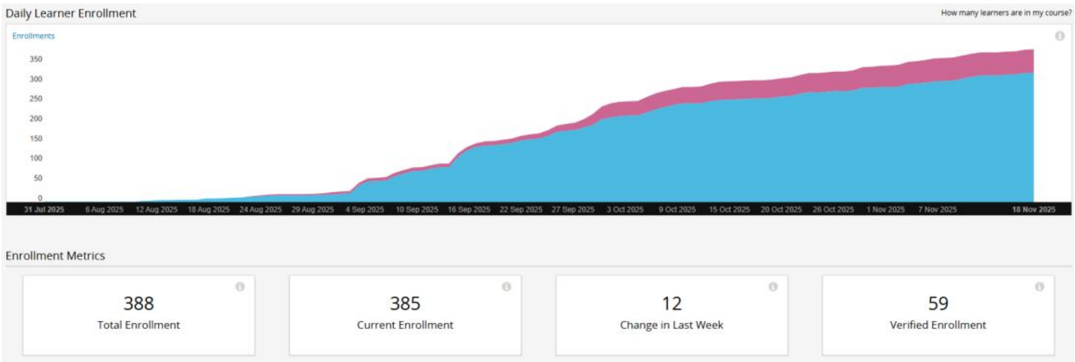
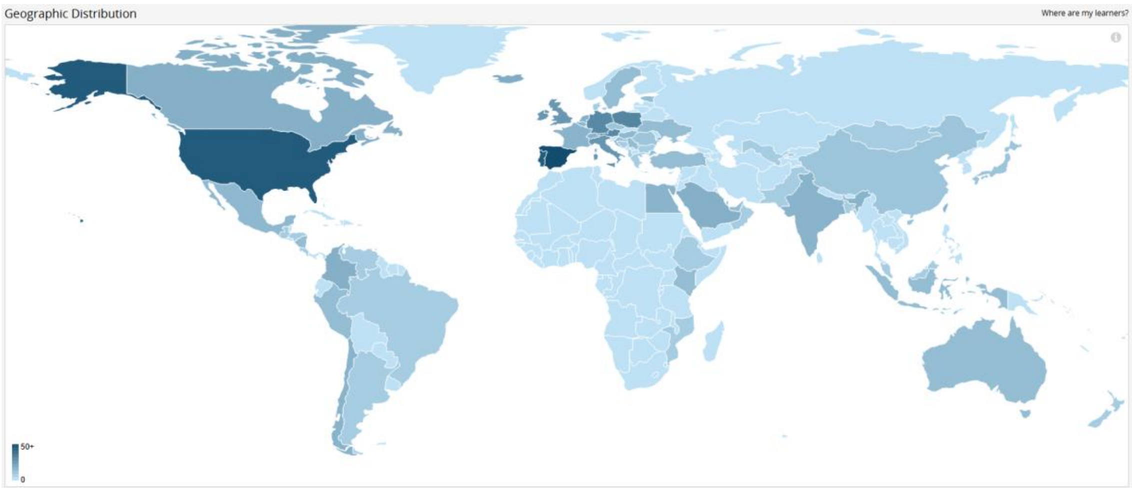


Figure 15: MOOC enrollment metrics.



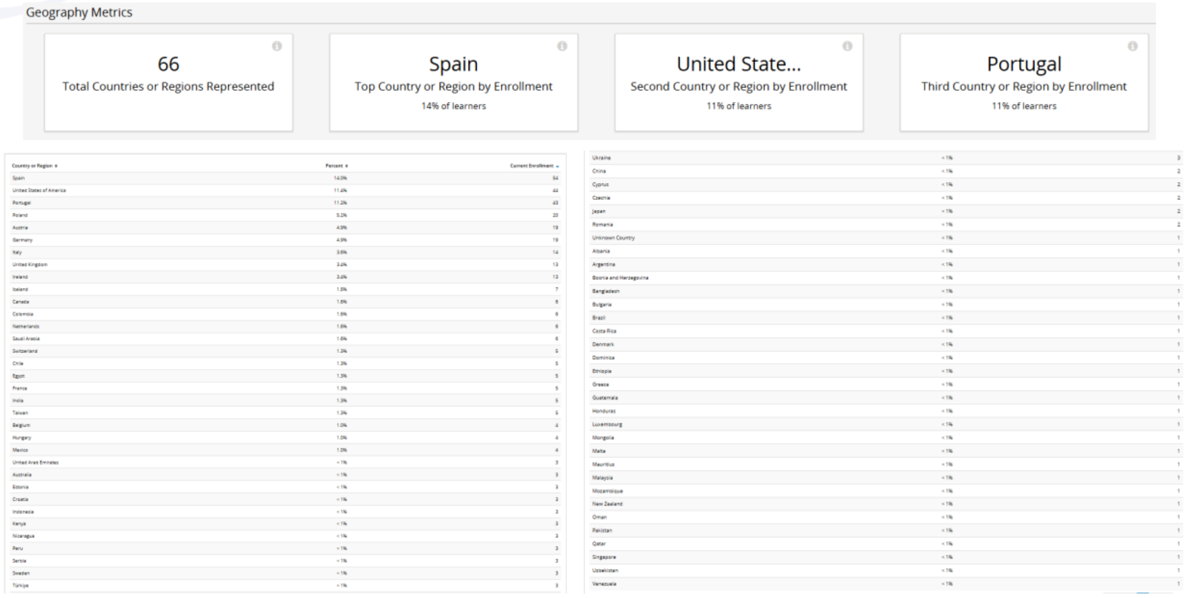


Figure 16: Graphical distribution, metrics, and breakdown of the MOOC enrollment.

- Total Enrollment: 388 learners
- Verified Track: 60 learners enrolled in the paid certificate track.
- International Outreach: Participants represent 66 countries or regions.
- Top Enrollment Countries: Spain (14%), Portugal (11%), and the United States (11%).

Figure 15 presents a demographic profile of the participants who responded to the pre-course survey, offering insights into the gender balance and educational background of the cohort. Out of the 388 total course enrollments, only 109 participants carried out the pre-course survey, representing a response rate of approximately 28.09%. The top chart, illustrating the gender breakdown, reveals a significant gender imbalance: Male participants constituted the overwhelming majority at 75%, while Female participants accounted for 25%. The low representation of female participants is a key finding for the course administrators. The bottom chart details the highest attained education level among the 109 respondents to that question. The data clearly indicates a highly educated cohort. The largest segment of participants holds a master's degree (58 respondents), followed by those with a bachelor's degree (28 respondents). Furthermore, 12 respondents reported holding a Doctoral degree. In total, a high percentage of participants, approximately 89.9%, already possess at least a bachelor's degree, suggesting that the course predominantly attracts individuals with a professional or academic background seeking further specialization.

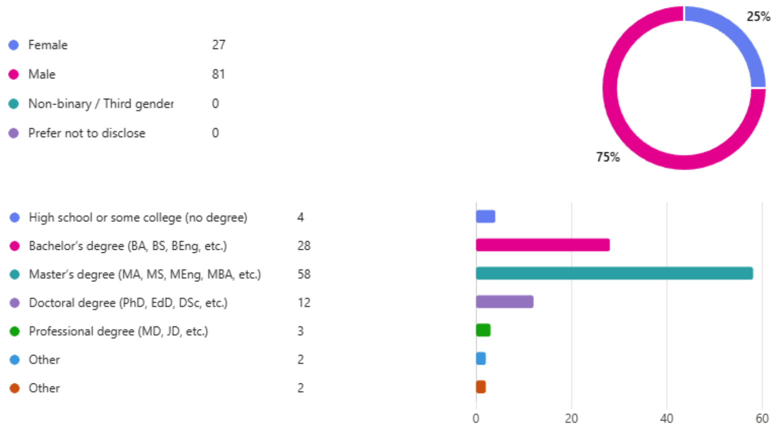


Figure 17: Participants' demographics.

Figure 16 illustrates the initial level of prior experience among participants, specifically addressing the question, "Have you attended any related courses in the past?" This data was collected through a highly recommended pre-course survey administered by UPV on the edX platform. The results show a clear majority of respondents (67%, or 73 individuals) have not attended related courses previously, indicating that a significant portion of the active learners are new to the subject matter. Conversely, 33% (36 individuals) affirmed that they had prior experience. This breakdown is crucial for understanding the diverse baseline knowledge within the MOOC cohort.

Figure 18: Participants' response breakdown to the question, "Have you attended any related courses in the past?".

Figure 17 shows the distribution of participants stated interest in specific target profile groups, which was the main objective of the pre-course survey. The data clearly demonstrates that participants are overwhelmingly interested in technical and consultative roles. The Installer, Designer, Energy Consultant profile is the dominant choice, selected by 58% of the respondents. The second largest group, interested in strategic planning and management, is the Decision-maker, Planner profile, accounting for 24% of the responses. Interest in regulatory and governance topics, represented by the Policy / Authority profile, stands at 10%, while the Driller profile was the least selected at 8%.This profile selection, made in the highly recommended survey, served as an essential guidance mechanism within the MOOC. Although all participants retain full access to all course materials, their chosen profile determined which specific sub-modules they were initially recommended. This targeted approach helped participants efficiently navigate the comprehensive content and prioritize information directly relevant to their chosen professional track.

Figure 19: Participants' profile interest breakdown.

Figure 18 consolidates the responses from all 109 survey participants to the question, "Are you currently working in the geothermal or energy sector?" The results confirm that the MOOC successfully attracts a highly targeted audience with existing professional or career interests in the field. The data reveals that the majority of respondents are already professionally engaged, with 62.4% currently employed in the geothermal or energy sector. Furthermore, an additional 21.1% indicated that they are "Not yet, but planning to" work in the sector. This means that a combined total of over 83% of the MOOC participants are actively focused on a career in the energy industry, demonstrating a strong match between the course content and the audience's professional needs. Only a small minority of participants responded that they are not currently working in the sector and do not plan to, representing 13.8% of the total. The remaining 2.8% selected the "Other" option. This high level of direct relevance among participants is a strong positive indicator for the potential impact and retention within the MOOC.

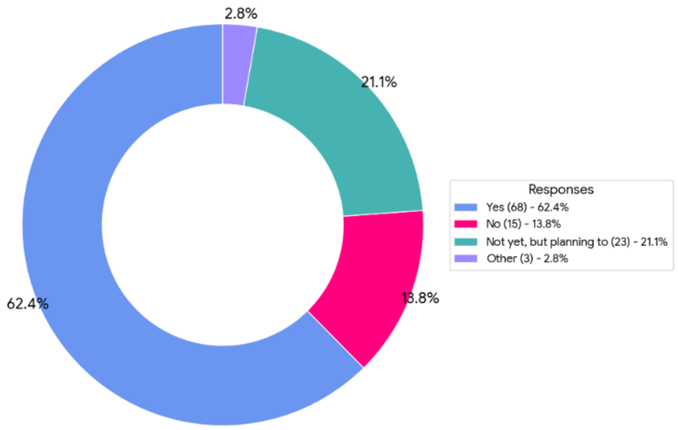


Figure 20: Participants' employment status breakdown in the geothermal or energy sector.

8. Status and Routes for the Establishment of a European Professional Certification for GSHP Drillers and Installers (Milestone 9)

This chapter has been prepared as the technical evidence base to fulfil Milestone MS9, “Report about the status and routes for the establishment of a European professional certification for drillers and installers of GHPs, with sample curricula and promotional materials”. It therefore goes beyond a descriptive overview: it consolidates the current status of national approaches and, most importantly, proposes practical routes to implement a second, technician-focused layer of certification (installers, drillers, and related on-site profiles) through a scalable training-and-assessment framework. In line with EU policy drivers and the "Shallow Geothermal Installer" profile referenced in the Renewable Energy Directive, the chapter focuses on extending and/or creating technician qualifications aligned to EQF levels 1–3 and on ensuring homogeneity of quality and learning outcomes across countries. This homogeneity is essential to enable transparency tools such as Europass[1] and, ultimately, professional mobility within the EU. The chapter structures the pathway around national roadmaps for extending existing qualifications into partner countries, harmonized guidelines, and reusable training/assessment materials (with the GEOBOOST MOOC as a common-core learning component), and engagement actions roadmap with the relevant national officials and stakeholders responsible for National Qualification Systems.

8.1. Introduction and scope

8.1.1. Context: Shallow Geothermal and EU Heating & Cooling Decarbonization

The successful scale-up of GSHP installations will depend on having a qualified professional workforce. Unlike conventional heating systems, GSHP projects involve specialized activities – notably the drilling of boreholes for ground heat exchangers and the proper design and installation of heat pump systems. The quality, safety, and performance of a GSHP installation are highly sensitive to the competencies of the drillers and installers/designers involved. Improper borehole drilling can risk environmental damage (e.g. groundwater contamination), and poor installation or sizing can lead to inefficient system operation. Thus, building a robust skills base for shallow geothermal is essential to meeting decarbonization targets: well-trained GSHP professionals help ensure that installations deliver expected energy savings and maintain public confidence in the technology. In summary, EU climate ambitions for the H&C sector create not only a strong impetus for deploying shallow geothermal systems, but also a clear need for qualified GSHP drillers and installers to support this growth.

8.1.2. Rationale for Professional Certification of GSHP Drillers and Installers

Given the imperative to expand shallow geothermal use, attention is turning to the qualification frameworks for the professionals who design and implement these systems. Currently, there is no uniform European standard for GSHP training or certification – each Member State has developed its own approach (ranging from mandatory licensing to voluntary accreditation, to no dedicated scheme at all). This heterogeneity in competency requirements and legal recognition is widely seen as a barrier to technology's uptake. Widespread

[1] https://europass.europa.eu/en/european-qualifications-framework-eqf

deployment of GSHPs remains constrained by fragmented national regimes and the absence of uniform training standards for technicians. For example, the Netherlands enforces a rigorous mandatory certification system for geothermal drillers and installers, whereas Sweden relies on a voluntary credential and Spain so far has no GSHP-specific certification scheme. Such divergent approaches – from the strict Dutch model to the voluntary or ad hoc systems elsewhere – underscore the need for harmonization. A homeowner or developer in one country may struggle to identify qualified contractors, and a skilled installer in another country may find their credentials not recognized beyond their national borders. Inconsistent standards also make it difficult to monitor or guarantee installation quality across the EU.

In practice, the lack of a common framework has several negative consequences. First, it hinders cross-border mobility of specialized workers – companies can face challenges expanding to other EU markets due to non-transferable certifications. Second, it can exacerbate skills shortages: some countries report too few certified GSHP drillers or installers, partly due to limited training opportunities or unclear career pathways in this field. Third, uneven quality assurance can result in suboptimal or unsafe installations, which in turn may damage customer confidence in GSHP technology. These issues motivate the case for a European-level professional certification.

Why certify GSHP drillers and installers? A well-designed certification framework offers multiple benefits:

- **Quality and Safety Assurance:** Establishing a common set of competencies ensures that all certified drillers and installers possess the necessary technical skills (e.g. proper borehole construction, heat pump sizing, system integration) and follow best practices. This leads to higher installation quality and fewer risks (both to users and the environment), protecting the reputation of shallow geothermal systems.
- **Consumer Confidence and Market Growth:** An official certification signals professionalism. Building owners and investors can have greater trust that a certified GSHP installer will deliver efficient, reliable results. This increased confidence can spur demand for geothermal heat pumps, knowing that qualified experts handle projects.
- **Cross-Border Recognition and Workforce Mobility:** A European certification would facilitate mutual recognition of qualifications between countries. Installers or drilling contractors could work abroad more easily, helping to fill skills gaps in emerging markets and encouraging knowledge exchange. Harmonized certification can thus support the single market for green technologies and allow companies to scale their services internationally.
- **Alignment with Policy and Incentives:** As EU and national policies (e.g. building codes, renewable incentives) increasingly call for renewable heating, having a certified workforce helps policymakers confidently introduce measures requiring qualified installers. For instance, some countries already tie heat pump subsidy eligibility to installer accreditation; a European GSHP certificate could be integrated

into such schemes to ensure consistency. It also aligns with broader EU initiatives on skills and training for the energy transition.

Indeed, the rationale for certification is strongly supported by findings from the GEOBOOST project's analysis of current national frameworks. The comparative study revealed that some Member States (like Germany, the Netherlands or Belgium) have strict training and licensing requirements for shallow geothermal specialists, while others (like Poland, Ireland, or Austria) maintain only voluntary programs or none. This patchwork leads to variable course content and competency levels, highlighting why a common benchmark is needed. A unified certification framework would introduce standard competence profiles for GSHP drillers and installers, ensuring that key topics (such as hydrogeology, thermal design, drilling safety, heat pump integration, and environmental regulations) are covered in training across all countries. It would also provide a mechanism for ongoing professional development, keeping practitioners up to date with technological and regulatory advancements (for example, new refrigerants or drilling techniques).

Notably, efforts to harmonize qualifications have been initiated in the past. Industry and EU-supported programs like GeoTrainet[2] developed a voluntary curriculum for geothermal heat pump installers, and pilot schemes such as "EUCERT" have been tested in certain countries. These initiatives demonstrate the feasibility of defining common training modules and assessment criteria for the sector. However, without formal recognition or integration into national systems, their uptake has remained limited. Building on these foundations, the GEOBOOST project and its partners see an opportunity to advance from voluntary guidelines to an agreed European certification framework[3]. In summary, professional certification for GSHP drillers and installers is rationalized by the need to ensure high-quality installations, to overcome market fragmentation, and to prepare the workforce required to meet Europe's heating decarbonization goals. Such certification would professionalize the shallow geothermal sector and give it a more solid footing as part of the clean energy transition.

8.1.3. Objectives and Scope of this Chapter

This chapter introduces and scopes out the pathway toward establishing a European professional certification for GSHP drillers and installers. It sets the stage by linking the policy context and market drivers with the human capacity and training needs that motivate a unified certification approach. The specific objectives of the chapter are threefold:

- **Contextualize shallow geothermal in EU decarbonization:** We begin by outlining how European climate and energy policies (e.g. Fit for 55, RED III, EED) and national heating strategies underscore the importance of ramping up renewable heating technologies like GSHPs. This provides a high-level rationale for focusing on the shallow geothermal sector and its workforce.

[2] https://geotrainet.eu/

[3] https://www.sanner-geo.de/media/c8848455cf28212fffff803dfffffff1.pdf

- **Justify the need for a certification framework:** The chapter then examines the current landscape of GSHP installer/driller qualifications, identifying disparities and gaps in existing national schemes. By analyzing these differences and their implications, we clarify why a common European certification is needed – specifically targeting the roles of drillers (borehole professionals) and installers (heat pump system integrators). Only these two professional profiles are considered in scope, as they are the critical hands-on roles for system deployment.
- **Outline the approach and link to GEOBOOST's work:** Finally, the chapter describes how the GEOBOOST project has addressed this need through its Work Package 5 (WP5) activities. In particular, WP5 has designed and delivered a European Modular Course System (Deliverable D5.2) for a GSHP MOOC (Massive Open Online Course) and has developed a roadmap for an EU-wide certification scheme. This chapter draws on WP5 findings – including the comparative review of eight target countries and the identification of best practices – to propose routes for harmonizing certification. It frames the content and strategy of Deliverable D5.2, demonstrating how the developed MOOC curriculum aligns with the competency requirements that a European certification entails. The scope of the chapter is therefore both analytical and forward-looking. It does not present a finished certification scheme; rather, it surveys the status quo and uses that insight to chart possible routes toward a common European GSHP certification framework. Subsequent sections (beyond this introduction) will detail the national certification systems in the GEOBOOST partner countries, highlight convergences and divergences, and then discuss the proposed roadmap for developing a unified scheme. Throughout, emphasis is placed on how a modular training approach – as exemplified by the MOOC – can serve as the backbone for this emerging framework.

By concentrating on drillers and installers, the chapter remains focused on the practical workforce level where certification can directly improve installation outcomes. Other important professional roles (such as system designers or geothermal planners) are acknowledged in the broader project context but are outside the scope of this specific chapter. The intention is to lay the groundwork for a certification model that could eventually be expanded or interfaced with related qualifications (for example, design engineers), while keeping the immediate pilot efforts targeted on the two core roles most urgently needed to expand shallow geothermal deployment.

Implications for the MOOC and Future Certification Framework: The analysis presented in this introduction has clear implications for the GEOBOOST training program (the MOOC) and the envisioned future certification framework. Firstly, it underlines why the pilot MOOC developed under WP5 is so important: the MOOC has been designed and implemented as a modular, pan-European course to impart the foundational knowledge and skills that all GSHP drillers and installers possess. By identifying common competency needs across different countries, this section reinforces the MOOC's achievement of "unifying competencies at the European level". In practical terms, the MOOC serves as a proof-of-concept for a standardized curriculum – covering topics like geology and thermal principles, borehole installation techniques, heat pump system design, environmental regulations, and safety practices – which is currently being delivered online to a broad audience of professionals. Furthermore, the discussion here supports a roadmap approach to certification, wherein the developed MOOC represents the initial step in a longer process. As executed, GEOBOOST's strategy has been to validate a core curriculum through the MOOC to subsequently work with national authorities and industry bodies towards mutual recognition. This means the MOOC is not an isolated educational product, but the first building block of a future certification scheme. By collaborating with key European certification organizations (such as EGEC/GeoTrainet, DVGW, BWP, RESCert, etc.), the project has ensured that the MOOC content aligns with existing standards, facilitating its formal acknowledgment in different national contexts.

8.2. Methodology and data sources

This chapter is designed to meet two complementary needs:

- To provide an evidence-based snapshot of the current status of national certification/qualification schemes for GSHP drillers and installers, and
- To define practical routes ("how to get there") towards a common European certification framework supported by a deliverable training architecture.

The methodology therefore combines a structured national data collection, complementary documentary sources (standards, regulations, and training schemes), and an analytical framework that links certification, training, regulation, and market readiness from other schemes. In line with the project strategy, all methodological choices are framed under the GeoTrainet umbrella, using GeoTrainet's European experience, terminology, and training references as a baseline for comparability and future scalability.

8.2.1. National data collection: GeoBOOST Certification Roadmap forms

- **National "Geothermal Certification Roadmap" Forms:** The primary data source was a set of structured national forms distributed to project partners and experts in eight representative European countries (Austria, Belgium, Germany, Ireland, Netherlands, Poland, Spain, and Sweden). Each form gathered detailed information on key dimensions of the national context, including existing certification schemes (for drillers and installers), available training programs and curricula, relevant regulations and standards, and the perceived market maturity of the shallow geothermal sector. The forms also included open-ended sections on barriers and opportunities for improving professional certification in each country. This standardized questionnaire ensured a consistent data format, allowing direct comparison between countries on critical factors like regulatory requirements, training availability, and certification uptake.

- **Complementary sources: standards, regulations, and training schemes:** To verify and enrich the national forms—and to ensure the chapter can be used by evaluators as a robust reference—data were triangulated against the following complementary sources:
  - National legislation permitting regimes relevant to shallow geothermal (water protection rules, drilling/well regulations, building/HVAC rules, environmental permitting, inspection regimes).
  - National and European standards and technical guidelines (e.g. drilling protocols, system design/installation guidance, safety, and environmental protection standards) that shape competence requirements even when there is no explicit legal certification obligation.
  - Existing certification and training schemes operated by industry associations, certification bodies, and training providers (e.g. installer accreditation schemes, driller certification protocols, and quality management requirements).

Desk Research on Standards and Training Schemes: The team conducted complementary desk research to supplement and verify the information from the national forms. This involved reviewing national legislation, technical standards, and existing training scheme documentation in each country. For example, national water or mining laws and technical guidelines (such as VDI 4640/4645 in Germany or BRL protocols in the Netherlands) were consulted to understand the regulatory framework governing GSHP installations. We also examined European initiatives and references such as the **GeoTrainet/EUcert** program, relevant CEN/ISO standards for heat pump systems, and published materials from industry associations (e.g. DVGW, BWP, RESCert) to capture any established curricula or certification procedures. This background research ensured that the analysis was evidence-based and anchored in up-to-date regulatory and technical context, especially in cases where the national form responses needed further detail or confirmation.

8.2.2. Analytical Framework (Dimensions, Classifications, Criteria)

A four-pillar comparison model was applied to each country, ensuring that certification is not treated in isolation but as part of a coherent "skills-to-market" system:

- **Certification Schemes:** We examined whether a dedicated professional certification or licensing scheme for GSHP drillers and/or installers exists in each country, and if so, its nature – for example, a mandatory license enforced by law, a voluntary accreditation program, or no specific scheme (reliance on general HVAC or construction certifications). This categorization (mandatory vs. voluntary vs. none) was a key criterion for grouping countries and understanding their baseline. It allowed us to create a typology ranging from those with strict legally required certification to those where certification is purely optional or absent.
- **Training and Curricula:** We compared the availability and structure of training programs for shallow geothermal professionals. This included reviewing whether formal courses or apprenticeships are in place (e.g. vocational training modules, certified installer

courses, drilling specialist training), their duration and content, and how they link (if at all) to certification. We noted whether countries have standardized curricula or examinations (such as national exams or recognized course certificates) and whether these align with any international standards. This dimension helped assess the educational readiness and capacity to support a certification framework – for instance, identifying if a country lacks training opportunities despite having a certification requirement (a potential gap), or conversely, if robust training exists without an official certification pathway to channel trainees into.

- **Regulations and Standards:** We analyzed the regulatory environment governing shallow geothermal installations in each country – including any laws, regulations, or technical standards that indirectly or directly impose qualifications on drillers/installers. This covers environmental permitting rules, water protection or mining laws that require licensed professionals, building codes, and national standards or guidelines (for example, drilling protocols, heat pump installation standards). By mapping the regulatory landscape, we identified how supportive or demanding each country's framework is regarding professional qualifications. This helped highlight cases where strong regulation drives certification (e.g. legal mandates for certified drillers), versus cases where lack of regulation might be a barrier to developing certification (no legal incentive for professionals to get certified). We also checked for enforcement mechanisms (inspection regimes, mandatory permits) that affect the efficacy of any certification scheme.
- **Market Readiness:** Although not a formal section of the questionnaire, we qualitatively assessed each country's market maturity for shallow geothermal heat pumps – for example, the level of deployment of GSHP systems, the number of active drilling/installation companies, and general awareness or demand for qualified GSHP professionals. This context is important because a more mature market often correlates with more established training and certification structures (or a clear need for them), whereas emerging markets may face different challenges (such as few training providers or lower demand for certification). Inputs on barriers (e.g. low awareness, high training costs) and opportunities (e.g. growing renewable energy targets, available funding) from the national forms were used as proxies for market readiness. Together, these give a sense of how prepared each national industry is to adopt or benefit from a certification framework.

Comparison and Synthesis: Using the above dimensions, we carried out a cross-country comparison. First, each country's data was summarized in a comparative matrix to see side-by-side the status of certification, training, and regulation. This made it easy to spot contrasts – for instance, some countries have comprehensive mandatory certification backed by law while others rely on voluntary schemes or general qualifications. We also identified misalignments within countries, such as cases where regulations require certified expertise, but corresponding training programs are scarce, or where extensive training exists without formal recognition. By applying a consistent set of criteria, we classified the national approaches into the broad typology mentioned (mandatory vs voluntary vs none) and noted intermediate situations (such as partial or regional schemes).

Identifying Gaps and Best Practices: The analysis paid special attention to gaps, barriers, and opportunities reported by national experts. We collated the barriers from all countries to find common themes – frequent issues included limited awareness of certification among practitioners, lack of enforcement of existing schemes, regional fragmentation of rules, high costs for training/certification, and fast-evolving technology outpacing current qualifications. Similarly, we noted recurring opportunities such as linking financial incentives to using certified installers, expanding training accessibility (e.g. via online modules), and pursuing mutual recognition of qualifications across borders. By comparing these inputs, we identified best practices in certain countries that could inform the European roadmap (for example, the existence of a national registry of certified geothermal installers, or integration of geothermal modules into formal vocational education). These best practices and common needs are directly fed into the design of the proposed roadmap and curriculum. In designing the European certification framework, we used criteria derived from the analysis – ensuring it addresses the typical gaps (e.g. by proposing a modular training curriculum to cover skill needs uniformly) and builds on successful elements observed nationally (such as mandatory refresher training or quality assurance mechanisms).

8.2.3. Limitations and Scope of the Analysis

While this methodology provides a structured and transparent assessment, it is important to acknowledge several limitations and scope constraints:

- **Coverage of Countries:** The analysis was limited to the eight participating countries, chosen to represent a range of contexts in the EU. Not all EU Member States were examined, so certain national scenarios or innovative schemes outside the sample may not be captured. The findings are indicative of common patterns and challenges but are not an exhaustive survey of every country in Europe.
- **Data Gaps and Consistency:** The information gathered through the national forms varied in detail. Some country inputs were more comprehensive than others, potentially due to differences in data availability or interpretation by respondents. In a few cases, data on specific aspects (e.g. exact numbers of certified people or very recent policy changes) were incomplete. We mitigated this with follow-up discussions and desk research, but minor information gaps remain for certain countries.
- **Evolving Regulatory Context:** The regulatory and market context for shallow geothermal is dynamic. New regulations, standards, or incentive programs can emerge even within the project’s timeframe. For instance, some countries indicated upcoming legislation or ongoing reforms in their responses. Therefore, the analysis represents a snapshot in time (2023–2024). The conclusions drawn must be understood in that temporal context – any significant legal changes after data collection are not reflected and could alter the national status regarding certification requirements.

- **Focus on Shallow Geothermal Drillers and Installers:** The scope of this study (and the proposed certification framework) is narrowly defined around shallow geothermal heat pump systems and the professionals who design, drill, or install these systems. Broader geothermal industry aspects (such as deep geothermal energy or other renewable heating technologies) were outside our scope. Likewise, within the shallow geothermal domain we concentrated on field roles (drillers, installers, possibly system designers) and did not deeply assess other roles like regulators or manufacturers. This focused approach allows tailored insights into GSHP workforce development, but it means that some related competencies (e.g. general HVAC skills or electrical licensing for heat pump installers) were considered only insofar as they are part of the GSHP installation context.
- **Qualitative Assessment:** Much of the analysis, especially regarding barriers and opportunities, is qualitative in nature. It relies on expert judgment and stakeholder opinions captured in the forms and workshops. There may be subjectivity in how certain challenges were rated or how "market readiness" was described by different respondents. We strove for objectivity by cross-comparing and validating through multiple sources, but the results are not derived from quantitative metrics alone.

Despite these limitations, the methodology provides a robust foundation for understanding the landscape of GSHP professional certification in Europe. It ensures that the subsequent recommendations are grounded in real-world national experiences rather than theoretical assumptions.

Implications for the MOOC and Future Certification Framework: The evidence-based methodology outlined above has directly supported the development of the project's MOOC and the European certification roadmap. By collecting uniform data across countries and engaging experts, we ensured that the MOOC's curriculum targets actual skill gaps and training needs identified in different markets. For example, as many countries lacked content on proper drilling practices or heat pump sizing, the MOOC includes core modules on those topics. The proposed certification framework is likewise built on verified best practices (such as modular training aligned with EQF levels) that emerged from the analysis.

8.3. Current Status of National Certification Schemes for GSHP Drillers and Installers

This section presents the current status of professional certification and qualification routes for GSHP drillers and installers in the eight GeoBOOST focus countries (Austria, Belgium, Germany, Ireland, Netherlands, Poland, Spain, and Sweden). The mapping follows the analytical lenses introduced in the Chapter 8.2 (certification–training–regulation–market readiness). The outcome of this section is therefore not only descriptive; it also identifies "routes" that can be scaled, aligned to EQF/NQFs, and later connected through EU tools such as Europass for professional mobility.

8.3.1. Country Overviews

Austria

Austria employs a mixed approach. Groundwater drillers must obtain a mandatory license under the Federal Mining Act (and comply with water law) to operate. In contrast, GSHP installers are not subject to a legal license; instead, there is a voluntary certification offered by the Austrian Institute of Technology (AIT). Training courses are available: the construction industry association VÖBU provides specialized courses for borehole design, and AIT offers training for heat pump system installation. National standards (ÖNORM EN 15323) and guidelines (ÖWAV 207, AHB 43) cover best practices. Key features of Austria's scheme include complex permitting procedures and a shortage of specialized trainers, but also strong R&D support and public incentives. Notably, some provinces link subsidies for heat pump installations to the use of certified installers, incentivizing voluntary certification.

Belgium

In Belgium, certification is regionally managed and largely voluntary. Both Flanders and Wallonia have their own frameworks – e.g. the Walloon SPW and Flemish VEKA oversee geothermal drilling permits – but there is no single national GSHP license. Instead, Belgium participates in the RESCert program, a voluntary certification for renewable energy installers including shallow geothermal. The RESCert course entails ~40 hours of training plus an exam, and successful candidates receive a certification valid across all regions for 7 years. For drillers, regional authorities organize training (e.g. a Class II well driller course in Wallonia) but requirements differ by region. Regulations are set by regional water and environmental laws, with no dedicated federal geothermal law. This fragmentation causes complexity: companies operating nationwide face varying permitting rules and training needs. Awareness of certification remains limited, and training costs are high, slowing uptake. On the upside, policy interest in geothermal (e.g. for district heating) and potential EU funding present opportunities to strengthen and harmonize Belgian certification efforts.

Germany

Germany's framework is characterized by mandatory certification for borehole drillers and voluntary schemes for installers. For drilling specialists, industry standards require a DVGW W120 or BHE certification (administered by the German gas & water association and the geothermal association) – effectively a license needed to meet water authority requirements. GSHP installers, however, are not subject to a national license; they may pursue voluntary accreditation through the heat pump association (BWP) or training certificates like VDI 4645 for system installers. Several training programs exist: the DVGW W120 course (for borehole construction), BWP installer courses (installation and commissioning), and VDI-4645 courses (system design and planning). Germany's legal framework includes federal water protection law (WHG) and mining law (BBergG), plus widely respected guidelines (VDI 4640/4645 for design/installation and DIN EN 378 for refrigerant safety). A key challenge is the federal-state governance – there is *no single "GSHP installer" certificate recognized nationwide*, leading to fragmented implementation across Länder. Permitting and oversight can be bureaucratic, and the absence of a unified mandatory qualification (especially on the heating installation side) is noted as a gap. Nonetheless, Germany's mature market and strong technical education (including university geothermal programs) have fostered a high skill level, and ongoing efforts (e.g. adoption of VDI and GeoTrainet standards) aim to improve standardization.

Ireland

Ireland currently has no mandatory certification scheme specific to GSHP, but it has recently developed formal training pathways. For drillers, a new Level 6 Geo-Drilling Apprenticeship (approximately EQF Level 5) has been launched, which combines classroom and on-the-job training over 41 weeks. For installers, there is a Level 6 Heat Pump Installer qualification that covers the installation and commissioning of heat pump systems. These qualifications are part of the national framework (QQI) but are not yet legally required to practice – they serve as recognized credentials and are encouraged through grant programs. For installation, competence is supported via accredited heat pump and shallow geothermal courses, and the SEAI Renewable Energy Installer Register requires evidence of certification from an accredited training provider for relevant technologies. These developments provide a formal foundation that can be aligned with a European competency framework and complemented with role-specific assessment. Training is available at institutes like the Technological University of the Southeast (Carlow) for drilling, and short courses for GSHP installers often follow the GeoTrainet curriculum. Ireland's regulations for shallow geothermal are still developing there is currently no dedicated GSHP law, though general building regulations and standards (e.g. electrical and F-gas certification for heat pump work) apply. Water abstraction and reinjection for open-loop systems fall under existing water/environmental legislation, but a comprehensive GSHP framework is pending. The Irish GSHP market remains small, with few specialized contractors, and no compulsory certification has been a barrier to quality assurance. On the positive side, climate policy targets, and robust industry-academic collaboration (e.g. research by universities and Geothermal Association of Ireland) are driving interest. Ireland is considering adopting elements of European schemes (GeoTrainet/EUCERT) to bolster its qualifications in the future.

Netherlands

The Netherlands has one of the most comprehensive and strict certification regimes for shallow geothermal in Europe. Since 2013, national law (currently the Omgevingswet and its BAL regulations) has made it *compulsory* for any company designing, drilling, installing, or operating GSHP systems to be certified under recognized standards. This scheme is built around BRL protocols (e.g. BRL 2100/11000 for drilling and underground design; BRL 6000-21 for heat pump system installation) which are integrated with an ISO 9001 quality system. Companies must undergo annual audits by accredited bodies to maintain certification. In addition, personnel must pass state-administered exams in five specializations: a general GSHP foundation, open-loop design, closed-loop design, heat pump energy center (above-ground components), and system operation/maintenance. Each exam is supported by a 2–3-day preparatory course offered by the national geothermal association (Bodemenergie NL). Every

GSHP project in the Netherlands requires a permit and registration: open-loop systems are permitted by regional water authorities, closed-loop by municipal authorities. The result is a tightly controlled environment – the Dutch framework ensures high competence and consistent standards but also entails high administrative overhead and compliance costs (yearly inspections, documentation). The benefit is a well-developed market with reliable installations, and the Dutch model is often seen as a best practice that could be exported or adapted elsewhere.

Poland

Poland does not yet have a dedicated GSHP installer certification, but related professions are regulated under general laws. Drillers (for geothermal boreholes) must obtain a license under the Geological and Mining Law – essentially a *"perforista"* certification for drilling wells. This legal requirement means companies or individuals drilling boreholes (typically deeper or larger systems) need appropriate geological qualifications and permits. For GSHP installers, there is no special certification; however, installers must hold standard trade credentials such as an electrician's license (for integrating heat pumps into electrical systems) and an F-gas certificate if handling refrigerants. In practice, many Polish GSHP installers are HVAC technicians or electricians with these general licenses. Training opportunities specific to geothermal are limited but growing universities like AGH Kraków and Poznań University of Technology include geothermal or heat pump modules in their curricula, and the Polish Geological Institute (PIG) and industry associations run short courses or seminars on best practices. Additionally, Poland has piloted the EUCERT training program – a European certification curriculum for heat pump installers – to improve competencies. Regulatory oversight for shallow geothermal falls under the Water Law (for groundwater protection) and the Geological and Mining Act, but there is no single GSHP-focused regulation – European EN standards are used as guidelines. The Polish market is still emerging, with relatively high upfront costs and few specialized contractors cited as barriers. The lack of a unified certification body or standard has been noted, but interest is increasing as Poland's National Energy Plan emphasizes renewable heating. This creates an opportunity for international cooperation and adoption of common training standards (like GeoTrainet/EUCERT) to build capacity.

Spain

Spain currently has no specific certification scheme for GSHP professionals, relying instead on general regulations for construction and HVAC installations. There is *no mandatory license uniquely for geothermal installers or drillers*. However, any technician installing a ground-source heat pump must hold the standard HVAC installer authorization under the nationwide RITE framework (Reglamento de Instalaciones Térmicas en los Edificios). This means geothermal heat pumps are treated like any conventional HVAC system in terms of required installer qualifications. On the drilling side, companies must follow general water well permitting processes set by regional water agencies, but there is no geothermal-specific driller license – only registered well drillers or geotechnical engineers as required by water laws. Spain has begun to introduce geothermal content into formal training: the government's vocational training (Formación Profesional) offers two relevant modules – a Level 2 course on *"Geothermal exchanger installation"* (~390 hours) and a Level 3 course on *"Heat pump system management"*. These modules align with the national qualification framework (and thus EQF levels 4–5) and mark an initial step toward specialized training. Additionally, professional bodies and renewable energy associations (ICOG – College of Geologists, GEOPLAT platform, APPA renewables) have organized short courses and guidelines to upskill practitioners. Regulatory aspects are fragmented: water well drilling and geothermal loop deployment are subject to regional water laws and varied permitting requirements in Spain's 17 autonomous communities. There are some technical standards (e.g. UNE 100715-1:2014 for thermal response testing and open-loop system design), but enforcement is inconsistent. The absence of a dedicated certification scheme is seen as a gap – the market is small and still developing, and administrative fragmentation further hinders projects. On the positive side, Spain has pioneered official vocational curricula for GSHP and is channeling NextGeneration EU funds into low-carbon heating, which could support future certification initiatives.

Sweden

Sweden historically has a well-established GSHP market and in recent years moved toward formalizing professional qualifications. Certification for both drillers and installers is effectively mandatory: the Research Institute of Sweeden (RISE), together with the INCERT certification body, administers an exam that specialists must pass to be recognized for shallow geothermal work. In practice, while not a "license" in the legal sense, many municipalities require that borehole drillers be certified (listed by RISE) to approve drilling permits, making it a de facto requirement. Installers of GSHP systems are often certified heat pump installers under INCERT as well. Training in Sweden is supported by industry associations – Borrföretagen (the drilling contractors' association) and INSU (the training arm of the HVAC trade) offer short courses of 2–3 days on GSHP system design, installation, and drilling practices. RISE also conducts seminars, and companies like Rototec provide hands-on training for new drillers. Some vocational schools have begun to include GeoTrainet modules, ensuring that curricula align with European competency frameworks. Sweden's regulatory environment is strong: the Environmental Code and RISE guidelines strictly govern borehole placement, environmental impact (an environmental permit and sometimes an EIA is required for larger systems), and there are Swedish standards mirroring EN ISO norms for heat pump design and installation. The main bottleneck is not regulation but education – there is no formal university degree specifically in GSHP, so the workforce relies on shorter courses and on-the-job learning. Permitting can also be complex and lengthy for larger projects. Overall, Sweden's long tradition with geothermal heat pumps has yielded a robust market uptake and familiarity, and the presence of RISE-accredited training centers and clear standards has maintained high installation quality. The system in Sweden is often held up as a successful example of industry-led certification (now moving toward official status) ensuring technical competency without a heavy legal mandate.

8.3.2. Typology of National Approaches

National schemes for GSHP installers and drillers can be grouped into four broad categories based on the above country analyses:

- **Regulation-driven recognition/certification (mandatory or de facto mandatory through permitting/audits):** Some countries impose legally required certification or licenses for GSHP professionals. For example, the **Netherlands** enforces compulsory company certification and exams for all GSHP activities by law. **Sweden** likewise requires certified drillers (via RISE/INCERT) and has formal exams for installers, making credentials effectively mandatory. In **Austria** and **Poland**, specific aspects are mandated – drilling companies must be licensed under mining law, though installer certification is voluntary. **Germany** also mandates certification for drillers (DVGW/BHE), though not by statute but through water authorities' requirements, which functions as a licensing system. These mandatory schemes are typically tied to safety and environmental regulations (water protection, etc.) and often integrate with vocational qualifications or state exams.
- **Voluntary accreditation schemes:** Many countries have industry-led or incentive-linked certification programs that are recommended but not compulsory. **Belgium**'s RESCert for geothermal installers is voluntary (though possession of the certificate can be encouraged through regional subsidies). **Germany** offers voluntary installer certifications (e.g. by BWP or via VDI-4645 training) to raise skills, but an installer may legally operate without them. **Austria** similarly has the AIT/ÖWAV accreditation for installers as an optional credential. **Sweden** historically had voluntary certifications before moving to the current exam system. These voluntary schemes often arise from professional associations or EU-backed programs and typically involve completing training courses and passing an exam. They are an important tool for quality assurance in countries where the law does not oblige certification.
- **General construction/HVAC certification only:** In some cases, there is no geothermal-specific certification, and practitioners simply comply with general construction or HVAC installer qualifications. **Spain** exemplifies this approach – GSHP installations fall under the general HVAC installer licensing (RITE), with no separate geothermal credential. **Ireland** is similar: aside from the new apprenticeship programs, a contractor installing a heat pump must have standard plumbing/electrical certifications and (for refrigerant work) an F-gas handling license. This category means the country treats GSHP like any conventional technology, without dedicated training requirements – which can simplify entry for installers but may leave specialized skills to on-the-job learning.
- **Qualification-based pathways and cross-technology RES installer certification (foundation for GSHP-specific competence):** Some countries are building the GSHP workforce through National Qualification Framework (NQF) routes (e.g., Spain's professional qualifications ENA710_2 and ENA711_3; Ireland's Geo-Drilling

apprenticeship) or through cross-technology RES installer certification that explicitly includes heat pumps and shallow geothermal (e.g., Poland via UDT). In these cases, the opportunity is to align learning outcomes and assessment with a shared European competency framework and to progressively formalize GSHP-specific certification routes.

- **No specific GSHP credential:** A few countries essentially lack any tailored certification framework for shallow geothermal. This overlaps with the above category – for instance, Spain and Ireland currently have no dedicated GSHP credential or registry at all. Practitioners operate under general regulations, and any geothermal-specific training is pursued voluntarily. In these countries, the regulatory focus is on permits and compliance (e.g. environmental permits for drilling in Spain's regions) rather than personnel certification. The absence of a scheme often correlates with a nascent market and is identified as a gap to be addressed for improving installation quality.

8.3.3. Comparative Synthesis of Competences, Training, Regulation, and Market Maturity

The current landscape of GSHP professional certification in Europe is highly heterogeneous. Competency profiles and training requirements vary widely between countries. Some have short specialist courses (2–3 days modules in the Netherlands, Sweden, Germany) while others integrate geothermal training into lengthy programs (Ireland's 41-week apprenticeship, Spain's 390-hour vocational module). The *breadth of competencies* expected also differs – e.g. the Netherlands defines multiple role-specific exams (driller, designer, installer, etc.) ensuring depth in each area, whereas other countries bundle roles (a single installer handling both ground loop and heat pump in Spain, with fewer formal skill distinctions). A few nations align their training with formal qualification frameworks: Ireland and Spain tie courses to their National Qualifications Framework (NFQ), mapping to certain EQF levels, thereby giving geothermal training official recognition. In contrast, many voluntary industry courses (e.g. Germany's VDI or Belgium's RESCert) are standalone credentials not yet linked to national education frameworks. This variability in course content, required hours, and competency definitions underscores the challenge of mutual recognition. A positive trend is the emergence of common reference materials (like the GeoTrainet curriculum and EU-certification pilots) which several countries have started adopting to harmonize the core skill set.

Regulatory frameworks and enforcement mechanisms also differ, influencing the certification landscape. In countries like the Netherlands and Sweden, shallow geothermal activities are strongly regulated by environmental and water laws, which either directly mandate certification or effectively enforce it via permit conditions. These comprehensive frameworks (Omgevingswet in NL, Environmental Code in SE) set consistent national standards. Germany and Austria likewise have robust technical standards (VDI guidelines, ÖNORM, etc.) and laws for drilling, but they stop short of mandating installer certification nationwide. Belgium and Spain illustrate the impact of administrative fragmentation: with regional authorities in charge, rules can vary within the country, leading to inconsistent requirements and complexity for companies. Notably, mandatory vs. voluntary approaches do not always align with geographic size – it often reflects policy choices and market history. For example, despite its federal structure, Belgium has pursued a voluntary certification (RESCert), whereas unitary Netherlands imposed a strict license regime. In the absence of legal mandates, enforcement is minimal: several countries report that even if a certification exists, *non-certified installers can still operate freely*, undercutting the incentive to get certified. This highlights a common issue where lack of enforcement and legal backing undermines voluntary schemes. On the other hand, a few countries use indirect levers – Austria and some Belgian regions make certification a criterion for subsidy eligibility, which encourages adoption without explicit legal obligation.

Market maturity and professional certification tend to be correlated. The countries with a long-established GSHP market (e.g. Sweden, Germany, Netherlands) generally have more developed training infrastructures or certification systems in place. These markets have a critical mass of installations that drove the need for quality standards early on, resulting in either mandatory licensing (NL, SE) or strong industry qualifications (DE) to maintain consumer confidence. In contrast, emerging or smaller markets (Spain, Ireland, Poland) often show underdeveloped certification regimes. The low penetration of GSHP in these countries has meant less immediate pressure to professionalize; however, it also creates a chicken-and-egg problem where lack of trusted qualified installers can hinder market growth. There are exceptions: Austria is a relatively mature market but chose a voluntary approach (leveraging European heat pump certification programs), and Belgium has a moderate market yet faces fragmentation due to governance rather than market size. It is also evident that mandatory schemes tied to vocational qualifications are more common in countries with either strong apprenticeship traditions or stringent environmental policies. For instance, the Netherlands and Germany both have strong vocational training cultures and regulatory oversight for groundworks, which facilitated their certification approach. Meanwhile, countries relying on general HVAC certifications typically have good general installer training (e.g. Spain's HVAC installers are well-regulated for safety), but they may lack geothermal-specific skills, affecting installation performance. Overall, the comparative analysis reveals that while there is no one-size-fits-all model yet, best practices are emerging from each approach – such as the Netherlands' rigorous protocol compliance, Sweden's combination of industry training with state exams, and the use of modular training curricula (GeoTrainet/EUCERT) to fill gaps in voluntary schemes. A summary of Certification Status Across Europe can be found below.

Country	Certification Scheme	Training Infrastructure	Regulatory Framework	Market Readiness
Sweden	🟢 National exam (SGU/INCert)	🟡 Short courses, no formal degree	🟢 Comprehensive standard	🟢 Strong market uptake
Netherlands	🟢 Mandatory BRL protocols	🟢 State-administered exams	🟢 Omgevingswet/BAL framework	🟡 High compliance costs
Germany	🟢 For drillers and for installers	🟢 Technical university programs	🟡 Fragmented regulations	🟢 Mature market
Spain	🔴 Not GSHP-specific	🟡 Few specialized courses	🔴 No national regulation	🔴 Developing market
Poland	🟡 No formal certification	🟡 University electives only	🔴 Minimal regulations	🟡 Growing interest
Ireland	🔴 Not GSHP-specific	🟡 Technical college modules	🔴 Building regulations	🟡 Growing adoption
Austria	🟡 EUCERT-HP (Voluntary)	🟢 Dual education system	🟢 Federal standards	🟢 Mature market
Belgium	🟡 Regional and voluntary	🟡 Industry-led courses	🟡 Regional frameworks	🟡 Varied by region

🟢 = Well-established 🟡 = Partially implemented 🔴 = Underdeveloped

Figure 21: Certification Status Across Europe.

Implications for the MOOC and Future Certification Framework: This mapping of national schemes provided critical guidance for the GEOBOOST project's pan-European training efforts. The developed **modular MOOC (Massive Open Online Course)** for shallow geothermal covers the core competencies common across countries while offering flexible modules to address country-specific requirements. Fundamental topics (geology, borehole design, heat pump fundamentals, environmental regulations) are included for all learners, ensuring a baseline aligned with the European Qualifications Framework (EQF), allowing the training to be recognized within national qualification systems. Specialized tracks and elective modules target distinct needs identified in the country overviews – such as drilling techniques for markets without formal drilling courses, or advanced design for engineers. By structuring the MOOC in a role-tailored, modular way, it accommodates both experienced professionals seeking upskilling and newcomers requiring comprehensive training.

8.4. Barriers and Opportunities for a Professional GSHP Workforce in Europe

Ground Source Heat Pump (GSHP) systems offer a key pathway for decarbonizing heating and cooling, but building a qualified workforce of drillers and installers faces numerous hurdles. This section synthesizes cross-country barriers—from regulatory fragmentation to training gaps and market constraints—and highlights opportunities and enabling factors. The focus is on Europe, drawing lessons from national schemes (as mapped in the Chapter 8.3) to inform a coherent European approach for GSHP driller and installer certification.

8.4.1. Regulatory and Administrative Barriers

Fragmented and inconsistent regulations across Europe: There is no uniform European standard for GSHP installers; each country (and sometimes regions within countries) imposes its own rules or certification schemes. This patchwork leads to duplication and confusion. For example, Germany's federal states have varying requirements, resulting in bureaucratic complexity and limited harmonization. In Belgium, the federal structure means Wallonia, Flanders, and Brussels each set different procedures and standards, making it hard to implement a unified scheme. Such fragmentation often creates unclear responsibilities between authorities and hinders companies that operate in multiple jurisdictions.

Complex permitting processes and unclear responsibilities: Many countries report that obtaining permits for GSHP drilling or installation is time-consuming and administratively burdensome. Austria and Sweden, for instance, note that complex or lengthy permit procedures can delay projects. In Wallonia (Belgium), a Class II geothermal drilling permit can take up to 110+ days. Often multiple agencies (water, mining, environment) are involved without clear coordination, complicating compliance for installers. Such red tape can discourage new projects and overwhelm small drilling contractors.

Lack of GSHP-specific categories in regulations: In some European markets, shallow geothermal systems are not explicitly recognized as a distinct category in law or codes. Instead, they fall under general water well drilling or generic heat pump rules. For example, Spain and Ireland have no dedicated GSHP regulations or certification, treating installations under broad building or environmental regulations. Poland similarly has only minimal regulation for geothermal installations. The absence of clear GSHP-specific standards means critical aspects (like borehole construction quality or ground-loop safety) may not be properly addressed. This regulatory gap makes it difficult to ensure quality and protect groundwater, and it undermines the professional status of geothermal specialists.

Inconsistent enforcement and cross-border recognition: Even where certification schemes exist nationally, enforcement can be weak. Many countries report a lack of enforcement, meaning non-certified drillers/installers continue to operate with impunity. Without inspections or penalties, the value of certification is undermined, as unqualified providers can undercut those who invest in training. Moreover, differences in national rules impede the mutual recognition of qualifications across Europe. While EU law conceptually allows free movement of professionals, in practice a geothermal installer certified in one country may not be recognized in another. This lack of reciprocity is a major barrier for international companies and mobile workers, and it runs counter to the idea of an integrated European market for renewable energy services.

8.4.2. Training and Qualification Gaps

Limited availability of specialized GSHP training: A common barrier is the scarcity of dedicated training programs for shallow geothermal technology. In many countries, there are few specialized courses or centers focusing on GSHP drilling and installation. For example, Spain has only a handful of GSHP-specific training offerings, and Poland's installers rely on occasional university electives rather than structured courses. Even where courses exist, they may be infrequent and geographically concentrated in major cities. This limits access for technicians in other regions. Language can be a barrier as well – in Belgium, some courses are offered only in French or Dutch, restricting participation for bilingual or international trainees. Overall, the current training infrastructure is patchy and insufficient to meet the growing needs of the sector.

Lack of harmonized curricula and competency standards: Because each national scheme defines its own syllabus, course content and competency requirements vary widely across Europe. Some countries emphasize hydrogeology and drilling safety, while others focus on heat pump sizing and HVAC integration, and many lack coverage of newer topics (like hybrid systems). This heterogeneity means there is no uniformly agreed skill set for a "qualified GSHP installer." As one study notes, the absence of uniform training standards and heterogeneous qualification schemes are constraining the workforce expansion. The result is that an installer trained in one country might not have the skills expected in another, making it hard to compare or mutually recognize qualifications. It also creates a mismatch between training and certification in some cases: the material taught in local courses may not align with the knowledge areas that a coherent certification framework would require, due to lack of standardization.

Insufficient practical and hands-on training: Many existing courses for geothermal installers are relatively short (often just 2–3 days workshops or seminars) and may not provide extensive field practice. For instance, Sweden's certification relies on short courses and seminars (with no formal degree program), and other countries similarly use brief training modules to cover a complex skill set. The limited duration often translates to insufficient on-site training – e.g. minimal time using drilling rigs or performing real borehole installations. Some countries have attempted to fill this gap via industry-led practical sessions (Sweden's ROTOTEC provides hands-on training on drilling, for example), but many trainees still graduate without robust field experience. The shortage of specialized instructors and training facilities (noted in Austria) exacerbates the problem. Without adequate practical training, installers may be unprepared for real-world challenges, affecting installation quality.

Lack of alignment with formal qualification frameworks: Another gap is that geothermal installer training and certification are often not integrated into national qualification frameworks or the European Qualifications Framework (EQF). This means the certifications are sometimes industry-led or informal, without a clear EQF level or recognition in vocational education systems. The need for alignment is clear: developing a core GSHP competency framework tied to EQF levels is identified as a priority. Currently, however, few countries have mapped their geothermal training to EQF/NQF. The lack of formal recognition of these skills and certificates can limit their credibility and portability. For example, a certificate earned through a short private course might not be recognized by public authorities or other EU states. Aligning curricula with EQF would help standardize learning outcomes and facilitate mutual recognition but achieving this remains a work in progress.

8.4.3. Market and Institutional Constraints

Low market demand and awareness in some regions: The maturity of the GSHP market varies greatly across Europe. In countries where the technology is still emerging (e.g. parts of Southern and Eastern Europe), demand for geothermal installations – and thus for certified professionals – is limited. This creates a vicious circle: because there are relatively few GSHP projects ("developing market" status), installers see little incentive to invest in specialized training or certification, which in turn can affect installation quality and consumer confidence. A common barrier reported is low awareness about shallow geothermal among key decision-makers and clients. Many potential customers (homeowners, builders) and even some regulators are unaware of the benefits of GSHP systems or the existence of certified installers. This low awareness translates to weak pull in the market – clients rarely demand a "certified driller/installer," so companies do not feel pressure to have one. Similarly, policymakers in regions with nascent markets may not prioritize geothermal training or include it in incentive programs, slowing workforce development.

Lack of financial and policy incentives for certification: Training a workforce requires investment, yet in many countries there are few incentives or support schemes to encourage it. Installers often bear the cost of courses and exams themselves. For small contracting businesses, taking time off for training and paying course fees is a significant hurdle. Unlike some other renewable sectors, there are limited subsidies, grants, or tax credits specifically for geothermal installer training or for companies hiring certified staff. The absence of financial support means the cost and time commitment deter participation in voluntary certification. Furthermore, companies do not always see immediate returns on these investments, especially if clients are not willing to pay a premium for certified work. On the policy side, few countries mandate the use of certified GSHP installers for projects (aside from certain large or public projects). Without mandates or at least preferential treatment (e.g. higher rebates for using certified professionals), the business case for certification remains weak. This lack of institutional push is a major constraint on expanding the qualified workforce.

Small and fragmented industry structure: The GSHP installation sector in Europe is largely composed of small firms or individual tradespeople. These small enterprises often have limited capacity to engage with formal certification schemes. As noted, taking time away from contracts to attend training can mean lost income, which is especially problematic for one-person or family businesses. In countries with only a handful of drilling companies or heat pump installers, it can also be challenging to sustain local training programs – there may simply not be enough trainees to run regular courses, leading to sporadic training availability. In some cases, industry associations or larger companies step in with ad-hoc training, but this leads to uneven coverage. The market's small size in certain countries (and varied demand regionally) is a structural barrier to creating a consistent, professionalized workforce.

Institutional gaps and weak coordination: Many experts point out the lack of a strong institutional framework to champion geothermal training and certification. Unlike the electricity or gas sector, which often has national licensing boards or associations, the shallow geothermal field has fragmented oversight. No single authority in most countries is responsible for accrediting geothermal installers – responsibilities may be split between water authorities (for drilling permits), building code officials (for heat pump systems), and private industry certification bodies. This can lead to overlap or gaps in oversight. For instance, the absence of a centralized installer registry or database is noted as a shortcoming – Belgium highlighted the lack of a national borehole registry or public list of certified installers. Without such tools, it is hard to monitor the sector or demonstrate the impact of certified professionals. Moreover, feedback loops are weak: there are few mechanisms for gathering data on system performance or installation quality that could inform training improvements. All these institutional weaknesses mean that even if good practices exist, they are not systematically scaled up or enforced.

8.4.4. Opportunities and Enabling Conditions

Despite the barriers above, there are clear opportunities and promising practices that Europe can build upon to develop a robust GSHP workforce:

Successful national schemes as models: Several European countries have implemented effective certification and training frameworks that could inspire broader adoption. For example, Sweden and the Netherlands both require mandatory certification/licensing for GSHP professionals, which has led to high installer competence and market confidence. Sweden's RISE/IN-cert exam system (covering both drillers and installers) and the network of accredited training centers ensure standardized skills and have contributed to a strong domestic market. The Netherlands has a rigorous scheme under the BRL protocols with state-administered exams and annual audits, creating a robust GSHP framework known for its quality assurance. These cases show that making certification a requirement (especially when tied to regulatory permits) can professionalize the industry and increase trust among consumers and authorities. Austria provides another best-practice element: integration of geothermal training into its dual education system and use of EU-wide certifications. Austrian installers can voluntarily obtain the EUCert heat pump certification, aligning their skills with a European standard, and the country benefits from a federal standard for drilling under its Mining Act. Learning from such examples – e.g. adopting mandatory exams, linking with vocational training, and enforcing standards – is a key opportunity for other countries currently lacking robust schemes.

EU policy drivers create momentum: Europe's climate and energy policies strongly favor heat pump deployment, which in turn boosts demand for qualified GSHP technicians. The EU "Fit for 55" package and the REPowerEU plan[4] set ambitious targets for renewable heating and reduced fossil fuel use, effectively calling for millions of new heat pump installations in the coming decade. Ground-coupled heat pumps are expected to play a significant role in this expansion. Achieving climate neutrality by 2050 will require rapid adoption of shallow geothermal technologies, and policymakers recognize that a skilled workforce is essential to scale up deployment. This high-level policy support translates into opportunities such as funding for workforce development, inclusion of geothermal in national energy and recovery plans, and potential new regulations favoring certified installers. For instance, ongoing revisions of the Renewable Energy Directive[5] (RED II) and the Energy Performance of Buildings

[4] https://commission.europa.eu/topics/energy/repowereu_en
[5] https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX%3A02018L2001-20240606&utm

Directive[6] (EPBD) emphasize the need for competent installers and could lead to requirements or incentives for certified professionals in renewable technologies. In addition, several countries have introduced grants or rebate programs for heat pump installations as part of pandemic recovery and energy security measures – many of these programs can be tweaked to encourage the use of accredited GSHP installers (for example, by offering higher subsidy rates if installation is done by certified personnel). Thus, EU-level policy is an enabling backdrop that can be leveraged to justify and support the creation of a coherent certification framework.

Towards mutual recognition and a European framework: There is a clear opportunity to move from isolated national schemes to a more coherent European certification framework. The benefits would include easier cross-border mobility for installers, a larger market for training services, and uniformly high standards of quality. Steps in this direction are already being taken. The GEOBOOST project, for example, is mapping national schemes and identifying common competencies as a basis for a European curriculum. It proposes a phased approach where an agreed core competence framework (aligned with EQF) is defined, and pilot mutual recognition agreements are established between willing countries. In practice, this could mean an installer certified in Country A can work in Country B without retraining, once both recognize a common qualification. Some groundwork exists: the Renewable Energy Directive encourages EU countries to recognize each other's certified installers for small-scale RES installations, though this has yet to be fully realized for GSHP. Initiatives like GeoTrainet (an EU-supported training program creating standardized geothermal courses) and EUCERT-HP (a Europe-wide heat pump installer certificate) provide templates that could be expanded. Belgium's RESCert scheme, which offers a certification for shallow geothermal installers valid across all its regions, is another example of how training aligned with European norms (EN standards in that case) can be a bridge towards broader mutual recognition. By building these platforms and fostering cooperation among national certification bodies, Europe can move toward an interoperable system. This would reduce redundancy (installers would not need to re-certify in each country) and help countries with fledgling programs latch onto an existing framework rather than start from scratch.

Synergies with broader renewable and construction training: Efforts to professionalize the GSHP workforce can piggyback on, or integrate with, other training initiatives in the renewable energy and construction sectors. Many skills required for GSHP installations overlap with those for conventional heat pumps, HVAC systems, or water well drilling. This presents an opportunity to embed geothermal modules into existing curricula for plumbers, HVAC technicians, drillers, and builders. For instance, an electrician or plumber training for air-source heat pump certification could receive additional modules on ground-loop design and geothermal specifics, obtaining a shallow geothermal endorsement on top of a general heat pump certificate. Likewise, drilling technicians licensed for water wells could undergo a shorter course to learn thermal grout, probe installation, and other geothermal techniques, instead of

[6] https://eur-lex.europa.eu/eli/dir/2024/1275/oj/eng

a separate qualification. Leveraging existing occupational standards (such as refrigeration handling certifications, or plumbing licenses) can accelerate the rollout of geothermal competencies. Some countries already pursue this approach: Austria's use of the EUCert-HP program (originally designed for all heat pumps) helps ensure geothermal installers also demonstrate general heat pump and refrigeration knowledge. This cross-cutting strategy not only avoids duplication but also widens the pool of potential GSHP installers by bringing in professionals from related trades. Moreover, integrating GSHP certification into broader frameworks (like national construction skill registers or continuing professional development programs) raises the profile of geothermal energy within the mainstream building sector.

Building stakeholder awareness and support: Finally, there is an opportunity to unlock market demand by educating stakeholders about the benefits of professional certification. Public authorities and energy agencies can run campaigns to raise awareness of quality assurance in geothermal installations. Highlighting success stories (e.g. well-performing installations done by certified installers) and tying financial incentives to certified work (as some regions do via rebates) can stimulate client demand for qualified professionals. If building owners, developers, and local governments start prioritizing certified drillers and installers for geothermal projects, it creates a virtuous cycle: companies will invest more in training, knowing it gives them a market edge. There are also opportunities to engage manufacturers and suppliers of heat pump equipment in training efforts – some have started offering specialized courses or certification partnerships, since they have a vested interest in seeing their products properly installed. EU funding programs (like those for coal regions in transition or Just Transition initiatives) could be tapped to support geothermal training centers, especially in regions with high unemployment where new green skills are needed. In short, by treating the development of a GSHP installer workforce as an integral part of the clean energy transition (akin to how solar PV installer training was boosted a decade ago), Europe can turn many of the current barriers into opportunities for growth and innovation.

Implications for the MOOC and Future Certification Framework: The identified barriers and opportunities have directly informed the design of the GEOBOOST project's MOOC and the phased roadmap for a European certification scheme. In terms of content and delivery, the MOOC has been structured to fill critical knowledge gaps and overcome access issues highlighted above. To address the lack of harmonized curricula and variable skill levels, the MOOC operates as a modular, role-tailored curriculum adaptable to different national contexts. Core modules on geology, borehole drilling, ground-loop design, heat pump installation, and relevant regulations reflect the common competency framework needed across Europe. By offering this content in an online, open format, the MOOC has improved accessibility – installers from any region can participate, mitigating the barrier of limited training availability. The project has also incorporated video demonstrations and case studies to supplement theoretical learning, partially compensating for the lack of hands-on training availability in certain regions. Additionally, recognizing the importance of practical skills, the MOOC incorporates video demonstrations and case studies to supplement theoretical learning, thus partially compensating for the lack of hands-on training. By raising awareness of best practices and including modules on business cases and environmental benefits, the MOOC only educates technicians but also indirectly boosts awareness among clients and decision-makers about the value of certified GSHP professionals. These efforts feed into the European certification framework roadmap by establishing a baseline of knowledge and a pilot group of trained individuals. In the short term, the MOOC serves as a validation of the core GSHP competencies and training approach. Insights from participants' performance and feedback will show the refinement of competency standards aligned with EQF levels (e.g. identifying which topics need more depth or practical assessment). In the medium term, the aim is to work with national authorities and industry bodies to have the MOOC modules (or their improved successors) formally recognized or integrated into national qualification systems. This could mean, for instance, that completion of the MOOC (plus a hands-on practicum) becomes an accepted pathway to attain a national certificate in countries that currently lack one. Concurrently, the project is using the momentum of the MOOC to foster mutual recognition agreements – if several countries acknowledge the MOOC's curriculum as meeting their requirements, it paves the way for bilateral or multilateral recognition of certified installers. Over the longer term, the lessons from the MOOC will help shape a unified European certification scheme. The ultimate roadmap foresees establishing a European committee or network (possibly under the lead of organizations like EGEC) to maintain and update standards and eventually move towards mandatory certification for GSHP installers in certain applications (aligned with EU directives like EPBD and RED II). In sum, the barriers identified (fragmentation, training gaps, low awareness) are being directly targeted by the MOOC's content emphasis and broad accessibility, while the opportunities (best practices, EU policy support, modular curricula) guide the priorities and sequencing of the certification roadmap. The MOOC acts as the first practical step of this roadmap – demonstrating a common training solution – which will be followed by formalization (through qualifications and agreements) and scaling up (through policy integration and continuous professional development requirements). By proceeding in phases, the initiative ensures that early actions (like the MOOC pilot) inform and de-risk later steps, ultimately leading to a coherent and recognized European certification framework for shallow geothermal drillers and installers.

8.5. Roadmap towards a common European certification framework for GSHP drillers and installers

8.5.1. Design principles and governance of a European certification framework

A European certification framework should be competence-based and modular, linking all GSHP professional profiles to a common skill profile aligned with the European Qualifications Framework (EQF). Key design principles include:

- **Common competency framework (EQF-aligned):** Define a core GSHP competence profile covering drilling, design, installation and planning tasks, referencing existing standards (e.g. GeoTrainet, VDI 4645). Curricula and assessments should be built on this common framework to ensure consistency across Member States.

- **Modular, role-based curricula:** Develop a set of harmonized training modules with clear learning outcomes, adapted for different professional roles (drillers, installers, energy planners, etc.). A basic foundational MOOC course can provide core theory (geology, probe design, heat-pump fundamentals, and regulations), followed by advanced modules (e.g. drilling techniques, system design/simulation, thermal interference) delivered by accredited centers. This role-tailored, layered approach builds on best practices.
- **Transparent assessment and certification:** Use clear, competency-based assessment methods (written exams, practical tests) tied to the common framework. Certification decisions should be made by independent bodies or accredited agencies under defined criteria. Exam content and passing criteria should be openly documented to build trust.
- **Continuing Professional Development (CPD):** Require periodic recertification (e.g. every 3–5 years) with mandatory CPD courses (covering new refrigerants, digital monitoring, energy storage) to keep skills updated. A formal CPD cycle ensures professionals maintain proficiency as technology evolves.

Governance of the framework should involve all levels:

- **EU-level coordination:** Establish an EU advisory committee or steering group (led by EGEC/GeoTrainet) to oversee the common standards and facilitate mutual recognition. This body would regularly update the curriculum framework, integrate new modules (e.g. emerging tech or regulations), and manage a European registry of certified installers.
- **National authorities:** Member State governments and qualification agencies should adopt the common framework into national qualifications and licensing systems. They would accredit training providers, incorporate the common modules into vocational education (NQFs), and enforce any certification requirements (e.g. tying certificates to subsidies or permits).
- **Professional associations and industry:** Industry bodies and training organizations should contribute expertise (e.g. on module content and teaching methods) and help promote the scheme. Existing certification bodies (e.g. DVGW, RESCert, national drilling licenses) should align their requirements to the common framework. An industry advisory board can ensure curricula stay up-to-date and consistent with technological advances.
- **Training providers:** Accredited institutes and universities will implement the standardized curricula and assessments. A quality-assurance mechanism (e.g. regular audits or peer reviews) should ensure providers deliver the content as specified and maintain teaching standards.

Together, these principles and a clear governance structure (EU coordination plus national implementation) will create a coherent, transparent certification framework that supports mobility and quality in the GSHP workforce.

8.5.2. First steps (0-2 years): GeoBOOST achievements

Within GEOBOOST, the short-term phase (0–2 years) has successfully delivered two key enabling outcomes for the future European certification pathway for GSHP professionals:

- A **core GSHP competency framework** defined as role-based learning outcomes and explicitly aligned to the European Qualifications Framework (EQF),
- **Launch the pilot MOOC:** The initial MOOC training has been released (in English with multilingual subtitles), covering basic GSHP theory and practice. This action has allowed the testing of content and pedagogy across partner countries.

Together, these project results provide a concrete, scalable training backbone that is now being used as the common "core" for technician upskilling (drillers and installers), for the development of modular/micro-credential routes in Member States, and for the next steps towards mutual recognition.

8.5.3. Short-Medium-term steps (0–5 years after project)

In the first phase (0–5 years), the focus should be on piloting and alignment, using voluntary and incremental approaches:

- **Establish a European working group on GSHP competencies:** Bring together experts from existing schemes to define a common competency profile (mapped to EQF/NQFs) and specify basic module descriptors. These core competencies form the basis of future curricula.
- **Refine the pilot MOOC and develop modular specializations:** Feedback from participants and partners should guide refinement of module content and delivery. Using MOOC feedback, create advanced training modules (e.g. drilling, system simulation, interference management) that can be delivered locally by accredited centers. These specializations allow drillers, installers, and planners to progress beyond the core MOOC content.
- **Mutual recognition pilot agreements:** Encourage certification bodies across Europe to sign voluntary mutual-recognition agreements. For example, formalize early pacts between participating countries so that certificates based on the common framework are accepted cross-border. Start a European registry (even as a voluntary database) under an agreed label (e.g. "Common European GSHP Technician") to list certified professionals.
- **Integrate modules into national systems:** Work with Member States to embed the modular curriculum into existing vocational qualifications and training programs. For instance, encourage national authorities to credit the MOOC or related courses as part

of national diplomas or licenses. Negotiate that certification becomes a qualifier for incentives (as done in BE/NL) or for participation in public GSHP projects.

- **Standardize curricula and QA:** Publish model curricula and module descriptors openly, to guide trainers. Set up a simple accreditation scheme for training providers (checklist or audit) so that only approved centers teach the modules. This could leverage existing accreditation bodies or GeoTrainet guidelines.
- **Data collection and monitoring:** Begin tracking GSHP workforce data: e.g. survey installer numbers, registered drillers, course completions, and uptake of certification. Collecting these baseline metrics will inform future targets and show progress.
- **Engage stakeholders and communicate:** Launch awareness campaigns on the benefits of certification (quality, safety, consumer confidence). Involve industry associations, installers, and academia in workshops to build buy-in. Early political support and some funding (e.g. EU project grants or co-financing from national sources) will be needed to kick-start curriculum development and MOOC deployment.
- **Voluntary labelling or branding:** Consider creating a voluntary “European GSHP Installer” logo or label linked to the certified qualification. This can raise visibility and encourage market demand without immediately requiring regulation (in collaboration with EHPA, European Heat Pump Association)

These steps aim to harmonize the most critical pieces (competences, curricula, recognition) while respecting national differences. By the 5-year mark, there should be widely available common training modules, pilot mutual recognition in place, and growing numbers of technicians certified under the common scheme.

8.5.4. Long-term vision (5+ years) and sustainability

Beyond five years, the roadmap envisions full implementation, mandatory elements, and continuous evolution:

- **Mandatory certification for major projects:** Push for EU and national regulatory alignment so that GSHP certification becomes required for large or critical installations. For example, amend the Energy Performance of Buildings Directive (EPBD) and Renewable Energy Directive (RED II) to mandate certified GSHP technicians for systems above a certain size. This ensures professional quality for higher-impact installations.
- **Widespread scheme adoption:** Aim for every EU country to adopt the common framework (either by integrating into national law or via recognized voluntary schemes). In countries with no current scheme, the roadmap provides a ready-made modular curriculum they can plug into national qualifications. In countries with existing schemes (e.g. mandatory licensing), align those requirements to the European baseline.
- **European and national registries:** Create an official European GSHP certification registry managed by the EGEC-led committee. This registry would collect entries from national databases, allowing stakeholders to verify certificates EU-wide. National

registries (or additions to existing licensing databases) should be set up in each country to feed the EU system.

- **Robust CPD framework:** By this stage, a formal recertification and CPD regime is in place. All certified professionals' cycle through updates (e.g. every 3–5 years) on new regulations, technologies, and best practices. A Europe-wide requirement (e.g. per 3-year EPBD recital) ensures compliance.
- **Professionalization and accreditation:** The certification scheme becomes a recognized profession. Training programs (including university and apprenticeship pathways) incorporate the modules as part of official qualifications. Industry sees the "European GSHP Installer" credential as the mark of competence.
- **Sustainable governance:** The EGEC-led European Certification Committee continues to manage the framework. It periodically revises the competency framework, coordinates the update of curricula, and oversees the mutual-recognition process. This body also monitors scheme outcomes and advises on further improvements.
- **Full exploitation of MOOC and digital tools:** The MOOC evolves into a multi-language platform with updated content. It could be supplemented by virtual labs or certification exams online, making access easier and reducing long-term training costs.
- **Data-driven evaluation:** With several years of data, evaluators should assess impacts (installer mobility, system quality, market uptake). Continuous monitoring allows policymakers to adjust requirements or incentives as needed.

In this vision, the European framework has become self-sustaining: political and economic incentives are aligned, industry recognizes its value, and a culture of professional development is embedded. The overarching EU climate goals (e.g. the 2030 targets and the Green Deal) provide leverage – for instance, linking certification to building permits or clean heating subsidies – helping cement the long-term mandate.

8.5.5. Risks, prerequisites, and success factors

Key risks and prerequisites must be managed to succeed:

- **Political commitment:** Strong buy-in from EU and national authorities is essential. Without a clear political signal or incentive (regulation, funding tie-ins), uptake may remain voluntary and slow. Early alignment with EU policy (EPBD, RED II) and linking certification to public incentives will help mitigate this risk.
- **Industry engagement:** The scheme must meet industry needs to succeed. If installers, drillers, and manufacturers feel it is bureaucratic or irrelevant, they will resist. Involving them in curriculum design and providing clear business incentives (e.g. eligibility for large contracts) are critical success factors.
- **Resource and funding:** Developing and maintaining the framework requires resources (creating materials, training trainers, running exams). Initial EU funding (Horizon projects, LIFE, etc.) and national training budgets should support this. However, costs

should be balanced by recognizing that well-trained professionals reduce system failures and environmental damage.

- **Adaptability to national contexts:** Europe's countries vary (languages, administrative structures, climate conditions). The framework must be flexible enough to accommodate local technical standards or regulations. A purely "one-size-fits-all" approach would fail; hence the modular design and national implementation roles are crucial.
- **Awareness and demand:** Many of the barriers identified at national level – low public and installer awareness of certification and limited demand – could impede success. Sustained communication and outreach campaigns are needed to highlight benefits (safety, efficiency, mobility).
- **Quality assurance:** The credibility of the certification hinges on consistent quality. Without rigorous training provider accreditation or exam auditing, the certificate's value will diminish. Setting up a monitoring mechanism (inspections or peer review) early on is a prerequisite for trust.
- **Data and feedback loops:** Lack of data and feedback (as noted in several country reports) can prevent learning. It is essential to build in monitoring from the start (numbers certified, job outcomes, installation performance) and use this feedback to adjust the framework over time.

If these prerequisites are met, the common framework can overcome the fragmentation and barriers currently noted in national schemes. The GEOBOOST analysis shows that leveraging existing best practices (e.g. EUCERT, VDI guidelines) and incremental scaling (from voluntary to mandatory) will be critical to ensure the roadmap's milestones are achieved.

Implications for the MOOC and future certification framework: The roadmap positions the GEOBOOST MOOC as a core building block of European certification. In the short term, the MOOC serves as the *pilot common curriculum* – a shared online course validating core content and teaching methods across countries. Its modules on geology, probe design, heat-pump fundamentals, and regulations form baseline training that can be reused by all Member States. As the roadmap evolves, these MOOC modules can be adapted (translated, specialized, and localized) into national training programs or used as exam preparation for certification. For national stakeholders, the roadmap provides a clear structure to integrate with the MOOC. Countries can map each MOOC module to national qualification levels or include it as part of their technician training. For example, a national certification body could require completion of the common MOOC modules (with localized case studies) as a prerequisite for exam entry. Training centers can blend the MOOC with in-person workshops for practical skills. In this way, the MOOC offers a flexible, reusable component – common theoretical content that reduces duplication of effort and ensures all trainees meet a pan-European standard. Moreover, by laying out a stepwise process (from shared curricula to mutual recognition and CPD), the roadmap helps policymakers and industry plan how to incorporate MOOC-based learning into formal schemes. It signals that investment in the MOOC (and its expansion into advanced modules) is not a separate project but an integral part of building the eventual European certification. As the framework matures, the MOOC could evolve into an official EU training platform, continuously updated to reflect the latest standards. In sum, the MOOC and certification roadmap are mutually reinforcing: the roadmap gives direction for how the MOOC feeds into certification requirements, and the MOOC embodies the common training principles that the roadmap calls for.

8.6. Sample Curricula for European GSHP Drillers and Installers

8.6.1. Core competency framework and learning outcomes

Within the framework of GEOBOOST, a common European competency profile for shallow geothermal specialists has been defined, aligned with the EQF. A European level working group (including both “mature and emerging” GSHP markets) identified the essential technical and practical skills for each role, using GeoTrainet, VDI 4645, and IGSHPA training as a reference. In practice, this results in different sets of specific competencies depending on the profile (for further information, see Chapter 3 of this deliverable).

8.6.2. Modular curriculum structure linked to the MOOC

The GEOBOOST MOOC is organized in a modular course system so that content can be combined flexibly by role. The pilot MOOC includes core modules on geology, borehole design, heat pump fundamentals, and relevant regulations. These modules mix theoretical sessions and hands-on/practical training and are aligned with the EQF level for each role. For a detailed description of the modular curriculum, see Chapter 3 of this deliverable.

Implications for the MOOC and future certification framework: This developed curriculum illustrates and supports the GEOBOOST MOOC’s modular design. By defining clear competencies and learning outcomes for each profile, the curricula guide which MOOC modules are needed and how to assess them. In the MOOC, each module’s content and quizzes can be directly tied to a learning outcome (e.g. “perform a thermal response test”), ensuring the training is competency-based. Furthermore, the outlined EQF levels and hour counts help instructors plan workload and balance theory vs. practice and provide a template for issuing credit or certificates. For Member States, these curricula serve as a reference model when launching or updating GSHP certification schemes. A country could adopt the modular topics and expected outcomes (translated as needed) and then append national regulatory requirements. In the longer term, having a common framework (and a European certificate) will ease cross-border mobility of trained drillers/installers. As noted in GEOBOOST’s roadmap, establishing an EU-wide competency framework and modular training will improve installer quality and accelerate GSHP deployment. In practice, the MOOC pilot and its assessment plan will validate this approach, and the curricula above can be refined based on feedback. Ultimately, a harmonized curriculum – building on GeoTrainet, EUCERT and these samples –

will underpin any future official European certification scheme, ensuring consistent training and enabling mutual recognition across Member States.

8.7. Promotional and Support Materials for Certification Uptake and MOOC Deployment

This section outlines a communication and engagement approach to support the uptake of the proposed GSHP certification framework and the associated MOOC. It translates the technical work on certification and curricula into practical outreach actions. The focus is on identifying key target audiences, crafting tailored messages, developing appropriate promotional materials, and outlining an engagement strategy. The aim is to ensure that GSHP drillers/installers, training institutions, authorities, and other stakeholders are aware of the certification's benefits and the MOOC as an entry point, thereby encouraging widespread participation.

8.7.1. Target audiences and communication objectives

A range of target audiences has been identified for outreach, each with specific communication objectives. The promotional effort will be segmented to address the needs and interests of the following groups:

- **GSHP drillers and installers:** These are the primary beneficiaries of the certification. **Objective:** Raise awareness of the new certification scheme and encourage these professionals to enroll in the MOOC as a first step. Emphasize how certification can improve their technical skills, ensure safer and higher-quality installations, and provide a market advantage (e.g. being listed as certified professionals). The goal is to motivate both individual technicians and companies to pursue certification for improved credibility and customer trust.
- **Regulators and public authorities:** This includes energy agencies, qualifications authorities, and policymakers at national or regional levels. **Objective:** Secure support by demonstrating that an EU-wide GSHP certification aligns with policy goals (e.g. Renewable Energy Directive requirements for qualified installers) and can be a tool to improve installation quality across the industry. Key communication points are how certified installers ensure compliance with safety and environmental standards, thereby protecting groundwater and building safety, and how authorities can leverage the scheme to enforce quality (for instance, tying financial incentives or permits to certified installers). Engaging regulators early will also facilitate recognition of the certification within national qualification frameworks or subsidy programs.
- **Wider stakeholders (engineering firms, designers, energy agencies, students):** These are actors who interact with GSHP projects but may not seek certification themselves. They include engineering consultants, architects/designers, construction firms, energy planners, and large clients (e.g. property developers or facility managers). **Objective:** Build general awareness about the certification so that these stakeholders prefer or

require certified professionals in projects. For example, messaging to building designers and engineering firms will stress that working with certified drillers/installers can reduce project risks and improve system performance. Energy agencies and industry associations will be approached to disseminate information to their networks, underscoring the broader market and environmental benefits of having certified GSHP specialists (better quality installations leading to higher confidence in geothermal technology).

Each audience segment will be addressed with language and channels appropriate to them – for instance, using industry associations and trade journals to reach installers, or official letters and workshops to reach regulators. In all cases, the communication objective is to create buy-in by showing "what's in it for them": whether it is professional development, improved quality standards, or progress toward policy targets.

8.7.2. Key messages and narrative for certification and the MOOC

Tailored key messages will be crafted to resonate with the above audience, while maintaining a consistent overall narrative. These messages highlight the benefits of certification, the value of the MOOC, and the alignment with broader goals:

- **Quality and safety:** Emphasize that the certification ensures a high standard of workmanship and safety in GSHP installations. For drillers and installers, the message is that certification validates their skills in line with best practices, leading to safer operations and reliable systems. For authorities, underscore that having certified professionals helps protect environmental resources (e.g. preventing borehole contamination) and improves public confidence in geothermal technology.
- **Market differentiation and career growth:** Communicate that being certified sets professionals apart in a growing renewable energy market. This appeals to workers and companies – a certified installer can market themselves as a qualified expert, potentially winning more contracts or commanding better prices. Companies employing certified staff can use this as a quality label. The narrative here is "grow your business and reputation by getting certified".
- **Accessibility of training (the MOOC):** Highlight that the project's MOOC provides an accessible entry point to the certification curriculum. This free, self-paced online course lowers the barrier for anyone interested: it is available to a wide audience including not just installers, but also planners, engineers, and even students. The key message is that "the MOOC is a first step toward certification" – it allows learners to acquire foundational knowledge at their own pace, after which they can pursue practical training or examinations for certification. For training centers, the MOOC is portrayed as a ready-made resource to complement their offerings. For individuals, it is a risk-free way to explore the field and prepare for more advanced training.
- **Alignment with EU and national priorities:** Frame the certification and training within the context of European Green Deal targets and national energy strategies. For public authorities and energy agencies, messages will connect the scheme to policy

objectives: e.g. contributing to renewable energy deployment, workforce upskilling, and climate targets. The narrative will reference how several EU countries link installer certification to renewable incentives, and how this European certification framework can support the implementation of EU directives (such as requirements for qualified installers under the Renewable Energy Directive) and national recovery or Just Transition funding that often earmarks money for green skills training. By doing so, regulators see the scheme as timely and supportive of their mandates, rather than an external imposition.

- **Consistency and mobility:** Another key message, relevant to all audiences, is that a European-level certification brings consistency in skills and facilitates cross-border recognition. This appeals to workers (their qualification would be recognized beyond their region), to companies (easier to hire or deploy staff across EU markets), and to authorities (harmonized standards improve overall industry quality). The MOOC's content is developed collaboratively across countries, which reinforces that it represents European best practices. We will stress success stories or best practices from countries that already have effective certification schemes to illustrate these benefits in practice (for instance, citing the Netherlands or Sweden where certification has led to strong market uptake and trust).
- **Benefits to end-users and clients:** While end-users (building owners, consumers) are not a direct audience for our materials, the narrative will indirectly highlight that certified GSHP professionals deliver better-performing systems and avoid common installation pitfalls. This message, conveyed through case studies or testimonials, bolsters the argument to all stakeholders that certification has tangible outcomes: higher customer satisfaction, energy savings, and fewer project issues.

In communicating these points, the tone will remain clear, factual, and professional – avoiding hype. Each audience will see messaging that ties the certification and MOOC to their own interests and drivers. For example, a flyer for installers might lead with "Improve your skills and gain recognition with the new European GSHP Installer Certification," whereas a briefing note for authorities might start with "Ensuring quality in geothermal installations – policy tools for Member States." All materials will share a coherent story: that this certification plus MOOC initiative enhances quality, fosters trust in geothermal solutions, and is a win-win for both industry and policymakers.

8.7.3. Examples of promotional and support materials

A set of promotional and support materials has been designed, with some items already developed. These are designed to be concise, visually engaging, and easily adaptable by project partners or national bodies. Examples of such materials produced include:

- **Concise factsheets and flyers:** One or two-page documents that summarize the certification scheme and the MOOC. These factsheets highlight key points – what the certification is, benefits, and how to get started (including the MOOC link). A general project brochure has been produced providing an overview in plain language.

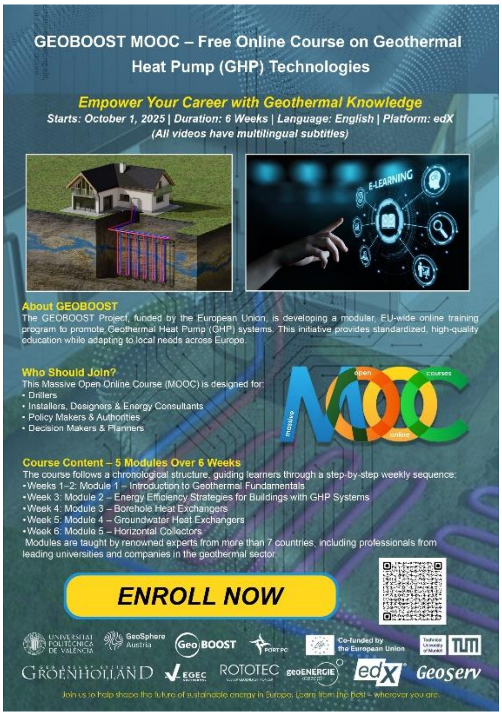


Figure 22: The factsheet / flyers of the MOOC.

- **Infographics explaining the certification pathway:** A visual infographic can illustrate the steps from initial training to certification, as presented below.

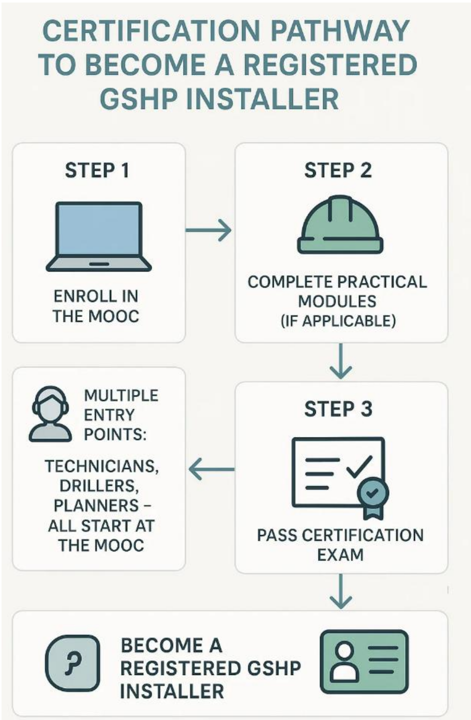


Figure 23: An example of an infographic explaining the certification pathway.

- **Short videos or testimonials (suggested for future):** Dynamic content like short videos (2-3 minutes) can be very effective. We plan to record testimonials from early adopters or pilot participants – for example, a drilling company manager who explains how certification improved their business, or a trainee who found the MOOC valuable. These videos can be shared on the project's website and social media and played during stakeholder workshops. Even simple animated videos explaining "Why certify your GSHP skills?" can capture attention. A video could visually depict common issues in bad installations vs. certified quality installations, ending with a call to action to join the course. While videos require more effort, they provide a personable touch and can be easily localized with subtitles for different languages.

- **Case study sheets (suggested for future):** Drawing from the project's research, we will prepare brief case studies of countries or regions that have successful certification or training schemes. For example, a one-page case study on the Netherlands might outline how mandatory certification led to a thriving, high-quality GSHP market, or how Sweden's installer examination system improved consumer confidence. These case study sheets serve as persuasive evidence, especially for regulators and training bodies in countries that are just starting. They demonstrate real-world impact (e.g. increased installations or fewer failures after implementing certification) and can be included in promotional packs or on the project website for download.
- **Guidance notes for authorities and training providers (suggested for future):** In addition to outward-facing promotional material, supportive documents will be created for more in-depth guidance. For public authorities, a guidance brief can outline how to adopt or endorse the certification framework nationally – touching on steps like integrating it with existing licensing or using it as a basis for incentive programs. For training centers and VET, guidance notes can explain how to deliver the curriculum (e.g. how the MOOC modules can be blended into classroom teaching, or how to organize the hands-on components leading to certification). These materials ensure that interested stakeholders have a clear roadmap to follow if they decide to support or implement the scheme. Plain text descriptions and recommendations are provided (rather than promotional slogans), so that these are read as technical guidance. All such materials are provided in annexes of this deliverable for reference.

All the above materials are designed to be easily accessible. They will be made available through the project website and shared with partners. Importantly, the materials can be translated and adapted by national bodies – for instance, the flyer template can be reissued in each partner's language with country-specific contacts listed. By providing a toolkit of promotional content, we enable project partners and stakeholder organizations to carry the message forward consistently.

Implications for the MOOC and future certification framework: Well-designed promotional and support materials have had a direct impact on the uptake of the GeoBOOST MOOC and the credibility of the wider, technician-focused certification pathway. During the project, a complete MOOC has been developed and made available as a scalable common-core training offer, and a dedicated communication toolkit (flyers, infographics, case studies, and guidance notes) has been produced to translate the technical framework into actionable messages for practitioners, training providers, and authorities. These materials were actively disseminated to key European stakeholders—most notably through targeted outreach at the European Geothermal Congress in Zürich (October 2025)—to boost awareness, drive MOOC participation and accelerate acceptance of a common European competence baseline. This communication approach supports a positive feedback loop: higher MOOC participation expands the trained community, which in turn strengthens the case for formal recognition and adoption of harmonized certification routes at national level. Ultimately, these outreach actions increase the likelihood that the certification framework is sustained beyond GeoBOOST, through integration into training provision, qualification pathways, and policy instruments, thereby supporting long-term quality and growth of the GSHP sector across Europe.

9. Conclusions and recommendations

The analysis of eight European countries revealed a wide variation in certification and training schemes for shallow geothermal (GSHP) installers and drillers. Approaches range from strict mandatory licensing tied to formal vocational qualifications in some countries to voluntary accreditation programs or even the absence of any specific geothermal certification in others. This heterogeneity in requirements leads to inconsistencies in installer competencies and a fragmented market. Differing legal frameworks, variable course content, and inconsistent competency criteria across nations have been identified as key barriers, impeding cross-border mobility of professionals and knowledge exchange. Common challenges include low awareness of certification benefits, limited availability of specialized training (especially in emerging markets), lack of enforcement where schemes are voluntary, and the financial and time costs for practitioners pursuing qualifications. These factors have collectively hindered the widespread uptake of certification and, by extension, the optimal quality and safety of GSHP installations in Europe.

Despite these barriers, the study also highlighted opportunities and best practices that can inform a more unified approach. Several countries have implemented measures that bolster training and certification: for example, some link installer certification to financial incentives or permitting requirements (as seen in Belgium and the Netherlands, where only certified installers can enable clients to access certain grants). Others have developed comprehensive curricula and standards – such as Germany's VDI 4645 guidelines for heat pump systems or the EU-supported GeoTrainet/EUCERT programs – which provide a strong foundation for harmonized competency benchmarks. The existence of these models and the growing political support for renewable heating (including EU targets for climate neutrality) signify a timely opportunity to align national efforts. Building on such best practices, the project formulated a **phased roadmap** toward a common European certification framework for shallow geothermal professionals.

Under this proposed roadmap, incremental steps were envisioned to gradually achieve harmonization. In the initial phase, a modular pan-European training program **has been piloted** to establish core competencies shared across countries. This took shape as a **Massive Open Online Course (MOOC)** – a freely accessible, multi-language online training hosted on the edx.org learning platform covering fundamental GSHP topics. The pilot MOOC has served to validate a common curriculum adapted to various professional roles (installers, drillers, designers) and aligned with national regulatory contexts.

In subsequent phases, the roadmap foresees expanding this curriculum with specialized modules delivered by accredited training centers in each Member State, alongside the formalization of mutual recognition agreements between national certification bodies. Integration of the modular curriculum into national qualification frameworks is planned, with encouragement for authorities to tie financial incentives or project permitting to the employment of certified GSHP professionals (a practice already adopted in some markets). In the longer term, the roadmap envisages that a **common European certification** will be widely recognized, potentially becoming a de facto requirement for large-scale geothermal projects. This would be supported by periodic recertification (continuing professional development) to keep the workforce's skills up to date and overseen by a dedicated European committee to ensure the scheme's ongoing integrity and evolution. If implemented, this strategy is expected to raise installation quality and safety standards, boost consumer and investor confidence, improve workforce mobility and career development, and ultimately accelerate the deployment of shallow geothermal heat pump technologies across Europe.

Importantly, the development of the **pilot MOOC and curriculum** has demonstrated the feasibility of delivering standardized training content on a European scale. By covering the essential theoretical and practical knowledge in a structured format, the MOOC exemplifies how a common set of competencies can be disseminated to a broad audience. This has addressed the gap in training availability in some regions and created a benchmark for quality. The positive reception of the MOOC in its pilot phase provides confidence that a larger-scale roll-out of the curriculum is achievable. In summary, the findings underscore that while national contexts differ, a collaborative effort – leveraging the identified opportunities and using tools like the MOOC – can pave the way toward a coherent European certification framework that benefits installers, industry, and policymakers alike.

9.1. Policy and regulatory recommendations

To establish a robust European certification for GSHP professionals, concerted action is required from both EU institutions and national/regional governments. The following policy and regulatory recommendations are proposed:

- **EU-level (European institutions and programs):** Develop and endorse a common European competency standard for shallow geothermal installers and drillers, serving as the basis for mutual recognition across Member States. This could be facilitated by an EU-supported framework or guidelines (in line with the Renewable Energy Directive's provisions on renewable installer certification) that align national schemes with a set of minimum criteria and the European Qualifications Framework. EU energy and education programs should provide funding and technical support for the deployment of standardized training modules (including translations and digital platforms) to ensure broad access to high-quality curricula. It is also recommended to create mechanisms for mutual recognition of qualifications – for instance, an EU-wide voluntary certification label or registry – so that a professional certified in one country can be recognized in others without redundancy. In the longer term, the European Commission could consider integrating geothermal heat pump installer certification into relevant directives/regulations. For example, future revisions of the Energy Performance of Buildings Directive (EPBD) or Renewable Energy Directive could include provisions requiring certified professionals for certain types of installations or projects above a defined capacity threshold. Such EU-level mandates, even if initially voluntary or incentivized rather than compulsory, would send a strong signal and gradually harmonize national approaches under a common umbrella.

- **National and regional authorities:** Strengthen and harmonize national certification frameworks by adopting the common competency standards and curricula developed through the GEOBOOST initiative. Each country (or region, where competence is sub-national) should review its existing schemes considering the European framework and identify gaps or misalignments to address. Regulatory bodies are encouraged to move toward **mandatory or formalized certification** for GSHP installers and drillers, particularly for projects that impact public safety or receive public funding. A practical step is to tie eligibility for government incentives, rebates, or permits to the use of certified geothermal professionals. This creates market pull for certification – as demonstrated in some countries – and ensures quality control for subsidized installations. Authorities should also invest in **awareness campaigns** to inform contractors and clients about the benefits of certified installers, thus increasing demand for qualified professionals. Improving enforcement is key: where installation licensing or certification is required by law, sufficient oversight (e.g. through project inspections or contractor licensing systems) must be in place so that non-certified practitioners cannot undercut standards without consequence. In countries with decentralized or regionalized systems (e.g. federal states or autonomous regions), efforts should be made to unify criteria and facilitate inter-regional recognition of qualifications, reducing internal market fragmentation. Finally, national policymakers should collaborate with European bodies and neighboring countries to share best practices and updates, ensuring that national regulations remain compatible with the evolving European certification framework over time.

9.2. Recommendations for training providers and industry

The success of a European GSHP certification framework will also depend on the active involvement of training organizations, professional associations, and industry stakeholders. The following recommendations target these groups:

- **Training providers and professional associations:** Align educational programs with the common European curriculum and competency profile for shallow geothermal systems. Vocational schools, technical institutes, and private training centers should integrate the modular courses developed by the project (as piloted in the MOOC) into their offerings, adapting them to local languages and any country-specific regulations. This may involve adopting the core syllabus – covering subjects like geology, drilling techniques, system design, heat pump operation, and relevant norms – and then adding local case studies or compliance specifics as needed. Trainers should be prepared (through "train-the-trainer" initiatives) to deliver this content effectively, ensuring a high and uniform standard of instruction across Europe. Professional associations (e.g. geothermal or heat pump industry groups) are encouraged to support this harmonization by certifying or endorsing courses that meet the European standard, and by facilitating workshops or continuous education sessions to keep their members up to date. Such bodies can also play a crucial role in establishing mutual recognition pacts – for instance, an association-led registry where certified individuals are listed with their qualifications, helping employers verify credentials across borders. Training organizations should leverage the MOOC platform not only to broaden access (especially for those in remote areas or smaller markets) but also to create blended learning opportunities (combining online theory with hands-on practical training at local centers). By collaborating through European networks (for example, the GeoTrainet consortium or EGEC's training committees), training providers can share experiences and continually improve the curriculum. Ultimately, the goal for the education sector is to produce a new generation of GSHP specialists whose skills are benchmarked to a common European level of excellence, thereby bolstering workforce quality and mobility.

- **Industry actors (installers, drilling companies, and technology providers):** Embrace the certification framework to professionalize the sector and improve project outcomes. Companies involved in installing or drilling for geothermal heat pump systems should encourage and support their technical staff to obtain the new European-aligned certification. This can be done by providing time and resources for employees to attend training courses or the MOOC, and by incentivizing certification (for example, tying it to career progression, pay grades, or recognition within the company). Firms should consider **only subcontracting or partnering with certified professionals** for critical project tasks – this ensures quality and pushes the wider market toward certification as a norm. The industry can also contribute expertise to the evolving curriculum: manufacturers, seasoned installers, and drilling experts have practical insights that can keep training content relevant (e.g. new equipment, drilling methodologies, or safety practices). By working with training bodies and associations, companies can help shape modules on emerging technologies and provide real-world case studies or apprenticeships to trainees. Moreover, by actively advertising their certified status, companies can enhance customer confidence – property owners and developers will be reassured knowing that qualified personnel are handling the installation, leading to better system performance and fewer failures. Industry groups at the European level (such as heat pump or renewable energy alliances) should also give feedback to policymakers about market responses, helping to fine-tune the certification requirements so they remain practical and effective. In summary, the industry's buy-in will be essential: when the private sector values and requires certification, it becomes a de facto standard, driving non-certified competitors out of the market or compelling them to upskill, thereby raising the overall competency level within the geothermal heating sector.

9.3. Outlook beyond the project

Looking ahead, the implementation of a European professional certification for GSHP drillers and installers will be an ongoing process that extends beyond the GEOBOOST project's timeline. In the **near term (the next 1–2 years after the project)**, efforts will concentrate on transitioning from pilot initiatives to established programs. A top priority is the full deployment of the pilot MOOC and associated training modules across interested countries – effectively moving from a prototype to a widely available resource for learners and trainers. Early feedback from the MOOC should be collected and analyzed to refine the curriculum content and delivery (ensuring, for example, that it meets the needs of both experienced contractors and new entrants). During this period, it will be important to formalize the cooperative structures initiated by the project: for instance, creating a working group or interim **European Certification Committee** that brings together representatives from EU institutions, national authorities, industry, and training organizations. Such a body can oversee the accreditation process of the curriculum, help broker **mutual recognition agreements** between existing national schemes, and serve as a platform for continued knowledge exchange. The committee (possibly under the leadership of organizations like EGEC or in synergy with the GeoTrainet initiative) would also be tasked with exploring funding avenues to sustain the training and certification roll-out – this could include EU programs (LIFE, Horizon Europe, Erasmus+ for vocational training) or public-private partnerships within the geothermal and heat pump industry. By the end of this initial period, we anticipate having a solid foundation: an active MOOC with multilingual support, a first cohort of installers and drillers trained under the common scheme, and formal commitment from several countries or regions to pilot the mutual recognition of certifications.

In the **longer term (5+ years)**, the vision is for the common certification framework to mature into a self-sustaining, Europe-wide standard for geothermal heat pump professionals. This means that over time, most if not all EU Member States would incorporate the harmonized certification into their national qualification systems – for example, by officially recognizing the European GSHP certificate as equivalent to (or part of) their domestic licenses for installers and drillers. Ideally, a **pan-European registry** of certified professionals will be in place, giving employers and customers an easy way to verify credentials and fostering cross-border trust in the workforce. Policy measures are expected to progressively align with this framework: future updates to EU or national energy regulations might require that large geothermal projects (e.g. community heating networks, commercial installations above a certain size) be designed or executed by certified experts. Such requirements, whether through formal legislation or through conditions on funding programs, would significantly boost participation in the certification scheme and embed it into the normal practice of the industry. Over this horizon, we also foresee the need for continuous improvement and governance of the certification system. Technological innovation in the geothermal field (e.g. new drilling techniques, advanced heat pump systems, digital monitoring, and control solutions) will necessitate regular updates to training materials. Establishing a permanent **European Certification Board or Committee** – potentially facilitated by a body like EGEC – will ensure there is oversight to periodically review and update the competency standards and curricula. This body would also manage the process of recertification (e.g. requiring professionals to refresh their knowledge every few years via short courses on the latest advancements, in line with a Continuing Professional Development model). By taking these steps, the European shallow geothermal sector can cultivate a highly skilled workforce with recognized credentials, which in turn will attract new talent and investment. In the long run, the convergence of training and certification standards across Europe is expected to yield a robust market with greater consumer confidence, lower risks, and a faster growth trajectory toward our renewable heating and cooling targets.

The conclusions above reinforce the central role of the MOOC and the developed curriculum in achieving a durable European certification system. The MOOC developed under GEOBOOST is more than just a course – it is a proof of concept for unifying training standards. By continuing to expand and update this platform, stakeholders can maintain momentum in skill development even as formal frameworks are being set up. The roadmap outlined (from mutual recognition to eventual harmonization) uses the MOOC's curriculum as a foundation, meaning each step builds upon the competencies and materials first tested in the pilot. In practical terms, the MOOC and its sample modules will serve as steppingstones for national training programs: they offer ready-made content that can be adopted or adapted, speeding up the creation of new courses where gaps exist. Moreover, the collaborative process of creating the MOOC – involving experts from multiple countries – has created a network of instructors and institutions that will be instrumental in the certification framework's rollout. Going forward, as the European certification takes shape, the MOOC can evolve into a continuous learning resource for certified professionals (for example, hosting refresher modules for recertification). In summary, the work done on the MOOC and curriculum design under this project provides a solid launching pad for a lasting European GSHP certification framework. The insights gained and the networks formed are key assets to be carried into the next phases, ensuring that the vision of a qualified, recognized, and mobile shallow geothermal workforce becomes a reality across Europe.

10. Annexes

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